SEISMIC RISK MANAGEMENT OF NON-ENGINEERED BUILDINGS

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Dedicated to
all people who live in developing countries with earthquake risk, particularly those in Indonesia

ABSTRACT

Earthquakes have long been feared as one of nature's most terrifying and devastating events. Although seismic codes clearly exist in countries with a high seismic risk to save lives and human suffering, earthquakes still continue to cause tragic events with high death tolls, particularly due to the collapse of widespread non-engineered buildings with non-seismic resistance in developing countries such as Indonesia. The implementation of seismic codes in non-engineered construction is the key to ensuring earthquake safety. In fact, such implementation is not simple, because it comprises all forms of cross disciplinary and cross sectoral linkages at different levels of understanding, commitment, and skill. This fact suggests that a widely agreed framework can help to harmonise the various perspectives. Hence, this research is aimed at developing an integrated framework for guiding and monitoring seismic risk reduction of non-engineered buildings in Indonesia via a risk management method.

Primarily, the proposed framework for the study has drawn heavily on wider literature, the three existing frameworks around the world, and on the contribution of various stakeholders who participated in the study. A postal questionnaire survey, selected interviews, and workshop event constituted the primary data collection methods. As a robust framework needed to be achieved, the following two workshop events, which were conducted in Yogyakarta City and Bengkulu City in Indonesia, were carried out for practicality, validity, and moderation or any identifiable improvement requirements. The data collected was analysed with the assistance of SPSS and NVivo software programmes.

This research found that the content of the proposed framework comprises 63 pairs of characteristic-indicators complemented by (a) three important factors of effective seismic risk management of non-engineered buildings, (b) three guiding principles for sustainable dissemination to the grass root communities and (c) a map of agents of change. Among the 63 pairs, there are 19 technical interventions and 44 non-technical interventions. These findings contribute to the wider knowledge in the domain of the seismic risk management of non-engineered buildings, in order to: (a) provide a basis for effective political advocacy, (b) reflect the multidimensional and inter-disciplinary nature of seismic risk reduction, (c) assist a wide range of users in determining roles, responsibilities, and accountabilities, and (d) provide the basis for setting goals and targets.

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ABBREVIATIONS

ADPC:	Asian Disaster Preparedness Center
BAKORNAS:	Badan Koordinasi Nasional (National Disaster Management Coordinating Board)
BAPPENAS:	Badan Perencanaan Pembangunan Nasional (National Development Planning Agency), Indonesia
BPS:	Badan Pusat Statistik (Statistic Center Board)
BSSC:	Building Seismic Safety Council, USA
CEEDEDS:	Center for Earthquake Engineering, Dynamic Effect, and Disaster Studies
DGURD:	Directorate General of Urban and Rural Development, UN
DFID:	Department for International Development, UK
DMO:	Disaster Management Organisation
DPU:	Departement Pekerjaan Umum, Indonesia (Public Work Department)
EERI:	Earthquake Engineering Research Institute. USA
FEMA:	Federal Emergency Management Agency, USA
GRDC:	Geological Research and Development Center, Indonesia
GREAT:	Gujarat Relief Engineering Advice Team
IDEA:	Instituto de Estudios Ambientales
IITK-BMTPC:	Indian Institute of Technology Kanpur and Building Materials and Technology Promotion Council, India
ISDR:	International Strategy for Disaster Reduction
IUDMP:	Indonesian Urban Disaster Mitigation Project
MHA:	The Ministry of Home Affairs, India
NDMD:	National Disaster Management Division, India
NICEE	National Information Center of Earthquake Engineering, India
RMSI:	Risk Management Software India
SATKORLAK:	Satuan Koordinasi Pelaksanaan (Provincial Disaster Management Coordinator Implementing), Indonesia
SATLAK:	Satuan Pelaksanaan (District/Municipal Disaster Management Implementing Unit), Indonesia
SCEC:	Southern California Earthquake Center, USA
SRRNEB:	Seismic Risk Reduction of Non-Engineered Buildings
TBSC:	Treasury Board of Canada Secretariat
UNCRD:	United Nations Centre for Regional Development
UNDP:	United Nations Development Programme
UN-ISDR:	The United Nations-International Strategy for Disaster Reduction
USGS:	The United Sates Geology Survey

GLOSSARY OF TERMS

Disaster:	A serious disruption of the functioning of society, causing widespread human, material or environmental losses, which exceed the ability of affected society to cope using only its own resources.
Earthquake:	The shaking or vibrating of the ground caused by the sudden release of energy stored in rock beneath the earth's surface.
Epicenter :	The position on the earth's surface above the focus of an earthquake
Fault:	A crack or fracture in the earth's surface along which the two sides have been displaced relative to each other. Active faults are assumed to be capable of producing earthquakes.
Focal depth:	The depth below the surface of the hypocenter or focus of an earthquake.
Intensity:	A measure of severity of shaking at a particular site. It is usually estimated
Isoseismal:	A contour on a map bounding areas of equal intensity for a particular earthquake
Magnitude:	A quantity characteristic of the total energy released by an earthquake, as
Non-engineered building:	A building which is spontaneously and informally constructed in the traditional manner. House owner is very much involved, and skilled technicians (engineers and architects) are generally not participated in their design and construction. They almost certainly have not been designed and constructed to resist earthquakes.
Risk:	The possibility of suffering loss as the product of hazard and vulnerability

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

Chapter I
Research Introduction

The principal aim of this chapter is to guide and familiarise the reader with the purpose and the subject area of the research study. In order to identify the research problem statement, the chapter begins with an explanation about global concerns, ranging from earthquake implications to non-engineered buildings, as to the biggest cause of human deaths and injuries during strong earthquakes. It then focuses on the description of the problem and its context; this introduces the subject itself and also the importance of reducing seismic risk in Indonesia, focusing on such non-engineered buildings. Subsequently, aim and objectives of the project are outlined, together with the significance of the research and an overview of the research methodology. The final section provides a guide to the thesis and the summary section.

1.1 Research Focus

An earthquake is a sudden, rapid shaking of the Earth caused by the breaking and shifting of rock beneath the Earth's surface. The National Earthquake Information Center (NEIC USA) locates about 50 earthquakes each day or about 20,000 a year (USGS, 2004a). The infamous Indian Ocean Indonesian Aceh's Earthquake on 26th December 2004 (located off the West Coast of Northern Sumatra, Indonesia) was the 5th largest earthquake recorded in the world since 1900 (USGS, 2004c). At the present time, scientists cannot predict precisely when and where an earthquake will occur (BSSC, 1995). Although earthquakes cannot be prevented, modern science and engineering provide tools that can be used to reduce their effects, based on the fact that much of the damage caused by earthquakes is predictable and preventable (USGS, 2004b). Broadly speaking, predicting earthquakes may be difficult, but preparing for disaster is not.

Several thousand earthquakes have occurred throughout the world, and populations have witnessed massive deaths and a series of costly and damaging outcomes. The Asian Disaster Preparedness Center (cited by BAPPENAS, 2006) comments that, certainly over the past ten years, such massive death tolls have not been necessary from a technical and scientific point of view. These disasters include: the 1999 Turkish earthquake, with a death toll of 17,127 people; the 2001 Indian earthquake, with 20,005 deaths; the infamous Indian Ocean Indonesian earthquake and tsunami in 2004, with more than 225,000 deaths across 12 nations (165,708 deaths in Indonesia alone); the 2005 Pakistani earthquake with 73,338 deaths, and again, in 2006, Indonesian Yogyakarta's earthquake with 5,716 deaths. With growing populations and infrastructures (high-rise buildings, bridges, apartments, pipelines, communication towers, and other utilities), earthquakes pose a greater hazard to people's lives and communities than ever before. A few hundred years ago, even large earthquakes could go unnoticed but now even a small earthquake is often felt by thousands of people.

Based on such field investigations from past earthquakes, the majority of damage caused by the ground shaking has been inflicted on buildings and houses, poor in design and construction, in both developing and developed countries. Most earthquake-related deaths and injuries have resulted from the collapse of such buildings. Almost all of them have been non-engineered buildings, particularly in developing countries (Mansouri et al., 2002; Sarwidi, 2001; and Blondet, 2003). In 2000, the Indonesian Bengkulu earthquake affected 42,342 houses, damaging around 1,386 (IUDMP, 2000). In 2004, the Indian Ocean Indonesian Aceh earthquake (together with tsunami) caused around 127,000 buildings/houses to be completely destroyed (BAPPENAS, 2005b). While the Indonesian disaster manager was still sympathising with the Aceh survivors in a reconstruction process following the Aceh earthquake, a second severe ground shaking hit Yogyakarta and Central Java on 27 May 2006, and left 156,662 private houses totally destroyed and 202,031 damaged (BAPPENAS, 2006). Most of the collapsed or heavily damaged buildings and houses were non-engineered, masonry constructions, with or without a reinforced concrete frame, in particular, those built by medium-low income communities or medium-low cost housing. On the other hand, the few buildings that were constructed according to seismic codes were able to survive the earthquakes. This evidence is similar to the findings from other developing countries (Mansouri et al., 2002).

The lesson learned from Yogyakarta's earthquake in 2006 brings home very forcefully the fact that a great disaster occurred in a densely populated area, which did not have earthquake-resistant constructions. Based on the Indonesian Seismic Zonation, clearly

Indonesia has large cities located in high seismic zones. It is found that almost 60% of the cities and urban areas are located in the relatively high to very high seismic zone, around 290 cities out of 481 cities in Indonesia (IUDMP, 2001). Constructions in these major cities are not earthquake resistant, as reported by CEEDEDS (2004).

According to the huge number of earthquake occurrences, the large amount of building damage after any quake and the concentration of population in cities in and around Indonesia, it can be widely seen that cities in Indonesia face a great earthquake hazard, threatening all elements of community life. As a result, earthquake disaster mitigation activities in the cities should be strengthened immediately; there is no need to delay implementing comprehensive earthquake disaster management plans in these cities. Tomorrow's risk is today's challenge.

1.2 Rationale for the Research Topic

A non-engineered building is an unsystematically designed, built, and supervised structure. These buildings are usually constructed by traditional builders and/or building owners, using common traditional approaches without intervention by qualified architects and engineers in their design and construction. In Indonesia, non-engineered buildings dominate most residential areas, are constructed of heavy materials such as masonry or multi-storey, reinforced concrete, and are built up to two stories high (CEEDEDS, 2004). Most of the loss of life in the past earthquakes has occurred due to the collapse of these buildings. It is well accepted amongst many engineers that earthquakes do not kill people; it is unsafe construction of buildings that kills people as a result of earthquakes.

Some of the evidence has shown that non-engineered buildings are still being constructed by self-build owners, builders, and local engineers within medium-low-income populations in Indonesia, due to demographic pressure (Sarwidi, 2001). Although these buildings will slowly be replaced by those of more reliable construction, it is widely accepted that they will remain the single greatest source of existing seismic risk for the foreseeable future. This gives a stronger urgency to introduce seismic resistance for both existing and new buildings, as it is imperative to reduce death tolls in future earthquakes.

In order to introduce seismic features in buildings, seismic codes have been generally developed and are mature and well-known in countries with high seismic areas. Seismic resistance in the codes helps to improve the behaviour of structures, so that they may withstand earthquake effects at the appropriate levels of ground motion. Proper implementation of seismic codes in structures created to be earthquake-resistant buildings covers four virtues: good structural configuration, adequate lateral strength, adequate stiffness, and good ductility. These standards and regulations do not ensure that structures suffer no damage during earthquakes of all magnitudes, but, to the best possible extent, they ensure that structures are able to respond to earthquake shakings of moderate intensities without structural damage, and of heavy intensities without total collapse (IITK-BMTPC, 2003). In Indonesia, the seismic codes for practical implementation of residential houses have been developed since 1978 (Boen, 1978). The newest formal seismic code for ordinary buildings (SNI-1726-2002) was launched in 2002.

Although the seismic codes clearly exist in countries to save lives and human suffering, earthquakes still continue to cause tragic events with high death tolls (Comartin et al., 2004). Obviously, it is widely accepted that there is a broad gap between the existence of seismic codes and recent earthquakes with massive deaths. Many of the deaths could have been reduced, even avoided, if the implementation of seismic codes had been properly employed. The implementation of the seismic codes in actual construction is paramount as the key to ensuring earthquake safety, particularly within non-engineered buildings, which are responsible for massive death tolls during earthquakes (Shah, 2002 and IITK-BMTPC, 2003).

In fact, seismic risk reduction through the implementation of seismic codes in construction is not simply physical and technical intervention (Petak, 2002); it comprises all forms of activities, multidisciplinary stakeholders, and citizens of different levels of understanding, commitment, and skill, including structural and non-structural measures. Broadly speaking, Wenzel (2006) mentions that slow progress in disaster risk reduction is due to five main impediments: (1) poor governance structures, (2) lack of a multi-sectoral, inter-disciplinary work culture, (3) inefficient use of resources, (4) lack of awareness and poor knowledge of risk, (5) poor professional standards and ethics. These are the most critical challenges facing a community living in a high seismic hotspot. Based on good practice in countries, the implementation of seismic codes can be achieved through an approach of seismic risk management, which includes: (1) seismic hazard analysis, (2) seismic risk assessment, and, (3) economic and political actions (seismic response) within all aspects of community life (SCEC, 2002).

Adopted from Charette (2002), seismic risk management can be described as a systematic process of using administrative decisions, organisation, operational skills, and capacities to implement policies and strategies for society and communities to lessen the impacts of seismic hazards and related environmental and technological disasters. Seismic risk management should be seen as advanced preparation and anticipation of possible adverse future seismic events, rather than responding as they happen. Generally, seismic risk management is pro-active. Some countries have employed integrated seismic risk management, embracing multidisciplinary stakeholders, with successful results (SCEC, 2002; UNDP, 2004; DFID, 2004; EERI, 1999; and IDEA, 2005).

The view that disasters are temporary disruptions to be managed only by humanitarian response, or that their impact will be reduced only by some technical intervention, has long been replaced by the recognition that they are intimately linked with sustainable development (UNDP, 2004 and UN-ISDR, 2002). Clearly, physical exposure itself as a result of development does not explain, nor automatically lead to, increased risk. If urban growth in a hazard-prone location is accompanied by adequate building standards and urban planning that takes into account risk considerations, disaster risk can be managed and even reduced. Therefore, seismic risk management should be factored into everyday decision-making in development planning; a shared responsibility and shared efforts are needed to reduce the impact of future earthquakes.

At present, disaster management programs in Indonesia are mostly oriented to provide response actions during disasters, are hardly ever involved in risk management actions, and furthermore, are not connected to an integral paradigm of sustainable development (Ngoedijo, 2003). Obviously, recognition of seismic risks as part and parcel of development planning can address some seismic risk management problems in Indonesia. At the same time, the full range of technical, social, cultural, and political consideration is evolving, and links with different fields and various stakeholders introduce new challenges. Each multi-sector stakeholder apparently approaches the issue from a different perspective, brings new practices, and has certain aspirations, which need to be harmonised to create the right mixture of seismic risk management initiatives. At the moment, current advances in information technology provide timely access to, and ease in transmission of, information within the systems, and significantly increase the range of interactions among individuals, within organisations, and between sets of organisations in reference to a common event or problem (Comfort, 2002). Dissemination of good practices and results can also encourage more commitment to seismic risk reduction; however, what has been achieved is not systematically assessed, recorded, and monitored (ISDR, 2003). As a result, the outcomes from seismic risk reduction are not yet supported by hard evidence. Furthermore, "what works and what does not work, and why" are not adequately known for informed advocacy, policy decision, or strategic planning.

These facts suggest that a widely agreed framework for guiding and monitoring seismic risk reduction can help to harmonise and systematise the field of integrated seismic risk management in order to implement seismic codes for non-engineered buildings in actual construction. Such a framework could also constitute the necessary backbone to collect information and data and capture good practices. It could also help to analyse trends in seismic risk reduction practices, and identify gaps and constraints for informed decisions (ISDR, 2003). The importance of developing an integrated framework for seismic risk reduction is also emphasised by Shah (2002), Petak (2002), and IDEA (2005).

It is definitely true for Indonesia that there appears to be a notable absence of any attempts to guide and monitor seismic risk reduction of non-engineered buildings in the integrated framework, at either a national or local level. The framework development could be a first step towards an integrated seismic risk management approach to reduce risk comprehensively in Indonesia. The proposed framework as a risk management tool offers a powerful means of changing policy and practice for Indonesian communities exposed to seismic risk; this is a new research area in Indonesia and will also contribute to the seismic risk management practices in developing countries. Moreover, the framework development is also in response to "the Istanbul Declaration on Human Settlements" (Habitat II) drafted on 14 June 1996, which underscores 'the right for everyone to adequate housing and the universal goal to provide safer, healthier, and sustainable human settlements'.

It must be emphasised, however, that the proposed framework is not the ultimate solution to all problems related to the implementation of seismic codes in the domain of non-engineered construction. Nevertheless, it is a tool or stepping stone which can be used to streamline individual, organisation, and agency involvement objectives, to make them more productive, efficient, and effective for all elements of shared responsibility and shared efforts to reduce seismic risk. The framework may be seen as a living document to be regularly reviewed and modified as issues emerge, knowledge expands, and capacities change. Furthermore, it is very important to disseminate the value of the framework as a tool benefiting all parties to achieve change permanently. Above all, the ultimate goal of this research project is to save lives and prevent human suffering due to the collapse of non-engineered buildings during strong earthquakes in the future.

1.3 Research Aim and Objectives

The principal aim of the research is to develop an integrated framework for guiding and monitoring seismic risk reduction of non-engineered buildings in Indonesia via a risk management approach. A key advantage in using a risk management approach in relation to seismic risk is that it ensures seismic risk reduction of non-engineered buildings is managed as part of wider decision-making. In sequence with the aim of the research, the objectives of the research are as follows.

a. to study and list some seismic features in building;
b. to study and analyse good practices of seismic risk management in specific countries;
c. to perform an in-depth evaluation of the implementation of disaster management activities in Indonesia;
d. to study, analyse, and evaluate three existing frameworks in disaster reduction around the world;
e. to develop a novel framework for guiding and monitoring seismic risk reduction of non-engineered buildings in Indonesia;
f. to review and validate the proposed framework for its application in two Indonesian cities, located in high seismic areas.

In line with ISDR (2003), generally, the proposed novel framework is expected to (a) provide a basis for effective political advocacy, (b) reflect the multidimensional and inter-disciplinary nature of seismic risk reduction, (c) assist a wide range of users in determining roles, responsibilities, and accountabilities, and (d) provide a basis for setting goals and targets. Chapter IV will explain this matter in detail.

1.4 Significance of the Research

Many integrated seismic risk management activities have already been deliberately studied and employed in countries with excellent achievements (SCEC, 2002; UNDP, 2004; DFID, 2004; EERI, 1999; and IDEA, 2005). In contrast, unsystematic disaster management in Indonesia commonly exists (Ngoedijo, 2001), even in seismic risk management areas. Therefore, this study, which aims to develop a novel framework for guiding and monitoring seismic risk reduction of non-engineered buildings, is currently one of novel research, combining a seismic risk and integrated risk management approach in Indonesia. The proposed framework differs from existing frameworks in other countries because it comprehensively identifies the core issues that underpin the understanding and practice of seismic risk reduction in Indonesia specifically; it: (a) focuses on non-engineered buildings, (b) involves many Indonesian active and multidisciplinary stakeholders in order to represent shared risk and adopt or adapt to their specific circumstances, (c) uses methodologies based on local resources so that the approaches are common and the solutions are local, providing a new form of solidarity and respecting cultural differences, (d) incorporates the poverty factor, as a common problem in developing countries. Accordingly, the proposed framework will be based on true and authentic Indonesian resources.

Moreover, the findings of this work may be useful in considerably assisting communities to reduce seismic risk of non-engineered buildings against future earthquakes in Indonesia. Here, the term 'community' means a broad audience composed of both those who have little specific knowledge about building regulations, seismic phenomena, design, and engineering and also those who are somewhat familiar with these concepts. This research refers to a critical investigation and evaluation, which has extended and led to a significant independent and original contribution to wider knowledge in the seismic risk management research area in developing countries by theory development sections, as presented in Chapters VII and IX. Furthermore, it could also be used to effectively mitigate the possible consequences of earthquakes by presenting balanced information in order to introduce seismic features on non-engineered buildings.

1.5 Overview of the Research Methodology

Generally, based on the absence of an integrated framework for disaster management in Indonesia, the principles within the proposed framework were drawn heavily from wider literature, the existing frameworks in other countries, and from the contributions of those who took part in the study; these contributions reveal the current conditions in Indonesia and are tailor-made for the needs and requirements of the multidisciplinary stakeholders. A brief research methodology is simply presented in Figure 1.1.

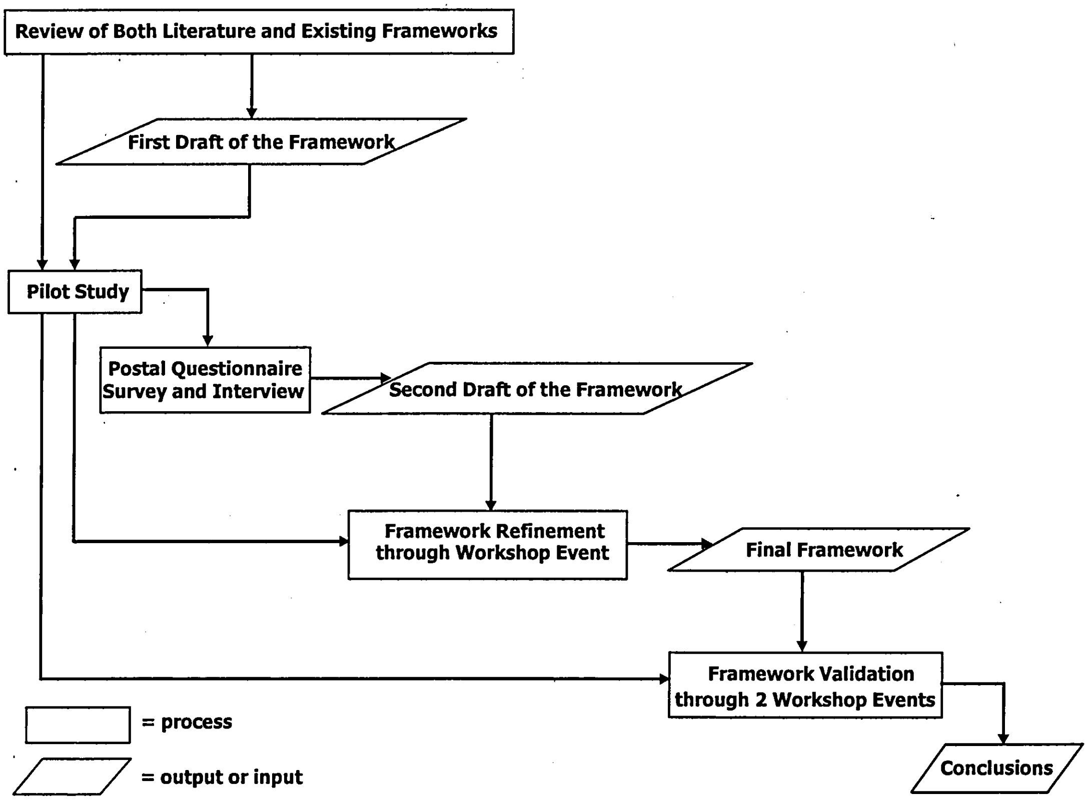


Figure 1.1 A brief research methodology

Firstly, a review of literature related to: earthquake definitions, lessons learned from past earthquakes in both developed and developing countries, frameworks of seismic implications, and the situation in Indonesia was carried out to gain a clear understanding of the causes of high death tolls during past earthquakes. The review encompasses literature from reference books, project reports, seminar proceedings, and journals on web-sites, which provide up-to-date information describing (1) why non-engineered buildings suffered most during past earthquakes, (2) the implementation of seismic risk management approaches around the world, and (3) the implementation of disaster management in Indonesia. These issues were explored to satisfy research objectives a, b, and c. The literature review mentioned above was intended to demonstrate a comprehensive grasp of existing knowledge in relation to the research subject. Furthermore, in addition to the categories of literature already mentioned, existing frameworks in disaster management around the globe were studied, analysed, and evaluated to fulfil the research objective d. These steps were able to list some emerging issues for primary data investigation; this was then called 'the first draft of the proposed framework'.

Following the desk-based analysis of the literature and the existing frameworks, research methodology was elaborated, and then a pilot study was carried out. The pilot study was conducted in order to refine the data collection plans as described in the research methodology section. The next phase was primary data collection. The method of data collection was justified primarily by the findings of the pilot study. The first and foremost data collection plan was a postal questionnaire survey, which was conducted by circulating the questionnaire to multidisciplinary stakeholder representatives who live in high seismic areas in Indonesia. Furthermore, an interview data collection method was conducted in order to find the causality behind the postal questionnaire findings. Combining the questionnaire survey and interviews generated 'the second draft of the framework'. Next, the final framework as the aim of the research (as precisely described in objective e) was achieved through a multidisciplinary stakeholder workshop event. In order to achieve a robust framework, the following two workshop events were held to review and validate the proposed framework developed in the previous stages in order to accomplish objective f. The final stage of the research was to draw some conclusions. The data collected was analysed with the use of a computer aided software programme i.e. SPSS. Specifically for qualitative data, NVivo software was utilised. Details of the research methodology are covered in Chapter VI.

1.6 Guide to the Thesis

This thesis is organised into eleven chapters, which correspond with the research process stages. A brief guide from Chapter II to Chapter XI is as follows:

Chapter II presents a comprehensive description about earthquake activities, their implications, and the current situation in Indonesia. This involves critically appraising what other people have written about earthquakes, from both developing and developed countries.

Chapter III focuses specifically on the relationship between non-engineered buildings and the existence of seismic codes, beginning with a definition of a non-engineered building. It is followed by a description of building behaviour during an earthquake then moves on to elaborate some seismic features in building. The final section of the chapter presents the wide gap between massive deaths and the existence of seismic codes.

Chapter IV covers many aspects of the integrated seismic risk management approach and good practice in certain countries. An in-depth evaluation of current disaster management programmes in Indonesia is given in the middle of the chapter, and then the final part presents the importance of developing an integrated novel framework for guiding and monitoring seismic risk reduction of non-engineered buildings (SRRNEB) in Indonesia.

Chapter V describes the evaluation of three existing frameworks in disaster management around the world, and emergent issues arising from the review of literature and existing frameworks, referred to as 'the first draft of the proposed framework'.

Chapter VI outlines the research methodology adopted for the project. Selected methodology is based on research objectives and issues, which are identified from the literature and world-wide existing frameworks. It covers in detail the research process, different methodological concepts and approaches and the strength, and weakness of different methods. Based on the comprehensive introduction, the chapter then outlines the methodological framework for this project and justifies the methods selected. The research design section of the chapter presents the structure of the data collection plans and analysis phase of the project and covers in detail the procedures and the criteria for various choices made.

Chapter VII outlines the pilot study for the research in order to refine the data collection plans, with respect to both the contents of the data and the procedures.

Chapter VIII reports on the data gathered from multidisciplinary stakeholders and examines their views and perspectives. The foremost data collection method is via a postal questionnaire survey and series of interviews. This is followed by data analysis, for refining 'the first draft of the proposed framework' into 'the second draft'.

Chapter IX elaborates the data collected from the workshop event and its analysis in order to refine 'the second draft of the proposed framework' into 'the final framework'. This chapter constitutes the final stage of the primary data collection phase in the thesis. The result analysis of the workshop constitutes a major part of the chapter.

Chapter X performs the validation of 'the final framework' presented in Chapter IX.

Chapter XI presents the conclusions drawn from the research work, which covers all the phases including the thorough review of literature and existing frameworks, data collection, and its analysis. The chapter also identifies the limitations of the research based on the fact that, despite an attempt to provide a full perspective on most of the more important issues, coverage cannot be exhaustive in a single study. Finally, a recommendation for further research in the area of integrated seismic risk management is presented.

1.7 Summary

This chapter presents a strong rationale for, and the direction of, the research project. Beginning with the definition of an earthquake and the massive death tolls during past earthquakes and based on lessons learned over time, it was followed by the definition of a non-engineered building. Next, it went on to introduce an integrated risk management approach in order to reduce seismic risk and describes the importance of developing an integrated framework for guiding and monitoring SRRNEB as a starting point to reduce seismic risk in Indonesia, since in Indonesia, there appears to be a notable absence of any attempt in the integrated framework to reduce seismic risk of non-engineered buildings. The aim and objectives of the research were covered in the middle of the chapter as a guide to the research direction. The significance of the research, the overview of the research methodology, and the guide to the thesis were described at the end of the chapter. As outlined above, the following chapter will present a thorough review of literature in relation to the research project.

Chapter II
Earthquake Activities, Their Implications, and Situation in Indonesia

This chapter provides extensive facts and figures about earthquakes, their implications, and the current situation in Indonesia through an in-depth review of existing literature. This study will explore current opinion that earthquakes are natural, devastating phenomena and their impact remains a significant challenge to all community life. This understanding excludes the view that earthquake disasters are 'acts of God' or external forces beyond any sort of possible human control or mitigation and praying to God is the primary solution to catastrophic hardship. The next section of this chapter introduces the definition of an earthquake, earthquake facts and statistics, and an earthquake implications framework. Lessons learned from past earthquakes are also covered in detail. The chapter concludes with an outline of the high seismic areas of Indonesia.

2.1 What is an Earthquake?

For hundreds of millions of years, the forces caused by the movement of tectonic plates have shaped the Earth. These tectonic plates are the large, thin, relatively rigid plates that move relative to one another on the outer surface of the Earth (see Figure 2.1). Tectonic plates form the Earth's surface and move slowly over, under, and past each other at different speeds from those of the neighbours. Sometimes the movement is gradual. At other times, the plates are locked together, unable to release the accumulating energy. When this energy grows sufficiently strong, the plates break free, causing the ground to shake, which is usually called an earthquake (FEMA, 2004). Broadly speaking, an earthquake is a sudden, rapid shaking of the Earth caused by the breaking and shifting of rock beneath the Earth's surface. They may occur at any time of year, day or night, with sudden impact and without any warning sign. Extensive research has been conducted in recent decades but there is no accepted method of predicting when and where an earthquake will occur (BSSC, 1995). Most occur at the boundaries where the plates meet; however, some earthquakes occur in the middle of plates. Most upheavals occur at depths of less than 80 km (50 miles) from the Earth's surface.

Figure 2.2 depicts world seismicity from 1975 to 1995, which shows that most sources of earthquakes are at the boundaries where the plates meet:

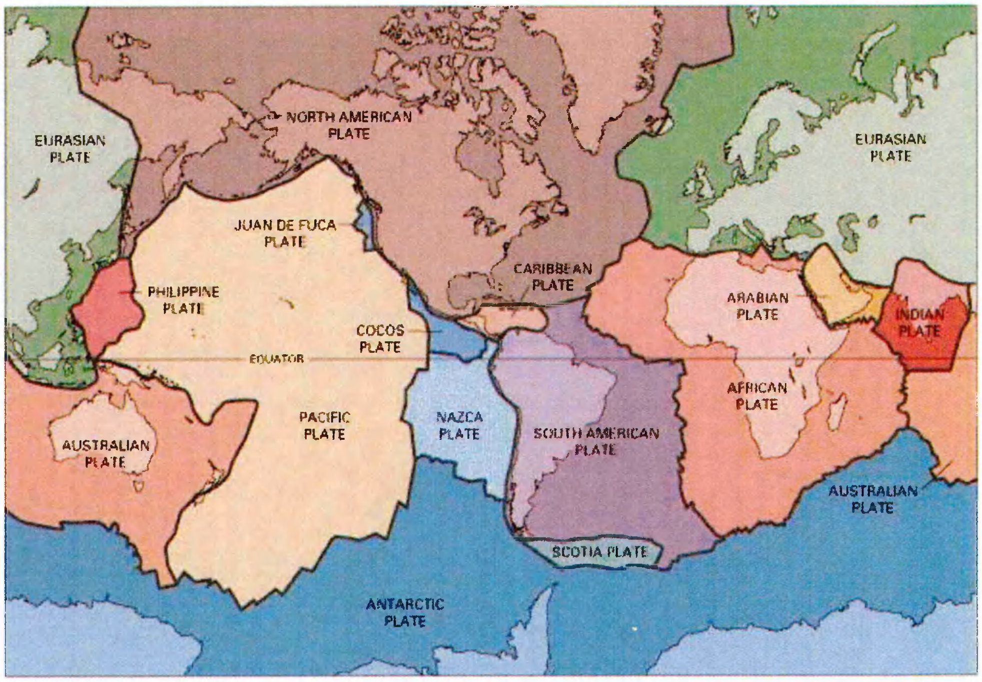


Figure 2.1 Earth tectonic plates (USGS, 2004a)

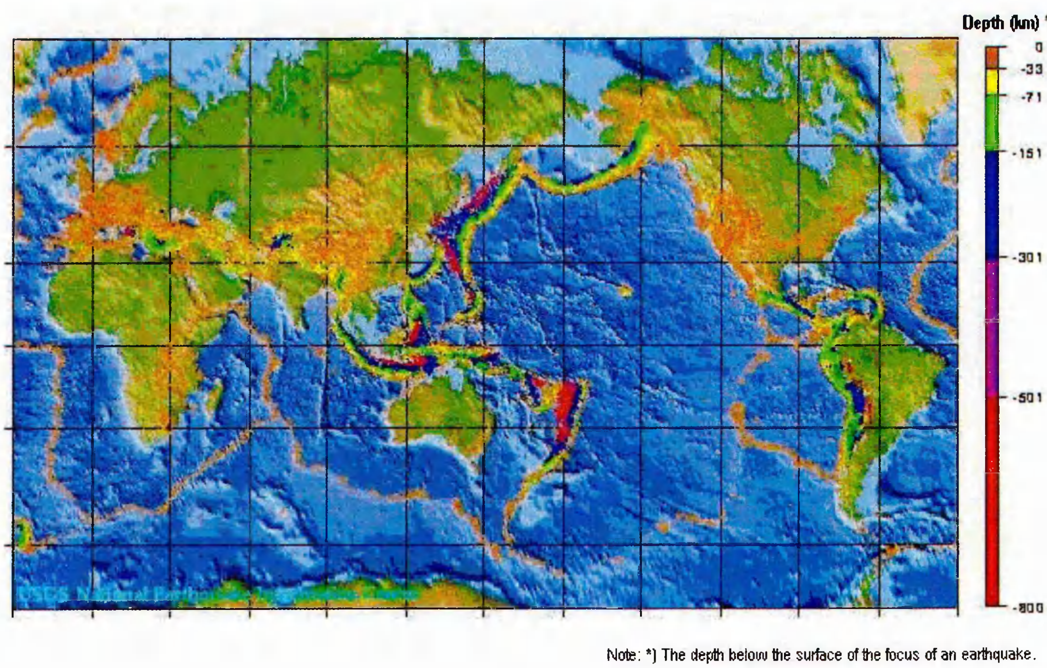


Figure 2.2 World seismicity from 1975 to 1995 (USGS, 2004c)

In the earthquake zone, there is a commonly used term: the 'Ring of Fire'. The 'Ring of Fire', technically called the Circum-Pacific belt, is the zone of earthquakes surrounding the Pacific Ocean; about 90% of the world's earthquakes occur there (see Figure 2.3). Indonesia is one of the countries within the Ring of Fire. The next most seismic region (5-6% of earthquakes) is the Alpide belt (extending from the Mediterranean region, eastward through Turkey, Iran, and northern India (USGS, 2004a)).

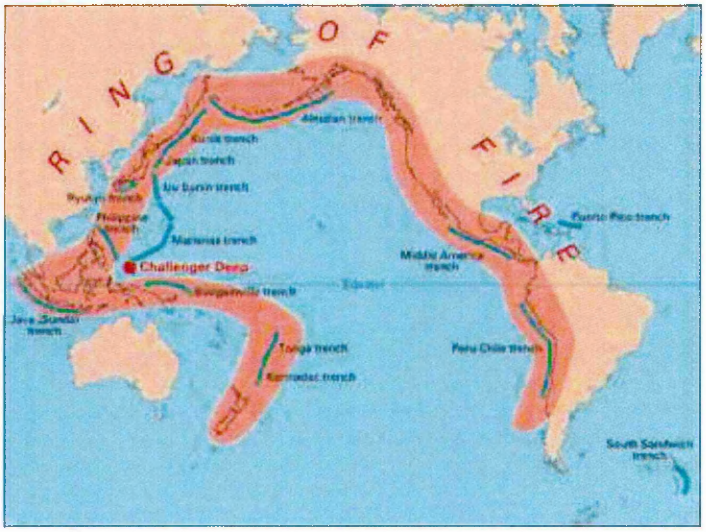


Figure 2.3 The Ring of Fire (USGS, 2004a)

2.2 The Strength of Earthquakes - Magnitude and Intensity

The magnitude of an earthquake is a quantitative measure of the actual size of the earthquake and is assigned as a figure on numerical scales. These *numerical* magnitude scales have no upper and lower limits; the magnitude of a very small earthquake can be zero or even negative. There are many magnitude scales, and one commonly used is the Richter Scale. An increase in magnitude (*M*) of 1.0 implies a 10 times higher waveform amplitude and about 31 times higher energy released. For instance, energy released in a *M7.7* earthquake is about 31 times that released in a *M6.7* earthquake, and is about 1,000 ($\approx 31 \times 31$) times that released in a *M5.7* earthquake. Most of the energy released goes into creating heat and fracturing the rocks, and only a small fraction of it (fortunately) goes into the seismic waves that travel large distances, causing a shaking of the ground en-route and hence, damage to structures (IITK-BMTPC, 2002). The magnitude is the same no matter where you are, or how strong or weak the shaking is in various locations.

Earthquakes are often classified into different groups based on their size; the annual average number of earthquakes across the Earth in each of these groups is shown in Table 2.1. It indicates that, on average, one 'great earthquake' occurs each year.

Table 2.1 Global occurrence of earthquakes (USGS, 2004d)

Group	Magnitude	Annual average number
Great	8 or higher	1
Major	7 – 7.9	18
Strong	6 – 6.9	120
Moderate	5 – 5.9	800
Light	4 – 4.9	6200 (estimated)
Minor	3 – 3.9	49000 (estimated)
Very minor	< 3.0	M2-3: ~1000/day; M1-2: ~8000/day

Large earthquakes at great distances can produce weak motions that may not damage structures or even be felt by humans; yet, sensitive instruments can still record them. From an engineering viewpoint, however, only actual shaking at a particular location that could possibly damage structures is of interest. This can happen with earthquakes in the vicinity or even with large earthquakes at reasonable medium to large distances.

Intensity is a qualitative measure of the actual shaking at a location during an earthquake, and is assigned as Capital Roman Numerals. This value does vary according to location and the motion at any site on the ground is random in nature. There are many intensity scales; one commonly used is the Modified Mercalli Intensity (MMI) Scale. The scale ranges from I (least perceptive) to XII (most severe). The intensity scales are based on three features of shaking – perception by people and animals, performance of buildings, and changes to natural surroundings.

Intensity of earthquake waves at a particular building location depends on a number of factors, including the magnitude of the earthquake, the earthquake distance, and the type of ground that the earthquake waves travelled through before reaching the location of interest. Shaking is more severe (about twice as much) at the Earth's surface than at substantial depths. This is often the basis for designing structures buried underground for smaller levels of acceleration than those experienced above the ground (IITK-BMTPC, 2002).

2.3 Earthquake Facts and Statistics

2.3.1 Earthquake Occurrences

The United States Geological Survey (USGS) estimates that several million earthquakes occur in the world each year. Many go undetected because they hit remote areas or have very small magnitudes. The National Earthquake Information Center (NEIC) USA now locates about 50 earthquakes each day or about 20,000 a year. Table 2.2 shows the 10 largest recorded earthquakes in the world from 1992; two of them occurred in Indonesia.

Table 2.2 The 10 largest recorded earthquakes in the world from 1900 to 26 Dec 2004 (USGS, 2004c)

	Location	Date	Magnitude	Coordinates	
1.	Chile	22 May 1960	9.5	38.24 S	73.05 W
2.	Prince William Sound, Alaska	28 March 1964	9.2	61.02 N	147.65 W
3.	Andrean of Islands, Alaska	09 March 1957	9.1	51.56 N	175.39 W
4.	Kamchatka	04 Nov 1952	9.0	52.76 N	160.06 E
5.	**Off West Coast of Northern Sumatra, Indonesia**	**26 Dec 2004**	**9.0**	**3.30 N**	**95.78 E**
6.	Off the Coast of Ecuador	31 Jan 1906	8.8	1.0 N	81.5 W
7.	Rat Islands, Alaska	04 Feb 1965	8.7	51.21 N	178.50 E
8.	Assam – Tibet	15 Aug 1950	8.6	28.5 N	96.5 E
9.	Kamchatka	03 Feb 1923	8.5	54.0 N	161.0 E
10.	**Banda Sea, Indonesia**	**01 Feb 1938**	**8.5**	**5.05 S**	**131.62 E**

2.3.2 Earthquake Implications

Ground shaking from earthquakes can collapse buildings and bridges, disrupt gas, electric, and phone services, and sometimes trigger landslides, avalanches, flash floods, fires, and huge destructive ocean waves (tsunamis). Buildings with foundations resting on unconsolidated landfill and other unstable soil and homes not tied to their foundations are at risk because they can be shaken off their mountings. When an earthquake occurs in a populated area, it may cause deaths and injuries and extensive property damage. Earthquakes have long been feared as one of nature's most terrifying and devastating phenomena (BSSC, 1995).

Earthquake damage to the built environment is caused by a number of factors. FEMA (2001) has developed a framework of earthquake effects, specifically inland. The framework starts with ground shaking (see Figure 2.4). Then, ground shaking can generate ground failure such as landslides and liquefaction (a process by which sediments below the water table temporarily lose strength and behave as a viscous liquid rather than a solid (EERI, 1999)).

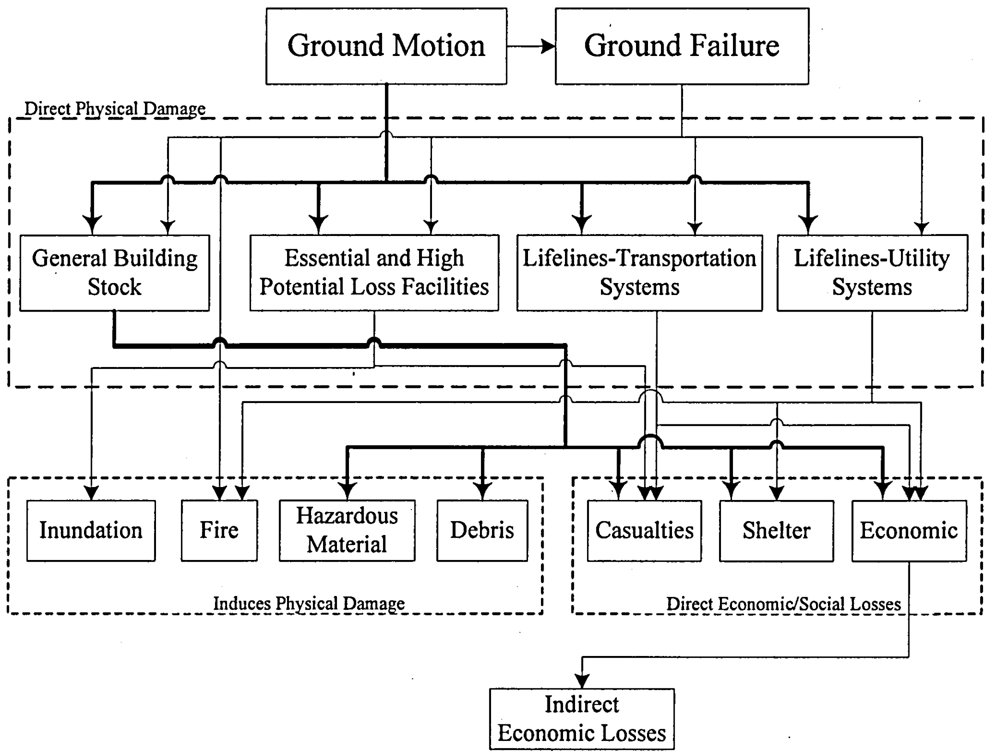


Figure 2.4 The framework of earthquake effects inland caused by both the ground shaking and ground failure (FEMA, 2001)

Both ground shaking and ground failure can cause direct physical damage to buildings, facilities, and lifeline systems. The direct physical damage can then induce other physical damage such as fire, inundation, hazardous material, and debris and can cause direct and non-direct economic and social losses. The indirect economic losses might be an additional cost due to damage or collapse of buildings, such as the cost of shelter, broken property, and major fire.

Ground movement during an earthquake is seldom the direct cause of death or injury. Most earthquake-related deaths and injuries result from collapsing walls and falling objects as a result of the ground shaking. Although earthquakes cannot be prevented, modern science and engineering provide new ways of tackling them and limiting their effects, based on the fact that much of the damage in earthquakes is predictable and preventable (USGS, 2004b).

The main concern caused by earthquakes is the number of deaths. There are several thousand earthquakes throughout the world, and people have witnessed massive deaths and a series of costly and damaging outcomes. The Asian Disaster Preparedness Center (cited by BAPPENAS, 2006) highlights that, over the past ten years, it has not been necessary from a technical and scientific point of view to see such massive death tolls, as presented in Table 2.3:

Table 2.3 International comparison of earthquake disasters, over the past ten years

Country	Disaster event	Date	Number killed	Damage & losses (US$ million)	Damage & losses (US$ million, 2006 constant prices)
Turkey	Earthquake	17 Aug 1999	17,127	8,500	10,281
India (Gujarat)	Earthquake	26 Jan 2001	20,005	2,600	2,958
Indonesia (Aceh)	Earthquake & tsunami	26 Dec 2004	165,708	4,450	4,747
Pakistan	Earthquake	5 Oct 2005	73,338	2,651	2,947
Indonesia (Yogyakarta & Central Java)	Earthquake	27 May 2006	5,716	3,134	3,134

Sources: Asia Disaster Preparedness Center, Thailand; ECLAC, EM-DAT, World Bank (cited by BAPPENAS, 2006)

2.4 Lessons Learned from Earthquake Damage

Every year, people around the globe can see the increasingly lethal effects of earthquakes. Because of the growing increase in the population and hence, infrastructure (high-rises, bridges, apartments, pipelines, communication towers, and other utilities), earthquakes pose a greater hazard to people's lives and communities than ever before. A few hundred years ago, even large earthquakes could go unnoticed, but now even a small earthquake is often felt by thousands of people. A major earthquake in a sparsely populated area, for example, is a natural phenomenon, not a hazard. Yet, when this natural ground shaking interacts with vulnerable man-made buildings and fragile infrastructures, this disruption of normal activities due to the natural strong jolting has the potential to cause widespread damage.

The earthquake engineering profession has learnt more from the performance of man-made structures during earthquakes than from laboratory tests or from analytical studies. Damaging earthquakes provide excellent full-scale test results on real-life structures; such results involve no modelling errors or approximations. Moreover, the results are for everyone to see and no sophisticated interpretation of results by the "experts" is required. Lessons learned from earthquake damage will present many explanations for damage regions, such as Indonesia, Iran, and Philippines, which represent developing countries, and Taiwan and USA, which represent developed countries.

The Indonesian Bengkulu earthquake took place on 4 June 2000. The earthquake affected 42,342 houses, 711 school buildings, 325 government offices, 3 university buildings, and 357 places of worship. The damage caused to the buildings varied from total collapse (around 1,386), heavy damage, and light damage (IUDMP, 2000).

On 26th December 2004, an earthquake and tsunami - the world's worst natural disaster at the dawn of this new century - struck the Indian Ocean region, killing more than 165,708 people in Indonesia alone, made almost a million people homeless, and sent a wave of shock across the globe, resulting in an outpouring of sympathy and worldwide offers of assistance. Indonesia bore the brunt of the disaster, concentrated in the Provinces of Aceh and North Sumatra. Hundreds of communities were washed away. In many cities and villages, the tsunami painted a line of destruction across the landscape. But the wounds on the other side were devastating as well, as the people of Aceh and North Sumatra were severely traumatised by the scale of the tragedy. The total estimated damage and loss amounted to 97% of Aceh Province's GDP/Gross Domestic Product. The highest damages and losses were in the building/housing sector. Around 127,000 buildings/houses were completely destroyed, leaving around 600,000 people homeless. Furthermore, about 152,000 housing units suffered damage estimated at 50% of their value. Private/residential houses suffered most, with damage 500 times higher than buildings in the public sector (BAPPENAS, 2005a).

While the Indonesian nation was still grappling with widespread demands for reconstruction following the Aceh earthquake, a second major earthquake struck Yogyakarta City on Java island (the most densely populated island in Indonesia) and its surrounding areas, on 27th May 2006. Private homes were the hardest hit, i.e. 156,662 totally destroyed and 202,031 damaged (Figure 2.5). This figure was far beyond the Aceh earthquake. Due to the series of disasters occurring around Indonesia, the area has faced situations whereby limited resources earmarked for development projects have had to be diverted to aid recovery and construction. Does this indicate that currently Indonesia is living in a constant state of recovery and reconstruction instead of development?

Figure 2.5 An area with almost completely collapsed buildings and houses caused by the Yogyakarta earthquake in 2006 (BAPPENAS, 2006)

Regarding the above three Indonesian earthquakes, building or home damages and losses dominated in number. It was clear in the Bengkulu and Yogyakarta earthquakes that most of the collapsed or heavily damaged buildings and houses were of a non-engineered origin, made of heavy materials, masonry constructions, with or without a reinforced concrete frame, in particular, those built by medium-low-income communities or low cost housing (IUDMP, 2000 and Boen, 2006a).

Based on field investigations in regions damaged by strong earthquakes such as Changureh, Iran on 22nd June 2002, immediately after the jolts, buildings and houses suffered the most damage. The main cause of the devastating destruction was due to poor design/construction (Figure 2.6) and the selection of poor building materials. Conversely, the few buildings that were constructed according to the Iranian building code were able to survive the earthquake (Mansouri et al., 2002).

Figure 2.6 Total collapse of the house due to poor design/construction and building materials after the Changureh earthquake (Mansouri et al., 2002)

Many residents of the historic city of Bam, Iran were still sleeping when the Magnitude 6.6 earthquake struck on 26th Dec 2003. Their traditional mud-brick and clay homes put up little resistance to the violent shaking, and as walls and roofs crumbled and collapsed, tens of thousands of victims were trapped beneath the rubble. According to recent reports, the death toll reached 41,000, with a final expected figure closer to 45,000. The Government of Iran estimated that a further 45,000 people were displaced from their homes, which may have risen to 75,000 as residents staying elsewhere with friends and relatives began to return (Adams et al., 2004).

Although there was an updated building code that was comparable to the Uniform Building Code (UBC) of the United States and was also used by Iranian civil engineers, the application of this code was limited primarily to the larger cities of Iran. In villages, there was typically no standard for the seismic design and/or construction of buildings. Villagers tend to build their own houses at minimal cost and with minimal safety measures in place. The Qazvin region is prone to earthquakes, with its most recent event occurring 39 years ago. That earthquake affected the Booeen Zahra region with devastating results. Unfortunately, little has changed in terms of the design or construction of village houses in that region, compared to those that were damaged then, 39 years ago (Mansouri et al., 2002).

A further example was seen on 16th July 1990, in an earthquake in the Philippines; about 90 percent of building stock in areas affected by the earthquake were non-engineered, designed and built by private homeowners, carpenters, and other non-professional builders. A large majority of those structures were residential buildings (Corpuz, 1990).

On 21st September 1999, the "Chi-Chi" earthquake struck the central region of Taiwan with a magnitude of $M_S = 7.6$ (Richter scale). A large percentage of buildings that collapsed due to the main shock or strong aftershocks were non-engineered, one-to-three stories reinforced concrete frame structures constructed with brick in-fill partitions and exterior walls. Many collapsed buildings had a pedestrian corridor and an open front at the ground floor, and only one wall at the back of the building along the direction of the street. This type of damage accounts for the majority of the complete building collapses near the epicentre due to severe ground shaking. However, in the "Chi-Chi" earthquake, more than 7,000 damaged buildings that were constructed according to the building code were able to survive the earthquake (Figure 2.7) and remained standing in and around the epicentre (Bruneau and Tsai, 2003).

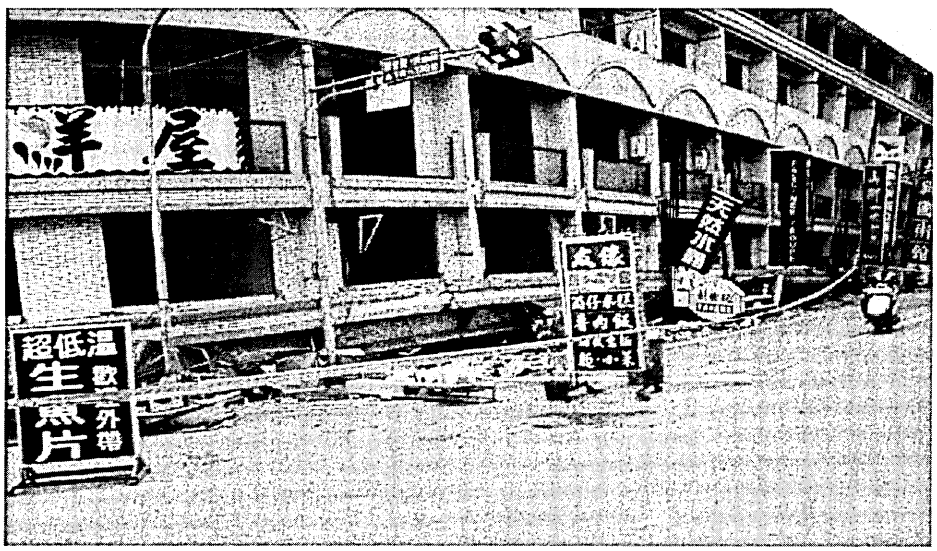


Figure 2.7 A building in the epicentral area, built with better construction techniques, after the "Chi-Chi" earthquake

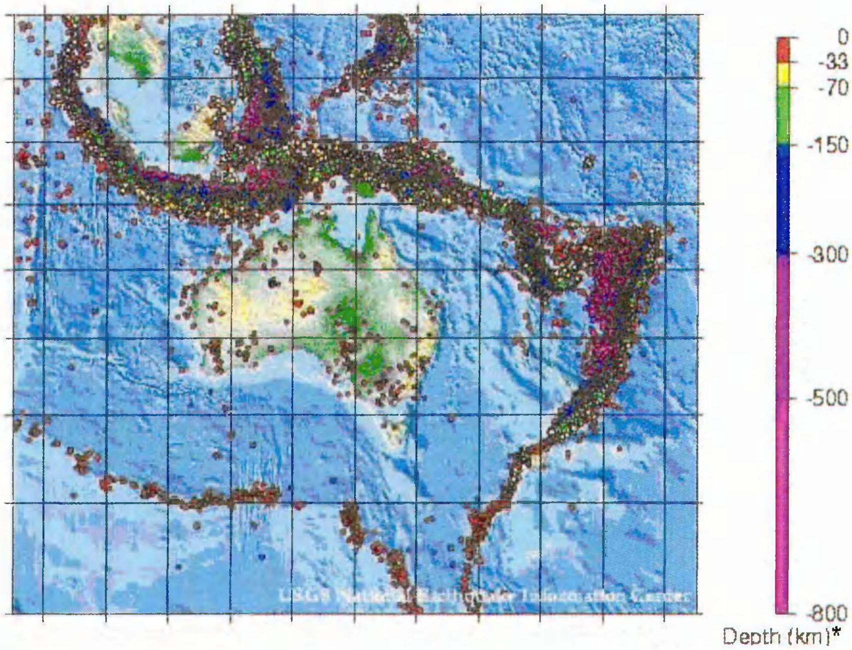
On the morning of the 20th April 2002, an earthquake struck at 6:50 a.m., approximately 15 miles southwest of Plattsburgh, New York. The USGS reported a preliminary magnitude of 5.1. Plattsburgh is located in New York State's Adirondack Mountain region, an area of relatively frequent seismic activity. There were reports of minor damage in the epicentre area. A bridge was damaged in Jay, New York, and road damage was reported in Keeseville, New York. A chimney was reported damaged in Lake Placid, and a window and foundation were cracked in Au Sable Forks, New York (USGS, 2004f).

Based on such field investigations above, it is clear that buildings and houses, which are poor in design and construction, suffer the majority of damage caused by the ground shaking in both developing and developed countries. Most earthquake-related deaths have resulted from the collapse of such buildings. Almost all were non-engineered buildings, which are spontaneously and informally constructed in the traditional manner. House owner is very much involved, and skilled technicians (engineers and architects) are generally not participated in their design and construction. They almost certainly have not been designed and constructed to resist earthquakes. The detail definition of non-engineered building will be presented in Chapter III. On the other hand, the few buildings that were constructed according to seismic codes were able to survive the earthquakes.

In conclusion, it is widely agreed that there is a strong correlation between loss of life and the collapse of non-engineered buildings around the world. Non-seismic resistance of non-engineered buildings is the underlying cause for the increase in losses from earthquake disasters. Hence, this research will focus on the risk posed by and to non-engineered buildings in earthquakes and the steps that can be taken, through building regulation and voluntary design education, to reduce this risk. Beyond the risk to life is the economic and social disruption caused by an earthquake; even moderate earthquakes can result in the loss of many homes, jobs, investments, and community resources.

2.5 The Situation in and around Indonesia

Tectonically, the Indonesian archipelago is one of the most active areas in the world, commonly called as 'The Ring of Fire' (see Figure 2.3). It has a typical four junction plate convergence (Australian plate in the South, Eurasian plate in the Northwest, Philippine plate in the North, and Pacific plate in the East) leading to the complicated geological and tectonic mechanisms of the region (see Figure 2.1). In addition, Indonesia suffers the highest number of potential volcano eruptions. Taken from earthquake data recorded by USGS (2004e) USA, earthquake occurrences in and around Indonesia (Indonesia, Philippines, Australia, and New Zealand) are depicted in Figure 2.8:



*) the depth below the surface of the focus of an earthquake

Figure 2.8 Seismicity in Indonesia, Philippines, Australia, and New Zealand 1977-1997 (USGS, 2004e)

The significant earthquakes in and around Indonesia from 1996 to 2006 are summarised in Table 2.4:

Table 2.4 Summary of significant earthquakes in and around Indonesia 1996 – 2006 (USGS, 2004c)

Year	The number of significant earthquakes	The biggest magnitude (Richter)	Region struck by the biggest magnitude & comments
2006*	13	7.7	SOUTH OF JAVA, INDONESIA Four-hundred and thirteen people killed, 2,741 injured and 15 missing in Ciamis; 62 people killed, 6,124 injured and 2 missing in Tasikmalaya; 15 people killed and 244 injured at Banjar; 1 person killed and 30 injured in Garut. At least 1,540 buildings damaged or destroyed, 176 boats destroyed and many roads damaged in Jawa Barat. Felt (IV) at Bandung, Jakarta, Pangandaran and Tasikmalaya.
2005	20	8.6	NORTHERN SUMATRA, INDONESIA At least 1,000 people killed, 300 injured and 300 buildings destroyed on Nias; 100 people killed, many injured and several buildings damaged on Simeulue; A 3 meter tsunami damaged the port and airport on Simeulue. Felt (VIII) at Gunungsitoli and (VII) at Telukdalem, Nias. Felt (VI) at Banda Aceh and (V)at Medan, Padang and Palembang; (IV) at Jambi; (III) at Bengkulu
2004	22	9	OFF WEST COAST OF NORTHERN SUMATRA, INDONESIA. The death toll from the earthquake and tsunamis across 12 nations (Indonesia, India, Srilanka, Thailand, Somalia, Maldives, Malaysia, Myanmar, Tanzania, Seychelles, Bangladesh, Kenya) has approached 200,000, with Indonesia worst affected (125,000 death), followed by Sri Lanka, India, and Thailand.

Table 2.4 continued

2003	18	7.2	SOUTH ISLAND OF NEW ZEALAND Minor damage in Otago and Southland. Chimneys fell and walls cracked at Dunedin, Invercargill and Te Anau. More than 200 landslides were observed and minor damage occurred to park infrastructure in Fiordland National Park.
2002	16	7.7	SOUTH OF THE FIJI ISLANDS Felt at Suva. Also felt in the Auckland area, New Zealand.
2001	20	7.5	a. MINDANAO, PHILIPPINES Felt at Butuan. Felt (III) on Ternate and at Manado, Sulawesi, Indonesia. b. BANDA SEA, INDONESIA Felt (IV) at Kendari and Raha, Indonesia.
2000	33	6.8	SOUTHERN SUMATRA, INDONESIA At least 103 people killed, 2,174 injured, extensive damage (VI) and landslides in the Bengkulu area; minor injuries and damage on Enggano. Felt (IV) in Lampung Province and at Palembang. Felt (III) at Jakarta, Jawa. Felt in much of southern Sumatra. Felt throughout Singapore. Also felt at Johor Bahru, Kuala Lumpur
1999	23	6.5	a. LUZON, PHILIPPINE ISLANDS. One person killed at Masinloc. Four people died from heart attacks and 40 injured on Luzon. Damage to structures (VII RF) at Santa Cruz; (VI RF) at Iba, Manila and Masinloc. Felt (VI RF) at Clark Air Base, Olongapo and San Fernando; (V RF) at Dagupan, Pasig, Quezon and Taguig; (IV RF) at Baguio, Lucban, Malolos, b. TAIWAN. At least 2,297 people killed, 8,700 injured, 600,000 people left homeless and about 82,000 housing units damaged by the earthquake and larger aftershocks. Maximum intensity (VI JMA) in Nan-tou and Tai-chung Counties. Half of a village was lost by subsidence into the Ta-an Hsi and landslides blocked the Ching-shui Hsi, creating a large lake. Two other lakes were created by substantial ground deformation near the epicenter. Surface faulting occurred along 75 km of the Chelungpu Fault. Felt (V JMA) at Chia-i and I-lan; (IV JMA) at Kao-hsiung, Taipei and Tai-tung. c. NEW BRITAIN REGION, PAPUA NEW GUINEA Felt on New Britain. Also felt at Port Moresby, New Guinea.
1998	29	6.6	MINDANAO, PHILIPPINE ISLANDS Items knocked from shelves (IV RF) at General Santos. Felt (IV RF) on Samal; (III RF) at Butuan, Davao and Kidapawan; (II RF) at Bislig, Cagayan de Oro and Cotabato; (I RF) at Zamboanga. Felt in much of Mindanao. Two events about 2.5 seconds apart.
1997	17	6.7	SOUTH OF FIJI ISLANDS Felt at Wellington, New Zealand. Complex earthquake, with Two events occurring about 6 and 12 seconds after the onset.
1996	23	6.6	FLORES SEA, INDONESIA Some damage at Kupang, Indonesia. Felt at Larantuka and Maumere, Indonesia. Also felt in the Kota Kinabalu area,Malaysia. Complex event.

*) in 2006, the most tragic earthquake event was in Yogyakarta, Java on 6.3 Richter. At least 5,749 people were killed, 38,568 were injured and as many as 600,000 people were displaced in the Bantul-Yogyakarta area. More than 127,000 houses were destroyed and an additional 451,000 were damaged in the area, with the total loss estimated at approximately 3.1 billion U.S. dollars. Felt (IX) at Bantul and Klaten, (VIII) at Sleman and Yogyakarta, (V) at Surakarta, (IV) at Salatiga and Blitar and (II) at Surabaya. Felt in much of Java. Also felt at Denpasar, Bali.

From Table 2.4, it can be assumed that the significant earthquakes in and around Indonesia were in the range of 13 to 33 occurrences, with an average of about 25 per year. It can be seen that there were many people killed, injured, missing, or homeless after the quakes. Many buildings were damaged or destroyed, and landslide and ground cracks were reported at several locations in the affected areas. The Bengkulu, Aceh, and Yogyakarta earthquakes clearly demonstrated the seismic vulnerability of Indonesia areas. Yet, there are many significant earthquakes that hit remote areas and/or the sources have great distances, so there is no further information about the effect of the quakes.

The Center for Earthquake Engineering, Dynamic Effect, and Disaster Studies (CEEDEDS), Islamic University of Indonesia, Yogyakarta, has organised field investigations in regions damaged by strong earthquakes, immediately after the jolts. Those investigation included: 1998 Blitar, 2000 Banggai, 2000 Bengkulu, 2000 Sukabumi, 2000 Banjarnegara, 2000 Pandeglang, 2001 Yogyakarta, and 2001 Majalengka (see Figure 2.9) (Sarwidi, 2001); also, the Yogyakarta earthquake 2006 (see Figure 2.10). In addition, CEEDEDS has also organised seminars, discussions, and other activities related to earthquake engineering issues. Findings of those investigations and other relevant activities showed that non-engineered buildings dominated in number and always suffered most, although there was a different percentage in each damaged area. Casualties and damage to property were mostly caused by the failure of non-engineered residential buildings (far less public buildings failed) due to ground shaking. The CEEDEDS investigation result was in line with earthquake damage in other countries, particularly in developing countries (Mansouri et al., 2002).

Figure 2.9 Residential building damaged after the Majalengka Indonesia earthquake in 2001 (Sarwidi, 2001)

Figure 2.10 New retail building damaged after the Yogyakarta earthquake in 2006

The lessons learned from the Bengkulu and Yogyakarta earthquakes bring home very forcefully the fact that, due to inland earthquakes, great disasters occurred in cities where most of the buildings or houses were not constructed to be earthquake-resistant. Based on Indonesian Seismic Zonation, Indonesia has large cities located in high seismic zones. It is found that almost 60% of the cities and urban areas are located in the relatively high to very high seismic zone, totalling around 290 out of 481 cities in Indonesia (IUDMP, 2001). Constructions in these major cities are not earthquake resistant, as reported by CEEDEDS (2004).

According to the huge number of earthquake occurrences and extensive building damage after quakes, and the concentration of the population in cities in and around Indonesia, it can be seen that cities in developing countries such as Indonesia and the Philippines pose a greater earthquake hazard to lives and communities than cities in developed countries such as New Zealand and Taiwan. As a result, earthquake disaster mitigation activities in the cities should be increased immediately. There is no need to delay implementing comprehensive earthquake disaster management plans in cities.

2.6 Seismic Mapping of Indonesia

As a seismic prone region, the data compiled by national and international foundations showed that the total number of earthquakes occurring in Indonesia between 1897 and 1999 with Magnitude >5.0 were approximately 8,237, of which about 5 percent occurred around Jawa Island, the most densely populated island in Indonesia (PLN Enjineering, 2003). According to the seismic prone region of Indonesia, in 2001 the Geological Research and Development Centre (GRDC), Indonesia, arranged 'The Earthquake Hazard Susceptible Map of Indonesia', which was compiled on the basis of the highest intensity figure or the highest level of destruction resulting from earthquake events. The magnitudes of the intensity and the level of destruction depend largely on a number of factors, e.g. distance from the earthquake source and the geology of the area. The closer the distance to the source, the higher the intensity figure and the more severe the destruction (see Figure 2.11):

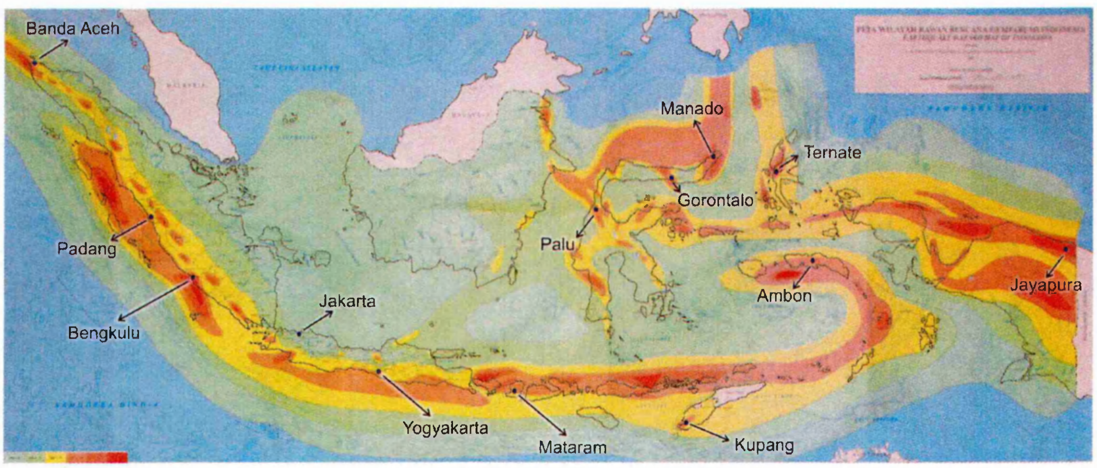


Figure 2.11 Earthquake hazard map of Indonesia (GRDC, 2001)

Places on the map which have a similar degree of intensity or a similar level of destruction are represented by an isoseismic line; this map, therefore, indicates or defines places or regions of an equal level of destruction. The intensity scale used in the map is the Modified Mercalli Intensity (MMI), with a range of intensity from I (lowest intensity) to XII (highest intensity).

The seismic zone maps are revised from time to time, as further data and understanding are gained of the geology, the seismotectonics, and the seismic activity in the country. This 2001 seismic zone map is not the final word on the seismic hazard of the country, and hence, there can be no sense of complacency in this regard.

The national Seismic Zone Map presents a large-scale view of the seismic zones in the country. Local variations in soil type and geology cannot be represented at that scale. Therefore, for important projects, such as a major dam or a nuclear power plant, the seismic hazard is evaluated specifically for that site. Also, for the purposes of urban planning, metropolitan areas are microzoned. Seismic microzonation accounts for local variations in geology and local soil profile.

As shown in Figure 2.11, there were 12 national capital cities in 2001 that had a high level of earthquake hazard, in which it was possible for the ground to shake on a scale of more than 6 MMI. In Figure 2.11, the zones are indicated by the colour red. The cities are Yogyakarta, Mataram, Banda Aceh, Manado, Gorontalo, Bengkulu, Kupang, Padang, Ternate, Palu, Ambon, and Jayapura. Among the 12 cities, the most densely populated city is Yogyakarta (BPS, 2003). It is also indicated that there are high concentrations of buildings and infrastructure at Yogyakarta City. In other word, Yogyakarta poses the greatest risk to its population in the event of a strong earthquake because of high population density and a high level of earthquake hazard.

Obviously, according to the map, the high seismic exposure of cities in Indonesia has been fully recognised by key government staff in GRDC, a few researchers, and specialists since 1998, but it is not widespread among local practitioners or community members as a whole. It would seem that the persistence of Bengkulu, Aceh, Yogyakarta, and other Indonesian communities not to implement strategic measures to cope with the existing huge seismic risk was because critical information and knowledge about earthquake data and its seismic map remained in the hands of a few experts and was never disseminated to all community member, agencies, and organisations in those affected areas. The public institutions, the people and the whole community seem to have a low awareness of that risk and of affordable means to reduce it and neglect the risk, leading to unpreparedness toward disaster. As a result, the outcome of the Aceh earthquake and tsunami in 2004 was unnecessary: 165,708 people dies and around 127,000 houses totally collapsed. Again, the Yogyakarta earthquake in 2006 tragically caused a further 5,716 unacceptable deaths and destroyed 156,662 residential houses and other constructions.

In conclusion, earthquakes are a real fact and also a threat for most Indonesian communities. This threat is inherently related to Indonesian geology; therefore, Indonesians should realise that the existence of seismic risk is unavoidable, and they should learn to live harmoniously with the risk in their everyday lives because an earthquake may happen at any time without any warning. As both people and seismic risk become attached to a place, Indonesian communities should be able to develop a sense of belonging and feel at home there, with the place being an anchor for his or her identity; this is inextricably linked to lives and activities. It is a very basic human need to feel attached to the landscape and community, to feel valued by friends and family, and to feel secure in all the things that make life truly meaningful. This term of sense of place is referred from Covenry and Dutson (2006) and Lynas (2007).

Moreover, it would be ideal if there was enough historical data about earthquakes and existing conditions in the cities to fit a model and its parameters in order to estimate the probability of losses if the big ones come. Unfortunately, such data exists only in the hands of a very few key government staff or experts. Therefore, the availability of current earthquake data and the geology profile in Indonesia should be soon disseminated to the local communities in order to enhance their awareness and encourage their active participation in local decision making.

2.7 Summary

An earthquake is a sudden, rapid shaking of the earth caused by the breaking and shifting of rock beneath the earth's surface. Earthquakes have long been feared as one of nature's most terrifying and devastating events. Although earthquakes cannot be prevented, modern science and engineering provides tools that can be used to reduce their effects, based on the facts that much of the damage caused by earthquakes is predictable and preventable. The main concern caused by earthquakes is the number of deaths and injuries caused by the collapse of buildings, which are poor in design and construction in both developing countries and developed countries. Almost all of them are non-engineered buildings. Conversely, the few buildings that were constructed according to the modern building code were able to survive the earthquakes.

On account of its geological conditions, the Indonesian region is highly prone to earthquakes, one of the most destructive natural hazards, with the potential to inflict huge losses to lives and property. Earthquakes pose a real threat to Indonesia, with almost 60% of cities and urban areas located in the relatively high to very high seismic zone. The Bengkulu, Aceh, and Yogyakarta earthquakes clearly demonstrated the seismic vulnerability of Indonesian areas. Findings from many of CEEDEDS's investigations around Indonesia into earthquake damage occurring after the jolts showed that non-engineered buildings dominated in number and always suffered most. Casualties and damage to property were mostly caused by the failure of non-engineered residential buildings. This situation is very similar around the globe, particularly in developing countries.

As Indonesia is an earthquake country, earthquake events are a real fact for Indonesian communities. Therefore, they should be able to live harmoniously with the event by developing a sense of place and incorporate the risk into everyday decision making. In addition, the availability of current earthquake data and the geology profile of Indonesia should soon be disseminated to local communities in order to enhance their awareness and encourage their active participation in local decision making. The next chapter will describe many aspects of non-engineered buildings and the existence of seismic codes.

Chapter III
Non Engineered Buildings and Seismic Codes

Based on lessons learned from past earthquakes, Chapter II explained that the non-seismic resistance of non-engineered buildings is the weakest link amidst the urban landscape during the strong, sudden onset of a quake. The aim of this chapter is to comprehensively examine existing literature on non-engineered buildings and seismic codes. It begins, by explaining precisely that non-engineered buildings are the biggest cause of high death tolls during earthquakes. In order to broadly understand such buildings, the following section presents non-engineered construction practice and general information on building behaviour during earthquakes, followed by the seismic design philosophy for buildings, building ductility, the effect upon non-engineered and engineered buildings during earthquakes, and the existence of seismic codes. Furthermore, this chapter summarises a list of seismic features in buildings, based on the explanation mentioned above. Finally, this chapter will elaborate on the wide gap between massive deaths and the existence of seismic codes. The summary concludes this chapter.

3.1 Non-Engineered Buildings and High Death Tolls During Earthquakes

Recently, strong earthquakes have occurred throughout the world. These earthquakes led to several early developments in earthquake engineering. Some developed countries have an excellent tradition of scientifically studying earthquake shaking. Referring to the performance of buildings during earthquake effects, man-made buildings can be classified into two extreme groups, engineered and non-engineered. The engineered building is systematically designed, built, and supervised using engineering approaches with the participation of competent professionals (Sarwidi, 2001). Conversely, the non-engineered building is an unsystematically designed, built, and unsupervised structure. Those non-engineered buildings are usually built by traditional builders and/or building owners using common, traditional approaches. GREAT (2001) refers to non-engineered buildings because often little or no engineering has gone into their design, and they almost certainly have not been designed and constructed to resist earthquakes. Moreover, NICEE (2004) mentions that non-engineered buildings are buildings which are spontaneously and informally constructed in the traditional manner without intervention by qualified architects and engineers during their design and construction, but which may follow a set of recommendations derived from the observed behaviour of such buildings during past earthquakes and trained engineering judgement. Between the two extreme groups, there are buildings classified as semi-engineered; however, people usually incorporate semi-engineered building into non-engineered building (Sarwidi, 2001). Therefore, the non-engineered buildings mentioned in this study are buildings other than those conforming to the engineered definition.

Non-engineered buildings are usually constructed from traditional materials such as stone, brick, adobe, and wood. Most of these buildings are identified as low-rise buildings, up to two storeys plus attic (GREAT, 2001). In Indonesia, non-engineered buildings dominate most residential areas; houses are constructed of one brick thick masonry without reinforcements and half brick thick masonry, with or without reinforced concrete, up to two storeys. Over the past 30 years, the latter has developed as 'a new culture' all over Indonesia: i.e. half-brick thick masonry buildings, built with reinforced concrete framing, consisting of the so called "practical columns and beams" (Sarwidi, 2001 and Boen 2006). The driving force behind the common use of heavy materials is the high price of appropriate wood, as the cost of light weight material is now increasing significantly. However, Boen highlights that if the new cultures of heavy non-engineered buildings were built with good quality materials and good workmanship, they would probably survive the strongest earthquakes in accordance with the Indonesian seismic hazard map. In fact, the Bengkulu and Yogyakarta earthquakes demonstrated that the majority of buildings constructed under the new culture were still not appropriately built for earthquake resistance, and only a very few were constructed according to advisable seismic resistance procedures.

Due to the rapid economic growth in Indonesia as a developing country, it is clear that many new buildings in cities are still needed to accommodate the large and increasing population. This indicates that non seismic resistance of non-engineered buildings is still being practised by self-build owners, builders, and local engineers. Although these buildings will slowly be replaced by those of a more reliable construction, they will remain the majority of total building stock and will be the single greatest source of existing seismic risk for the foreseeable future, especially those masonry houses of questionable structure, which are mainly occupied by medium-low income families in Indonesia (IUDMP, 2002).

Statistically, the number of non-engineered buildings is enormous. More than 95% of buildings, the existing as well as new constructions in Nepal, including those in urban areas, are built by owners using small-medium contractors who do not have any knowledge on earthquake-resistance construction. In Manila, Philippines, more than 90% of the buildings are non-engineered (Corpuz, 1990). Studying the quantitative number of non-engineered buildings at Yogyakarta City just before the 2006 earthquake, Sarwidi and Winarno (2006) described that 93.5% of Yogyakarta City residential housing stocks were non-engineered structures (see Figure 3.1). The percentage of non-engineered houses made of heavy materials, i.e. one or half-brick thick masonry buildings, was 84.8%, of which 1% were the very old houses without reinforcement and proper maintenance and the remainder seemed to be 'the new culture' buildings. The percentage of non-engineered houses built with lightweight materials such as teak wood in traditional and historic houses, or other lightweight materials elsewhere, was 8.7%. Some of them belong to the poorest of the poor and are made from very lightweight materials that, perhaps, may be able to resist strong ground shaking and would also be less deadly if they collapse. The remaining 6.5% are the engineered houses, which definitely belong to wealthy people.

Explanation in Chapter II has shown that the true nature of the seismic risk has shown that most of the loss of life in past earthquakes has occurred due to the collapse of those non-seismic resistant buildings made of heavy materials, in both developing and developed countries, as described in Chapter II, Section 2.4 (Mansouri et al., 2002; Ellull et al, 2004; Blondet, 2003; Corpuz, 1990; Lee et al., 2003; Sarwidi, 2001). Hence, this research will focus on 'the new culture' non-engineered buildings made of heavy materials, which tend to be the majority of building stock in Indonesia.

The strong correlation between the large number of deaths and injuries and the collapse of non-engineered buildings suggests it is imperative to introduce seismic resistance for both existing and new non-engineered buildings in order to reduce death tolls in future earthquakes. The ground shaking when earthquakes strike will not become a disaster if communities have such measures to reduce the risk beforehand. The following section mentions some understanding of the building behaviours during earth-quake, seismic codes, and other relevant issues compiled from many healthy literature.

3.2 Construction Practice in Non-Engineered Construction

In a simplified version of the process, the management of construction moves from the investment appraisal study and then goes to design and planning stage. The last stage is the construction process. Progression through the above construction stages is complex, requiring a wide range of interrelated activities. Such complexity is, in fact, amplified by many external factors. Better management of the first stage will contribute to improvement in the execution of the next stage. In engineered constructions such as high rise buildings, the above stages are usually carried out in detail. The construction risk is already analysed from the very beginning of the whole process. Because the stages are usually developed within a period of time, the decision can therefore be determined from a comprehensive point of view. The advancement of information technology and the utilisation of many experts and professionals maintain the quality of the product they create. Moreover, government decision makers are likely to arrange the policy and regulation in accordance with this high investment in engineered construction.

On the other hand, construction practice on non-engineered buildings is totally different to engineered ones. Usually, non-engineered buildings include the simple houses or low rise buildings, where local builders, foremen, masons, carpenters, and small-medium contractors are the main actors. In certain cases, the house owners act as the builders as well. Design and planning stages are very rarely conducted in a systematic way. Sometimes, the construction risk is considered as the process is going on. Lack of training, standards, access to information, and less attention to strict regulations are part of this practice; most residential houses in developing countries are built this way. Wealthy people, however, can hire professional actors to build their houses, so the quality and structural integrity of their buildings can stay at a high level. Figure 3.1 describes a characteristic comparison between non-engineered and engineered houses.

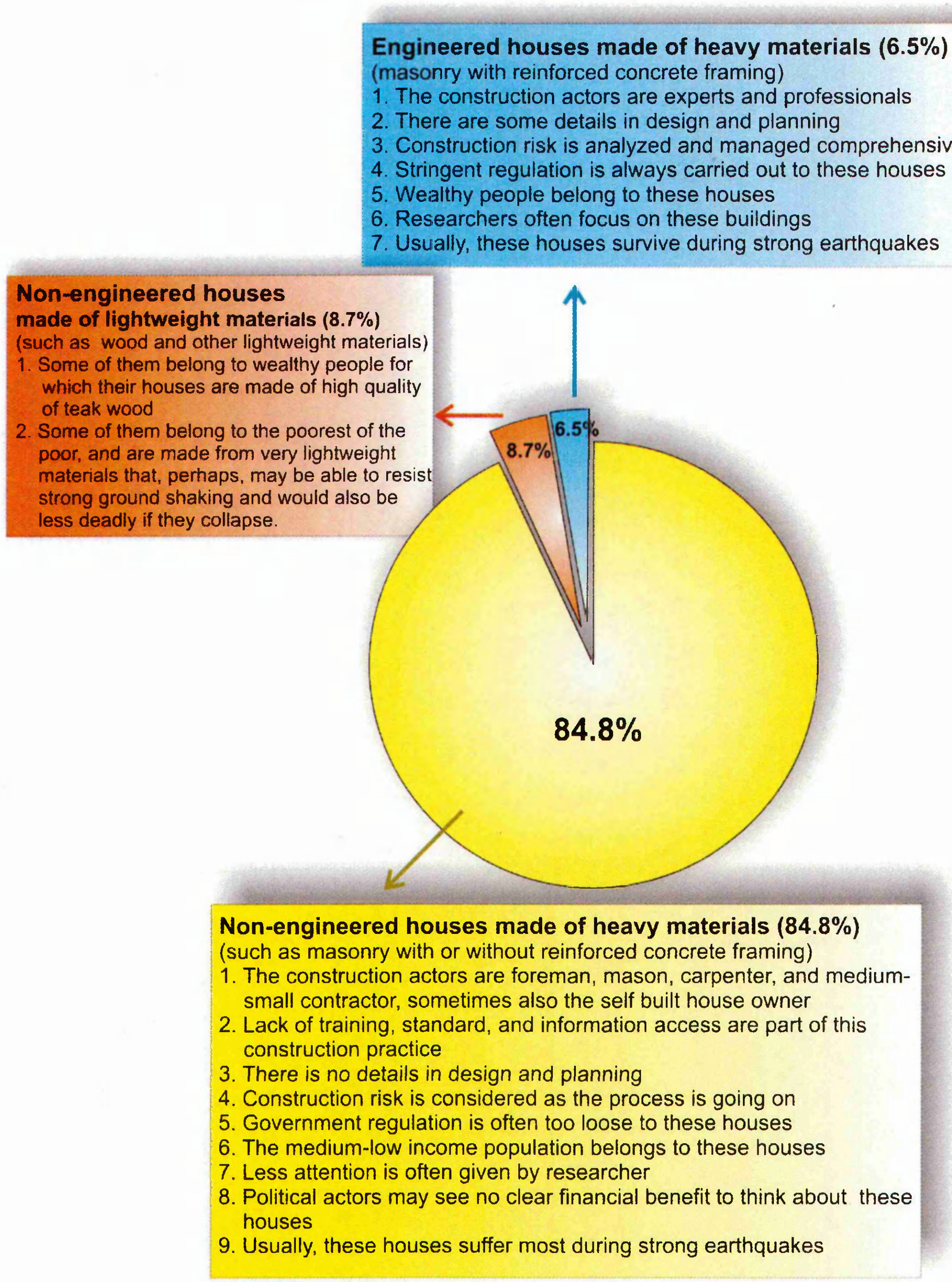


Figure 3.1 A characteristic comparison between non-engineered and engineered houses in the Yogyakarta City (Sarwidi and Winarno, 2006)

Building simple or low rise houses is relatively uncomplicated and the project duration is a short period. For example, building one house unit with a floor area of 36 m^2 can be accomplished within 2-4 months, as the design for this type of house construction is not complex. For the purpose of the seismic resistance of houses, the common design of seismic resistance is now available in a simple manual on how to implement seismic resistance in a simple structure. After the Aceh and Yogyakarta earthquakes, many organisations, agencies and individuals made and distributed thousands of such manuals to the affected areas. Also, many electronic books and articles on a similar subject from many countries can be downloaded from the internet. Through this approach, the seismic design time is reduced, and then many seismic structural engineers are able to urge non-engineered construction actors to focus on the construction process. If they build a house corresponding to the manual, the building will comply with the advisable seismic features. Broadly speaking, the tools to implement such seismic codes now truly exist in non-engineered construction environments; thus, the most important issue is the construction process.

The construction process involves a physical covering procedure, from the foundations to the walls, columns, floors, and roofing. All components should conform to the quality standard, particularly to ensure structural integrity. However, various reconnaissance reports (Ellul et al, 2004 and Sarwidi, 2001) and interviews with local practitioners such as those undertaken in Majalengka, reveal some inadequate construction materials. Frequently, mortar and in-situ concrete is batch mixed on site. Aggregate and sand are not washed or sieved and any water source which is at hand is used in the mix. Such methods result in mixing by volume and not by weight and therefore no account for moisture content is made. The resulting mortar and concrete are generally of poor quality, with a weak compressive strength (see Figure 3.2). Additionally, it is poorly graded, compaction on site being inadequate, having a high water content and aggregates over 30mm in size. Segregation and honeycombing are common, whilst concrete cover to the reinforcement varies widely, though generally less than 25mm. All reinforcement is generally smooth mild steel. Steel reinforcement ratios and details are usually only adequate for gravity loading considerations, and include 90 degree hooks at longitudinal bar ends (stirrups) and lap slice locations not suitable for laterally loaded frames. All too often, there is incorrect beam – column connection detail (see Figure 3.3). The volumetric ratio of transverse steel is often less than 0.3% and therefore does not provide the necessary tri-axial state of stress for the concrete core. The masonry infills vary in form and material, ranging from hollow or solid clay bricks, cement and concrete blocks, and hewn stones amongst others, generally laid in a cement mortar.

Figure 3.2 Poor quality of concrete, weak compressive strength (Boen, 2006a)

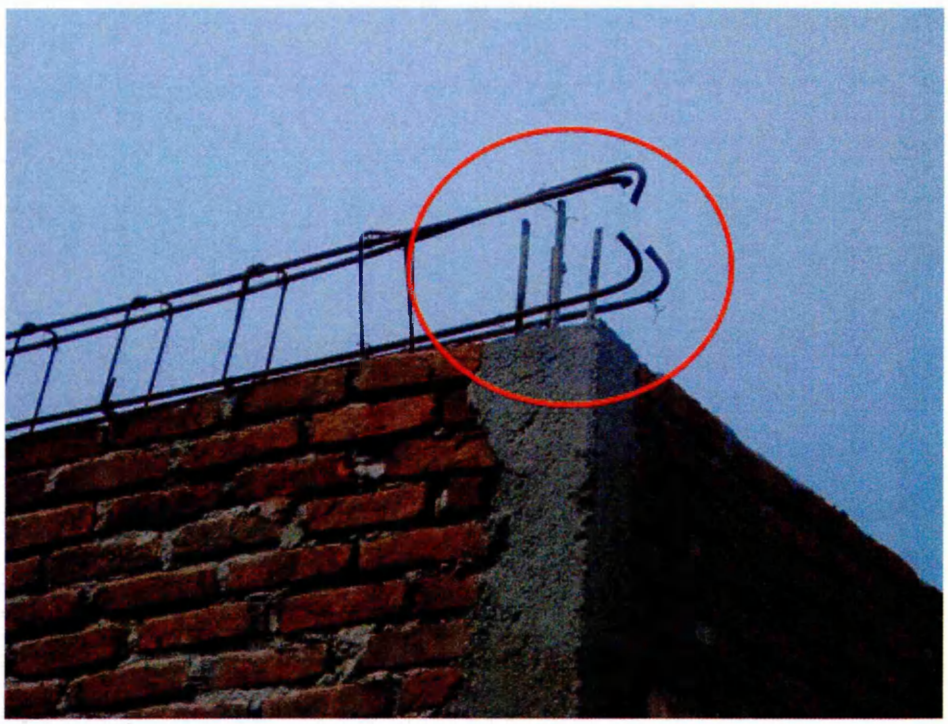


Figure 3.3 Incorrect beam – column connection detail (Boen, 2006a)

The quality of materials, in fact, depends largely on the knowledge of the builders. Local builders, foremen, masons, and carpenters continue to practise the traditional approach and are often reluctant to accept new techniques. They feel that what they do is in line with their belief and tradition, and there is no strict regulation which confronts their practices. In this situation, many organisations have organised training for those actors. For example, CEEDEDS (2001) conducted training for many foremen on how to implement seismic features in simple houses, administered with the Government of Japan. CEEDEDS believes that the role of foreman is important in the existence of non-engineered buildings, because they are in the front line during the construction process. Frequently, the house owners hire the foremen to build their houses by providing all labour forces, such as masons, carpenters and non-skilled labour. In many cases, the masons and carpenters work directly on the house construction without the involvement of foremen. In common construction practice, the foremen supply 95.63% of the labour force in the construction industry, because they have knowledge of a construction labour force who are not permanent workers in the construction industry. During the construction process, the awarded contractor hires the foreman to supply the labour force. When the construction ceases, the foremen, together with their labour force, move to another construction site. Based on the present situation in Indonesia, it would seem that the role of foreman will continue to exist for years, perhaps even decades. Build-Change NGO (Hausler, 2006) has also conducted training for technical assistance and capacity building on local construction actors in Aceh. Build-Change is providing technical expertise on design and construction of earthquake resistant, culturally appropriate, and low-cost houses.

Past experiences of the collapse of many non-engineered buildings give a stronger urgency to change the non-engineered construction practice permanently. The tools to implement this change are now widely available. It would seem that the greatest challenge is to improve the skill of people in the domain of the non-engineered construction sector. However, at the moment, most of the outstanding resources are prevalently used for the more formal sector, such as the research and teaching of structural engineering which, however, does not study or analyze in detail the structure of the small residential masonry buildings. At the same time, key government officials seem less enthusiastic to arrange a regulation to cultivate the seismic resistance on non-engineered buildings in this sense, as they see no clear financial and political benefit. Therefore, a combination of skilled, non engineered construction actors and the proactive involvement of government and non-government organisations are imperative in these circumstances to change construction practice. Everybody should bear in mind that each brick laid in the construction process can either contribute to risk reduction or become an enabler for the next big disaster.

3.3 Building Behaviours during Earthquake Shaking

From Section 3.3 to 3.7 below, many more explanations are taken from Earthquake Tip 1-24 which were published from 2002 to 2004 by Indian Institute of Technology Kanpur and Building Materials and Technology Promotion Council, India. The basic concept of earthquake resistant construction through simple language which is described in Earthquake Tip 1-24 is very helpful for and quite similar with Indonesian construction.

3.3.1 Inertia Forces in Buildings

During earthquake shaking, a building resting on ground will experience motion at its base. From Newton's First Law of Motion, even though the base of the building moves with the ground, the roof has a tendency to stay in its original position. Since the walls and columns are connected to it, they drag the roof along with them. This tendency to continue to remain in the previous position is known as inertia. In the building, since the walls or columns are flexible, the motion of the roof is different from that of the ground.

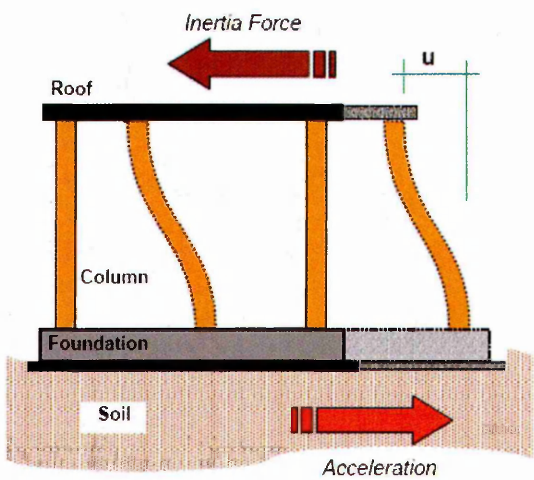


Figure 3.4 Inertia force and relative motion within a building (IITK-BMTPC, 2002)

Consider a building whose roof is supported on columns (Figure 3.4), when the ground moves, even the building is thrown backwards, and the roof experiences a force, called inertia force. If the roof has a mass M and experiences an acceleration *a*, then from Newton's Second Law of Motion, the inertia force/IF is mass *M* times acceleration *a*, and its direction is opposite to that of the acceleration. Clearly, more mass means a higher inertia force. Therefore, lighter buildings resist the earthquake shaking better.

3.3.2 Effect of Deformations in Buildings

The inertia force experienced by the roof is transferred to the ground via the columns, causing forces in columns. These forces generated in the columns can also be understood in another way. During earthquake shaking, the columns undergo relative movement between their ends. In Figure 3.4, this movement is shown as quantity u between the roof and the ground. Yet, given a free option, columns would like to come back to the straight vertical position, i.e., columns resist deformations. In the straight vertical position, the columns carry no horizontal earthquake force through them. Yet, when forced to bend, they develop internal forces. The larger is the relative horizontal displacement *u* between the top and bottom of the column, the larger this internal force is in columns. It is true that the stiffer the columns are (*i.e.,* the column cross section is bigger), the larger is this force. For this reason, these internal forces in the columns are called stiffness forces. In fact, the stiffness force in a column is the column stiffness times the relative displacement between its ends.

3.3.3 Flow of Inertia Forces to Foundations

Under shaking of the ground, inertia forces are generated at level of the mass of the structure (usually situated at the floor levels). These lateral inertia forces are transferred by the floor slab to the walls or columns, to the foundations, and finally to the soil system underneath. So, each of these structural elements (floor slabs, walls, columns, and foundations) and the connections between them must be designed to transfer safely these inertia forces through them.

Walls or columns are the most critical elements in transferring the inertia forces. Yet, in traditional construction, floor slabs and beams receive more care and attention during design and construction than walls and columns. Walls are relatively thin and often made of brittle materials like masonry. They are poor in carrying horizontal earthquake inertia forces along the direction of their thickness. Failures of masonry walls have been observed in many earthquakes in the past. Similarly, poorly designed and constructed reinforced concrete columns can be disastrous.

3.3.4 Importance of Architectural Features

The behaviour of a building during earthquakes depends critically on its overall shape, size, and geometry, in addition to how the earthquake forces are carried to the ground. Hence, at the planning stage itself, architects and structural engineers must work together to ensure that the unfavourable features are avoided and a good building configuration is chosen.

A desire to create an aesthetic and functionally efficient structure drives architects to conceive wonderful and imaginative structures. Sometimes the *shape* of the building catches the eye of the visitor, sometimes the *structural system* appeals, and in other occasions *both shape and structural system* work together to make the structure marvellous. However, each of these choices of shapes and structure has significant bearing on the performance of the building during strong earthquakes. The wide range of structural damages observed during past earthquakes across the world is very educational in identifying structural configurations that are desirable versus those which must be avoided.

a. Size of buildings

In tall buildings with large height-to-base size ratio, the horizontal movement of the floors during ground shaking is large. In short but very long buildings, the damaging effects during earthquake shaking are many. Moreover, in buildings with large plan area like warehouses, the horizontal seismic forces can be excessive to be carried by columns and walls.

b. Horizontal layout of buildings

In general, buildings with simple geometry in plan (Figure 3.5a) have performed well during strong earthquakes. Buildings with re-entrant corners, like those U, V, H and + shaped in plan (Figure 3.5b) have sustained significant damage. Many times, the bad effects of these interior corners in the plan of buildings are avoided by making the buildings in two parts. For example, an L-shaped plan can be broken up into two rectangular plan shapes using a separation joint at the junction (Figure 3.5c). Often, the plan is simple, but the columns/walls are not equally distributed in plan. Buildings with such features tend to twist during earthquake shaking.

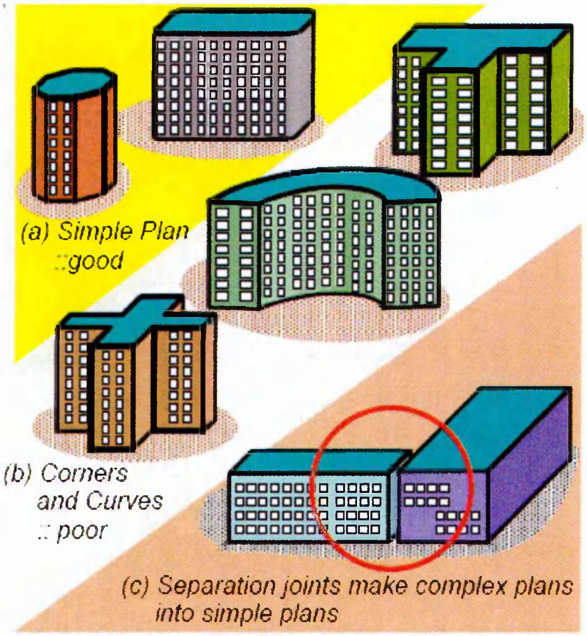


Figure 3.5 Simple plan shape buildings do well during earthquakes (IITK-BMTPC, 2002)

c. Vertical layout of buildings

The earthquake forces developed at different floor levels in a building need to be brought down along the height to the ground by the shortest path; any deviation or discontinuity in this load transfer path results in poor performance of the building. Buildings with vertical setbacks (like the hotel buildings with a few storeys wider than the rest) cause a sudden jump in earthquake forces at the level of discontinuity (Figure 3.6a). Buildings that have fewer columns or walls in a particular storey or with unusually tall storey (Figure 3.6b) tend to damage or collapse which is initiated in that storey. Many buildings with an open ground storey intended for parking collapsed or were severely damaged in most earthquakes.

Buildings on sloping ground have unequal height columns along the slope, which causes ill effects like twisting and damage in shorter columns (Figure 3.6c). Buildings with columns that hang or float on beams at an intermediate storey and do not go all the way to the foundation, have discontinuities in the load transfer path (Figure 3.6d). Some buildings have reinforced concrete walls to carry the earthquake loads to the foundation. Buildings, in which these walls do not go all the way to the ground but stop at an upper level, are liable to get severely damaged during earthquakes.

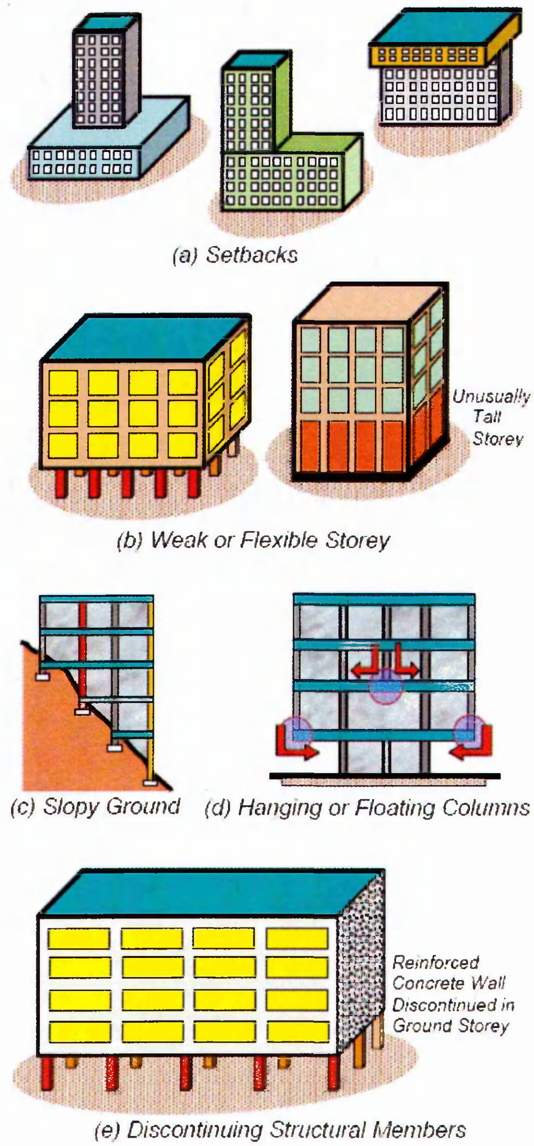


Figure 3.6 Sudden deviations in load transfer path along the height lead to poor performance of buildings (IITK-BMTPC, 2002)

In conclusion, of course, one will continue to make buildings interesting rather than monotonous. However, this need not be done at the cost of poor behaviour and earthquake safety of buildings. Architectural features that are detrimental to earthquake response of buildings should be avoided. If not, they must be minimised. When irregular features are included in buildings, a considerably higher level of engineering effort is required in the structural design and yet the building may not be as good as one with simple architectural features. Decisions made at the planning stage on building configuration are more important, or are known to have made greater difference, than accurate determination of code specified design forces.

3.3.5 Twisting in Buildings

Consider a rope swing, a wooden cradle tied with coir ropes to the sturdy branch of an old tree that is tied identically with two equal ropes. It swings equally, when someone sits in the middle of the cradle. Buildings too are like these rope swings; just that they are inverted swings (Figure 3.7). The vertical walls and columns are like the ropes, and the floor is like the cradle. Buildings vibrate back and forth during earthquakes. Buildings with more than one storey are like rope swings with more than one cradle.

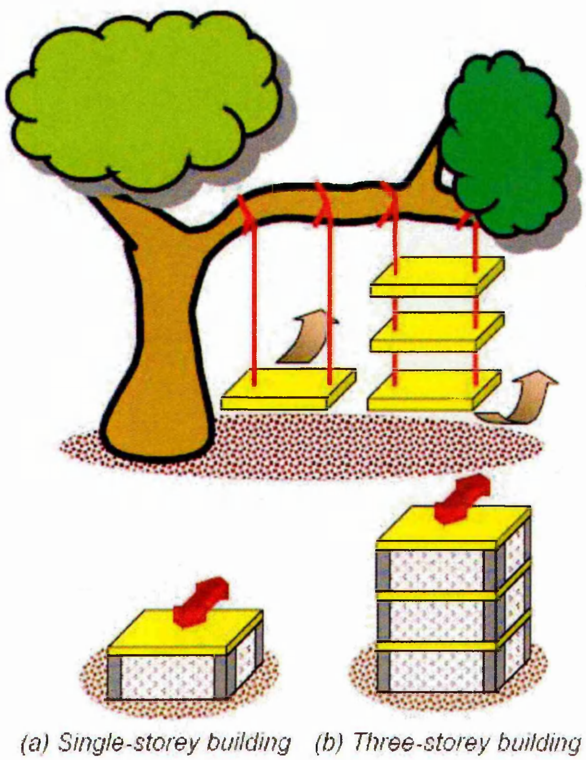


Figure 3.7 Rope swings and buildings both swing back-and-forth when shaken horizontally (the former are hung from the top, while the latter are raised from the ground) (IITK-BMTPC, 2002)

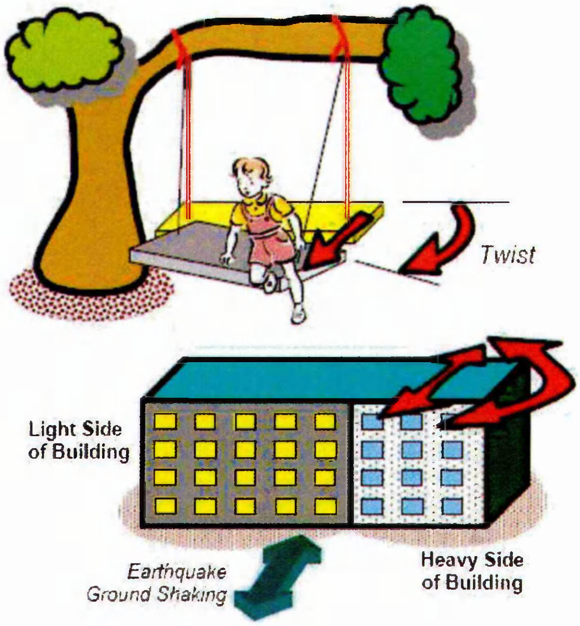
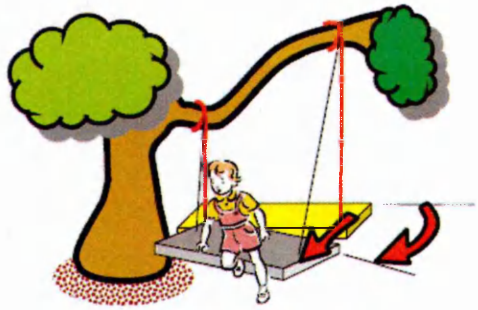


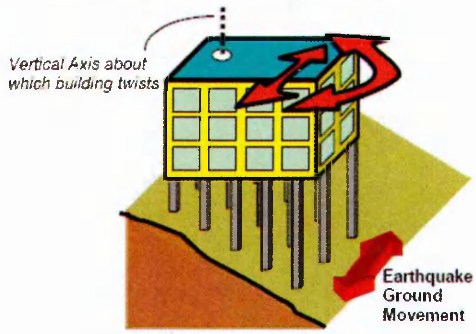
Figure 3.8 Even if vertical members are placed uniformly in plan of building, more mass on one side causes the floors to twist (IITK-BMTPC, 2002)

Again, let us go back to the rope swings on the tree: if someone sits at one end of the cradle, it *twists* (*i.e.,* moves more on the side she is sitting). Likewise, if the mass on the floor of a building is more on one side (for instance, one side of a building may have a storage or a library), then that side of the building moves more under ground movement (Figure 3.8). This building moves such that its floors displace horizontally as well as rotate.

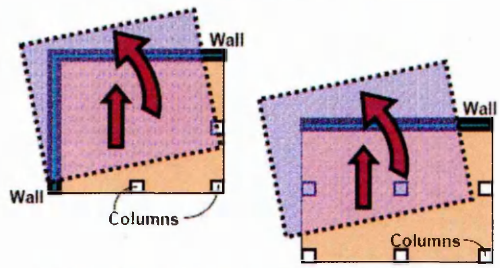
Once more, let us consider the rope swing on the tree. This time let the two ropes with which the cradle is tied to the branch of the tree be different in length. Such a swing also *twists* even if you sit in the middle (Figure 3.9a). Similarly, in buildings with unequal vertical members (*i.e.,* columns and/or walls) also the floors twist about a vertical axis (Figure 3.9b) and displace horizontally. Likewise, buildings, which have walls only on two sides (or one side) and thin columns along the other, twist when shaken at the ground level (Figure 3.9c).



(a) Swing with unequal ropes



(b) Building on slopy ground



(c) Buildings with walls on two/one sides (in plan)

Figure 3.9 Buildings have unequal vertical members;
they cause the building to twist about a vertical axis (IITK-BMTPC, 2002)

Buildings that are irregular shapes in plan tend to twist under earthquake shaking. For example, in a propped overhanging building (Figure 3.10), the overhanging portion swings on the relatively slender columns under it. The floors twist and displace horizontally.

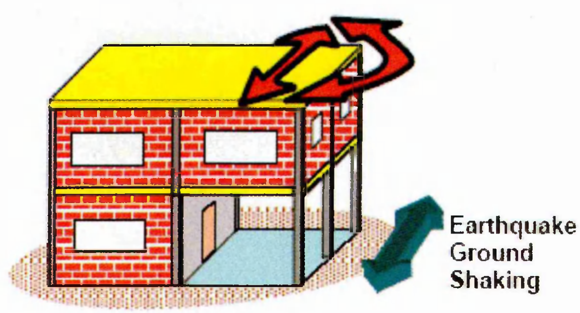


Figure 3.10 One-side open ground storey building twists during earthquake shaking (IITK-BMTPC, 2002)

3.4 The Seismic Design Philosophy for Buildings

Severity of ground shaking at a given location during an earthquake can be *minor*, *moderate,* and *strong*. Relatively speaking, minor shaking occurs frequently, moderate shaking occasionally, and strong shaking rarely. For instance, on average annually about 800 earthquakes of magnitude 5.0-5.9 occur in the world while the number is only about 18 for magnitude range 7.0-7.9 (see Table 1.1). So, should engineers design and construct a building to resist that *rare* earthquake shaking that may come only once in 500 years or even once in 2000 years at the chosen project site, even though the life of the building itself may be only 50 or 100 years?. Since it costs money to provide additional earthquake safety in buildings, a conflict arises: Should engineers do away with the design of buildings for earthquake effects? Or should engineers design the buildings to be "earthquake proof" wherein there is no damage during the strong but rare earthquake shaking? Clearly, the former approach can lead to a major disaster, and the second approach is too expensive. Hence, the design philosophy should lie somewhere in between these two extremes.

The engineers do not attempt to make earthquake proof buildings that will not get damaged even during the rare but strong earthquake; such buildings will be too robust and also too expensive. Instead, the engineering intention is to make buildings earthquake resistant; such buildings resist the effects of ground shaking, although they may get damaged severely but would not collapse during the strong earthquake. Thus, safety of people and contents is assured in earthquake-resistant buildings, and thereby a disaster is avoided. This is a major objective of seismic design codes throughout the world.

The earthquake design philosophy may be summarized as follows:

a. Under minor but frequent shaking, the main members of the building that carry vertical and horizontal forces should not be damaged; however building parts that do not carry load may sustain repairable damage.
b. Under moderate but occasional shaking, the main members may sustain repairable damage, while the other parts of the building may be damaged such that they may even have to be replaced after the earthquake; and
c. Under strong but rare shaking, the main members may sustain severe (even irreparable) damage, but the building should not collapse.

Thus, after minor shaking, the building will be fully operational within a short time and the repair costs will be small. Next, after moderate shaking, the building will be operational once the repair and strengthening of the damaged main members is completed. Yet, after a strong earthquake, the building may become dysfunctional for further use, but will stand so that people can be evacuated and property recovered.

The consequences of damage have to be borne in mind in the design philosophy. For example, key buildings, such as hospitals and fire stations, play a critical role in post-earthquake activities and must remain functional immediately after the earthquake. These structures must sustain very little damage and should be designed for a higher level of earthquake protection. Collapse of dams during earthquakes can cause flooding in the downstream reaches, which itself can be a secondary disaster. Therefore, dams (and similarly, nuclear power plants) should be designed for still higher level of earthquake motion.

Design of buildings to resist earthquakes involves controlling the damage to acceptable levels at a reasonable cost. Contrary to the common thinking that any crack in the building after an earthquake means the building is unsafe for habitation, engineers designing earthquake-resistant buildings recognize that some damage is unavoidable. Different types of damage (mainly visualized though cracks; especially so in concrete and masonry buildings) occur in buildings during earthquakes. Some of these cracks are acceptable (in terms of both their size and location), while others are not. For instance, in a reinforced concrete frame building with masonry filler walls between columns, the cracks between vertical columns and masonry filler walls are acceptable, but diagonal cracks running through the columns are not. In general, qualified technical professionals are knowledgeable of the causes and severity of damage in earthquake-resistant buildings.

Earthquake-resistant design is therefore concerned about ensuring that the damages in buildings during earthquakes are of the acceptable variety, and also that they occur at the right places and in right amounts. This approach of earthquake-resistant design is much like the use of electrical fuses in houses: to protect the entire electrical wiring and appliances in the house, someone sacrifices some small parts of the electrical circuit, called fuses; these fuses are easily replaced after the electrical over current. Likewise, to save the building from collapsing, someone needs to allow some pre-determined parts to undergo the acceptable type and level of damage.

3.5 Building Ductility

Earthquake-resistant buildings, particularly their main elements, need to be built with ductility, the property that allows buildings to sway back-and-forth by large amounts, in them. Such buildings have the ability to sway back-and-forth during an earthquake, and to withstand earthquake effects with some damage, but without collapse. Ductility is one of the most important factors affecting the building performance. Thus, earthquake-resistant design strives to predetermine the locations where damage takes place and then to provide good detailing at these locations to ensure ductile behaviour of the building.

In Indonesia, most residential urban and non-urban buildings are made in masonry (CEEDEDS, 2001). In the plains, masonry is generally made of burnt clay bricks and cement mortar. However, in hilly areas, stone masonry with cement mortar is more prevalent; but, in recent times, it is being replaced with masonry. Masonry can carry loads that cause compression (i.e., pressing together), but can hardly take load that causes tension (i.e., pulling apart).

Concrete is another material that has been popularly used in building construction particularly over the last four decades. Concrete is made of crushed stone pieces (called aggregate), sand, cement, and water mixed in appropriate proportions. Concrete is much stronger than masonry under compressive loads, but again their behaviour in tension are poor. The properties of concrete critically depend on the amount of water used in making concrete; too much and too little water both can cause havoc. In general, both masonry and concrete are brittle, and fail suddenly.

Steel is used in masonry and concrete buildings as reinforcement bars of diameter ranging from 6mm to 40mm. Reinforcing steel can carry both tensile and compressive loads. Moreover, steel is a ductile material. This important property of ductility enables steel bars to undergo large elongation before breaking.

Concrete is used in buildings together with steel reinforcement bars. This composite material is called simply reinforced concrete (RC). The amount and location of steel in a member should be such that the failure of the member is by steel reaching its strength in tension before concrete reaches its strength in compression. This type of failure is ductile failure, and hence is preferred over a failure where concrete fails first in compression. Therefore, contrary to common thinking, providing too much steel in RC buildings can be harmful even!!

Buildings should be designed like the ductile chain which has the weakest link. For example, consider the common urban residential apartment construction - the multi-storey building made of reinforced concrete. It consists of horizontal and vertical members, namely beams and columns. The seismic inertia forces generated at its floor levels are transferred through the various beams and columns to the ground. The correct building components need to be made ductile. The failure of a column can affect the stability of the whole building, but the failure of a beam causes localized effect. Therefore, it is better to make beams to be the ductile weak links than columns. This method of designing RC buildings is called the strong-column weak-beam design method (Figure 3.11).

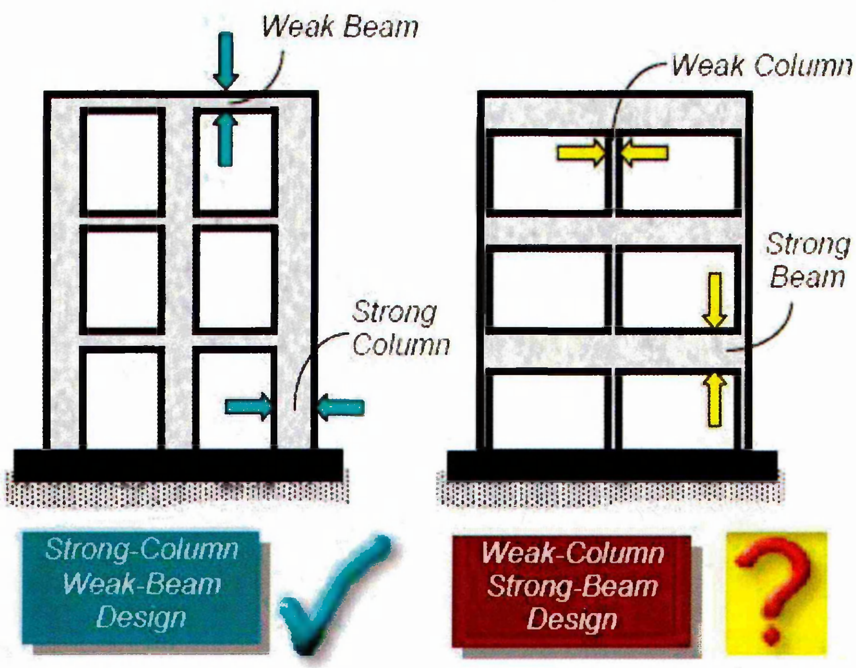


Figure 3.11 Reinforced Concrete Building Design: the beams must be the weakest links and not the columns (this can be achieved by appropriately sizing the members and providing correct amount of steel reinforcement in them) (IITK-BMTPC, 2002)

3.6 Effect upon Non-Engineered and Engineered Building during Earthquakes

3.6.1 Effects Upon Non-Engineered Building

Based on critical analysis in Chapter II, poor design and construction on non-engineered buildings was the main cause of the devastating construction during the strong jolting throughout Indonesia and in other developing countries. It has revealed the global scale of the problem. Boen (2006) highlight that in general, the damage and collapse of the new culture 'non-engineered' reinforced masonry buildings during the Yogyakarta earthquake of 27 May 2006 are mostly caused by the poor quality of materials and poor workmanship, resulting in, among others poor detailing, poor mortar quality, poor concrete quality, and poor brick laying. It is a common practice that roof trusses are not strongly anchored to the ring beams. Non-engineered buildings in this category include houses, one story shops, two story shops, religious and school buildings.

In the last few years, EERI (Earthquake Engineering Research Institute) and IAEE (International Association Earthquake Engineering) have made a modest step forward in this direction, by creating the WHE (World Housing Encyclopaedia), an Internet-based network of volunteer architects and engineers from 34 countries that has been collecting information on housing construction practices in zones of high seismic risk (www.world-housing.net). It was believed that the WHE should be used as a platform to allow EERI members and others to identify and pursue activities to make buildings safer from earthquakes around the world. According to WHE, Table 3.1.a and 3.1.b describe a lot of non-engineered houses in countries which are still being practised both in urban and rural areas. Almost all of structural and architectural features in these houses do not comply with seismic resistance codes, therefore the very poor or poor seismic performance is common in these houses. In addition, the economic of inhabitants are below the medium class (very poor or poor population).

Table 3.1.a Examples of seismic features, for many **non-engineered** house types

No	Structural/ Architectural Feature	Statement	Country – House Type				
			Indonesia – Unreinforced clay brick masonry house	Argentina – Traditional Adobe house without seismic features	Malawi – Rammed earth house with pitched roof	Malawi – Unburnt brick wall building with pitched roof	Romania – One family one storey house, also called "wagon house"
1	Lateral load path	The structure contains a complete load path for seismic force effects from any horizontal direction that serves to transfer inertial forces form the building to the foundation.	X	X	X	X	X
2	Building Configuration	The building is regular with regards to both the plan and the elevation.	√	X	√	√	√
3	Roof construction	The roof diaphragm is considered to be rigid and it is expected that the roof structure will maintain its integrity, i.e.. shape and form, during an earthquake of intensity expected in this area.	X	X	X	X	X
4	Floor construction	The floor diaphragm(s) are considered to be rigid and it is expected that the floor structure(s) will maintain its integrity, during an earthquake of intensity expected in this area.	N/A	X	X	X	X
5	Foundation Performance	There is no evidence of excessive foundation movement (e.g. settlement) that would affect the integrity or performance of the structure in an earthquake.	X	X	N/A	N/A	N/A
6	Wall and frame Structures-redundancy	The number of lines of walls or frames in each principal direction is greater than or equal to 2.	√	X	√	√	√
7	Wall proportions	Height-to-thickness ratio of the shear walls at each floor level is: 1) Less than 25 (concrete walls); 2) Less than 30 (reinforced masonry walls); 3) Less than 13 (unreinforced masonry walls).	X	√	√	√	√
8	Foundation- wall Connection	Vertical load-bearing elements (columns, walls) are attached to the Foundations; concrete columns and walls are doweled into the foundation.	N/A	X	X	X	√
9	Wall-roof Connections	Exterior walls are anchored for out-of-plane seismic effects at each diaphragm level with metal anchors or straps.	N/A	X	X	X	N/A
10	Wall openings	The total width of door and window openings in a wall is: 1) for brick masonry construction in cement mortar: less than 1/2 of the distance between the adjacent cross walls; 2) for adobe masonry, stone masonry and brick masonry in mud mortar: less than 1/3 of the distance between the adjacent cross walls; 3) for precast concrete wall structures: less than 3/4 of the length of a perimeter wall.	X	X	X	√	√

Table 3.1.a continued

11	Quality of building Materials	Quality of building materials is considered to be adequate per requirements of national codes and standards (an estimate)	X	X	X	X	N/A
12	Quality of Workmanship	Quality of workmanship (based on visual inspection of few typical buildings) is considered to be good (per local construction standards).	X	X	X	X	N/A
13	Maintenance	Buildings of this type are generally well maintained and there are no visible signs of deterioration of building elements (concrete, steel, and timber).	X	X	N/A	N/A	X
14	Where is this construction commonly found?	a) In urban areas, b) In rural areas, c) In suburban areas, d) Both in rural and urban areas	Rural areas	Rural & suburban areas	Rural areas	Rural and urban areas	Urban and Suburban areas
15	Is this construction still being practised?	a) Yes, b) No	Yes	Yes	Yes	Yes	Yes
16	Economic level of inhabitants	a) Very poor, b) Poor , c) Middle Class, d)Rich	Poor	Poor	Very poor and poor	Very poor, poor, and middle class	Middle class
17	Typical number of stories		1	1	1	1	1
18	Is this construction type addressed by codes/standards?	a) Yes, b) No	No	No	No	No	No
19	Seismic performance	a) Very poor, b) Poor, c) Medium, d) Good, e) Very good, f) Excellent	Medium	Very poor	Very poor	Very poor	Poor

(Source: Arnold et al, 2004; Dan et al, 2004; Gandica et al, 2004; Lutman et al, 2004; Maki et al, 2004; Mehrain 2004; Moroni et al, 2004; Pao et al, 2004; Rodriguez et al, 2004; Sassu et al, 2004; Wijayanto, 2004; Zhou et al, 2004)

Table 3.1.b Examples of seismic features, for many **non-engineered** house types

No	Structural/ Architectural Feature	Statement	Country – House Type				
			Venezuela – Urban non-engineered popular housing on flat terrain	Iran – Adobe House	Chile - Buildings with hybrid masonry walls	Romania - A single-family, two-storey house with brick walls and timber floors	Slovenia – Rubble-stone masonry house
1	Lateral load path	The structure contains a complete load path for seismic force effects from any horizontal direction that serves to transfer inertial forces form the building to the foundation.	X	X	√	√	X
2	Building Configuration	The building is regular with regards to both the plan and the elevation.	√	√	√	√	√
3	Roof construction	The roof diaphragm is considered to be rigid and it is expected that the roof structure will maintain its integrity, i.e.. shape and form, during an earthquake of intensity expected in this area.	X	X	N/A	X	X
4	Floor construction	The floor diaphragm(s) are considered to be rigid and it is expected that the floor structure(s) will maintain its integrity, during an earthquake of intensity expected in this area.	X	X	√	X	√
5	Foundation Performance	There is no evidence of excessive foundation movement (e.g. settlement) that would affect the integrity or performance of the structure in an earthquake.	√	√	X	√	√
6	Wall and frame Structures-redundancy	The number of lines of walls or frames in each principal direction is greater than or equal to 2.	√	√	√	√	√
7	Wall proportions	Height-to-thickness ratio of the shear walls at each floor level is: 1) Less than 25 (concrete walls); 2)Less than 30 (reinforced masonry walls); 3) Less than 13 (unreinforced masonry walls).	X	√	√	√	√
8	Foundation- wall Connection	Vertical load-bearing elements (columns, walls) are attached to the Foundations; concrete columns and walls are doweled into the foundation.	√	N/A	√	N/A	X
9	Wall-roof Connections	Exterior walls are anchored for out-of-plane seismic effects at each diaphragm level with metal anchors or straps.	X	X	N/A	N/A	X
10	Wall openings	The total width of door and window openings in a wall is: 1) for brick masonry construction in cement mortar: less than 1/2 of the distance between the adjacent cross walls; 2) for adobe masonry, stone masonry and brick masonry in mud mortar: less than 1/3 of the distance between the adjacent cross walls; 3) for precast concrete wall structures: less than 3/4 of the length of a perimeter wall.	X	√	√	√	√

Table 3.1.b continued

11	Quality of building Materials	Quality of building materials is considered to be adequate per requirements of national codes and standards (an estimate)	X	X	X	√	X
12	Quality of Workmanship	Quality of workmanship (based on visual inspection of few typical buildings) is considered to be good (per local construction standards).	X	X	X	√	X
13	Maintenance	Buildings of this type are generally well maintained and there are no visible signs of deterioration of building elements (concrete, steel, and timber).	X	X	X	√	X
14	Where is this construction commonly found?	a) In urban areas, b) In rural areas, c) In suburban areas, d) Both in rural and urban areas	Urban areas	Rural and urban areas	Urban areas	Rural and urban areas	Rural and urban areas
15	Is this construction still being practised?	a) Yes, b) No	Yes	Yes	Yes	Yes	Yes
16	Economic level of inhabitants	a) Very poor, b) Poor , c) Middle Class, d)Rich	Poor	Very poor – Poor – Middle class	Very poor – Poor – Middle class	Middle class	Poor and middle class
17	Typical number of stories		2 – 3	1	4	2 – 3	2 – 3
18	Is this construction type addressed by codes/standards?	a) Yes, b) No	No	No	No	No	No
19	Seismic performance	a) Very poor, b) Poor, c) Medium, d) Good, e) Very good, f) Excellent	Poor	Very poor	Poor	Medium	Very poor

(Source: Arnold et al, 2004; Dan et al, 2004; Gandica et al, 2004; Lutman et al, 2004; Maki et al, 2004; Mehrain 2004; Moroni et al, 2004; Pao et al, 2004; Rodriguez et al, 2004; Sassu et al, 2004; Wijayanto, 2004; Zhou et al, 2004)

3.6.2 Improving of Seismic Resistance on Masonry and Multi-Storey Reinforced Concrete Building

CEEDEDS (2004) highlight that non-engineered buildings are commonly constructed with masonry or multi-storey reinforced concrete, therefore this section describes only on these types which have been responsible for very high death toll during seismic events. By the way, there are uncommon wood and steel buildings as residential buildings in developing countries which are not further explained.

3.6.2.1 Masonry Building

a. Brick masonry buildings behaviour during earthquakes

Masonry buildings are brittle structures and one of the most vulnerable of the entire building stock under strong earthquake shaking. The large number of human fatalities in such constructions during the past earthquakes in Indonesia corroborates this. Thus, it is very important to improve the seismic behaviour of masonry buildings. A number of earthquake-resistant features can be introduced to achieve this objective.

Ground vibrations during earthquakes cause inertia forces at locations of mass in the building. These forces travel through the roof and walls to the foundation. The main emphasis is on ensuring that these forces reach the ground without causing major damage or collapse. Of the three components of a masonry building (roof, wall, and foundation) (Figure 3.12.a), the walls are most vulnerable to damage caused by horizontal forces due to earthquake. A wall topples down easily if pushed horizontally at the top in a direction perpendicular to its plane (termed weak direction), but offers much greater resistance if pushed along its length (termed strong direction) (Figure 3.12.b).

The ground shakes simultaneously in the vertical and two horizontal directions during earthquakes. However, the horizontal vibrations are the most damaging to normal masonry buildings. Horizontal inertia force developed at the roof transfers to the walls acting either in the weak or in the strong direction. If all the walls are not tied together like a box, the walls loaded in their weak direction tend to topple (Figure 3.13.a).

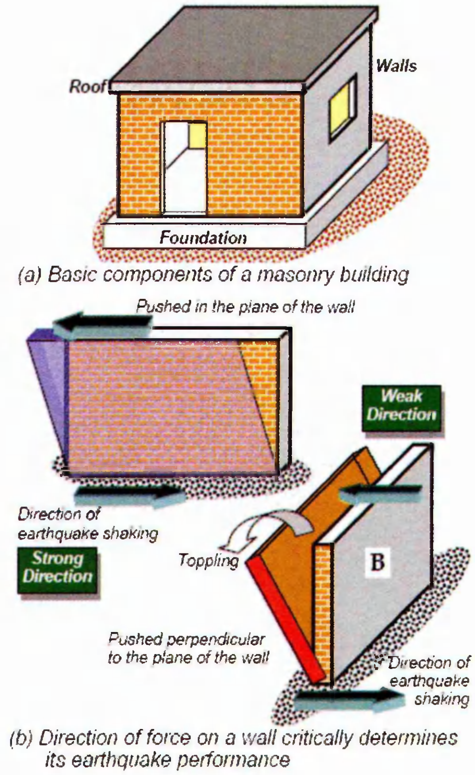


Figure 3.12 Basic components of a masonry building: walls are sensitive to direction of earthquake forces (IITK-BMTPC, 2003)

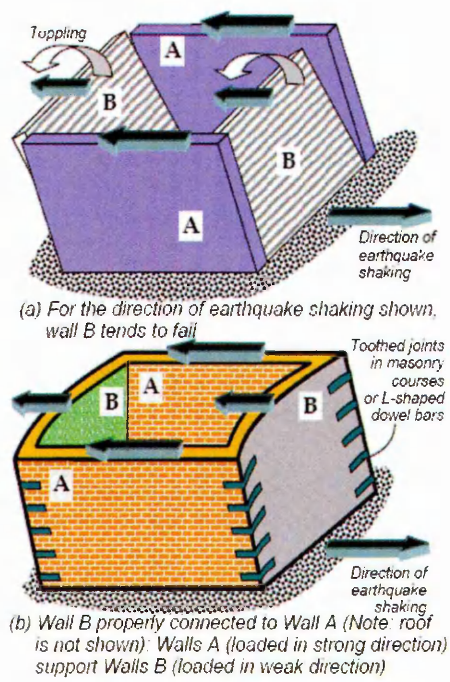


Figure 3.13 Advantage sharing between walls – only possible if walls are well connected (IITK-BMTPC, 2003)

To ensure good seismic performance, all walls must be joined properly to the adjacent walls. In this way, walls loaded in their weak direction can take advantage of the good lateral resistance offered by walls loaded in their strong direction (Figure 3.10.b). Further, walls also need to be tied to the roof and foundation to preserve their overall integrity.

b. How to improve behaviour of masonry walls

Masonry walls are slender because of their small thickness compared to their height and length. A simple way of making these walls behave well during earthquake shaking is by making them act together as a box along with the roof at the top and with the foundation at the bottom. A number of construction aspects are required to ensure this box action. Firstly, connections between the walls should be good. This can be achieved by (a) ensuring good interlocking of the masonry courses at the junctions, and (b) employing horizontal bands at various levels, particularly at the lintel level. Secondly, the sizes of door and window openings need to be kept small. The smaller the openings, the larger the resistance offered by the wall. Thirdly, the tendency of a wall to topple when pushed in the weak direction can be reduced by limiting its length-to-thickness and height to thickness ratios. Design codes specify limits for these ratios. A wall that is too tall or too long in comparison to its thickness is particularly vulnerable to shaking in its weak direction.

c. Choice and quality of building materials

Earthquake performance of a masonry wall is very sensitive to the properties of its constituents, namely masonry units and mortar. The properties of these materials vary across Indonesia due to variation in raw materials and construction methods. A variety of masonry units are used in the country, e.g., clay bricks (burnt and unburnt), concrete blocks (solid and hollow), stone blocks. Burnt clay bricks are most commonly used. These bricks are inherently porous, and so they absorb water. Excessive porosity is detrimental to good masonry behaviour because the bricks suck away water from the adjoining mortar, which results in poor bond between brick and mortar, and in difficulty in positioning masonry units. For this reason, bricks with low porosity are to be used, and they must be soaked in water before use to minimise the amount of water drawn away from the mortar.

Various mortars are used, e.g., mud, cement-sand, or cement-sand-lime. Of these, mud mortar is the weakest; it crushes easily when dry, flows outward and has very low earthquake resistance. Cement-sand mortar with lime is the most suitable. This mortar mix provides excellent workability for laying bricks, stretches without crumbling at low earthquake shaking, and bonds well with bricks. The earthquake response of masonry walls depends on the relative strengths of brick and mortar. Bricks must be stronger than mortar.

Excessive thickness of mortar is not desirable. A 10mm thick mortar layer is generally satisfactory from practical and aesthetic considerations.

d. Simple structural configuration in masonry building

Brick masonry buildings have large mass and hence attract large horizontal forces during earthquake shaking. They develop numerous cracks under both compressive and tensile forces caused by earthquake shaking. The focus of earthquake resistant masonry building construction is to ensure that these effects are sustained without major damage or collapse. Appropriate choice of structural configuration can help achieve this.

The structural configuration of masonry buildings includes aspects like (a) overall shape and size of the building, and (b) distribution of mass and (horizontal) lateral load resisting elements across the building. Large, tall, long and asymmetric buildings perform poorly during earthquakes. A strategy used in making them earthquake resistant is developing good box action between all the elements of the building, i.e., between roof, walls and foundation (Figure 3.14). Loosely connected roof or unduly slender walls are threats to good seismic behaviour. For example, a horizontal band introduced at the lintel level ties the walls together and helps to make them behave as a single unit.

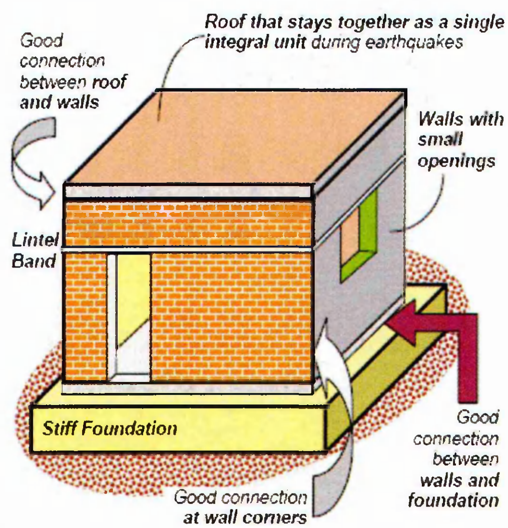


Figure 3.14 Essential requirements to ensure box action in a masonry building (IITK-BMTPC, 2003)

e. Influence of openings

Openings are functional necessities in buildings. However, location and size of openings in walls assume significance in deciding the performance of masonry buildings in earthquakes.

To understand this, consider a four-wall system of a single storey masonry building (Figure 3.15). During earthquake shaking, inertia forces act in the strong direction of some walls and in the weak direction of others. Walls shaken in the weak direction seek support from the other walls, *i.e.,* walls B1 and B2 seek support from walls A1 and A2 for shaking in the direction shown in Figure 3.12. To be more specific, wall B1 pulls walls A1 and A2, while wall B2 pushes against them. At the next instance, the direction of shaking could change to the horizontal direction perpendicular to that shown in Figure 3.12. Then, walls A and B change their roles; Walls B1 and B2 become the strong ones and A1 and A2 weak.

Thus, walls transfer loads to each other at their junctions (and through the lintel bands and roof). Hence, the masonry from the walls meeting at corners must have good interlocking. For this reason, openings near the wall corners are detrimental to good seismic performance. Openings too close to wall corners hamper the flow of forces from one wall to another. Further, large openings weaken walls from carrying the inertia forces in their own plane. Thus, it is best to keep all openings as small as possible and as far away from the corners as possible.

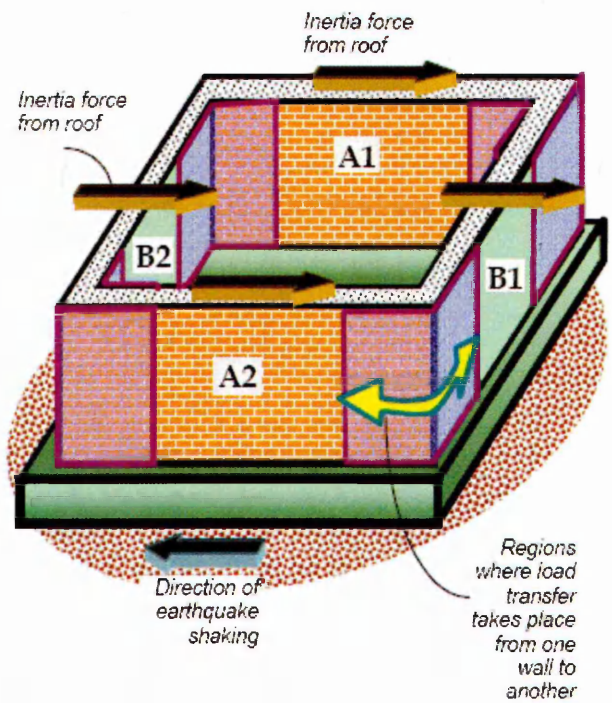


Figure 3.15 Regions of force transfer from weak walls to strong walls in a masonry building: wall B1 pulls walls A1 and A2, while wall B2 pushes walls A1 and A2 (IITK-BMTPC, 2003)

Inclined staircase slabs in masonry buildings offer another concern. An integrally connected staircase slab acts like a cross-brace between floors and transfers large horizontal forces at the roof and lower levels. These are areas of potential damage in masonry buildings, if not accounted for in staircase design and construction. To overcome this, sometimes, staircases are completely separated and built on a separate reinforced concrete structure. Adequate gap is provided between the staircase tower and the masonry building to ensure that they do not pound each other during strong earthquake shaking.

f. Necessity of horizontal bands in masonry building

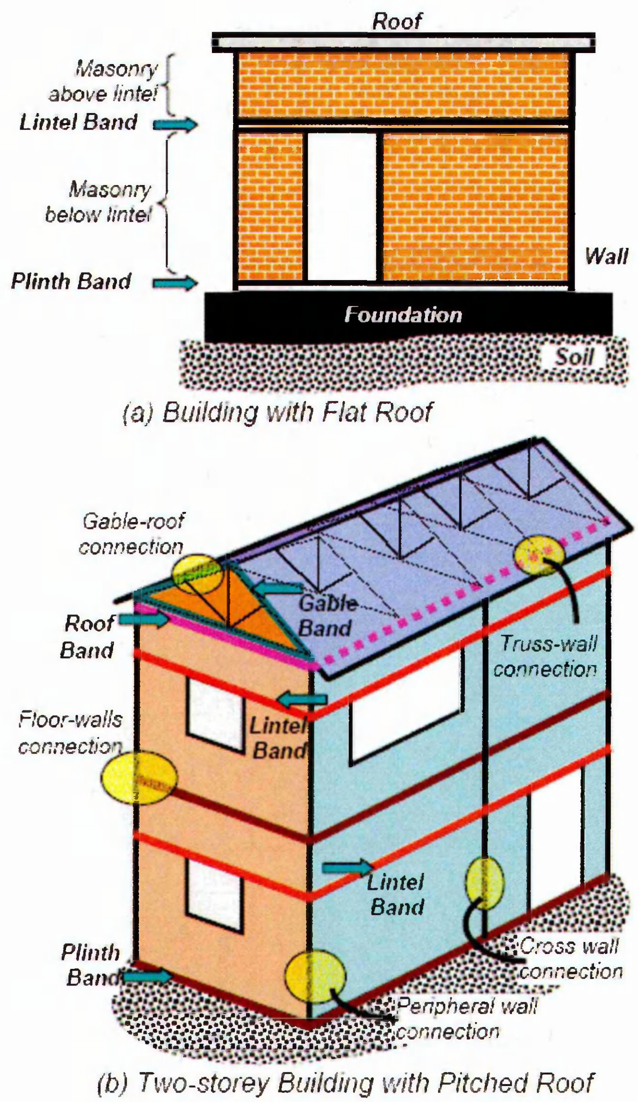


Figure 3.16 Horizontal bands in masonry building: Improve earthquake-resistance (IITK-BMTPC, 2003)

Horizontal bands are the most important earthquake-resistant feature in masonry buildings. The bands are provided to hold a masonry building as a single unit by tying all the walls together, and are similar to a closed belt provided around cardboard boxes. There are four types of bands in a typical masonry building, namely gable band, roof band, lintel band, and plinth band (Figure 3.16), named after their location in the building. The lintel band is the most important of all, and needs to be provided in almost all buildings. The gable band is employed only in buildings with pitched or sloped roofs. In buildings with flat reinforced concrete or reinforced brick roofs, the roof band is not required, because the roof slab also plays the role of a band. In buildings with pitched or sloped roof, the roof band is very important. Plinth bands are primarily used when there is concern about uneven settlement of foundation soil.

The lintel band ties the walls together and creates a support for walls loaded along weak direction from walls loaded in strong direction. This band also reduces the unsupported height of the walls and thereby improves their stability in the weak direction. During the 1993 Latur earthquake (Central India), the intensity of shaking in Killari village was IX on MSK scale. Most masonry houses sustained partial or complete collapse. On the other hand, there was one masonry building in the village, which had a lintel band and it sustained the shaking very well with hardly any damage.

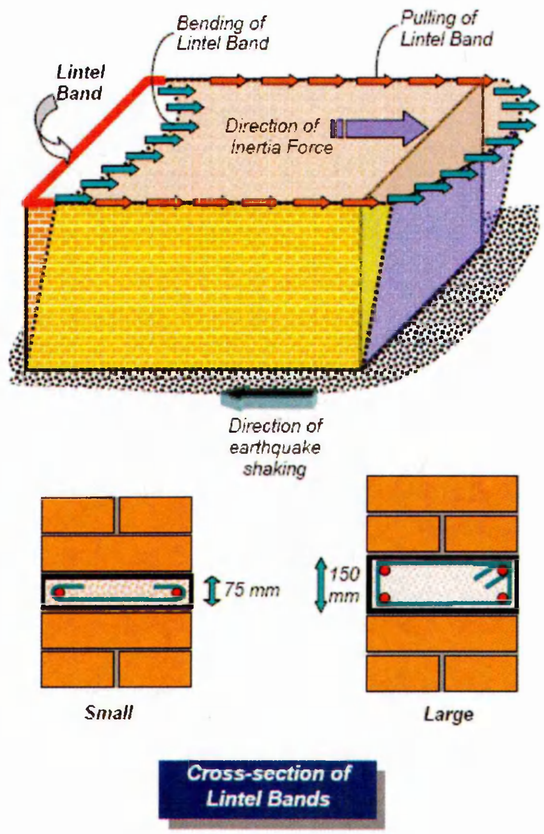


Figure 3.17 Bending and pulling in lintel bands:
Bands must be capable of resisting these (IITK-BMTPC, 2003)

g. Design of lintel bands

During earthquake shaking, the lintel band undergoes bending and pulling actions (Figure 3.18). To resist these actions, the construction of lintel band requires special attention. Bands can be made of wood (including bamboo splits) or of reinforced concrete (RC); the RC bands are the best. The straight lengths of the band must be properly connected at the wall corners. This will allow the band to support walls loaded in their weak direction by walls loaded in their strong direction. Small lengths of wood spacers (in wooden bands) or steel links (in RC bands) are used to make the straight lengths of wood runners or steel bars act together. In wooden bands, proper nailing of straight lengths with spacers is important. Likewise, in RC bands, adequate anchoring of steel links with steel bars is necessary.

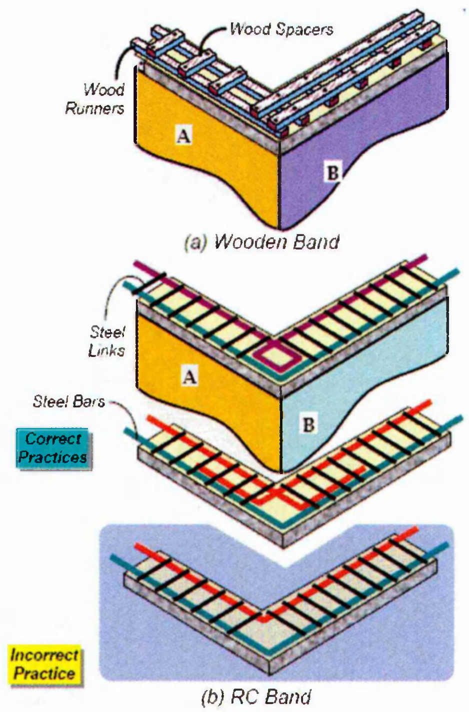


Figure 3.18 Horizontal Bands in masonry buildings: RC bands are the best (IITK-BMTPC, 2003)

h. Vertical reinforcement in masonry buildings

Horizontal bands are provided in masonry buildings to improve their earthquake performance. These bands include plinth band, lintel band, and roof band. Even if horizontal bands are provided, masonry buildings are weakened by the openings in their walls (Figure 3.19). During earthquake shaking, the masonry walls get grouped into three sub-units, namely spandrel masonry, wall pier masonry and sill masonry.

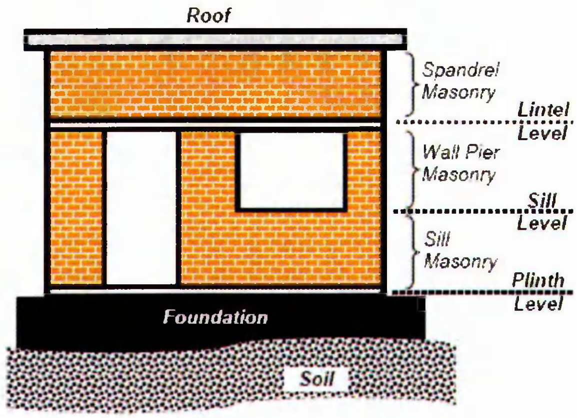


Figure 3.19 Sub-units in masonry building – walls behave as discrete units during earthquakes (IITK-BMTPC, 2003)

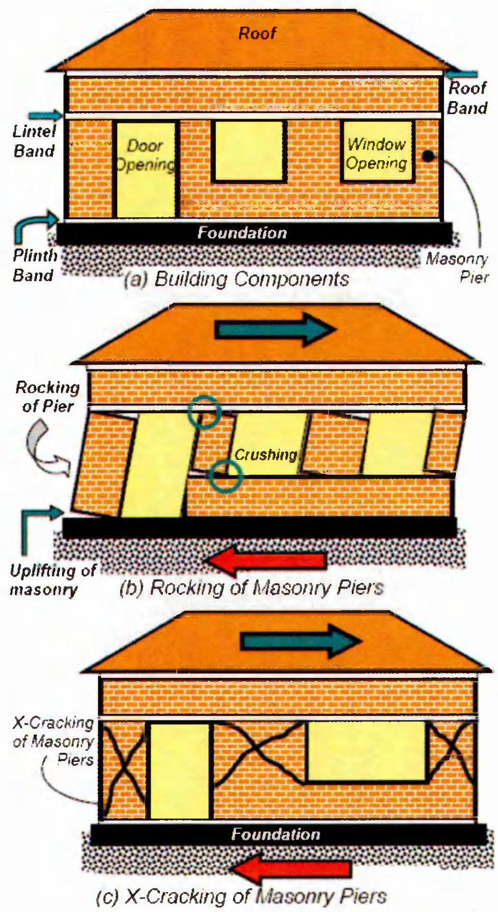


Figure 3.20 Earthquake response of a hipped roof masonry building; no vertical reinforcement is provided in walls (IITK-BMTPC, 2003)

Consider a hipped roof building with two window openings and one door opening in a wall (Figure 3.20.a). It has lintel and plinth bands. Since the roof is a hipped one, a roof band is also provided. When the ground shakes, the inertia force causes the small-sized masonry wall piers to disconnect from the masonry above and below. These masonry sub-units rock back and forth, developing contact only at the opposite diagonals (Figure 3.20.b). The rocking of a masonry pier can crush the masonry at the corners. Rocking is possible when masonry piers are slender, and when weight of the structure above is small. Otherwise, the piers are more likely to develop diagonal (X-type) shear cracking (Figure 3.20.c); this is the most common failure type in masonry buildings.

i. How vertical reinforcement helps?

Embedding vertical reinforcement bars in the edges of the wall piers and anchoring them in the foundation at the bottom and in the roof band at the top (Figure 3.21) forces the slender masonry piers to undergo *bending* instead of *rocking*. In wider wall piers, the vertical bars enhance their capability to resist horizontal earthquake forces and delay the X-cracking. Adequate cross-sectional area of these vertical bars prevents the bar from yielding in tension. Further, the vertical bars also help protect the wall from sliding as well as from collapsing in the weak direction.

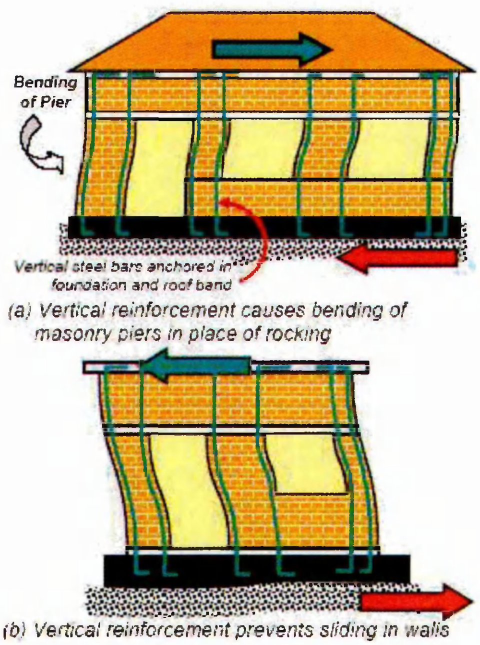


Figure 3.21 Vertical reinforcement in masonry walls – wall behaviour is modified (IITK-BMTPC, 2003)

j. Protection of openings in walls

Sliding failure mentioned above is rare, even in unconfined masonry buildings. However, the most common damage, observed after an earthquake, is diagonal X-cracking of wall piers, and also inclined cracks at the corners of door and window openings. When a wall with an opening deforms during earthquake shaking, the shape of the opening distorts and becomes more like a *rhombus* - two opposite corners move away and the other two come closer. Under this type of deformation, the corners that come closer develop cracks (Figure 3.22.a). The cracks are bigger when the opening sizes are larger. Steel bars provided in the wall masonry all around the openings restrict these cracks at the corners (Figure 3.22.b). In summary, lintel and sill bands above and below openings, and vertical reinforcement adjacent to vertical edges, provide protection against this type of damage.

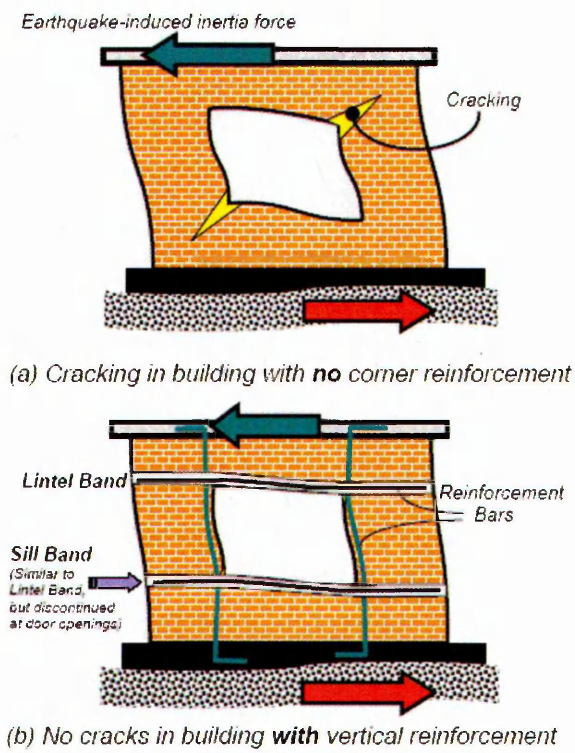


Figure 3.22 Cracks at corners of openings in a masonry building – reinforcement around them helps (IITK-BMTPC, 2003)

3.6.2.2 Multi-Storey Reinforced Concrete Building

a. Reinforced concrete building

In recent times, reinforced concrete buildings have become common in Indonesia, particularly in towns and cities. Reinforced concrete (or simply RC) consists of two primary materials, namely concrete with reinforcing steel bars. Concrete is made of sand, crushed stone (called aggregates) and cement, all mixed with predetermined amount of water. Concrete can be moulded into any desired shape, and steel bars can be bent into many shapes. Thus, structures of complex shapes are possible with RC.

A typical RC building is made of horizontal members (beams and slabs) and vertical members (columns and walls), and supported by foundations that rest on ground. The system comprising of RC columns and connecting beams is called a RC Frame. The RC frame participates in resisting the earthquake forces. Earthquake shaking generates inertia forces in the building, which are proportional to the building mass. Since most of the building mass is present at floor levels, earthquake-induced inertia forces primarily develop at the floor levels. These forces travel downward – through slab and beams to column and walls, and then to the foundations from where they are dispersed to the ground. As inertia forces accumulate downwards from the top of the building, the columns and walls at lower storeys experience higher earthquake –induced forces and are therefore designed to be stronger than those in storeys above.

b. Roles of floor slabs and masonry walls

Floor slabs are horizontal plate-like elements, which facilitate functional use of buildings. Usually, beams and slabs at one storey level are cast together. In residential multi-storey buildings, thickness of slabs is only about 110-150 mm. When beams bend in the vertical direction during earthquakes, these thin slabs bend along them. Furthermore, when beams move with columns in the horizontal direction, the slab usually forces the beams to move together with it. In most buildings, the geometric distortion of the slab is negligible in the horizontal plane; this behaviour is known as the rigid diaphragm action. Structural engineer must consider this during design.

After columns and floors in a RC building are cast, and the concrete hardens or matures, vertical spaces between columns and floors are usually filled-in with masonry walls to demarcate a floor area into functional spaces (rooms). Normally, these masonry walls, also called infill walls, are not connected to surrounding RC columns and beams. When columns receive horizontal forces at floor levels, they try to move in the horizontal direction, but masonry walls tend to resist this movement. Due to their heavy weight and thickness, these walls attract rather large horizontal forces. However, since masonry is a brittle material, these walls develop cracks once their ability to carry horizontal load is exceeded. Thus, infill walls act like sacrificial fuses in buildings; they develop cracks under severe ground shaking but help share the load of the beams and columns until cracking. Earthquake performance of infill walls is enhanced by mortars of good strength, making proper masonry courses, and proper packing of gaps between RC frame and masonry infill walls. However, an infill walls that is unduly tall or long in comparison to its thickness can fall out-of-plane, which can be threatening. In addition, placing infill irregularly in the building causes ill effects like short column effect and torsion (Figure 3.23).

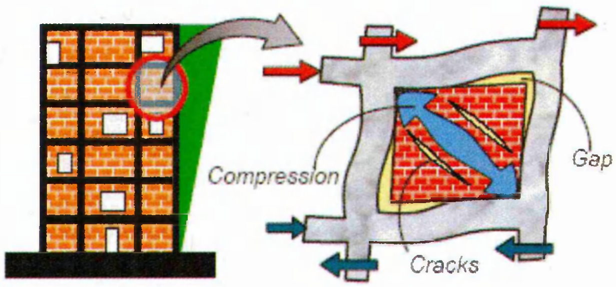


Figure 3.23 Infill walls move together with the columns under earthquake shaking (IITK-BMTPC, 2003)

c. Strength hierarchy

For building to remain safe during earthquake shaking, columns (which receive forces from beams) should be stronger than beams, and foundations (which receive forces from columns) should be stronger than columns. Further, connection beams-columns and columns-foundations should not fail so that beams can safely transfer forces to columns and columns to foundations.

When this strategy is adopted in design, damage is likely to occur first in beams. When beams are detailed properly to have large ductility, the buildings a whole can deform by large amounts despite progressive damage caused due to consequent yielding of beams. In contrast, if columns are made weaker, they suffer severe local damage, at the top and bottom of a particular storey. This localized damage can lead to collapse of a building, although columns at storeys above remain almost undamaged (Figure 3.24).

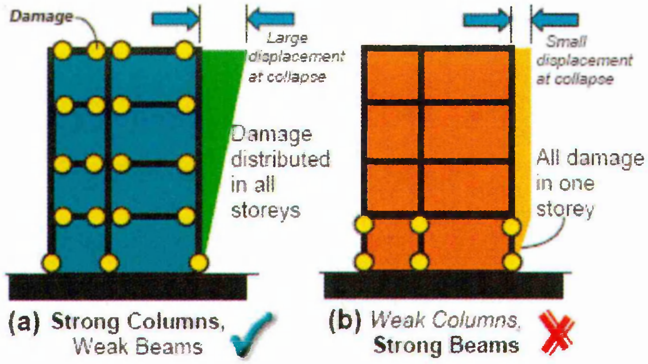


Figure 3.24 Two distinct designs of buildings that result in different earthquake performances-columns should be stronger that beams (IITK-BMTPC, 2003)

d. Beam in RC building during earthquakes

In RC buildings, the vertical and horizontal members (i.e., the beams and columns) are built integrally with each other. Thus, under the action of loads, they act together as a frame transferring forces from one to another. This is meant for beams that are part of a building frame and carry earthquake-induced forces.

Beams in RC buildings have two sets of steel reinforcement, namely: (a) long straight bars (called longitudinal bars) placed along its length, and (b) closed loops of small diameter steel bars (called stirrups) placed vertically at regular intervals along its full length.

Beams sustain two basic types of failures, namely:

i. Flexural (or bending) failure

   As the beam sags under increased loading, it can fail in two possible ways. If relatively more steel is present on the tension face, concrete crushes in compression; this is a brittle failure and is therefore undesirable. If relatively less steel is present on tension face, the steel yields first (its keeps elongating but does not snap, as steel has ability to stretch large amount before it snaps) and redistribution occurs in the beam until eventually the concrete crushes in compression; this is a ductile failure and hence is desirable. The ductile failure is characterised with many vertical cracks starting from the stretched beam face, and going towards its mid-depth.

ii. Shear failure

   A beam may also fail due to shearing action. A shear crack is inclined at 45^0 to the horizontal; it develops at mid-depth near the support and grows towards the top and bottom faces. Closed loop stirrups are provided to avoid such shearing action. Shear damage occurs when the area of these stirrups is insufficient. Shear failure is brittle, and therefore, shear failure must be avoided in the design of RC beams.

e. Beam design strategy

Designing a beam involves the selection of its material properties (i.e., grades of steel bars and concrete) and shape and size; these are usually selected as a part of an overall design strategy of the whole building. Furthermore, the amount and distribution of steel to be provided in the beam must be determined by performing design calculations (Figure 3.25 and 3.26).

Longitudinal bars are provided to resist flexural cracking on the side of the beam that stretches. Since both top and bottom faces stretch during strong earthquake shaking, longitudinal steel bars are required on both faces at the end and the bottom face at mid-length. Most seismic codes prescribes that

i. At least two bars go through the full length of the beam at the top as well as the bottom of the beam.
ii. At the ends of beams, the amount of steel provided at the bottom is at least half that at top.

Stirrups in RC beams help in three ways, namely

i. they carry the vertical shear force and thereby resist diagonal shear cracks
ii. they protect the concrete from bulging outward due to flexure, and
iii. they prevent the buckling of the compressed longitudinal bars due to flexure.

Steel reinforcement bars are available usually in length of 12 m. Thus, it becomes necessary to overlap bars when beams of longer lengths are to be made. At the location of the lap, the bars transfer large forces from one another. Thus, the seismic code prescribes that such laps of longitudinal bar are

i. made away from the face the column, and
ii. not made at locations where they are likely to stretch by large amounts and yield (e.g., bottom bars at mid length of the beams). Moreover, at the locations of laps, vertical stirrups should be provided at a closer spacing.

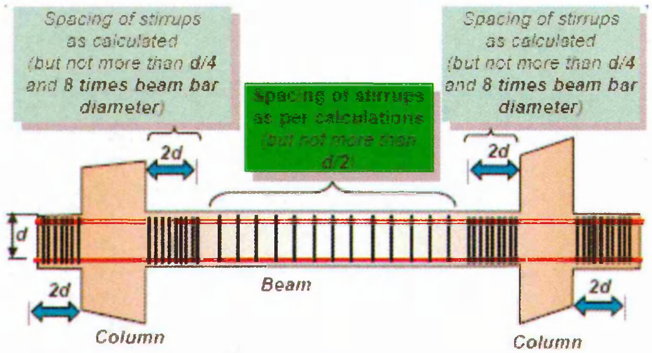


Figure 3.25 Location and amount of vertical stirrups in beams-limit on maximum spacing ensures good earthquake behaviour (IITK-BMTPC, 2003)

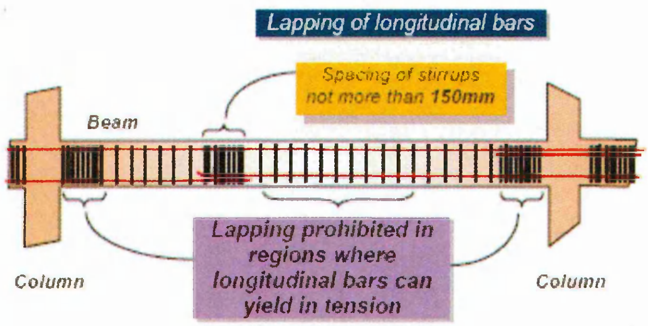


Figure 3.26 Details of lapping steel reinforcement in seismic beams (IITK-BMTPC, 2003)

f. Column in RC building earthquake resistant

Columns, the vertical members in RC buildings, contain two types of steel reinforcement, namely: (a) long straight bars (called longitudinal bars) placed vertically along the length, and (b) closed loops of smaller diameter steel bars (called transverse ties) placed horizontally at regular intervals along its full length. Columns can sustain two types of damage, namely axial-flexural (or combined compression bending) failure and shear failure. Shear damage is brittle and must be avoided in columns by providing transverse ties at close spacing.

g. Column design strategy

Designing a column involves selection of materials to be used (i.e., grades of concrete and steel bars), choosing shape and size of the cross-section, and calculating amount and distribution of steel reinforcement. The first two aspects are part of the overall design strategy of the whole building. Seismic code requires columns to be at least 300mm wide. Columns that are required to resist earthquake forces must be designed to prevent shear failure by a skilful selection of reinforcement.

h. Column vertical bars tied together with closed ties

Closely spaced horizontal closed ties help in three ways, namely (i) they carry the horizontal shear forces induced by earthquakes, and thereby resist diagonal shear cracks, (ii) they hold together the vertical bars and prevent them from excessively bending outwards (in technical terms, this bending phenomenon is called buckling), and (iii) they contain the concrete in the column within the closed loops. The ends of the ties must be bent as 135° hooks. Such hook ends prevent opening of loops and consequently buckling of concrete and buckling of vertical bars.

Construction drawings with clear details of closed ties are helpful in the effective implementation at construction site. In columns where the spacing between the corner bars exceeds 300mm, seismic code prescribes additional links with 180° hook ends for ties to be effective in holding the concrete in its place and to prevent the buckling of vertical bars. These links need to go around both vertical bars and horizontal closed ties; special care is required to implement this properly at site.

i. Column lapping vertical bars

In the construction of RC buildings, due to the limitations in available length of bars and due to constraints in construction, there are numerous occasions when column bars have to be joined. A simple way of achieving this is by overlapping the two bars over at least a minimum specified length, called lap length. The lap length depends on types of reinforcement and concrete. For ordinary situations, it is about 50 times bar diameter. Further, seismic code prescribes that the lap length be provided only in the middle half of column and not near its top or bottom ends (Figure 3.27). Also, only half the vertical bars in the column are to be lapped at a time in any storey. Further, when laps are provided, ties must be provided along the length of the lap at a spacing not more than 150 mm.

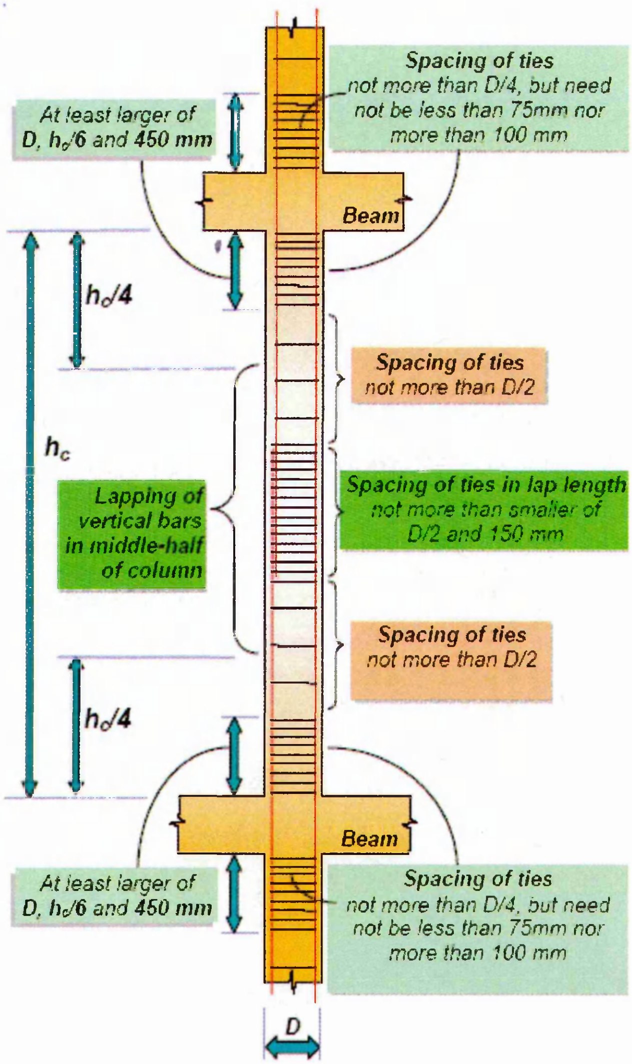


Figure 3.27 Placing vertical bars and closed ties in columns; column ends and lap lengths are to be protected with closely spaced ties (IITK-BMTPC, 2003)

j. Beam-column joint in RC building earthquake resistant

In RC buildings, portion of columns that are common to beams at their intersections are called beam-column joints. Since their constituent material has limited strength, the joints have limited force carrying capacity. When forces larger than these are applied during earthquakes, joints are severely damaged. Repairing damaged joints are difficult, and so damage must be avoided. Thus, beam-column joints must be design to resist earthquake effects.

k. Earthquake behaviour of joint

Under earthquake shaking, the beams adjoining a joint are subjected to moment in the same (clockwise or anti-clockwise) direction. Under these moments, the top bars in the beam-column joint are pulled in one direction and the bottom ones in the opposite direction. These forces are balanced by bond stress developed between concrete and steel in the joint region. If the column is not wide enough of if the strength of concrete in the joint is low, there is insufficient grip of concrete on the steel bars. In such circumstances, the bar slips inside the joint region, and beams loose their capacity to carry load (Figure 3.28)

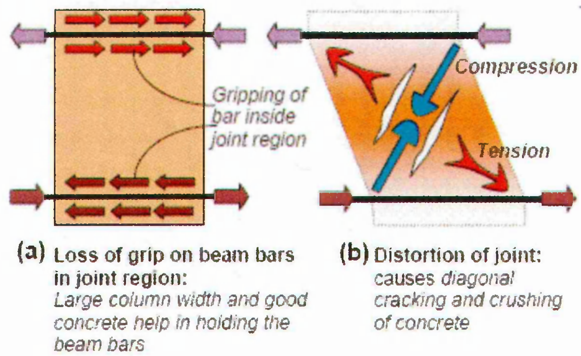


Figure 3.28 Pull-push forces on joints cause two problems- these result in irreparable in joints under strong seismic shaking (IITK-BMTPC, 2003)

Further, under the action of the above pull-push forces at top and bottom ends, joints undergo geometric distortion, one diagonal length of the joint elongates and the other compresses. If the column cross-sectional size is insufficient, the concrete in the joint develops diagonal cracks.

l. Reinforced the beam-column joint

Problem of diagonal cracking and crushing of concrete in the joint region can be controlled by two means, namely providing large column sizes and providing closely spaced closed-loop steel ties hold together the concrete in the joint and also resist shear force, thereby reducing and crushing of concrete (Figure 3.29).

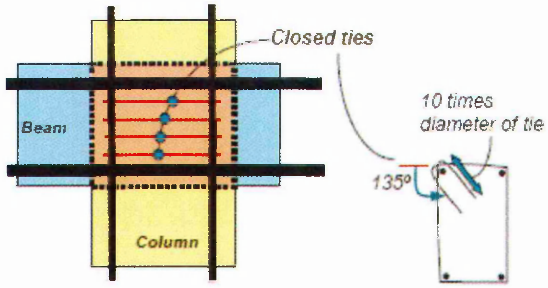


Figure 3.29 Closed loop steel ties in beam-column joint:
such ties with 135^0 hooked resist the ill effect of distortion of joints (IITK-BMTPC, 2003)

Providing closed-loop ties in the joint requires some extra effort. Seismic code recommends continuing the transverse loops around the column bar through the joint region. In practice, this is achieved by preparing the cage of the reinforcement (both longitudinal and stirrups) of all beams at a floor level to be prepared on op of the beam formwork of that level and lowered into the cage. However, this may not always be possible particularly when beams are long and the entire reinforcement cage becomes heavy.

m. Anchoring beam bars

The gripping of beam bars in the joint region is improved first by using column of reasonably large cross-sectional size. Seismic code requires building columns in red seismic zones to be at least 30 cm wide in each direction of the cross-section when these columns are taller than 4m between floors (or beams). The American Concrete Institute recommends a column width of al least 20 times the diameter of largest longitudinal bar used in the adjoining beam.

In exterior joints where beams terminate at columns, longitudinal beam bars to be anchored into the column to ensure proper gripping of bar in joint. The length of anchorage for a bar of grade fy415 (characteristic tensile strength of 415MPa) is about 50 times its diameter. This length is measured from the face of the columns to the end of the bar anchored in to the column. In columns of small widths and when beam bars are of large diameter a portion of beam top bar is embedded in the column that is cast up to the soffit of the beam, and a part of it overhangs. It is difficult to hold such an overhanging beam top bar in position while casting the column up to the soffit of the beam. On the other hand, if column width is large, the beam may not extend below the soffit of the beam. Thus, it is preferable to have columns with sufficient width. Such an approach has been used in the American practice.

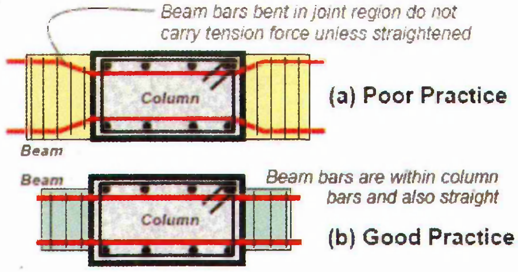


Figure 3.30 Anchorage of beam bars in interior joints;
diagrams (a) and (b) show cross sectional views in plan of joint region (IITK-BMTPC, 2003)

In interior joint, the beam bars (both top and bottom) need to go through the joint without ant cut in the joint region. In addition, these bars must be placed within the column bars and with no bends (Figure 3.30).

n. Vulnerability of open-ground storey building during earthquakes

Reinforced concrete (RC) frame buildings are becoming increasingly common in developing country. Many such buildings constructed in recent times have a special feature – the ground storey is left open for the purpose of parking, i.e., columns in the ground storey do not have any partition walls (of either masonry or RC) between them. Such buildings are often called open ground storey buildings. Open ground storey buildings have consistently shown poor performance during past earthquakes across the world (for example during 1999 Turkey, 1999 Taiwan and 2003 Algeria earthquakes.

An open ground storey building, having only columns in the ground storey and both partition walls and columns in the upper storeys, have two distinct characteristics, namely:

i. It is relatively flexible in the ground storey, i.e., the relative horizontal displacement it undergoes in the ground storey is much larger than what each of the storeys above it does. This flexible ground storey is also called soft storey.
ii. It is relatively weak in ground storey, i.e., the total horizontal earthquake force it can carry in the ground storey is significantly smaller than what each of the storeys above it can carry. Thus, the open ground storey may also be a weak storey. Often, open ground storey buildings are called soft storey buildings, even though their ground storey may be soft and weak. Generally, the soft or weak storey usually exists at the ground storey level, but it could be at any other storey level too.

The presence of walls in upper storeys makes them much stiffer than the open ground storey. Thus, the upper storeys move almost together as a single block, and most of the horizontal displacement of the building occurs in the soft ground storey itself. In common language, this type of buildings can be explained as a building on chopsticks. Thus, such buildings swing back-and-forth like inverted pendulums during earthquake shaking (Figure 3.28.a), and the columns in the open ground storey are severely stressed (Figure 3.28.b). If the columns are weak (do not have the required strength to resist these high stresses) or if they do not have adequate ductility, they may be severely damaged which may even lead to collapse of the building.

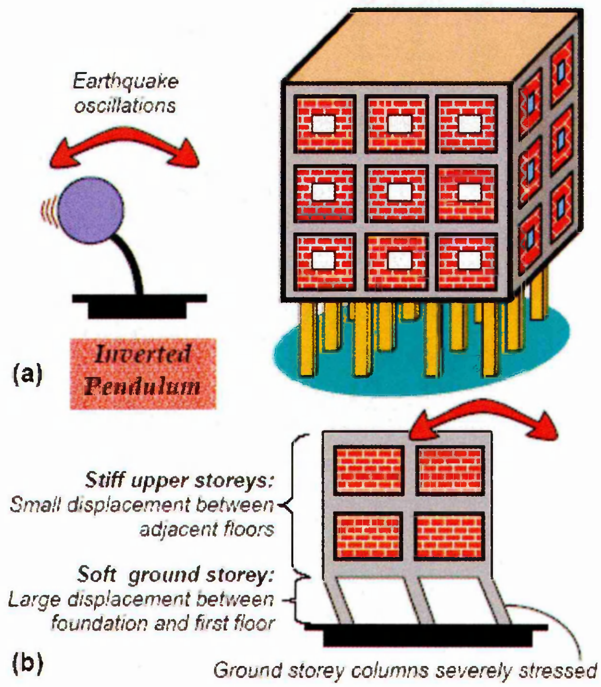


Figure 3.31 Upper storeys of open ground storey buildings move together as a single block; such buildings are like inverted pendulums (IITK-BMTPC, 2003)

Open ground storey buildings are inherently poor systems with sudden drop in stiffness and strength in the ground storey. In the current practice, stiff masonry walls are neglected and only bare frames are considered in design calculations. Thus, the inverted pendulum effect is not captured in design.

o. Open ground storey improved design strategies

Many seismic codes have included special design provisions related to soft storey buildings. Firstly, it specifies when a building should be considered as a soft and a weak storey building. Secondly, it specifies higher design forces for the soft storey as compared to the rest of the structure. Seismic code suggests that the forces in the columns, beams and shear walls (if any) under the action of seismic loads specified in the code, may be obtained by considering the bare frame building (without any infill). However, beams and columns in the open ground storey are required to be designed for 2.5 times the forces obtained from this bare frame analysis.

For all new RC frame buildings, the best option is to avoid such sudden and large decrease in stiffness and/or strength in any storey; it would be ideal to build walls (either masonry or RC walls) in the ground storey also. Designers can avoid dangerous effects of flexible and weak ground storeys by ensuring that too many walls are not discontinued in the ground storey, i.e., the drop in stiffness and strength in the ground storey level is not abrupt due to the absence of infill walls.

The existing open ground storey buildings need to be strengthened suitably so as to prevent them from collapsing during strong earthquake shaking. The owners should seek the services of qualified structural engineers who are able to suggest appropriate solutions to increase seismic safety of these buildings.

p. Short columns during earthquakes

During past earthquakes, reinforced concrete (RC) frame buildings that have columns of different heights within one storey, suffered more damage in the shorter columns as compared to taller columns in the same storey. Two examples of buildings with short columns are shown in Figure 3.32 – buildings on a sloping ground and buildings with a mezzanine floor.

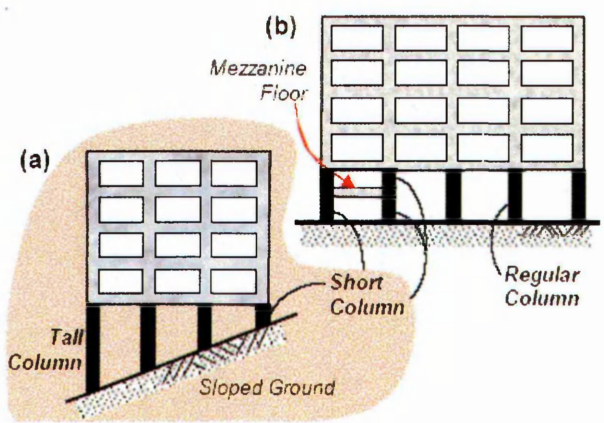


Figure 3.32 Buildings with short columns – two explicit examples of common occurrences (IITK-BMTPC, 2004)

Poor behaviour of short columns is due to the fact that in an earthquake, a tall column and a short column of same cross-section move horizontally by same amount Δ (Figure 3.33). However, the short column is stiffer as compared to the tall column, and it attracts larger earthquake force. Stiffness of a column means resistance to deformation – the larger is the stiffness, the larger is the force required to deform it. If a short column is not adequately designed for such a large deformation, it can suffer significant damage during an earthquake. This behaviour is called Short Column Effect. The damage in these short columns is often in the form of X-shaped cracking – this type of damage of columns is due to shear failure

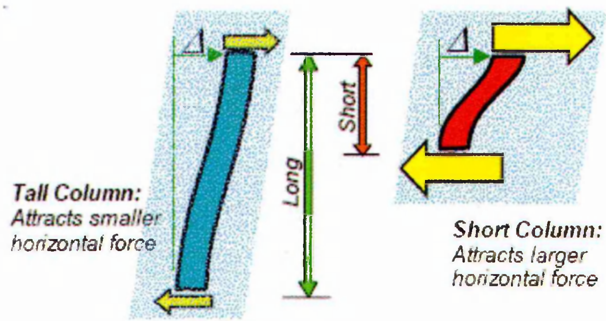


Figure 3.33 Short columns are stiffer and attract larger forces during earthquakes; this must be accounted for in design (IITK-BMTPC, 2004)

q. The short column behaviour

Many situations with short column effect arise in buildings. When a building is rested on sloped ground, during earthquake shaking all columns move horizontally by the same amount along with the floor slab at a particular level (this is called rigid floor diaphragm action). If short and tall columns exist within the same storey level, then the short columns attract several times larger earthquake force and suffer more damage as compared to taller ones. The short column effect also occurs in columns that support mezzanine floors or loft slabs that are added in between two regular floors.

There is another special situation in buildings when short-column effect occurs. Consider a wall (masonry or RC) of partial height built to fit a window over the remaining height. The adjacent columns behave as short columns due to presence of these walls. In many cases, other columns in the same storey are of regular height, as there are no walls adjoining them. When the floor slab moves horizontally during an earthquake, the upper ends of these columns undergo the same displacement (Figure 3.34). However, the stiff walls restrict horizontal movement of the lower portion of a short column, and it deforms by the full amount over the short height adjacent to the window opening. On the other hand, regular columns deform over the full height. Since the effective height over which a short column can freely bend is small, it offers more resistance to horizontal motion and thereby attracts a larger force as compared to the regular column. As a result, short column sustains more damage.

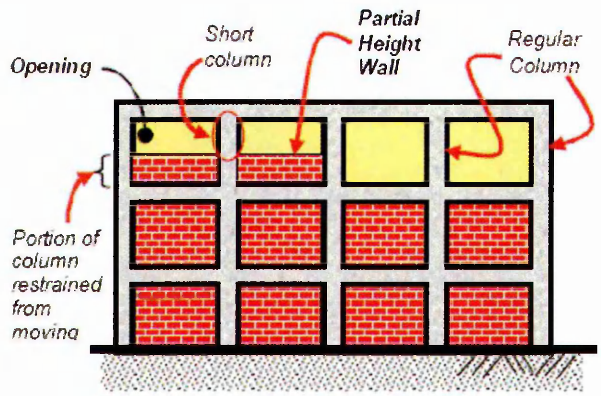


Figure 3.34 Short columns effect in RC buildings when partial height walls adjoin columns; the effect is implicit here because infill walls are often treated as non-structural elements (IITK-BMTPC, 2004)

In new buildings, short column effect should be avoided to the extent possible during architectural design stage itself. When it is not possible to avoid short columns, this effect must be addressed in structural design. Seismic code for ductile detailing of RC structures requires special confining reinforcement to be provided over the full height of columns that are likely to sustain short column effect. The special confining reinforcement (i.e., closely spaced closed ties) must extend beyond the short column into the columns vertically above and below by a certain distance as shown in Figure 3.35.

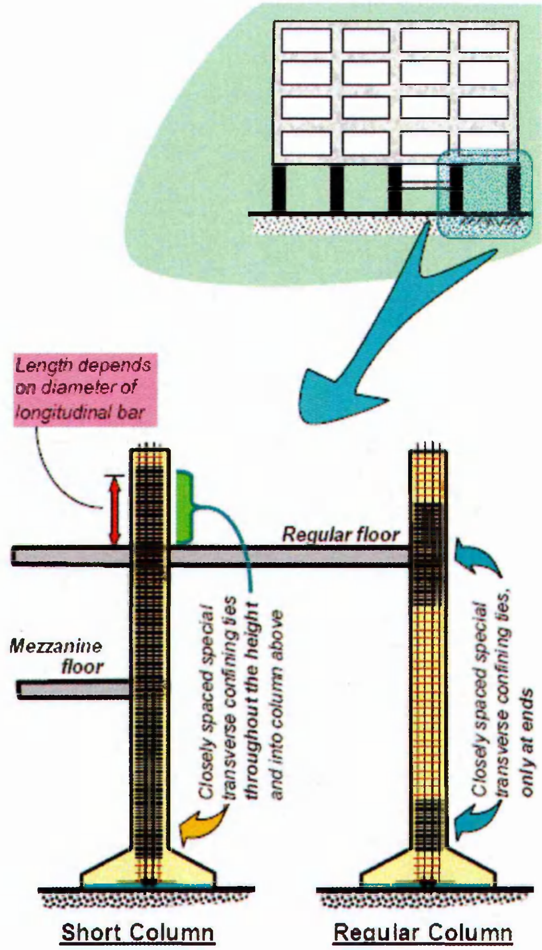


Figure 3.35 Details of reinforcement in a building with short column effect in some columns (IITK-BMTPC, 2004)

In existing buildings with short columns, different retrofit solutions can be employed to avoid damage in future earthquakes. Where walls of partial height are present, the simplest solution is to close the openings by building a wall of full height – this will eliminate the short column effect. If that is not possible, short columns need to be strengthened using one of the well established retrofit techniques. The retrofit solution should be designed by a qualified structural engineer with requisite background.

3.6.3 Effects upon Engineered Buildings

The primary focus of most model engineered building codes, which are also currently released by the International Building Code, is to ensure life safety. According to seismic design philosophy, the engineering intention is to make buildings earthquake resistant; such buildings resist the effects of ground shaking, although they may get damaged severely, but would not collapse during a strong earthquake, so that people can be evacuated. Designing buildings to resist earthquakes involves controlling the damage to acceptable levels at a reasonable cost. Obviously, engineers designing earthquake-resistant buildings recognise that some damage is unavoidable. Earthquake-resistant design is therefore concerned about ensuring that the damage in buildings during earthquakes is of the acceptable variety, and also that it occurs at the right places and in the right amounts.

Observations of the nature, degree, and spatial distribution of damage in past earthquakes have shown that engineered buildings are not expected to collapse in a major earthquake, both in developed and developing countries. In engineered buildings, almost no structural components failed due to the shaking, but a large number of the non-structural components such as partition walls were damaged, even failed. Sometimes, such a destructive earthquake generates a peak ground acceleration more (PGA) than that of maximum design criterion. In the Taiwan earthquake (1999), there was PGA (0.99g) of more than four times this maximum design criterion (0.23g). It is easy to see why so many buildings and bridges collapsed, including engineered buildings (Lee et al, 2003).

Based on excellent full-scale test results on real-life structures after earthquakes, seismic codes used to design engineered building have rapidly matured. In the Kobe earthquake (1995), the damage statistics data described that there was clear evidence of the impact of substantial improvements in the Japanese codes and standards of design practice according to ground shaking; the engineered buildings built post 1982 survived the earthquake much better than those constructed prior to 1982. In the Taiwan earthquake (1999), all failure modes observed were well known and have been extensively described in the past (Bruneau et al, 2003).

However, in the Yogyakarta earthquake, some engineered buildings collapsed. Boen (2006b) observes that the most obvious type of damage is to the first, soft story. From the damaged columns of all those buildings, it can be concluded that the reinforcement detailing, particularly the size and spacing of stirrups, did not cater for earthquake resistance. The spacing of the stirrups (transverse reinforcement/column ties) is inadequate. The hooks at the ends of the stirrups are not 135°. Inadequate lap slices and embedment lengths for the longitudinal bars are observed. Poor quality concrete is evident. The STIE and ISI buildings represent interesting findings. There are four identical buildings at the STIE site. One suffered a first soft story type of damage and in the second building, the roof collapsed and the top floor suffered structural damage. On the other hand, the third and fourth survived with minor damage. There are two identical buildings at the ISI area; one suffered partial first soft story damage and the second survived without any visible damage.

From a general assessment, it could be assumed that those identical buildings were designed in the same way, but the construction process was actually completely different, although the performance of the identical buildings was exactly the same after the overall construction processes were finished. Those buildings have been utilised in a normal manner for many years. In fact, the latest earthquake has proven that something goes deadly wrong with the poorly constructed buildings. Is there any misconduct during the construction process, corruption for example? It is difficult to evaluate the extent to which corruption might have played a role. Corruption in the Indonesian government is prevalent and seem to contribute to corrupt practice in the construction industry. In the construction of public low or high rise buildings, corruption can occur when building permits are obtained through bribes and political favours or inspectors are paid to design or building practices that deviate from the compliance of code and standard specification. Here, it can be surmised that, no matter how good or sophisticated the design or planning in both engineered and non engineered buildings, it will be the people who make the decisions on how extensive the risk will be. The morals and ethics are very crucial in every decision.

In general, the engineered buildings constructed in recent years were built using modern seismic codes. An enormous impact has been made in improvements to the new buildings, both in rural and urban areas. Good, very good, and even excellent seismic performance has been shown in engineered buildings during past earthquakes. WHE (World Housing Encyclopaedia) in www.world-housing.net, which is founded by EERI and IAEE, have resumed some engineered building in many high seismic zones (Table 3.2). Almost all the structural and architectural features in these houses comply with seismic resistance codes.

Table 3.2 Examples of seismic features, for many **engineered** house types

No	Structural/ Architectural Feature	Statement	Country – House Type					
			Chile – Concrete shear wall building	Canada – Concrete shear wall high-rise buildings	Chile – Reinforced clay/concrete block masonry building	China – Multi-storey base-isolated brick masonry building with reinforced concrete floors and roof	Japan – Single-family wooden house	USA - Wood frame single family house
1	Lateral load path	The structure contains a complete load path for seismic force effects from any horizontal direction that serves to transfer inertial forces form the building to the foundation.	√	√	√	√	√	√
2	Building Configuration	The building is regular with regards to both the plan and the elevation.	√	√	√	√	√	√
3	Roof construction	The roof diaphragm is considered to be rigid and it is expected that the roof structure will maintain its integrity, i.e.. shape and form, during an earthquake of intensity expected in this area.	√	√	X	√	√	√
4	Floor construction	The floor diaphragm(s) are considered to be rigid and it is expected that the floor structure(s) will maintain its integrity, during an earthquake of intensity expected in this area.	√	√	√	√	√	√
5	Foundation Performance	There is no evidence of excessive foundation movement (e.g. settlement) that would affect the integrity or performance of the structure in an earthquake.	√	√	X	√	√	√
6	Wall and frame Structures- redundancy	The number of lines of walls or frames in each principal direction is greater than or equal to 2.	√	√	√	√	√	√
7	Wall proportions	Height-to-thickness ratio of the shear walls at each floor level is: 1) Less than 25 (concrete walls); 2)Less than 30 (reinforced masonry walls); 3) Less than 13 (unreinforced masonry walls).	√	√	√	√	√	N/A
8	Foundation- wall Connection	Vertical load-bearing elements (columns, walls) are attached to the Foundations; concrete columns and walls are doweled into the foundation.	√	√	√	N/A	√	√
9	Wall-roof Connections	Exterior walls are anchored for out-of-plane seismic effects at each diaphragm level with metal anchors or straps.	N/A	√	N/A	√	√	√

Table 3.2 continued

10	Wall openings	The total width of door and window openings in a wall is: 1) for brick masonry construction in cement mortar: less than 1/2 of the distance between the adjacent cross walls; 2) for adobe masonry, stone masonry and brick masonry in mud mortar: less than 1/3 of the distance between the adjacent cross walls; 3) for precast concrete wall structures: less than 3/4 of the length of a perimeter wall.	N/A	N/A	√	√	√	N/A
11	Quality of building Materials	Quality of building materials is considered to be adequate per requirements of national codes and standards (an estimate)	√	√	√	√	√	√
12	Quality of Workmanship	Quality of workmanship (based on visual inspection of few typical buildings) is considered to be good (per local construction standards).	√	√	X	√	√	√
13	Maintenance	Buildings of this type are generally well maintained and there are no visible signs of deterioration of building elements (concrete, steel, and timber).	√	√	X	√	X	√
14	Where is this construction commonly found?	a) In urban areas, b) In rural areas, c) In suburban areas, d) Both in rural and urban areas	Urban areas	Urban areas	Rural and urban areas	Urban areas	Rural and urban areas	Rural, suburban, and urban areas
15	Economic level of inhabitants	a) Very poor, b) Poor , c) Middle Class, d)Rich	Middle class and rich	Middle class and rich	Very poor – Poor - Middle class	Middle class	N/A	Very poor, poor, middle class and rich
16	Typical number of stories		4 – 30	12 – 35	1 – 3	6	1 – 3	1 – 3
17	Is this construction type addressed by codes/standards?.	a) Yes, b) No	Yes	Yes	Yes	Yes	Yes	Yes
18	Seismic performance	a) Very poor, b) Poor, c) Medium, d) Good, e) Very good, f) Excellent	Excellent	Very good	Good	Very good	N/A	Very good

(Source: Arnold et al, 2004; Dan et al, 2004; Gandica et al, 2004; Lutman et al, 2004; Maki et al, 2004; Mehrain 2004; Moroni et al, 2004; Pao et al, 2004; Rodriguez et al, 2004; Sassu et al, 2004; Wijayanto, 2004; Zhou et al, 2004)

3.7 The Existence of Seismic Codes

Ground vibrations during earthquakes cause forces which deform structures. Structures need to be designed to withstand such forces and deformations. Seismic codes help to improve the behaviour of structures, so that they may withstand the earthquake effects at the appropriate levels of ground motion. A seismic code is a set of legal requirements intended to ensure that a building is designed and constructed so that, if it is subjected to earthquake destructive forces, it will present no significant threat to the life, health, or welfare of its occupants or the general public (BSSC, 1995).

The primary focus of most seismic codes is to ensure life safety. Continued operation of a facility and reduction of economic losses associated with earthquake damage to the facility are of secondary consideration, if they are considered at all during the design process (Gould, 2002). Seismic codes are minimum standards, but they ensure a certain quality of construction and performance when enforced. Countries around the world have procedures outlined in seismic codes to help design engineers in the planning, designing, detailing, and constructing of structures. An earthquake-resistant building covers four virtues, as follows:

a. Good structural configuration

   Its size, shape, and structural system carrying loads are such that they ensure a direct and smooth flow of inertia forces to the ground.

b. Adequate lateral strength

   The maximum lateral (horizontal) force that it can resist is such that the damage induced does not result in collapse.

c. Adequate stiffness

   Its lateral load resisting system is such that the earthquake-induced deformations do not damage its contents under low-to-moderate shaking.

d. Good ductility

   Its capacity to undergo large deformations under severe earthquake shaking, even after yielding, is improved by favourable design and detailing strategies.

Generally, the use of seismic design provisions can affect a building owner or a community in various ways and to varying degrees. Among the major factors to be considered are the followings (BSSC, 1995):

a. Buildings designed and constructed in accordance with up-to-date seismic provisions can be expected to reduce life loss, injuries, and property damage when an earthquake occurs. For an individual building owner, this should reduce the cost of repairs and minimize the amount of time that the building cannot be used. For a community, this should reduce the costs of emergency response and recovery, keep essential facilities operational, and lower the cost of replacing public buildings.

b. The possibility of costly litigation concerning liability for earthquake effects would most likely be reduced for all those involved in the building process.

c. Requiring seismic design and construction of new buildings may increase costs but far less than many people think.

Seismic codes are unique to a particular region or country. They take into account the local seismology, accepted level of seismic risk, building typologies, and materials and methods used in construction. Furthermore, they are indicative of the level of progress a country has made in the field of earthquake engineering.

The manual for seismic resistance in simple houses in Indonesia has been published since 1978 (Boen, 1978). The newest formal seismic code in Indonesia for ordinary buildings, namely SNI-1726-2002, was published in 2002 (DPU, 2002). This code replaced the old one, SNI-1726-1989, published in 1989. In SNI-1726-2002, ordinary buildings are designed for an earthquake return period of 500 years, which corresponds to approximately 10 percent probability of exceedance in 50 years. It was assumed that the economic life of ordinary buildings is about 50 years. On the other hand, SNI-1726-1989 was designed for a return period of 200 years only. The earthquake return period of 500 years was also adopted for ordinary buildings by the USA Seismic Code. In addition, for essential facilities in the USA (such as electrical power and water networks, hospital, bridges which are required to be operational after the quake event), they are designed for earthquake return period of 2,500 years, which corresponds to approximately 2 percent probability of exceedance in 50 years (Gould, 2004).

Countries with a history of earthquakes have well developed earthquake codes. Thus, countries such as Japan, New Zealand, and the United States of America have detailed seismic code provisions. Development of seismic codes in Indonesia started rather late. The most important thing, according to the existence of seismic codes, is that there is no need to delay enforcing and implementing these design code provisions in actual construction, particularly on non-engineered buildings in areas susceptible to earthquakes.

3.8 Seismic Features in Building

It is widely accepted that the adoption of seismic features, based on up-to-date seismic safety design provisions for new and existing buildings, is generally considered to be a significant way of lessening the risk to life by requiring that such buildings be designed and constructed in a manner that will prevent their structural collapse during an earthquake (BSSC, 1995). In this respect, past experience shows the world community just how horrifying an earthquake is, while also illustrating that buildings, designed and constructed under up-to-date seismic features, will perform well.

Therefore, it is very useful to list some seismic features for masonry and reinforced concrete buildings, materials used for most 'new culture' non-engineered buildings in Indonesia. Some seismic features mentioned in Table 3.3 are scrutinised and extracted from several literature corresponding with Tables 3.1 and 3.2 and presents a checklist consisting of general structural and architectural features, together with a brief explanation:

Table 3.3 Common seismic features for masonry and reinforced concrete

No	Structural/ Architectural Features	Statement
1	Lateral load path	The structure contains a complete load path for seismic force effects from any horizontal direction that serves to transfer inertial forces from the building to the foundation. This include plinth band, lintel band, sill bands, roof band, gable band, vertical reinforcement in all wall corners.
2	Building configuration	The building is regular with regards to both the plan and the elevation.
3	Roof construction	The roof diaphragm is considered to be rigid and it is expected that the roof structure will maintain its integrity, i.e. shape and form, during an earthquake of the intensity expected in this area.
4	Floor construction	The floor diaphragm(s) are considered to be rigid and it is expected that the floor structure(s) will maintain its integrity, during an earthquake of the intensity expected in this area.
5	Foundation performance	There is no evidence of excessive foundation movement (e.g. settlement) that would affect the integrity or performance of the structure in an earthquake.
6	Wall & frame structures-redundancy	The number of lines of walls or frames in each principal direction is greater than or equal to 2.
7	Wall proportions	Height-to-thickness ratio of the shear walls at each floor level is: (a) Less than 25 (concrete walls); (b)Less than 30 (reinforced masonry walls); (c) Less than 13 (un-reinforced masonry walls).
8	Foundation-wall connection	Vertical load-bearing elements (columns, walls) are attached to the foundations; concrete columns and walls are doweled into the foundation.

Table 3.3 continued

9	Wall-roof connections	Exterior walls are anchored for out-of-plane seismic effects at each diaphragm level with metal anchors or straps.
10	Wall corner connections	Wall corner connections are considered to be good.
11	Wall openings	The total width of door and window openings in a wall is: (a) for brick masonry construction in cement mortar: less than ½ of the distance between the adjacent cross walls; (b) for adobe masonry, stone masonry and brick masonry in mud mortar: less than 1/3 of the distance between the adjacent cross walls; (c) for precast concrete wall structures: less than ¾ of the length of a perimeter wall.
12	Vertical reinforcements	Steel bars provided in the wall masonry all around the openings restrict X-cracks at the openings in walls.
13	Compliance with the soil and reinforced concrete analysis	Compliance with the reinforced concrete analysis is considered to be good (per local construction standards). Some failures below should be highlighted: (a) failure of weak and soft stories, (b) failure due to irregularity, (c) failure due to overturning, (d) failure of columns in shear, (e) failure due to short column, (f) failure of beam-to-column joints, (g) damage to precast concrete cladding elements.
14	Quality of building materials	Quality of building materials is considered to be adequate per requirements of national codes and standards (an estimate)
15	Quality of workmanship	Quality of workmanship (based on visual inspection of few typical buildings) is considered to be good (per local construction standards).
16	Maintenance	Buildings of this type are generally well maintained and there are no visible signs of deterioration of building elements (concrete, steel, and timber).

In conclusion, lateral load path or horizontal bands (including vertical reinforcement in all wall corners) are the most important earthquake-resistant feature in masonry buildings. The bands are provided to hold a masonry building as a single unit by tying all the walls together, and are similar to a closed belt provided around cardboard boxes. These bands need to be provided in almost all buildings. The gable band is employed only in buildings with pitched or sloped roofs. In buildings with flat reinforced concrete or reinforced brick roofs, the roof band is not required, because the roof slab also plays the role of a band. In buildings with pitched or sloped roof, the roof band is very important. Plinth bands are primarily used when there is concern about uneven settlement of foundation soil. Although almost all of the seismic features mentioned in Table 3.3 are in line with the existing seismic codes in Indonesia, the above checklist provides a systematic way to have a look seismic features element by element, and this can be used as a complement for the existing codes in Indonesia.

3.9 A Wide Gap between Earthquake Facts and the Existence of Seismic Codes

The catastrophic earthquakes around the globe have reminded the world communities of the importance of understanding the facts of high seismic risk. Over the past few years, this type of depressing scenario has repeated itself in India, Afghanistan, Algeria, Iran, and, the most tragic at the end of 2004, across 12 nations, during which Indonesia suffered most. The Yogyakarta earthquake in 2006 is also a remainder. Lessons learned from past earthquakes have indicated that non-engineered buildings will suffer most during earthquakes. Most of the loss of life during earthquakes has occurred due to the collapse of these buildings. This is especially true in the developing world in areas such as Indonesia, where most residential buildings are low rise, non-engineered constructions. With increasing number of non-engineered buildings without seismic resistance into areas susceptible to earthquakes, vulnerability to earthquakes will intensify. It is deeply concerning that communities continue to experience excessive losses of precious human lives and valuable property, as well as serious injuries and major displacement, due to earthquake events (UNDP, 2004). Some of the evidence above shows that earthquake incidents will remain the single largest cause of massive human deaths and injuries as long as many non-engineered buildings without seismic features still exist in high seismic areas.

On the other hand, most developing countries in high seismic areas such as India and Indonesia have developed seismic features/codes. Proper implementation of seismic codes in construction can help structures to withstand ground shaking during earthquake. The existence of seismic codes can be easily applied to non-engineered buildings. Hence, non-engineered buildings without seismic features will eventually be replaced by more reliable constructions built using seismic code features, both new and retrospectively.

All professionals and people who have embraced seismic reduction find the high death tolls to be emotionally wrenching and simply unacceptable (Comartin et al., 2004). Professionals in each country have sufficient knowledge of seismic codes to save lives and human suffering. It is evident from many examples that progress has been made in the analysis of risk and vulnerabilities, or knowledge of how to reduce these risks. Yet, earthquakes continue to claim thousands of lives every year due to the persistence of people not implementing the existing seismic codes. Obviously, it is widely accepted that there is a wide gap between massive death tolls caused by earthquakes and the existence of seismic codes (Figure 3.36). Many of the deaths could have been reduced, even avoided, if understanding and implementation of seismic codes had been employed properly. In fact, failures are often due to a lack of action or enforcement of well-known solutions, namely seismic codes. The most important means of tackling the compelling problem is to realise that the key to ensuring earthquake safety lies in having a robust mechanism that enforces and implements these design code provisions in actual construction, bridging the gaps between knowledge and action, to avoid the generation of new risks (IITK-BMPTC, 2002 and Shah, 2002).

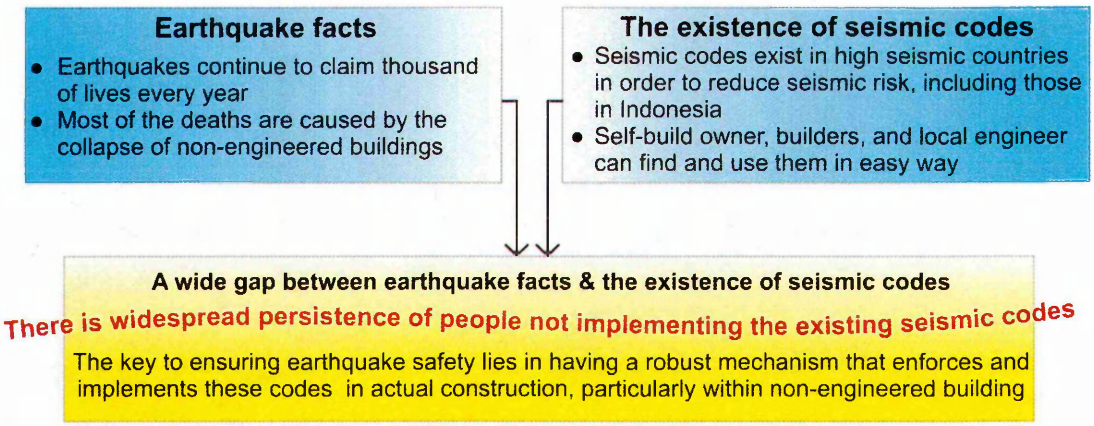


Figure 3.36 The wide gap between earthquake facts and the existence of seismic codes

It is clear that unless something is done quickly to implement significantly seismic codes in developing countries, earthquakes will continue to cause tragically greater human and economic losses in these countries. All too often in developing countries, the resources available in terms of manpower, money and management skills are limited, therefore it is suggested that they are primarily focused on setting up systems to ensure that all new constructions are seismically safe. Once there is a level of confidence in new constructions, efforts can be directed towards seismic retrofitting programmes.

3.10 Summary

A non-engineered building is an unsystematically designed, built, and supervised construction. They are usually built by traditional builders, and/or building owners, using common traditional approaches without intervention by qualified architects and engineers in their design and construction. In Indonesia, non-engineered buildings dominate most residential buildings constructed by masonry or multi-storey reinforced concrete, up to two stories. Most of the loss of life in past earthquakes has occurred due to the collapse of these buildings in both developing and developed countries.

Some of the evidence shows that non-engineered buildings are still being constructed by self-build owners, builders, and local engineers within medium-low-income populations in Indonesia. Although these buildings will slowly be replaced by those of a more reliable construction, it is widely accepted that they will remain the single greatest source of existing seismic risk for the foreseeable future. Therefore, this gives a stronger urgency to the introduction of seismic resistance for non-engineered buildings, both for existing and new buildings; in fact, it is imperative in order to reduce death tolls in future earthquakes.

Descriptions of structural behaviours during earthquakes and a comparison of seismic effects between non-engineered and engineered buildings in simple language are very useful as a starting point to introduce the importance of seismic features for 'new culture' non-engineered buildings made of heavy materials within medium-low-income populations in Indonesia. The seismic features cover many aspects in both masonry and RC buildings, and describe elements such as: simple structural configuration, influence of openings, vertical reinforcement, necessity of horizontal bands in masonry buildings, openings in walls, roles of floor slabs and masonry walls, strength hierarchy in RC, beam and column design strategies, beam-column joints, vulnerability of open-ground storey, and short columns.

Seismic codes help to improve the behaviour of structures so that they may withstand earthquake effects at the appropriate levels of ground motion. The enforcement and implementation of the seismic codes in actual construction is the key to ensuring earthquake safety. The newest formal seismic code in Indonesia for ordinary buildings, namely SNI-1726-2002, was published in 2002.

Chapter IV
Seismic Risk Management, the Situation in Indonesia, and the Importance of Integrated Seismic Risk Management in Indonesia

The previous chapter mentioned some tremendous and detrimental impacts of earthquakes and the wide spread persistence of communities not to implement seismic codes on their non-engineered buildings; the solution seemed merely to be physical or technical intervention. This chapter, however, gives a broader spread of ideas and useful seismic risk management methods in relation to why the problem of introducing seismic codes is not only related to technical intervention, but also non-technical measures. In general, Chapter IV will set out some good practices in seismic risk management activities in various countries, provide an in-depth evaluation of these activities in the current Indonesian situation, and, highlight the importance of conducting integrated seismic risk management in Indonesia through the development of an integrated seismic risk management framework. The latter is obviously an important section and also emphasises the benefits, the novelty, and the contribution of the developed framework.

4.1 Definition of Risk Management

The term 'risk' can be defined in variety of ways. Risk is commonly used as a synonym for 'hazard', 'danger', or 'threat', i.e. an unplanned and undesirable event. It can also correspond to the likelihood of an event occurring. Another meaning is the loss, injury, or other outcome resulting from an event. It can also be described as the generality of volatility and uncertainty – the combined effect of all the individual risks in an investment or situation (Telford, 1998).

In terms of a disaster (such as earthquake and flood), risk can be defined as the probability of harmful consequences or expected loss (of lives, people injured, property, livelihoods, disruption of economic activity or environment damage) resulting from interactions between natural or human-induced hazards and vulnerable conditions (UN-ISDR, 2002). Risk is conventionally expressed by the equation: Risk = Hazard + Vulnerability (UNDP, 2004). In this research, the risk means the possibility of suffering loss as the product of hazard and vulnerability.

Telford (1998) mentions that the basic model of the classic art system of management consists of input, process, output, and feedback loop, which is very vital to effective control of any system. Management decision-makers have the responsibility to make formal judgements and appropriate decisions that will lead the organisation to a successful destiny. Ideally, such decisions should be taken in an environment of total certainty. In reality, the decisions are contemplating future events, the outcomes of which are therefore uncertain. As a result, risk has always been an intrinsic part of the decision making process. Decision-makers cannot generally predict a particular outcome with absolute confidence. Nevertheless, using relevant experience and judgement, they can usually define the range of possible outcomes, and then generate estimates of the likelihood and consequences of each, with a reasonable degree of confidence.

Wideman (1992) highlights that risk management is seen as a formal process, whereby risks are systematically identified, assessed, and provided for. Risk management should be seen as advanced preparation for possible adverse risk events, rather than being taken by surprise when they arise; with such advanced planning, it still enables system objectives to be achieved successfully. Flanagan and Norman (1996) mention that risk management is a discipline for living with the possibility that future events may cause adverse effects. In other word, risk management is pro-active in long term vision. In contrast to the pro-active mode, crisis management is identified as being re-active, which consists of selecting an appropriate response; however, if deliberate planning makes it possible to avoid an adverse situation in the first place, then the pro-active approach would obviously be much better.

Similar to Wideman, Charette (2002) notes that risk management can be described as the continuous analysis of the current situation to realign current resources and management policies against current and future threats, or to maximise the opportunities that are present, thus helping to ensure that the desirable state originally envisioned occurs. Today's risks are often yesterday's opportunities, and tomorrow's success is constrained by how well today's risks are managed.

The status of risk on a system varies significantly during the course of its life cycle, and, as with most of the other system functions, the most effective time for achieving the greatest impact on system results is early in the system development phase. Consequently, risk management should be established as a continuing integrative function throughout the system's life cycle. In its most simplistic form, Wideman (1992) explains that the risk management approach consists essentially of four phases, i.e. risk identification, risk assessment, risk response, and risk documentation. Meanwhile, the Government of Canada, in their context of public policy, has developed an integrated approach to risk management (TBSC, 2001), which is really similar to Wideman's approach. The similarities between Wideman's and TBSC's risk management approaches are illustrated in Table 4.1 as follows:

Table 4.1 Similarities between Wideman's and TBSC's risk management approaches (Wideman, 2004 and TBSC, 2001)

Wideman's Risk Management Approach	TBSC's Risk Management Approach
Risk Identification This phase consists of identifying all the possible risks, which may significantly impact the success of the system. Conceptually, these may range from high-to-low impact vice versa. Obviously, the high and medium risks should receive the most attention.	**Risk Identification** Related activities are identifying issues and setting context. This can be achieved through defining the problem or opportunities, scope, context, and associated risk issues and deciding on necessary people, expertise, tools, and techniques.
Risk Assessment Having identified the range of possible risks, the next step is to assess them. The purpose is to determine their status in term of type, impact, and probability. In practice, depending on the size and nature of the system, effective risk management may require some quite detailed quantitative assessment of the impact of the various uncertainties. This data provides a basis for judging the reliability of the original estimates, the effectiveness of possible alternative strategies, and for planning the best overall responses.	**Risk Assessment** Three activities related to this phase are a. Assessing key risk areas (analysing context/result of environmental scan and determining types/categories of risk to be addressed) b. Measuring likelihood and impact (determining degree of exposure and considering both the empirical/scientific evidence) c. Ranking risk (ranking risk, considering risk tolerance, using existing or developing new criteria and tools)
Risk Response Risk response requires decisions that will enhance opportunities and reduce threats to the organisation's objectives, as follows a. Establishing an appropriate system strategy, such as avoiding the risk (do something to remove it), mitigating the risk (taking actions to lessens the impact or chance of the risk occurring), and accepting the risk (the risk might be so small, the effort to do anything is not worthwhile), b. Taking out insurance as appropriate as transferring the risk.	**Responding to Risk** This requires four activities as follows a. Setting desired result (defining objectives and expected outcomes for ranked risks b. Developing actions (identifying and analysing options – ways to minimise threats and maximise opportunities – approaches, and tools c. Selecting a strategy (choosing strategy, applying decision criteria) d. Implementing the strategy (developing and implementing a plan

Table 4.1 continued

Risk Documentation	Monitoring and Evaluation
Final documentation is a vital part of any project activity though regretfully often overlooked. The purpose is to build database of reliable data for the continuing evaluating of risk on the current system, as well as for improving the database for all subsequent systems	This can be conducted through learning, improving the decision making/risk management process locally and organisation-wide, using effectiveness criteria, and reporting on performance and results.

Based on Table 4.1, it can be seen that the contents of the risk management approach vary in rigour or the extent of actions considered, but the basic steps are similar. Particularly, risk response may embrace risk retention/absorption, risk mitigation, risk transfer, and risk avoidance (similar to Flanagan and Norman, 1996). Organisations may vary the supporting task most suited to achieve common understanding and the implementation of consistent, efficient, and effective risk management. Organisations need to work with creativity and a desire to innovate in order to meet their evolving needs and priorities.

4.2 Seismic Risk Management

Based on the above definition of risk, seismic risk can be defined as the possibility of suffering loss (of lives, people injured, property, livelihoods, disruption of economic activity or environment damage) resulting from interactions between seismic hazard and vulnerable conditions. The term of seismic risk is occasionally used in a general sense to mean the potential for both the occurrence of natural phenomena and the losses associated with earthquakes.

If the earthquake occurrence causes widespread losses that exceed specified values at a site, at several sites, or in an area, during a specified exposure time, this event will become a disaster. A disaster is a sudden, calamitous event that seriously disrupts the functioning of a community or society, causing widespread human, material, economic, or environmental losses that exceed the community's or society's ability to cope using its own resources. Disasters result from a combination of hazards, vulnerability, and inability to reduce the potential negative consequences of risk (UN-ISDR, 2003). Disaster risk represents public risk, which affects all residents of a risk-prone community with shared responsibility.

Reduction of disaster risk can be conducted through two principal methods (NDMD, 2004b), i.e. preparedness and mitigation. Preparedness is a protective process, embracing measures which enable governments, communities and individuals to respond rapidly to disaster situations and to cope with them effectively. Preparedness includes the formulation of viable emergency plans, the development of warning systems, the maintenance of inventories and the education and training of personnel. It may also embrace search and rescue measures as well as evacuation plans for areas that may be at risk from a recurring disaster. Meanwhile, mitigation embraces all measures taken to reduce both the effect of the hazard itself, and conditions vulnerable to it, in order to reduce the scale of a future disaster. Therefore, mitigation activities can be focused on the hazard itself or the elements exposed to the threat. An example of a mitigation measure is the implementation of seismic features in buildings. All disaster reduction strategies need to be supported by appropriate legislation with a clear allocation of responsibilities and budgetary provisions. In this research, such implementation of seismic features on non-engineered buildings is not only a simply physical measure, but also conforms to non-technical intervention, such as government political will, education, and training of personnel. Therefore, the term 'seismic risk reduction' is highly utilised instead of 'seismic risk mitigation'.

Specific to seismic risk, SCEC (2002) explains that seismic risk contains three factors, as follows:

a. Hazard (faulting, shaking, land-sliding, liquefaction)

   Living in a seismic prone area means that seismic risk is unavoidable. The risk is a fact of everyday life. It is impossible to manage the risk through prevention of future earthquakes, but improvement of seismic hazard assessment and the provision of reliable seismological and engineering-seismological information for planning and design purposes is an important factor contributing to the efficiency of risk management programs.

b. Exposure (extent and density of built environment)

   When earthquakes occur in uninhabited areas, they are not considered to be disasters. Sometimes civilisation and urbanisation make human beings more vulnerable to natural phenomena. It happens, in particular, when there is high concentration of population and complicated infrastructure in earthquake prone zones. Hence, the processes of land use and urban planning, as well as the development of new technologies, should take into account the existing seismic threat.

c. Fragility (structural fragility)

   The bitter engineering truth is that earthquakes do not kill people, vulnerable buildings do. Though future earthquakes cannot be avoided, the community can improve the seismic performance of buildings and lifelines; reconstruct or retrofit old structures and build new earthquake-resistant constructions using modern seismic codes, in particular, for residential and critical buildings.

According to the definition of disaster risk management developed by UNDP (2004), seismic risk management can be described as the systematic process of using administrative decisions, organisation, operational skills and capacities to implement policies, strategies and coping capacities of society and communities to lessen the impacts of seismic hazards and related environmental and technological disasters. This comprises all forms of activities, multiple groups at different levels of understanding, commitment, and skill, including structural and non-structural measures to avoid or to limit adverse effects of hazards. Similar to Wideman (1992), seismic risk management has been advanced as an integral paradigm that builds on and incorporates all the previous strategies from the perspective that all development activities should reduce seismic risks. Seismic events are uncontrollable and unstoppable; hence much more activity in seismic risk management is required to produce controllable long-term strategies and priorities. Usually, some elements in seismic risk response correspond highly to risk absorption, risk mitigation, and risk transfer.

Problem of seismic risks different from risk in some business organizations. In such organizations, the goal may be narrowly defined, such as profitability for the corporation. Different measures of profitability – each representing different level of risk – are used as the basis for projecting the next state of the corporations as a system. The goal of the system is control in the system's performance (Comfort, 1999). In contrast, she also points out that some problems of seismic risk are much more complicated as follows.

a. The management of seismic risk poses several problems for decision-makers. For example, the large scale seismic events for which planning is required are rare. Consequently, planners rarely have access to realistic information upon which to base their deliberations. The rarity of seismic event also means that experience is often limited to one or two, often small-scale events that can bias thinking and result in an underestimation of the complexity of seismic hazard activity.
b. Seismic risk represents public risk, which affects all residents of a risk-prone community. Whether or not they have contributed to the condition producing the threat.
c. Not only the problem, but also the decision-making responsibilities are shared in matters of public risk. Public managers are accountable to the citizens for the actions they take (or do not take) in the interest of public safety and welfare. The methods needed to solve problems of seismic risk require a continuing process of collective learning, rather than control, to support collective action. Flux in global processes, tied in particular to

economic globalisation, changing local conditions, and including rapid urbanisation, mean that seismic risk is not a static condition.

d. The policy problem becomes not how to achieve a specific outcome, but rather how to generate and sustain a process of iterative inquiry and action that will, through its system, lead its members to create new and more appropriate policies and practices in response to needs from its environment.

e. The capacity of a community to mobilize collective action in anticipation and response to perceived risk depends directly upon the degree of awareness, level of skills, access to resources, and commitment to informed action among its members prior to the occurrence of a damaging event.

f. In seismic risk that endangers an entire community, interdependencies among technical, organizational, cultural, and other types of systems affect a community's capacity to both mitigate and respond to disaster. The best interest of the individual is directly tied to the community's capacity to provide services that benefit the whole. There is no longer a single actor, but many actors, involved in interdependent decisions that increase or decrease the threat of danger to the community. Seismic risk represents the type of actual policy problem that illustrates the interdisciplinary, inter-organisational, and inter-jurisdictional characteristics that have made problems of shared risk extraordinarily to resolve.

g. Seismic risk includes a class of policy problems that have defied solution by traditional means of analysis and planning.

4.2.1 Seismic Risk Management Approach

Seismic risks can be managed effectively in a number of ways. SCEC (2002) has developed a seismic risk management approach as advanced preparation, using a multidisciplinary method. There are three phases that influence the seismic risk management approach. Seismic hazard analysis corresponds with science, seismic risk assessment conforms to engineering, and finally, political and economic action accords with mitigation. The length or relative importance of each component phase may vary and the boundaries between each phase are not well defined, depending largely on the certain situation. Moreover, the seismic risk management approach developed by SCEC (2002) tends to divide into three phases: risk identification, risk assessment, and risk response, where risk documentation is embedded in each phase, explained in Figure 4.1:

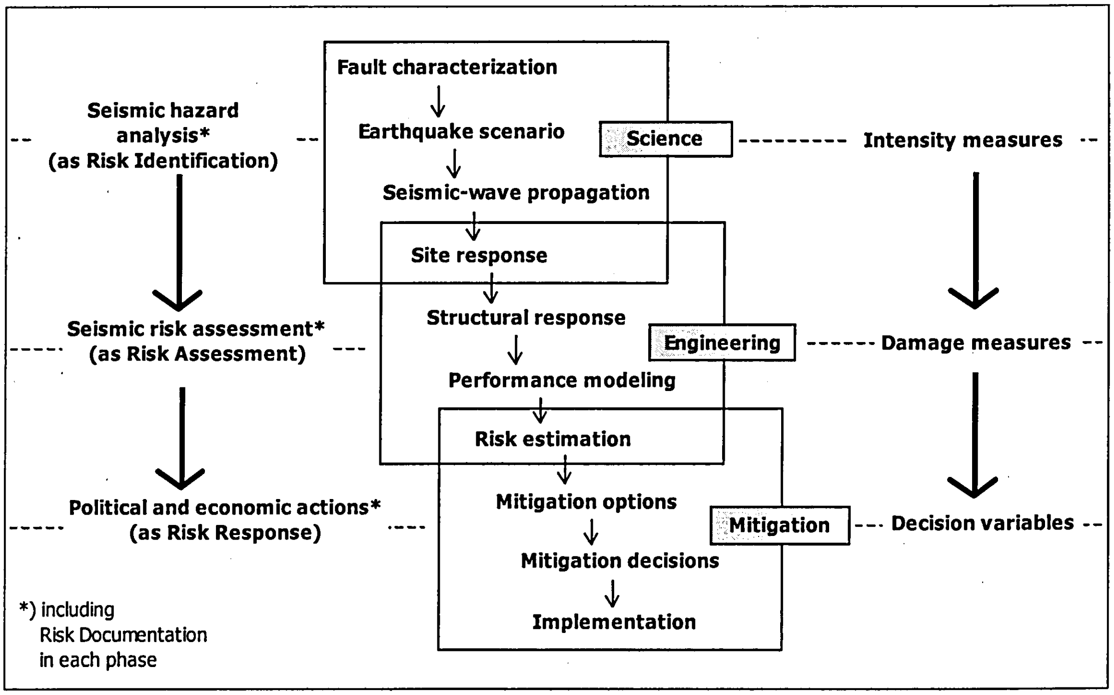


Figure 4.1 Seismic risk management approach (SCEC, 2002)

During the phase of seismic hazard analysis and seismic risk assessment, scientists and engineers seek methods and approaches that will reduce the levels of uncertainty associated with the causes of an event and the fragility and vulnerability of structures subjected to the event. Individuals become advocates of methods and approaches which, when accepted, provide individual recognition and rewards. In addition, an important role for science and engineering is to improve knowledge about the mitigation of the effects of extreme events, effectively transferring knowledge and facilitating collaboration among users of the knowledge (Petak, 2002).

In general, there are two types of seismic hazard analysis, deterministic and probabilistic (Gould, 2003). In a deterministic analysis, an earthquake event of a specified magnitude is assumed to occur on the fault that causes the greatest damage to the subject building(s). This approach can intuitively be expected to generate a reasonably conservative "worst-case" scenario for loss. On the other hand, a probabilistic analysis accounts for the full range of possible earthquakes, their location, return period, size, and the propagation of the earthquake motion from the rupture zone to the site(s) of interest. This provides a return period curve with a more complete and 'realistic' evaluation of the potential earthquake losses.

In line with Figure 4.1, the next phase is political and economic actions as a seismic risk response, which corresponds with mitigation action. An effective mitigation plan anticipates actions that a community must take before a disaster strikes. Planning is one of the most important parts of any mitigation effort. Taking the time up front to make people aware of the earthquake risk to their community, making a plan of how to reduce that risk over time, and what to do in the event of an earthquake can make a tremendous difference in post-disaster recovery efforts.

It is clear from Figure 4.1 that seismic risk management needs risk "dimensioning", and risk sizing takes into account not only the expected physical damage, victims and equivalent economic loss, but also social, organisational and institutional factors. The difficulty in achieving effective seismic risk management, in part, has been the lack of a comprehensive conceptual framework of seismic risk, facilitating its evaluation and intervention from a multidisciplinary perspective. Most existing indices and evaluation techniques do not express risk in words adequate for the diverse types of decision-makers, and they are not based on a holistic approach that invites intervention (IDEA, 2005).

According to the growing recognition mentioned above, although the risk management approach in Figure 4.1 shows distinctive steps, those activities in the seismic risk management approach enables an overlap between each step. This means that the activities in each step are not as clear-cut as are sometimes implied. In most cases, while different countries have implemented earthquake risk management movements that differ from each other in detail and degree, they are nevertheless the same in principle.

The seismic risk management approach in Figure 4.1 has been adopted in this research. In addition, it should be emphasised that Chapters II and III have clearly identified the true nature of the seismic risk focused on by this research, i.e. the continued non-seismic resistance of non-engineered buildings in Indonesia. Hence, the risk identification phase in this research is not to further identify the risk, rather to capture progress, hence the name 'seismic hazard analysis', as precisely adopted from SCEC. However, the term 'political and economic actions' used by SCEC is not adopted, and seismic response phase in this research is simply named 'seismic risk response'. Finally, the seismic risk management approach adopted in this research will comprise three headings: seismic hazard analysis, seismic risk assessment, and seismic risk response. The first draft of the proposed framework in Chapter V will elaborate this matter further.

4.2.2 Reducing the Cost of Loss Using Seismic Risk Management Actions

Seismic risk management has been well known in recent decades. Some countries have employed seismic risk management actions, based on a belief that investment in mitigation is much more cost effective than expenditure on relief and rehabilitation (NDMD, 2004a). In other words, the expected cost of loss after an earthquake has occurred can be reduced using seismic risk management actions. Chen et al., (2003) mentions that expected loss during an earthquake can be cut down significantly through preventive activities before the disaster happens. Some examples below present the cost-effectiveness of disaster risk reduction (DFID, 2004):

a. The World Bank and the US Geological Survey calculated that economic losses worldwide from disasters during the 1990s could have been reduced by US$ 280 billion worldwide if US$ 40 billion were invested in mitigation and preparedness.
b. In China, an investment of US$ 3.15 billion in flood control measures over 40 years is believed to have averted potential losses of US$ 12 billion.
c. In Vietnam, 12,000 hectares of mangroves planted by the Red Cross protect 110 km of sea-dykes. Planting and protection cost US$ 1.1 million but has reduced the cost of dyke maintenance by US$ 7.3 million per year (and the mangroves have protected 7,750 families living behind the dyke).
d. According to Oxfam, the value of cattle saved on a flood shelter of four acres in Bangladesh during the 1998 floods was as much as £150,000, against a construction cost of only £8,650.

Obviously, seismic risk management decisions must be made and implemented, particularly in high seismic areas around the world. Setting priorities for action is imperative, since the need for improvement will always vastly exceed the available resources (SCEC, 2002).

4.3 Some Evidence of Good Practices of Seismic Risk Management Implementation in Countries

In many countries with significant seismic problems, the implementation of seismic risk management has increased. Some evidence of good practices employing seismic risk management from their seismic hazard, assessment, and response might be used as best examples for other countries with similar problems. This section presents, as extracted from many sources of literature, three important factors that drive successful and effective implementation of seismic risk management in various countries, particularly interrelated with non-engineered buildings. These are (a) direct involvement of multidisciplinary

stakeholders, (b) strengthening of local capacities, and (c) poverty consideration. Evidence that the successful three factors have widely contributed in reducing seismic risk in countries such as the United States of America, Taiwan, India, Algeria, Colombia, Nepal, and Peru will be presented as follows.

4.3.1 Direct Involvement of Multidisciplinary Stakeholders in Seismic Risk Management

As described in Chapter II, the key to bridging the wide gap between massive death tolls and the existence of seismic codes is a robust mechanism of enforcement and implementation of the seismic codes in actual construction. The enforcement and implementation of seismic codes is not simple because seismic risk is interrelated with interdependencies among technical, organisational, cultural, and other types of systems affecting a community's capacity to both mitigate and respond to disaster. There is no longer a single actor, but many actors, involved in interdependent decisions that increase or decrease the threat of danger to the community (Comfort, 1999). Moreover, there is growing evidence that the partial perspective of disciplines among community members generate actions that are unsustainable (Petak, 2002). Thus, bringing a wide range of stakeholders together to cross both disciplinary boundaries and sectors in seismic risk management is a substantial key to sharing effort and responsibility before disaster strikes. How well they work together can determine the quality and outcome of the risk management process.

In general, multidisciplinary stakeholders involved in seismic risk management can be divided into two extreme groups: government and non-government agency. Both of them have specific and significant roles within their sphere of operation.

4.3.1.1 Involvement of Government Agencies

UNDP (2003) claims that the role of government, in order to reduce disaster, is very important. It is because governments as public institutions generally view the mitigation of extreme event consequences as an integral part of their responsibility to provide for public safety, which they see as occurring through their regulatory-controlled activities, which are in the "public interest". At the present time, many governments in the examples below have brought a new paradigm shift in their approach to disaster management, based on the conviction that investments in risk management as pro-active actions are much more cost effective than expenditure on relief and rehabilitation. They have the existence of an administrative structure responsible for seismic risk reduction as a structural entity with

adequate budget allocation as evidence of their commitment to disaster management. In general, UNDP (2004) highlights that the lack of wider political commitment to disaster reduction is often stated as the main barrier to progress in implementation.

In the USA, earthquakes are the most costly natural hazard. In 1978, the US government created the National Earthquake Hazards Reduction Program (NEHRP) under the Federal Emergency Management Agency (FEMA) to improve the nation's understanding of earthquake hazards and to mitigate their effects (www.fema.gov). Since its creation, NEHRP has provided a comprehensive framework for efforts to reduce the risk from earthquakes. Besides NEHRP, in the area of seismic hazard, the U.S. Geological Survey (USGS) Earthquake Hazards Program is the world scientific leader in seismic-hazard studies (www.usgs.gov). In implementing the results of their activities to understand and mitigate the effects of earthquakes, US government agencies have actively collaborated with state geological surveys, emergency-response officials, earthquake engineers, local governments, and the public. This collaboration has resulted in dramatic improvements in earthquake preparedness and public safety in the United States.

Similar to the USA, the Government of Taiwan has established a National Center for Research in Earthquake Engineering (NCREE) to promote seismic hazard mitigation in an integrated and systematic approach (www.ncree.gov). Furthermore, the Government of India launched a 'National Programme for Capacity Building of Architects in Earthquake Risk Management'. The overall goal of the programme is sustainable earthquake risk reduction. The Government of India has brought about a paradigm shift in the approach to disaster management, namely that development cannot be sustainable unless disaster mitigation is factored into the development process (NDMD, 2004a). In Algeria, there are Seismological and Earthquake Engineering Centres (Belazougui, 2003). In Nepal, there were three municipalities which expressed their interest immediately after the Government of Nepal launched the 'Kathmandu Valley Earthquake Risk Management Project' in 1997 (ADPC, 2000).

In conclusion, the existence of government agency(s) as a structural entity, which actively manages seismic risk, is the primary role in mitigating, directing, and organizing disaster response operations. This shows the high degree of political commitment of the government to disaster management, which is accompanied by a high level of commitment to implementation. The Government of the USA, for example, mentioned that between 1983 and 2001, only 129 people died in eight severe earthquakes, compared to 1,600,000 world-wide (SCEC, 2002).

4.3.1.2 Involvement of Non-government Agencies

While governments bear the primary responsibility with regard to safety and security, they cannot and should not shoulder these tasks alone. Non-government agencies, or the private sector, are a government's partner in reducing disaster. Private sectors include non-profit organisations, non-government organisations, and the business sector. Encouraging governments and private sectors to formally take account of disaster risk together in their decision-making might be a first step in raising the profile of disaster in corporate social responsibility, as well as promoting the responsibility of employers for human rights and environmental stewardship in and beyond the workplace, in order to prevent the accumulation of disaster risk (UNDP, 2004).

Indeed, the private sector has a role to play, in moving towards community resilience, that incorporates an awareness of disaster risk. Unfortunately, there are very few recorded examples of corporate social responsibility that have engaged with the disaster risk reduction agenda in developing countries (UNDP, 2004). There is great scope for encouraging the private sector to incorporate disaster risk issues into their corporate social responsibility planning. In the developed countries with significant earthquake problems, it is the professional engineers that have been at the forefront of earthquake reconnaissance studies (Jain, 1998).

There are a lot of non-government agencies in the area of Earthquake Engineering (EE) in the USA. Tremendous improvement has been achieved in order to manage seismic risk (EERI, 2003), as described below:

a. Establishment of major EE research centres in the United States, such as PEER Center headquartered at the University of California at Berkeley, Multidisciplinary Center for Earthquake Engineering Research (MCEER) at SUNY Buffalo, and Mid-America Earthquake (MAE) Center at the University of Illinois, Urbana-Champaign. These three centres are funded by the National Science Foundation (NSF) with matching funds from other sources.
b. Establishment of several important experimental facilities to conduct EE research including, among others: Cornell University UCB, University at Buffalo (SUNY), University of Michigan, University of Minnesota, University of Nevada at Reno,

University of Texas at Austin, University of Washington, Georgia Institute of Technology, Lehigh University, Ransellaar Polytechnic Institute.

c. Establishment of the Applied Technology Council (ATC) in 1971 and its first significant activity, ATC 3-06 "Tentative provisions for the development of seismic regulations for buildings," was a turning point, casting a framework for the next generation of seismic design code.
d. Establishment of California Universities for Research in Earthquake Engineering (CUREe) in 1988, and its reorganization to Consortium of Universities for Research in Earthquake Engineering (CUREE) in 2000.
e. Publication of reports from studies conducted at the above-mentioned research centres. Also, EE specific journals, including Earthquake Engineering and Structural Dynamics, Earthquake Spectra, Soil Dynamics and Earthquake Engineering, Journal of Earthquake Engineering, among others, have provided media to disseminate research and development.
f. Publications of books, monographs, and reports have greatly enhanced people's understanding of earthquakes, and performance of facilities. These include reports published by ATC, EERC, EERI, FEMA, SCEC, MAE, MCEER, NCEER, PEER, SEAOC, USGS, among others.

Furthermore, there is an Earthquake Engineering Centre in Algeria, which was founded in January 1987. Their missions and objectives are (a) to perform investigation and research activities in the field of seismic risk reduction, (b) to train its future researchers, (c) to build its specific research and testing laboratories, (d) to train and improve the knowledge of specialists in seismic design at the national level (seminar courses, conferences and symposia), (f) to educate and inform the public and the authorities, (g) to aid and assist the engineering offices and concerned institutions, and (h) to integrate hazard mapping and the results of vulnerability and risk investigations in development and the urban planning with mandatory implementations. In India, there is the National Core Group for Earthquake Mitigation, founded in 2003, with seven National Resource Institutions: (a) Centre for Environmental Planning and Technology, (b) Indian Institute of Technology Kharagpur, (c) Indian Institute of Technology Roorkee, (d) Jawaharlal Nehru Technical University, (e) Manipal Institute of Technology, (f) Maulana Azad National Institute of Technology, and (g) School of Planning and Architecture, New Delhi (NDMD, 2004a)

Private sectors operate their business within the structure of the free market, where there is most often significant market competition. Their focus is on increased and improved sales of products and services, meeting customer needs while achieving an acceptable return on their investment. In contrast, governments operate within the structure of the political system and understand that extreme events often produce broad scale damage with losses having large socio-economic impacts or significant impacts on community resilience. Governments generally view mitigation of extreme event consequences as part of their responsibility to provide for public safety. The conflict here is between advocates for risk management through appropriate mitigation facilitated through government action and the notion of a free market maximisation of return on investments with minimum governmental regulation. There is a disconnection between the short term good of the business in private organisation and the long term good of the community. In other words, there is considerable controversy regarding how the government and the private sector can best implement seismic loss-reduction measures through regulatory policies, economic incentives, long-term investment, and public education (Bruneau et al., 2004). Apparently, the role of business sectors in seismic risk management still needs to be enhanced.

In summary, involvement of multidisciplinary stakeholders should embrace multi-target audiences to develop a sense of responsibility in seismic risk reduction in daily life. Some literature suggests that those parties are government officials, community leaders, businessmen, small and medium contractors, educators, foremen, researchers, scientists, and NGOs (IUDMP, 2001; CEEDEDS, 2004; SCEC, 2002; GREAT, 2001)

4.3.2 Strengthening of Local Capacities within Seismic Risk Management

Each risk scenario at the local level represents a unique configuration of hazards and vulnerabilities in the context of broader processes of development at the national and global levels. Yet ultimately, vulnerability and risk are manifested at the local level (UNDP, 2004). Local level community response remains the most important factor enabling people to reduce and cope with the risks associated with disaster. Local organisations play a pivotal role in overcoming local obstacles, in defining and shaping a regional level of risk management policy, in sharing and promoting further exchanges and knowledge between other localities or regional levels and between key agencies and individuals, and in supporting the development of national capacities. In general, strengthening of local communities can be achieved through three aspects: developing local leadership, conducting participatory approaches, and increasing public seismic awareness.

a. Developing local leadership

Local authorities are in charge of basic needs such as land-use planning, construction planning and control, including the protection of people on its territory. In addition, outsiders are rarely able to effectively contribute single-handedly to safety programmes in developing countries. It is rare to find outside experts with a good understanding of the local situation, who can work in developing countries for long periods of time. Hence, the best results are achieved when the problem is tackled by local experts, with outsiders providing a guiding role: developing local leadership is the key to success.

In developing local leadership in communities, a long-term commitment is needed, which is often beyond the funding and staffing cycles of many agencies. Perhaps, in developing countries, the greatest difficulty is avoiding the trap of communities becoming dependent on well-meaning external agencies. The application of appropriate technology is one approach that has been promoted as a way to overcome some of the problems associated with the implementation and long-term sustainability of development projects in the Third World. Appropriate technology should be able to satisfy the requirements for fitness for purpose in the particular environment in which it is to be used. It should also be maintainable using local resources, and it should be affordable (Vickridge, 1996).

Examples of the successful and long-term improvement of local communities do exist, but remain uncommon. The earthquake event in Northridge, California on 17th January 1994 is a good example. Response operations were immediately activated by the earthquake and carried out largely by experienced, well-trained, local emergency service organisations (Comfort, 1999). Improving local capacity to repair and strengthen their own houses using modern seismic features can be seen in the increasing number of house units in Maharastra, India. In 1995, the number of completed repaired or strengthened houses was around 38,000 units; in 1998 the number reached approximately 182,000 units, a tremendous increase (EERI, 1999).

b. Conducting participatory approaches

Capacity improvement at a local level, together with a participatory approach, might bring about other important things to strengthen local communities. For policy interventions seeking to include a participatory approach, preliminary discussions to help map the social relationships within the community are essential if the vulnerable (who are also the socially excluded) are to be reached and helped to build their own levels of resilience through participation. Building meaningful participation with vulnerable groups and individuals in development is not easy. Principle characteristics of social vulnerability are political marginalisation and social exclusion. Encouraging social integration and political participation to enhance resilience and other goals for quality of life is a major challenge to disaster and development policy (UNDP, 2004). The example of participatory process has been carried out by the Government of Nicaragua, who undertook a participatory process of local development planning within a disaster reduction approach. Disaster reduction was factored into a range of planning sectors, including infrastructure development, productive sectors, social sectors and environmental management (UNDP, 2004). Community participation has also been noted in the small Senegalese town of Rufisque (UNDP, 2004).

The participatory programme is itself a learning process. Key elements of success have included the realisation that risk profiles and participatory processes in each region are different, so strategies should rely on local decision-making and be flexible in approach and implementation. In addition, local plans should be linked with central institutions to access support and blend with national development policy, called bottom up vision The involvement of local stakeholders into disaster risk management and participation are also a key factor in maintaining local support and generating significant local outputs for disaster risk reduction, as well as motivating the acceptance of shared responsibilities and cooperation.

c. Increasing public seismic awareness

The next factor to enhance local communities is public seismic awareness. Lack of public awareness to seismic risk tends to contribute to essential barriers in implementation of seismic codes within non-engineered building. SCEC (2002) highlights that public seismic awareness can be achieved primarily through public education. Creating a community of knowledgeable people through public education is essential to the development of 'resonance' or willingness to support shared action, when necessary, to sustain the goal of a responsible, civil society. In the USA, publications of books, monographs and reports using both hard copy and on-line systems have greatly enhanced community understanding about earthquakes and performance of facilities. These include reports published by ATC, EERI, FEMA, SCEC, MCEER, and USGS (EERI, 2003). The citizens, elected officials, property owners, and other decision makers must be informed about the nature of the risks, their mitigation options, and the costs of action and inaction. In order to close the gap between existing knowledge and its implementation, public education is the best solution (SCEC, 2002).

A good example of a strong, earthquake resilient local community might be seen in Manizales City, Colombia. The success of the seismic risk management action was evident during the massive earthquake of 1938, which did not damage the city significantly. Similarly, the earthquakes of 1962, 1964, 1979, 1995, and 1999 caused only minor or moderate damage. Since the 1980s, the city has had a municipal disaster prevention system in place, based on municipal development and land-use plans, that incorporates disaster risk management as a strategic and political cornerstone. Disaster preparedness has become part of the city's culture. Prevention-related information and education activities are conducted regularly in schools. Drills are held periodically to ensure that awareness and alertness remain high. The mayor has a disaster risk advisor for inter-agency co-ordination and the city employs a team of professionals who work at scientific research centres. All residents who take steps to reduce the vulnerability of their homes receive a tax break as an incentive. A collective and voluntary housing insurance scheme has been promoted by the city. It is added to local bimonthly tax payments, with the aim of covering the tax-free lower socio-economic strata, once a defined percentage of taxpayers paying for the insurance has been achieved. Seismic micro-zonation has enabled the local administration to estimate the expected annual losses of its public buildings and insure them selectively. The city administration of Manizales has produced a disaster risk plan that aims to translate state-of-the-art theory into practice, transfer best practice from current experiences in other places, focus on local participation and sustainability, and build in local ownership (UNDP, 2004).

Conversely, specific to Indonesia, a survey about public awareness of earthquake and quake preparedness given to the community in the Minomartani residential area, adjacent to Yogyakarta City, reveals that the whole community tends to overlook the future earthquake risk. It seems that there is no public education of the grass-root community of seismic risk from government and private agencies (Chandra et al., 2004).

In summary, the strengthening of local capacities through improving their local leadership, participatory approaches, and public awareness is important to enhance resilient communities against future disaster. According to the World Disasters Report, UNDP (2004) claims 'effective and accountable local authorities are the single most important institution for reducing the toll of natural and human-induced disasters in urban areas'. Furthermore, providing a local lens allows a large number of small events to be catalogued, re-shaping perceptions on risk as a priority concern for development policy and contributing to a potentially genuine process of self-organization to reduce risk. This is an essential precursor to a bottom up decision making process for development policies, strategies, plans, programs and projects in disaster reduction (Yodmani, 2003) focusing on the local ownership of prevention projects. Sometimes, knowledge from a developed country is not fully suitable for the local situation, and the impact on policy and practice at a local level is dubious.

4.3.3 Poverty Consideration in Seismic Risk Management

UNDP (2004) reveals that, in global terms, disaster risk was found to be considerably lower in high-income countries than in medium- and low-income countries. Disasters affect the poor disproportionately. Poor people are often the most likely to be exposed to natural and non-natural hazards. "Disasters in medium- and low-income countries are an integral part of their poverty cycle. Poverty causes disasters, and disasters exacerbate poverty" (UNDP, 1994). It is true that the majority of the earthquake losses are concentrated in non-engineered buildings, which mostly belong to the poor, who often bear the greatest cost in terms of lives, and livelihood, and rebuilding their shattered communities and infrastructure (Sarwidi, 2001).

Poor people are often unable to obtain basic services because (a) institutions are not accountable, (b) local elites dominate the political process and control private sector resources, (c) corruption is widespread, (d) social relationships are inequitable, and (e) poor people lack experience with participation. Poverty levels, or the absolute number of poor and destitute persons, have increased continually, with dramatic effects in terms of increases in social risk and disaster vulnerability (UNDP, 2004).

The urban poor are often forced to make difficult decisions about risk. In low-and-middle income countries, city governments have often proved ineffective in regulating the process of urban expansion through land-use planning and building codes. Unregulated low-income settlements, where land values are lowest, often occupy the most hazard-prone locations, for example, in peripheral squatter settlements located in ravines, on unstable slopes or in flood-prone areas, or else in dense inner city slums.

Living in hazardous locations is sometimes 'chosen' if individuals seek opportunities not only to improve their own quality of life, but also to enhance the health and educational attainment of their children, for greater prospects for their children tomorrow. Poor or non-existent sanitation, high unemployment and underemployment, deficient health and education services, insecure land tenure, crime and violence, and other factors configure a panorama of everyday risk. For individuals caught up in the immediate concerns of daily survival, disaster risk management is often not a priority. Hence, everyday risks accumulate and prepare the way for disaster (UNDP, 2004).

The disaster impact largely depends on the kind of development choices countries have made previously. As countries become more prosperous, for example, they are often better able to afford the investments needed to build houses more likely to withstand earthquakes. At the same time, the rush for growth and the resulting urbanisation can trigger haphazard urban development, which increases the risk of large-scale fatalities during such a disaster. When populations expand faster than the capacity of urban authorities or the private sector to supply housing or a basic infrastructure, risk can accumulate quickly in informal settlements. The urbanisation process leads to the concentration of populations in risk-prone cities, and risk-prone locations within cities. This is true in megacities and in rapidly expanding small- and medium-sized urban centres in developing countries (UNDP, 2004).

Regression analysis of vulnerability indicators shows that, statistically, physical exposure and the rate of urban growth acted together in being associated with the risk of death by earthquake (UNDP, 2004). In other words, the risk of dying in an earthquake is greater in countries with rapid urban growth. Mass migration from rural to urban settlements has resulted in the growth of city slums; many located on unsafe land and built with environmentally inadequate construction techniques. Low building standards may reflect a lack of control and supervision in middle income areas and the lack of resources to build hazard resistant structures in low-income areas. It is a fact that, in many rapidly growing cities, earthquake risk considerations have not been factored into the building and planning process. In general, city governments have not been capable of regulating either building or settlement in a way that reduces risks (UNDP, 2004).

International experiences, including tragic lessons from the recent large earthquakes in Aceh on 26th Dec 2004 and Yogyakarta, on 27th May 2006, show that the growth of earthquake prone communities, following the global processes of development and urbanisation, commonly give rise to seismic risk unless proper countermeasures are taken to prepare for future earthquakes and to manage the risk. This is also true for countries of low and moderate seismicity, taking into account that the risk value depends not only on the hazard level, but also on the aggregate elements at risk and their vulnerability to probable seismic influence. The overcrowding and deterioration of inner city slum areas in Lima, Peru has been identified as a critical process of seismic risk accumulation in that city (UNDP, 2004).

This situation may be attributable to resource constraints in poorer countries. In 2001, in Indonesia, for example, only 7.2% of the population lived below 1$/day, but up to 55.4% lived below 2$/day (Timmer, 2004). The governments of such countries lack, not only the financial resources needed to shoulder the economic burden, but also the institutional and human resource capacities needed to deal quickly and comprehensively with disasters and emergencies. Also since the 1970s, but with increasing emphasis in the 1980s and 1990s, researchers from social sciences and humanities have argued that the impact of a natural hazard depends, not only on the physical resistance of a structure, but also on the capacity of people to absorb the impact and recover from loss or damage (UNDP, 2004).

In the area of seismic risk management, in order to protect poor people from the collapse of non-engineered buildings, which are prevalent among the medium to low income population, it is urgent to disseminate seismic codes which are (a) socially acceptable, (b) economically feasible, and (c) easily absorbed into local construction methodologies down through the grass root communities (Arya, 1994). In fact, earthquake resistance need not be expensive when incorporated into a sound design from the very beginning of the planning effort by a competent team; it usually only amounts to about 1.5% of the cost of construction (BSSC, 1995). Again, Maharastra, India, provides an example of good practice; there were over 500 model houses constructed in order to demonstrate cost-effective building techniques, use of local materials and seismic features in 1998 (EERI, 1999). One way for communities to encourage well-enforced seismic codes, and not add a monetary burden, is to provide tax incentives for more disaster-resistant homes. For example, if a homeowner reduces the chances of damage from an earthquake by installing a mitigation measure, then this taxpayer would receive a rebate on state taxes to reflect the lower costs for disaster relief (Kunreuther, 2000).

Finally, it can be assumed that the widespread persistence of collapse of non-engineered buildings in developing countries has a tremendously devastating impact on efforts to eradicate poverty at all levels. As a whole, the collapse of such buildings during an earthquake seriously undermines the result of development investment, and therefore remains a major threat and impediment to sustainable development and poverty alleviation.

In conclusion, based on the three essential factors captured from such good practices in seismic risk management mentioned above, this points towards the need for policy responses that begin to identify and then tackle the root causes of risk that are embedded within contemporary development practices — as an integrated part of sustainable development policy. Thus, the proper approach to the problem of seismic risk management should include consideration of all three contributing factors, particularly within the broader context of sustainable development. There is a strong sense that these factors are inter-linked. It is true that the length and importance of the three factors should be cornerstones and influence each other to ensure continuous movement and improvement of seismic risk management actions, particularly within non-engineered construction in developing countries (Figure 4.2), so that the approach is common but the solutions are local.

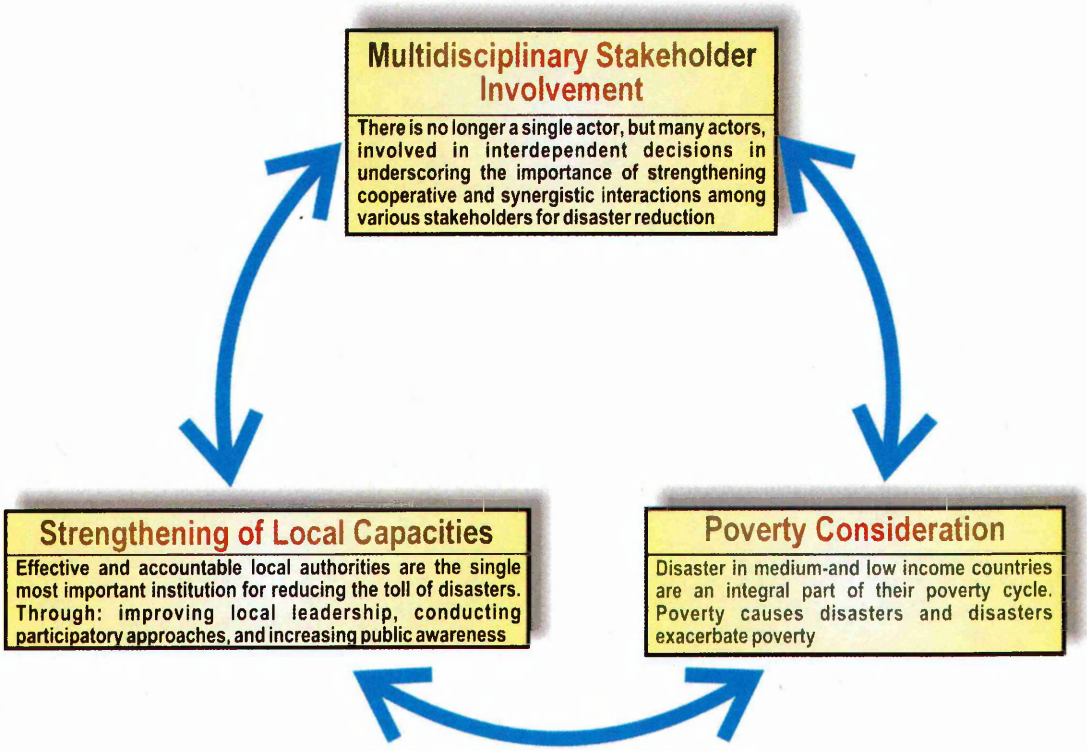


Figure 4.2 Three important factors of effective seismic risk management of non-engineered buildings

4.4 Seismic Risk Management and Sustainable Development

Development actions of both yesterday and today can increase or reduce disaster risk in the foreseeable future. Seismic risks are no longer seen as extreme events created entirely by natural forces but as manifestations of unresolved problems of development. In recent years, there has been a major shift in people's attitudes and behaviour towards coping with natural disasters. In the past, more emphasis was placed on humanitarian response and relief activities, with little attention being paid to disaster reduction strategies that have the potential to save thousands of lives by even the simplest of measures. Today, there is increasing recognition that, while humanitarian efforts are important and need continued attention, risk and vulnerability are crucial elements in reducing the negative impacts of hazards and are thus essential to the achievement of sustainable development (UN-ISDR, 2002). This translates into the need for much greater attention in the implementation of protective strategies, which can contribute to saving lives and protecting property and resources before they are lost. It is for this reason that a more holistic approach, that emphasises vulnerability and risk factors, has coalesced around the concept of seismic risk management.

Clearly, physical exposure itself as a result of development does not explain nor automatically lead to increased risk. If urban growth in a hazard-prone location is accompanied by adequate building standards and urban planning that takes into account risk considerations, disaster risk can be managed and even reduced. This is difficult in the cities of Low and Middle Human Development countries, where more than half of the urban population may be living in illegal and unserviced neighbourhoods. It is important to address these issues at the scale of the city and over the medium to long-term by arguing for a reorientation in disaster reduction — an approach that focuses exclusively on reducing the impact of disasters on development towards an integrated risk management approach that, in addition, promotes forms of development that help reduce, rather than increase, disaster risk. Municipal government will have a central role to play in strategic planning for disaster risk at this scale (UNDP, 2004).

UN-ISDR (2002) defines sustainable development as development that meets the needs of the present, without compromising the ability of future generations to meet their own needs. Seismic risk management should be seen in the broader context of sustainable development. The frequency with which some countries experience seismic disaster should certainly place seismic risk at the forefront of development planners' minds. It is argued that the post-disaster reconstruction period provides the most opportune time to introduce seismic risk reduction into sustainable development planning. Therefore, political commitment and social acceptance of the value of risk reduction are necessary for forward-looking developers who want to increase the sustainability of communities. Development needs to be regulated in terms of its impact on seismic risk. There is a need for institutional systems and administrative arrangements that link public, private, and civil society sectors and build vertical ties between local, district, national and global scale actors. To achieve safety and sustainability of livelihood for effective disaster management at a grass-roots level, UNCRD (2003) mentions three key elements: self help, co-operation, and education.

It is clear that nobody can prevent earthquakes but it is possible to mitigate the seismic risk using available means. SCEC (2002) highlights that earthquakes damage the environment more than any other extreme event. Their occurrence is highly uncertain; there is no known method for the reliable, short-term prediction of large earthquakes. Therefore, seismic risk management should be factored into development planning, which needs shared responsibility and shared efforts to reduce the impact of future earthquakes. This leads to considerable challenges in the building of ecologically sustainable communities. It is imperative for society to develop integrative approaches that combine the disciplinary insights and strengths of the disciplines to give appropriate consideration to the reduction of risk, through both voluntary and regulatory approaches.

Successful integration of the disciplines will be difficult to demonstrate empirically. Case studies are needed to document experiences in the successful implementation of resilience and enhanced standards in order to help learning. Work should be done that helps to facilitate integration of the disciplines through best practice benchmarking, software, simulation, training materials, and curriculum enhancements. Fundamental research is needed for the development of understanding and methods to enhance the process of integrating technical, economic and organisational/institutional disciplines to achieve increased seismic resilience and knowledge transfer.

The degree to which these effects will be felt depends on several factors, including the nature of the seismic hazard, the degree of seismic risk that a building owner or a community deems to be acceptable, and the extent to which attempts have already been made to mitigate the risk. A variety of community members with expertise in different roles and varying interests will play a part in assessing the significance of these effects, and the decision each makes will reflect his or her view on how well seismic risk is managed. Therefore, seismic risk management policies should be harmoniously integrated into a responsibility among governmental entities, economic interests, communities and citizens. This requires integration of expertise from many disciplines and close cooperation among professionals from varying and often hardly overlapping fields (such as building and social welfare) (Wenzel, 2005). Therefore, putting the seismic risk management of non-engineered buildings into a disaster management system with the integration of a large amount of expertise is very important.

4.5 An Overview of Disaster Management According to the Decentralization Process in Indonesia

Indonesia is a vast, populous country with enormous economic and cultural diversity. Spread over 5,000 kilometres and more than 13,000 islands, the country has more than 300 identified languages and about 20 distinct cultural groups (Kassum et al., 2003). For three decades until 2001, the Indonesian government was highly centralised. Indonesia joined a global trend to decentralise government, which began in January 2001. Decentralisation substantially changed the pattern of government and administration in Indonesia by giving the sub-national level (especially for local government) far-reaching responsibilities for the provision of the public services. A wide range of functions was transferred to local government control, city [*kota*] and regency [*kabupaten*] (Turner et al., 2003). It is clear that decentralisation is intended to strengthen the local government (city and regency) and to bring them closer to their community. In contrast, provincial authority was considerably diminished. There is now clear recognition of the need for local governments, not only to be involved, but to directly lead the planning, decision-making, budgeting, and monitoring process.

The implementation of Indonesia's new decentralisation policy has provided a new setting for disaster management. Despite recent efforts of the Government of Indonesia to strengthen the regulation, structure, and organisation of the National Coordinating Board for Disaster Management (BAKORNAS), significant gaps still exist in policy, planning processes, mechanisms and procedures; legislation, institutions, organizations and budgeting at different levels of government also need to be strengthened to ensure disaster management is effectively carried out at the local/regional level (Ngoedijo, 2003).

This section provides a general picture of disaster management practices in Indonesia, which is primarily summarised from "An Overview of Disaster Mitigation in Local Planning and Programming in Decentralized Indonesia" written by Ngoedijo (2003). The pattern of disaster management tends to be vastly different across regions and different levels of government in their disaster mitigation planning and budgeting practices.

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a. There are no Disaster Management Organisations (DMO) established structurally in government organisation from the central to a local level. BAKORNAS, SATKORLAK, and SATLAK are DMO and non-structural entity organisations, which manage disaster management at central, provincial, and local level respectively. The form of non-structural organisation causes lack of coherence and competence in disaster management. Specifically in SATKORLAK and SATLAK, the nature of non-structural organisation has meant that no expert or competent person works continuously in disaster management on local agenda. This limits the seriousness of attention given to disaster management and, subsequently, any increase in capacity for good governance in disaster management. Agencies and individuals see working for disaster management as a side job assignment or as an additional workload.

b. There is a lack of detailed guidelines and manuals for disaster management. BAKORNAS Decree 2-2001 on general guidelines provides broad policies, strategy, and a management framework for handling disasters; however, it has not been accompanied by detailed guidelines for implementing disaster management. Besides, limited socialisation of the guidelines means that only a few local governments can fulfil the functions assigned by the Decree. According to the Decree, local governments are required to prepare guidelines for the implementation of a response for managing disasters, and co-ordination of efforts for disaster, reporting, monitoring and supervision.

c. There is a lack of effective links between DMO and its horizontal organisation as well as its strategic partner in disaster management. A clear and effective link among BAKORNAS, BAPPENAS (The National Development Planning Agency), and BKTRN (The National Coordinating Board for Spatial Planning) has not been fully developed. The lack of an effective link with strategic partners in disaster management can be seen in the members of BAKORNAS that are purely sectoral departments.

d. Currently, most planning, programming and budgeting related to disaster issues is left to sectoral departments, without the intensive co-ordination and involvement of BAKORNAS, SATKORLAK, and SATLAK. There is no incorporating disaster management within a wider context in sustainable development. For example, the Urban Sector Development Reform Program (USDRP) was an Indonesian government program in 2003, which purported to support local governments in their efforts to alleviate poverty, stimulate the development of the local/regional economy, and to improve the delivery of sustainable and demand-driven urban services. The ultimate goal of these efforts was to improve the living quality of the urban population (DGURD, 2003). Within the programs, there were no specific actions correlating with disaster management.

e. There is also a lack of National Strategy and Plan for disaster management. For influencing the decision making process related to planning and budgeting in disaster management, it is important for BAKORNAS to prepare a National Strategic Plan for Disaster Management in consultation with regional/local governments and non-government stakeholders.

f. Most of disaster management expenditure comes from a contingency fund and almost all of the expenditure is for disaster response. Permanent expenditure budget for disaster issues, particularly in disaster mitigation, depends largely on sectoral department programs and is not carried out systematically and comprehensively.

g. There is still no established and sustainable framework for financing disaster mitigation. Local governments funds are characterised by a high level of routine budget (more than 60 percent) allocated mostly for personnel expenditure, while budget allocation for development expenditure is limited. There is a high degree of dependency on central government transfers and provincial subsidies for financing development activities, including disaster mitigation and management. They are in an uncertain position to obtain multiple sources of funding for disaster management. Every year, they have to be active in preparing proposals and consulting and negotiating with departments/agencies at the Central and Provincial levels to obtain financial assistance for disaster management. There is no guarantee that their proposal will be accepted.

h. The primary role of SATKORLAK and SATLAK at a regional level is to co-ordinate and implement responses for all phases of disaster management; they are hardly ever involved in any preventive actions. The organisational structure can be seen in Figure 4.3.

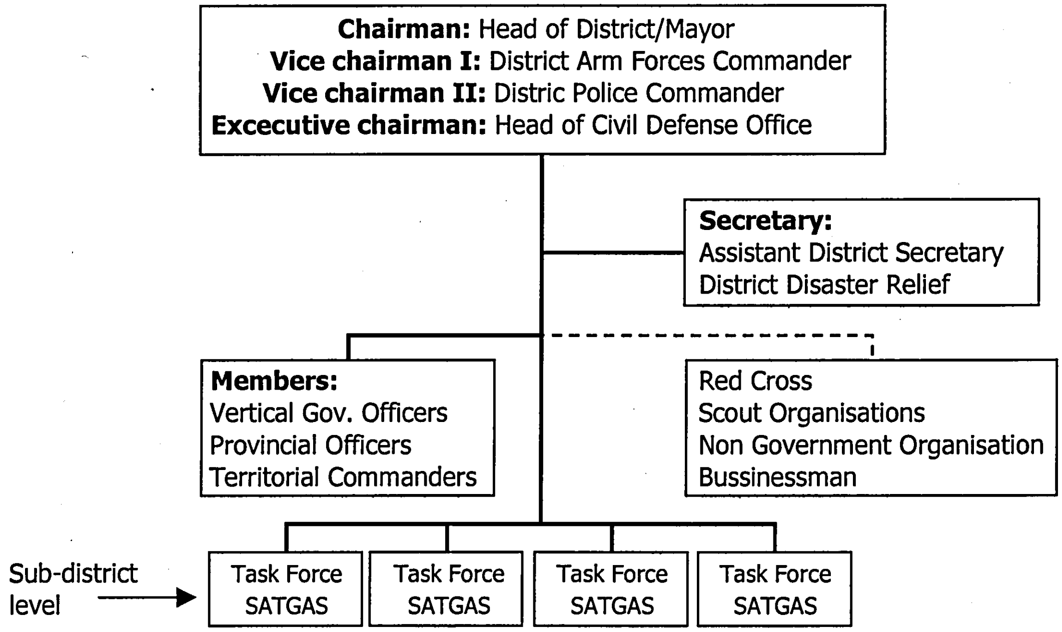

Figure 4.3 SATLAK organisational structure (Ngoedijo, 2003)

The vice chairmen and the members of the SATLAK organisation in Figure 4.5 are from departments that only manage disaster response. There is not any established link between SATLAK and other departments, which relate to a wider context of sustainable development.

i. There is a lack of 'locus', leadership, and capacity in disaster management organisation. Since SATKORLAK and SATLAK are 'non structurally' organised with a high orientation to provide response actions during disaster, they will find it very difficult to build capacity and competence in disaster management.

j. A minimum service performance for disaster management is not yet developed. In order to implement effective disaster management at a regional level, minimum service standards for disaster management, as the obligatory functions of regional government, need to be developed. This will guide regional governments in developing a systematic, efficient program and budget; allocate sufficient expenditure for disaster management and help regional government build credible disaster management. The development of a minimum standard of service performance will also help regional government to implement the newly introduced regulations on performance budgeting effectively.

economic globalisation, changing local conditions, and including rapid urbanisation, mean that seismic risk is not a static condition.

d. The policy problem becomes not how to achieve a specific outcome, but rather how to generate and sustain a process of iterative inquiry and action that will, through its system, lead its members to create new and more appropriate policies and practices in response to needs from its environment.
e. The capacity of a community to mobilize collective action in anticipation and response to perceived risk depends directly upon the degree of awareness, level of skills, access to resources, and commitment to informed action among its members prior to the occurrence of a damaging event.
f. In seismic risk that endangers an entire community, interdependencies among technical, organizational, cultural, and other types of systems affect a community's capacity to both mitigate and respond to disaster. The best interest of the individual is directly tied to the community's capacity to provide services that benefit the whole. There is no longer a single actor, but many actors, involved in interdependent decisions that increase or decrease the threat of danger to the community. Seismic risk represents the type of actual policy problem that illustrates the interdisciplinary, inter-organisational, and inter-jurisdictional characteristics that have made problems of shared risk extraordinarily to resolve.
g. Seismic risk includes a class of policy problems that have defied solution by traditional means of analysis and planning.

4.2.1 Seismic Risk Management Approach

Seismic risks can be managed effectively in a number of ways. SCEC (2002) has developed a seismic risk management approach as advanced preparation, using a multidisciplinary method. There are three phases that influence the seismic risk management approach. Seismic hazard analysis corresponds with science, seismic risk assessment conforms to engineering, and finally, political and economic action accords with mitigation. The length or relative importance of each component phase may vary and the boundaries between each phase are not well defined, depending largely on the certain situation. Moreover, the seismic risk management approach developed by SCEC (2002) tends to divide into three phases: risk identification, risk assessment, and risk response, where risk documentation is embedded in each phase, explained in Figure 4.1:

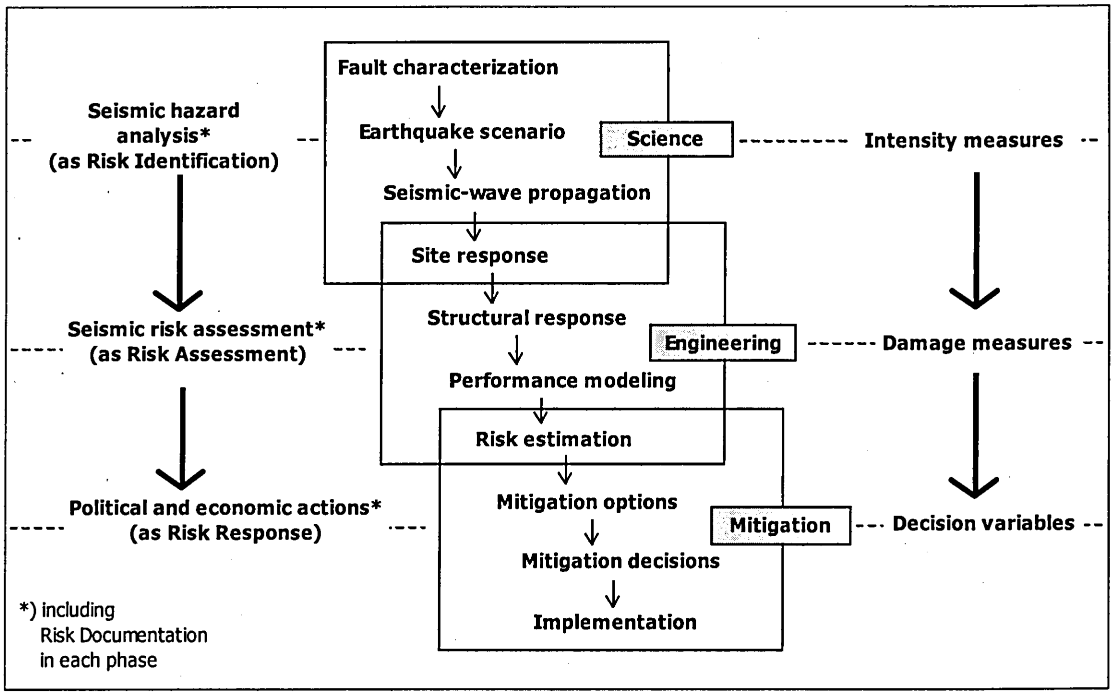

Figure 4.1 Seismic risk management approach (SCEC, 2002)

During the phase of seismic hazard analysis and seismic risk assessment, scientists and engineers seek methods and approaches that will reduce the levels of uncertainty associated with the causes of an event and the fragility and vulnerability of structures subjected to the event. Individuals become advocates of methods and approaches which, when accepted, provide individual recognition and rewards. In addition, an important role for science and engineering is to improve knowledge about the mitigation of the effects of extreme events, effectively transferring knowledge and facilitating collaboration among users of the knowledge (Petak, 2002).

In general, there are two types of seismic hazard analysis, deterministic and probabilistic (Gould, 2003). In a deterministic analysis, an earthquake event of a specified magnitude is assumed to occur on the fault that causes the greatest damage to the subject building(s). This approach can intuitively be expected to generate a reasonably conservative "worst-case" scenario for loss. On the other hand, a probabilistic analysis accounts for the full range of possible earthquakes, their location, return period, size, and the propagation of the earthquake motion from the rupture zone to the site(s) of interest. This provides a return period curve with a more complete and 'realistic' evaluation of the potential earthquake losses.

In line with Figure 4.1, the next phase is political and economic actions as a seismic risk response, which corresponds with mitigation action. An effective mitigation plan anticipates actions that a community must take before a disaster strikes. Planning is one of the most important parts of any mitigation effort. Taking the time up front to make people aware of the earthquake risk to their community, making a plan of how to reduce that risk over time, and what to do in the event of an earthquake can make a tremendous difference in post-disaster recovery efforts.

It is clear from Figure 4.1 that seismic risk management needs risk "dimensioning", and risk sizing takes into account not only the expected physical damage, victims and equivalent economic loss, but also social, organisational and institutional factors. The difficulty in achieving effective seismic risk management, in part, has been the lack of a comprehensive conceptual framework of seismic risk, facilitating its evaluation and intervention from a multidisciplinary perspective. Most existing indices and evaluation techniques do not express risk in words adequate for the diverse types of decision-makers, and they are not based on a holistic approach that invites intervention (IDEA, 2005).

According to the growing recognition mentioned above, although the risk management approach in Figure 4.1 shows distinctive steps, those activities in the seismic risk management approach enables an overlap between each step. This means that the activities in each step are not as clear-cut as are sometimes implied. In most cases, while different countries have implemented earthquake risk management movements that differ from each other in detail and degree, they are nevertheless the same in principle.

The seismic risk management approach in Figure 4.1 has been adopted in this research. In addition, it should be emphasised that Chapters II and III have clearly identified the true nature of the seismic risk focused on by this research, i.e. the continued non-seismic resistance of non-engineered buildings in Indonesia. Hence, the risk identification phase in this research is not to further identify the risk, rather to capture progress, hence the name 'seismic hazard analysis', as precisely adopted from SCEC. However, the term 'political and economic actions' used by SCEC is not adopted, and seismic response phase in this research is simply named 'seismic risk response'. Finally, the seismic risk management approach adopted in this research will comprise three headings: seismic hazard analysis, seismic risk assessment, and seismic risk response. The first draft of the proposed framework in Chapter V will elaborate this matter further.

4.2.2 Reducing the Cost of Loss Using Seismic Risk Management Actions

Seismic risk management has been well known in recent decades. Some countries have employed seismic risk management actions, based on a belief that investment in mitigation is much more cost effective than expenditure on relief and rehabilitation (NDMD, 2004a). In other words, the expected cost of loss after an earthquake has occurred can be reduced using seismic risk management actions. Chen et al., (2003) mentions that expected loss during an earthquake can be cut down significantly through preventive activities before the disaster happens. Some examples below present the cost-effectiveness of disaster risk reduction (DFID, 2004):

a. The World Bank and the US Geological Survey calculated that economic losses worldwide from disasters during the 1990s could have been reduced by US$ 280 billion worldwide if US$ 40 billion were invested in mitigation and preparedness.
b. In China, an investment of US$ 3.15 billion in flood control measures over 40 years is believed to have averted potential losses of US$ 12 billion.
c. In Vietnam, 12,000 hectares of mangroves planted by the Red Cross protect 110 km of sea-dykes. Planting and protection cost US$ 1.1 million but has reduced the cost of dyke maintenance by US$ 7.3 million per year (and the mangroves have protected 7,750 families living behind the dyke).
d. According to Oxfam, the value of cattle saved on a flood shelter of four acres in Bangladesh during the 1998 floods was as much as £150,000, against a construction cost of only £8,650.

Obviously, seismic risk management decisions must be made and implemented, particularly in high seismic areas around the world. Setting priorities for action is imperative, since the need for improvement will always vastly exceed the available resources (SCEC, 2002).

4.3 Some Evidence of Good Practices of Seismic Risk Management Implementation in Countries

In many countries with significant seismic problems, the implementation of seismic risk management has increased. Some evidence of good practices employing seismic risk management from their seismic hazard, assessment, and response might be used as best examples for other countries with similar problems. This section presents, as extracted from many sources of literature, three important factors that drive successful and effective implementation of seismic risk management in various countries, particularly interrelated with non-engineered buildings. These are (a) direct involvement of multidisciplinary

stakeholders, (b) strengthening of local capacities, and (c) poverty consideration. Evidence that the successful three factors have widely contributed in reducing seismic risk in countries such as the United States of America, Taiwan, India, Algeria, Colombia, Nepal, and Peru will be presented as follows.

4.3.1 Direct Involvement of Multidisciplinary Stakeholders in Seismic Risk Management

As described in Chapter II, the key to bridging the wide gap between massive death tolls and the existence of seismic codes is a robust mechanism of enforcement and implementation of the seismic codes in actual construction. The enforcement and implementation of seismic codes is not simple because seismic risk is interrelated with interdependencies among technical, organisational, cultural, and other types of systems affecting a community's capacity to both mitigate and respond to disaster. There is no longer a single actor, but many actors, involved in interdependent decisions that increase or decrease the threat of danger to the community (Comfort, 1999). Moreover, there is growing evidence that the partial perspective of disciplines among community members generate actions that are unsustainable (Petak, 2002). Thus, bringing a wide range of stakeholders together to cross both disciplinary boundaries and sectors in seismic risk management is a substantial key to sharing effort and responsibility before disaster strikes. How well they work together can determine the quality and outcome of the risk management process.

In general, multidisciplinary stakeholders involved in seismic risk management can be divided into two extreme groups: government and non-government agency. Both of them have specific and significant roles within their sphere of operation.

4.3.1.1 Involvement of Government Agencies

UNDP (2003) claims that the role of government, in order to reduce disaster, is very important. It is because governments as public institutions generally view the mitigation of extreme event consequences as an integral part of their responsibility to provide for public safety, which they see as occurring through their regulatory-controlled activities, which are in the "public interest". At the present time, many governments in the examples below have brought a new paradigm shift in their approach to disaster management, based on the conviction that investments in risk management as pro-active actions are much more cost effective than expenditure on relief and rehabilitation. They have the existence of an administrative structure responsible for seismic risk reduction as a structural entity with

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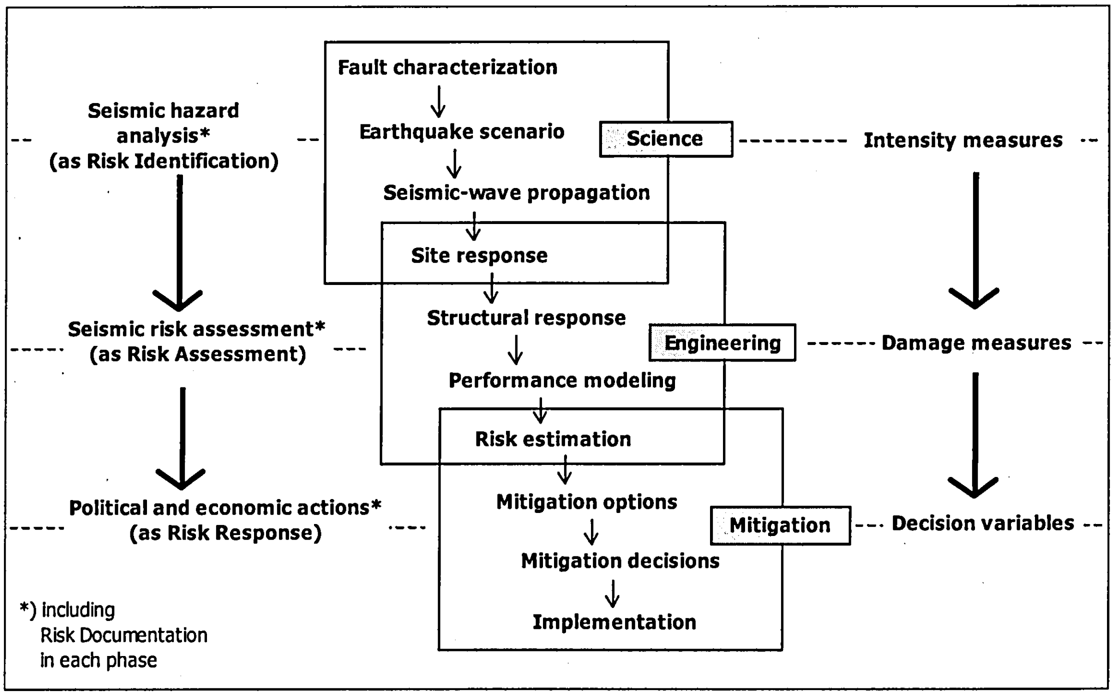

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adequate budget allocation as evidence of their commitment to disaster management. In general, UNDP (2004) highlights that the lack of wider political commitment to disaster reduction is often stated as the main barrier to progress in implementation.

In the USA, earthquakes are the most costly natural hazard. In 1978, the US government created the National Earthquake Hazards Reduction Program (NEHRP) under the Federal Emergency Management Agency (FEMA) to improve the nation's understanding of earthquake hazards and to mitigate their effects (www.fema.gov). Since its creation, NEHRP has provided a comprehensive framework for efforts to reduce the risk from earthquakes. Besides NEHRP, in the area of seismic hazard, the U.S. Geological Survey (USGS) Earthquake Hazards Program is the world scientific leader in seismic-hazard studies (www.usgs.gov). In implementing the results of their activities to understand and mitigate the effects of earthquakes, US government agencies have actively collaborated with state geological surveys, emergency-response officials, earthquake engineers, local governments, and the public. This collaboration has resulted in dramatic improvements in earthquake preparedness and public safety in the United States.

Similar to the USA, the Government of Taiwan has established a National Center for Research in Earthquake Engineering (NCREE) to promote seismic hazard mitigation in an integrated and systematic approach (www.ncree.gov). Furthermore, the Government of India launched a 'National Programme for Capacity Building of Architects in Earthquake Risk Management'. The overall goal of the programme is sustainable earthquake risk reduction. The Government of India has brought about a paradigm shift in the approach to disaster management, namely that development cannot be sustainable unless disaster mitigation is factored into the development process (NDMD, 2004a). In Algeria, there are Seismological and Earthquake Engineering Centres (Belazougui, 2003). In Nepal, there were three municipalities which expressed their interest immediately after the Government of Nepal launched the 'Kathmandu Valley Earthquake Risk Management Project' in 1997 (ADPC, 2000).

In conclusion, the existence of government agency(s) as a structural entity, which actively manages seismic risk, is the primary role in mitigating, directing, and organizing disaster response operations. This shows the high degree of political commitment of the government to disaster management, which is accompanied by a high level of commitment to implementation. The Government of the USA, for example, mentioned that between 1983 and 2001, only 129 people died in eight severe earthquakes, compared to 1,600,000 world-wide (SCEC, 2002).

4.3.1.2 Involvement of Non-government Agencies

While governments bear the primary responsibility with regard to safety and security, they cannot and should not shoulder these tasks alone. Non-government agencies, or the private sector, are a government's partner in reducing disaster. Private sectors include non-profit organisations, non-government organisations, and the business sector. Encouraging governments and private sectors to formally take account of disaster risk together in their decision-making might be a first step in raising the profile of disaster in corporate social responsibility, as well as promoting the responsibility of employers for human rights and environmental stewardship in and beyond the workplace, in order to prevent the accumulation of disaster risk (UNDP, 2004).

Indeed, the private sector has a role to play, in moving towards community resilience, that incorporates an awareness of disaster risk. Unfortunately, there are very few recorded examples of corporate social responsibility that have engaged with the disaster risk reduction agenda in developing countries (UNDP, 2004). There is great scope for encouraging the private sector to incorporate disaster risk issues into their corporate social responsibility planning. In the developed countries with significant earthquake problems, it is the professional engineers that have been at the forefront of earthquake reconnaissance studies (Jain, 1998).

There are a lot of non-government agencies in the area of Earthquake Engineering (EE) in the USA. Tremendous improvement has been achieved in order to manage seismic risk (EERI, 2003), as described below:

a. Establishment of major EE research centres in the United States, such as PEER Center headquartered at the University of California at Berkeley, Multidisciplinary Center for Earthquake Engineering Research (MCEER) at SUNY Buffalo, and Mid-America Earthquake (MAE) Center at the University of Illinois, Urbana-Champaign. These three centres are funded by the National Science Foundation (NSF) with matching funds from other sources.
b. Establishment of several important experimental facilities to conduct EE research including, among others: Cornell University UCB, University at Buffalo (SUNY), University of Michigan, University of Minnesota, University of Nevada at Reno,

University of Texas at Austin, University of Washington, Georgia Institute of Technology, Lehigh University, Ransellaar Polytechnic Institute.

c. Establishment of the Applied Technology Council (ATC) in 1971 and its first significant activity, ATC 3-06 "Tentative provisions for the development of seismic regulations for buildings," was a turning point, casting a framework for the next generation of seismic design code.

d. Establishment of California Universities for Research in Earthquake Engineering (CUREe) in 1988, and its reorganization to Consortium of Universities for Research in Earthquake Engineering (CUREE) in 2000.

e. Publication of reports from studies conducted at the above-mentioned research centres. Also, EE specific journals, including Earthquake Engineering and Structural Dynamics, Earthquake Spectra, Soil Dynamics and Earthquake Engineering, Journal of Earthquake Engineering, among others, have provided media to disseminate research and development.

f. Publications of books, monographs, and reports have greatly enhanced people's understanding of earthquakes, and performance of facilities. These include reports published by ATC, EERC, EERI, FEMA, SCEC, MAE, MCEER, NCEER, PEER, SEAOC, USGS, among others.

Furthermore, there is an Earthquake Engineering Centre in Algeria, which was founded in January 1987. Their missions and objectives are (a) to perform investigation and research activities in the field of seismic risk reduction, (b) to train its future researchers, (c) to build its specific research and testing laboratories, (d) to train and improve the knowledge of specialists in seismic design at the national level (seminar courses, conferences and symposia), (f) to educate and inform the public and the authorities, (g) to aid and assist the engineering offices and concerned institutions, and (h) to integrate hazard mapping and the results of vulnerability and risk investigations in development and the urban planning with mandatory implementations. In India, there is the National Core Group for Earthquake Mitigation, founded in 2003, with seven National Resource Institutions: (a) Centre for Environmental Planning and Technology, (b) Indian Institute of Technology Kharagpur, (c) Indian Institute of Technology Roorkee, (d) Jawaharlal Nehru Technical University, (e) Manipal Institute of Technology, (f) Maulana Azad National Institute of Technology, and (g) School of Planning and Architecture, New Delhi (NDMD, 2004a)

Private sectors operate their business within the structure of the free market, where there is most often significant market competition. Their focus is on increased and improved sales of products and services, meeting customer needs while achieving an acceptable return on their investment. In contrast, governments operate within the structure of the political system and understand that extreme events often produce broad scale damage with losses having large socio-economic impacts or significant impacts on community resilience. Governments generally view mitigation of extreme event consequences as part of their responsibility to provide for public safety. The conflict here is between advocates for risk management through appropriate mitigation facilitated through government action and the notion of a free market maximisation of return on investments with minimum governmental regulation. There is a disconnection between the short term good of the business in private organisation and the long term good of the community. In other words, there is considerable controversy regarding how the government and the private sector can best implement seismic loss-reduction measures through regulatory policies, economic incentives, long-term investment, and public education (Bruneau et al., 2004). Apparently, the role of business sectors in seismic risk management still needs to be enhanced.

In summary, involvement of multidisciplinary stakeholders should embrace multi-target audiences to develop a sense of responsibility in seismic risk reduction in daily life. Some literature suggests that those parties are government officials, community leaders, businessmen, small and medium contractors, educators, foremen, researchers, scientists, and NGOs (IUDMP, 2001; CEEDEDS, 2004; SCEC, 2002; GREAT, 2001)

4.3.2 Strengthening of Local Capacities within Seismic Risk Management

Each risk scenario at the local level represents a unique configuration of hazards and vulnerabilities in the context of broader processes of development at the national and global levels. Yet ultimately, vulnerability and risk are manifested at the local level (UNDP, 2004). Local level community response remains the most important factor enabling people to reduce and cope with the risks associated with disaster. Local organisations play a pivotal role in overcoming local obstacles, in defining and shaping a regional level of risk management policy, in sharing and promoting further exchanges and knowledge between other localities or regional levels and between key agencies and individuals, and in supporting the development of national capacities. In general, strengthening of local communities can be achieved through three aspects: developing local leadership, conducting participatory approaches, and increasing public seismic awareness.

a. Developing local leadership

Local authorities are in charge of basic needs such as land-use planning, construction planning and control, including the protection of people on its territory. In addition, outsiders are rarely able to effectively contribute single-handedly to safety programmes in developing countries. It is rare to find outside experts with a good understanding of the local situation, who can work in developing countries for long periods of time. Hence, the best results are achieved when the problem is tackled by local experts, with outsiders providing a guiding role: developing local leadership is the key to success.

In developing local leadership in communities, a long-term commitment is needed, which is often beyond the funding and staffing cycles of many agencies. Perhaps, in developing countries, the greatest difficulty is avoiding the trap of communities becoming dependent on well-meaning external agencies. The application of appropriate technology is one approach that has been promoted as a way to overcome some of the problems associated with the implementation and long-term sustainability of development projects in the Third World. Appropriate technology should be able to satisfy the requirements for fitness for purpose in the particular environment in which it is to be used. It should also be maintainable using local resources, and it should be affordable (Vickridge, 1996).

Examples of the successful and long-term improvement of local communities do exist, but remain uncommon. The earthquake event in Northridge, California on 17th January 1994 is a good example. Response operations were immediately activated by the earthquake and carried out largely by experienced, well-trained, local emergency service organisations (Comfort, 1999). Improving local capacity to repair and strengthen their own houses using modern seismic features can be seen in the increasing number of house units in Maharastra, India. In 1995, the number of completed repaired or strengthened houses was around 38,000 units; in 1998 the number reached approximately 182,000 units, a tremendous increase (EERI, 1999).

b. Conducting participatory approaches

Capacity improvement at a local level, together with a participatory approach, might bring about other important things to strengthen local communities. For policy interventions seeking to include a participatory approach, preliminary discussions to help map the social relationships within the community are essential if the vulnerable (who are also the socially excluded) are to be reached and helped to build their own levels of resilience through participation. Building meaningful participation with vulnerable groups and individuals in development is not easy. Principle characteristics of social vulnerability are political marginalisation and social exclusion. Encouraging social integration and political participation to enhance resilience and other goals for quality of life is a major challenge to disaster and development policy (UNDP, 2004). The example of participatory process has been carried out by the Government of Nicaragua, who undertook a participatory process of local development planning within a disaster reduction approach. Disaster reduction was factored into a range of planning sectors, including infrastructure development, productive sectors, social sectors and environmental management (UNDP, 2004). Community participation has also been noted in the small Senegalese town of Rufisque (UNDP, 2004).

The participatory programme is itself a learning process. Key elements of success have included the realisation that risk profiles and participatory processes in each region are different, so strategies should rely on local decision-making and be flexible in approach and implementation. In addition, local plans should be linked with central institutions to access support and blend with national development policy, called bottom up vision The involvement of local stakeholders into disaster risk management and participation are also a key factor in maintaining local support and generating significant local outputs for disaster risk reduction, as well as motivating the acceptance of shared responsibilities and cooperation.

c. Increasing public seismic awareness

The next factor to enhance local communities is public seismic awareness. Lack of public awareness to seismic risk tends to contribute to essential barriers in implementation of seismic codes within non-engineered building. SCEC (2002) highlights that public seismic awareness can be achieved primarily through public education. Creating a community of knowledgeable people through public education is essential to the development of 'resonance' or willingness to support shared action, when necessary, to sustain the goal of a responsible, civil society. In the USA, publications of books, monographs and reports using both hard copy and on-line systems have greatly enhanced community understanding about earthquakes and performance of facilities. These include reports published by ATC, EERI, FEMA, SCEC, MCEER, and USGS (EERI, 2003). The citizens, elected officials, property owners, and other decision makers must be informed about the nature of the risks, their mitigation options, and the costs of action and inaction. In order to close the gap between existing knowledge and its implementation, public education is the best solution (SCEC, 2002).

A good example of a strong, earthquake resilient local community might be seen in Manizales City, Colombia. The success of the seismic risk management action was evident during the massive earthquake of 1938, which did not damage the city significantly. Similarly, the earthquakes of 1962, 1964, 1979, 1995, and 1999 caused only minor or moderate damage. Since the 1980s, the city has had a municipal disaster prevention system in place, based on municipal development and land-use plans, that incorporates disaster risk management as a strategic and political cornerstone. Disaster preparedness has become part of the city's culture. Prevention-related information and education activities are conducted regularly in schools. Drills are held periodically to ensure that awareness and alertness remain high. The mayor has a disaster risk advisor for inter-agency co-ordination and the city employs a team of professionals who work at scientific research centres. All residents who take steps to reduce the vulnerability of their homes receive a tax break as an incentive. A collective and voluntary housing insurance scheme has been promoted by the city. It is added to local bimonthly tax payments, with the aim of covering the tax-free lower socio-economic strata, once a defined percentage of taxpayers paying for the insurance has been achieved. Seismic micro-zonation has enabled the local administration to estimate the expected annual losses of its public buildings and insure them selectively. The city administration of Manizales has produced a disaster risk plan that aims to translate state-of-the-art theory into practice, transfer best practice from current experiences in other places, focus on local participation and sustainability, and build in local ownership (UNDP, 2004).

Conversely, specific to Indonesia, a survey about public awareness of earthquake and quake preparedness given to the community in the Minomartani residential area, adjacent to Yogyakarta City, reveals that the whole community tends to overlook the future earthquake risk. It seems that there is no public education of the grass-root community of seismic risk from government and private agencies (Chandra et al., 2004).

In summary, the strengthening of local capacities through improving their local leadership, participatory approaches, and public awareness is important to enhance resilient communities against future disaster. According to the World Disasters Report, UNDP (2004) claims 'effective and accountable local authorities are the single most important institution for reducing the toll of natural and human-induced disasters in urban areas'. Furthermore, providing a local lens allows a large number of small events to be catalogued, re-shaping perceptions on risk as a priority concern for development policy and contributing to a potentially genuine process of self-organization to reduce risk. This is an essential precursor to a bottom up decision making process for development policies, strategies, plans, programs and projects in disaster reduction (Yodmani, 2003) focusing on the local ownership of prevention projects. Sometimes, knowledge from a developed country is not fully suitable for the local situation, and the impact on policy and practice at a local level is dubious.

4.3.3 Poverty Consideration in Seismic Risk Management

UNDP (2004) reveals that, in global terms, disaster risk was found to be considerably lower in high-income countries than in medium- and low-income countries. Disasters affect the poor disproportionately. Poor people are often the most likely to be exposed to natural and non-natural hazards. "Disasters in medium- and low-income countries are an integral part of their poverty cycle. Poverty causes disasters, and disasters exacerbate poverty" (UNDP, 1994). It is true that the majority of the earthquake losses are concentrated in non-engineered buildings, which mostly belong to the poor, who often bear the greatest cost in terms of lives, and livelihood, and rebuilding their shattered communities and infrastructure (Sarwidi, 2001).

Poor people are often unable to obtain basic services because (a) institutions are not accountable, (b) local elites dominate the political process and control private sector resources, (c) corruption is widespread, (d) social relationships are inequitable, and (e) poor people lack experience with participation. Poverty levels, or the absolute number of poor and destitute persons, have increased continually, with dramatic effects in terms of increases in social risk and disaster vulnerability (UNDP, 2004).

The urban poor are often forced to make difficult decisions about risk. In low-and-middle income countries, city governments have often proved ineffective in regulating the process of urban expansion through land-use planning and building codes. Unregulated low-income settlements, where land values are lowest, often occupy the most hazard-prone locations, for example, in peripheral squatter settlements located in ravines, on unstable slopes or in flood-prone areas, or else in dense inner city slums.

Living in hazardous locations is sometimes 'chosen' if individuals seek opportunities not only to improve their own quality of life, but also to enhance the health and educational attainment of their children, for greater prospects for their children tomorrow. Poor or non-existent sanitation, high unemployment and underemployment, deficient health and education services, insecure land tenure, crime and violence, and other factors configure a panorama of everyday risk. For individuals caught up in the immediate concerns of daily survival, disaster risk management is often not a priority. Hence, everyday risks accumulate and prepare the way for disaster (UNDP, 2004).

The disaster impact largely depends on the kind of development choices countries have made previously. As countries become more prosperous, for example, they are often better able to afford the investments needed to build houses more likely to withstand earthquakes. At the same time, the rush for growth and the resulting urbanisation can trigger haphazard urban development, which increases the risk of large-scale fatalities during such a disaster. When populations expand faster than the capacity of urban authorities or the private sector to supply housing or a basic infrastructure, risk can accumulate quickly in informal settlements. The urbanisation process leads to the concentration of populations in risk-prone cities, and risk-prone locations within cities. This is true in megacities and in rapidly expanding small- and medium-sized urban centres in developing countries (UNDP, 2004).

Regression analysis of vulnerability indicators shows that, statistically, physical exposure and the rate of urban growth acted together in being associated with the risk of death by earthquake (UNDP, 2004). In other words, the risk of dying in an earthquake is greater in countries with rapid urban growth. Mass migration from rural to urban settlements has resulted in the growth of city slums; many located on unsafe land and built with environmentally inadequate construction techniques. Low building standards may reflect a lack of control and supervision in middle income areas and the lack of resources to build hazard resistant structures in low-income areas. It is a fact that, in many rapidly growing cities, earthquake risk considerations have not been factored into the building and planning process. In general, city governments have not been capable of regulating either building or settlement in a way that reduces risks (UNDP, 2004).

International experiences, including tragic lessons from the recent large earthquakes in Aceh on 26th Dec 2004 and Yogyakarta, on 27th May 2006, show that the growth of earthquake prone communities, following the global processes of development and urbanisation, commonly give rise to seismic risk unless proper countermeasures are taken to prepare for future earthquakes and to manage the risk. This is also true for countries of low and moderate seismicity, taking into account that the risk value depends not only on the hazard level, but also on the aggregate elements at risk and their vulnerability to probable seismic influence. The overcrowding and deterioration of inner city slum areas in Lima, Peru has been identified as a critical process of seismic risk accumulation in that city (UNDP, 2004).

This situation may be attributable to resource constraints in poorer countries. In 2001, in Indonesia, for example, only 7.2% of the population lived below 1$/day, but up to 55.4% lived below 2$/day (Timmer, 2004). The governments of such countries lack, not only the financial resources needed to shoulder the economic burden, but also the institutional and human resource capacities needed to deal quickly and comprehensively with disasters and emergencies. Also since the 1970s, but with increasing emphasis in the 1980s and 1990s, researchers from social sciences and humanities have argued that the impact of a natural hazard depends, not only on the physical resistance of a structure, but also on the capacity of people to absorb the impact and recover from loss or damage (UNDP, 2004).

In the area of seismic risk management, in order to protect poor people from the collapse of non-engineered buildings, which are prevalent among the medium to low income population, it is urgent to disseminate seismic codes which are (a) socially acceptable, (b) economically feasible, and (c) easily absorbed into local construction methodologies down through the grass root communities (Arya, 1994). In fact, earthquake resistance need not be expensive when incorporated into a sound design from the very beginning of the planning effort by a competent team; it usually only amounts to about 1.5% of the cost of construction (BSSC, 1995). Again, Maharastra, India, provides an example of good practice; there were over 500 model houses constructed in order to demonstrate cost-effective building techniques, use of local materials and seismic features in 1998 (EERI, 1999). One way for communities to encourage well-enforced seismic codes, and not add a monetary burden, is to provide tax incentives for more disaster-resistant homes. For example, if a homeowner reduces the chances of damage from an earthquake by installing a mitigation measure, then this taxpayer would receive a rebate on state taxes to reflect the lower costs for disaster relief (Kunreuther, 2000).

Finally, it can be assumed that the widespread persistence of collapse of non-engineered buildings in developing countries has a tremendously devastating impact on efforts to eradicate poverty at all levels. As a whole, the collapse of such buildings during an earthquake seriously undermines the result of development investment, and therefore remains a major threat and impediment to sustainable development and poverty alleviation.

In conclusion, based on the three essential factors captured from such good practices in seismic risk management mentioned above, this points towards the need for policy responses that begin to identify and then tackle the root causes of risk that are embedded within contemporary development practices — as an integrated part of sustainable development policy. Thus, the proper approach to the problem of seismic risk management should include consideration of all three contributing factors, particularly within the broader context of sustainable development. There is a strong sense that these factors are inter-linked. It is true that the length and importance of the three factors should be cornerstones and influence each other to ensure continuous movement and improvement of seismic risk management actions, particularly within non-engineered construction in developing countries (Figure 4.2), so that the approach is common but the solutions are local.

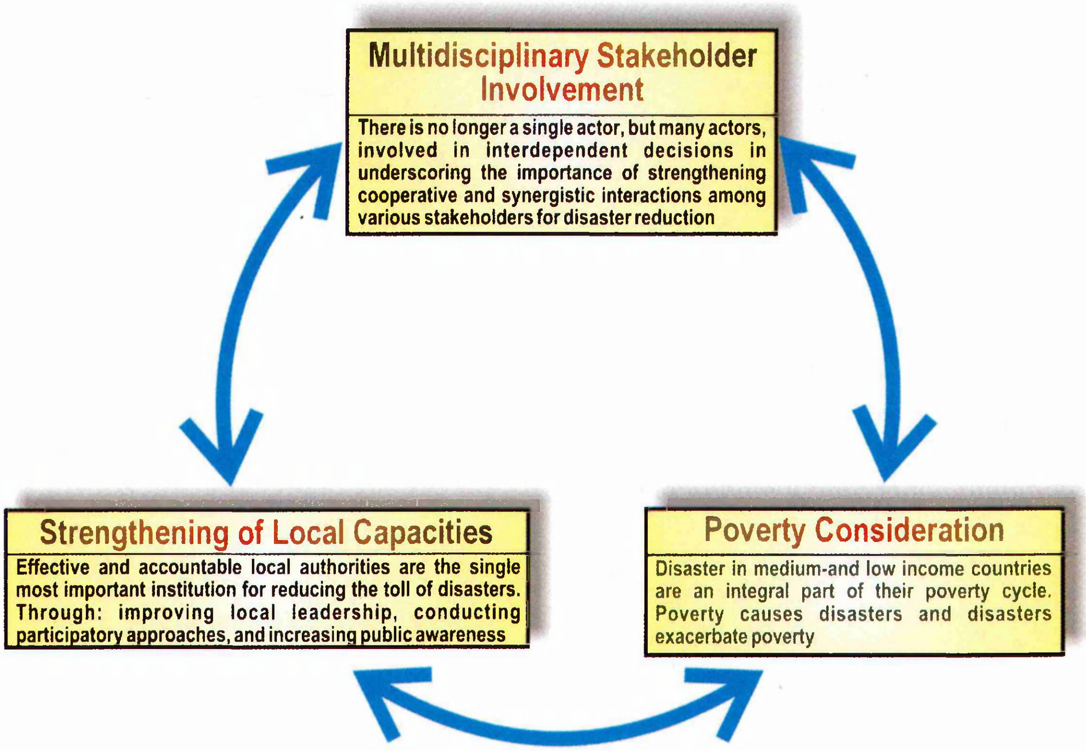

Figure 4.2 Three important factors of effective seismic risk management of non-engineered buildings

4.4 Seismic Risk Management and Sustainable Development

Development actions of both yesterday and today can increase or reduce disaster risk in the foreseeable future. Seismic risks are no longer seen as extreme events created entirely by natural forces but as manifestations of unresolved problems of development. In recent years, there has been a major shift in people's attitudes and behaviour towards coping with natural disasters. In the past, more emphasis was placed on humanitarian response and relief activities, with little attention being paid to disaster reduction strategies that have the potential to save thousands of lives by even the simplest of measures. Today, there is increasing recognition that, while humanitarian efforts are important and need continued attention, risk and vulnerability are crucial elements in reducing the negative impacts of hazards and are thus essential to the achievement of sustainable development (UN-ISDR, 2002). This translates into the need for much greater attention in the implementation of protective strategies, which can contribute to saving lives and protecting property and resources before they are lost. It is for this reason that a more holistic approach, that emphasises vulnerability and risk factors, has coalesced around the concept of seismic risk management.

Clearly, physical exposure itself as a result of development does not explain nor automatically lead to increased risk. If urban growth in a hazard-prone location is accompanied by adequate building standards and urban planning that takes into account risk considerations, disaster risk can be managed and even reduced. This is difficult in the cities of Low and Middle Human Development countries, where more than half of the urban population may be living in illegal and unserviced neighbourhoods. It is important to address these issues at the scale of the city and over the medium to long-term by arguing for a reorientation in disaster reduction — an approach that focuses exclusively on reducing the impact of disasters on development towards an integrated risk management approach that, in addition, promotes forms of development that help reduce, rather than increase, disaster risk. Municipal government will have a central role to play in strategic planning for disaster risk at this scale (UNDP, 2004).

UN-ISDR (2002) defines sustainable development as development that meets the needs of the present, without compromising the ability of future generations to meet their own needs. Seismic risk management should be seen in the broader context of sustainable development. The frequency with which some countries experience seismic disaster should certainly place seismic risk at the forefront of development planners' minds. It is argued that the post-disaster reconstruction period provides the most opportune time to introduce seismic risk reduction into sustainable development planning. Therefore, political commitment and social acceptance of the value of risk reduction are necessary for forward-looking developers who want to increase the sustainability of communities. Development needs to be regulated in terms of its impact on seismic risk. There is a need for institutional systems and administrative arrangements that link public, private, and civil society sectors and build vertical ties between local, district, national and global scale actors. To achieve safety and sustainability of livelihood for effective disaster management at a grass-roots level, UNCRD (2003) mentions three key elements: self help, co-operation, and education.

It is clear that nobody can prevent earthquakes but it is possible to mitigate the seismic risk using available means. SCEC (2002) highlights that earthquakes damage the environment more than any other extreme event. Their occurrence is highly uncertain; there is no known method for the reliable, short-term prediction of large earthquakes. Therefore, seismic risk management should be factored into development planning, which needs shared responsibility and shared efforts to reduce the impact of future earthquakes. This leads to considerable challenges in the building of ecologically sustainable communities. It is imperative for society to develop integrative approaches that combine the disciplinary insights and strengths of the disciplines to give appropriate consideration to the reduction of risk, through both voluntary and regulatory approaches.

Successful integration of the disciplines will be difficult to demonstrate empirically. Case studies are needed to document experiences in the successful implementation of resilience and enhanced standards in order to help learning. Work should be done that helps to facilitate integration of the disciplines through best practice benchmarking, software, simulation, training materials, and curriculum enhancements. Fundamental research is needed for the development of understanding and methods to enhance the process of integrating technical, economic and organisational/institutional disciplines to achieve increased seismic resilience and knowledge transfer.

The degree to which these effects will be felt depends on several factors, including the nature of the seismic hazard, the degree of seismic risk that a building owner or a community deems to be acceptable, and the extent to which attempts have already been made to mitigate the risk. A variety of community members with expertise in different roles and varying interests will play a part in assessing the significance of these effects, and the decision each makes will reflect his or her view on how well seismic risk is managed. Therefore, seismic risk management policies should be harmoniously integrated into a responsibility among governmental entities, economic interests, communities and citizens. This requires integration of expertise from many disciplines and close cooperation among professionals from varying and often hardly overlapping fields (such as building and social welfare) (Wenzel, 2005). Therefore, putting the seismic risk management of non-engineered buildings into a disaster management system with the integration of a large amount of expertise is very important.

4.5 An Overview of Disaster Management According to the Decentralization Process in Indonesia

Indonesia is a vast, populous country with enormous economic and cultural diversity. Spread over 5,000 kilometres and more than 13,000 islands, the country has more than 300 identified languages and about 20 distinct cultural groups (Kassum et al., 2003). For three decades until 2001, the Indonesian government was highly centralised. Indonesia joined a global trend to decentralise government, which began in January 2001. Decentralisation substantially changed the pattern of government and administration in Indonesia by giving the sub-national level (especially for local government) far-reaching responsibilities for the provision of the public services. A wide range of functions was transferred to local government control, city [*kota*] and regency [*kabupaten*] (Turner et al., 2003). It is clear that decentralisation is intended to strengthen the local government (city and regency) and to bring them closer to their community. In contrast, provincial authority was considerably diminished. There is now clear recognition of the need for local governments, not only to be involved, but to directly lead the planning, decision-making, budgeting, and monitoring process.

The implementation of Indonesia's new decentralisation policy has provided a new setting for disaster management. Despite recent efforts of the Government of Indonesia to strengthen the regulation, structure, and organisation of the National Coordinating Board for Disaster Management (BAKORNAS), significant gaps still exist in policy, planning processes, mechanisms and procedures; legislation, institutions, organizations and budgeting at different levels of government also need to be strengthened to ensure disaster management is effectively carried out at the local/regional level (Ngoedijo, 2003).

This section provides a general picture of disaster management practices in Indonesia, which is primarily summarised from "An Overview of Disaster Mitigation in Local Planning and Programming in Decentralized Indonesia" written by Ngoedijo (2003). The pattern of disaster management tends to be vastly different across regions and different levels of government in their disaster mitigation planning and budgeting practices.

a. There are no Disaster Management Organisations (DMO) established structurally in government organisation from the central to a local level. BAKORNAS, SATKORLAK, and SATLAK are DMO and non-structural entity organisations, which manage disaster management at central, provincial, and local level respectively. The form of non-structural organisation causes lack of coherence and competence in disaster management. Specifically in SATKORLAK and SATLAK, the nature of non-structural organisation has meant that no expert or competent person works continuously in disaster management on local agenda. This limits the seriousness of attention given to disaster management and, subsequently, any increase in capacity for good governance in disaster management. Agencies and individuals see working for disaster management as a side job assignment or as an additional workload.

b. There is a lack of detailed guidelines and manuals for disaster management. BAKORNAS Decree 2-2001 on general guidelines provides broad policies, strategy, and a management framework for handling disasters; however, it has not been accompanied by detailed guidelines for implementing disaster management. Besides, limited socialisation of the guidelines means that only a few local governments can fulfil the functions assigned by the Decree. According to the Decree, local governments are required to prepare guidelines for the implementation of a response for managing disasters, and co-ordination of efforts for disaster, reporting, monitoring and supervision.

c. There is a lack of effective links between DMO and its horizontal organisation as well as its strategic partner in disaster management. A clear and effective link among BAKORNAS, BAPPENAS (The National Development Planning Agency), and BKTRN (The National Coordinating Board for Spatial Planning) has not been fully developed. The lack of an effective link with strategic partners in disaster management can be seen in the members of BAKORNAS that are purely sectoral departments.

d. Currently, most planning, programming and budgeting related to disaster issues is left to sectoral departments, without the intensive co-ordination and involvement of BAKORNAS, SATKORLAK, and SATLAK. There is no incorporating disaster management within a wider context in sustainable development. For example, the Urban Sector Development Reform Program (USDRP) was an Indonesian government program in 2003, which purported to support local governments in their efforts to alleviate poverty, stimulate the development of the local/regional economy, and to improve the delivery of sustainable and demand-driven urban services. The ultimate goal of these efforts was to improve the living quality of the urban population (DGURD, 2003). Within the programs, there were no specific actions correlating with disaster management.

e. There is also a lack of National Strategy and Plan for disaster management. For influencing the decision making process related to planning and budgeting in disaster management, it is important for BAKORNAS to prepare a National Strategic Plan for Disaster Management in consultation with regional/local governments and non-government stakeholders.

f. Most of disaster management expenditure comes from a contingency fund and almost all of the expenditure is for disaster response. Permanent expenditure budget for disaster issues, particularly in disaster mitigation, depends largely on sectoral department programs and is not carried out systematically and comprehensively.

g. There is still no established and sustainable framework for financing disaster mitigation. Local governments funds are characterised by a high level of routine budget (more than 60 percent) allocated mostly for personnel expenditure, while budget allocation for development expenditure is limited. There is a high degree of dependency on central government transfers and provincial subsidies for financing development activities, including disaster mitigation and management. They are in an uncertain position to obtain multiple sources of funding for disaster management. Every year, they have to be active in preparing proposals and consulting and negotiating with departments/agencies at the Central and Provincial levels to obtain financial assistance for disaster management. There is no guarantee that their proposal will be accepted.

h. The primary role of SATKORLAK and SATLAK at a regional level is to co-ordinate and implement responses for all phases of disaster management; they are hardly ever involved in any preventive actions. The organisational structure can be seen in Figure 4.3.

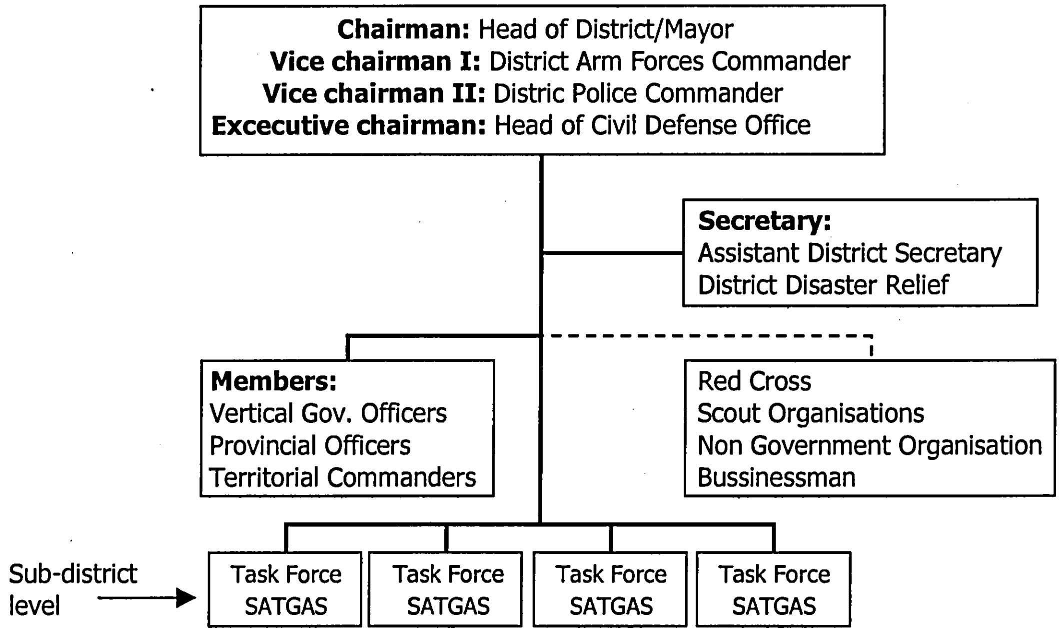

Figure 4.3 SATLAK organisational structure (Ngoedijo, 2003)

The vice chairmen and the members of the SATLAK organisation in Figure 4.5 are from departments that only manage disaster response. There is not any established link between SATLAK and other departments, which relate to a wider context of sustainable development.

i. There is a lack of 'locus', leadership, and capacity in disaster management organisation. Since SATKORLAK and SATLAK are 'non structurally' organised with a high orientation to provide response actions during disaster, they will find it very difficult to build capacity and competence in disaster management.

j. A minimum service performance for disaster management is not yet developed. In order to implement effective disaster management at a regional level, minimum service standards for disaster management, as the obligatory functions of regional government, need to be developed. This will guide regional governments in developing a systematic, efficient program and budget; allocate sufficient expenditure for disaster management and help regional government build credible disaster management. The development of a minimum standard of service performance will also help regional government to implement the newly introduced regulations on performance budgeting effectively.

For many years, legislation on a specific agency of disaster management in Indonesia has not existed. The regulations on disaster management, however, are stipulated and scattered in several sectoral bylaws such as Public Acts on Spatial Planning, Water Resources, Environment, Forestry, Epidemics (Public Acts no 4 Year 1984), and Government Regulation on Disease Outbreak (GR no 40 Year 1991). In response to what it labelled as the ineffective management of national disasters over several years, on the 29th March 2007, the House of Representatives approved a bill that will introduce a new agency to manage natural disasters and give more protection to Indonesian communities who face such occurrences. This new agency is a non-departmental agency to replace the current ad hoc one. The new agency is to organise preventative measures, handle disaster in emergency conditions, and conduct post-disaster rehabilitation and reconstruction work. In particular, it is hoped that the future disaster management in Indonesia can reduce the loss of life and human suffering.

In conclusion, institutional issues are key in disaster management in Indonesia. It should be recognised that, without proper locus of disaster management in the organisational structure at all levels of government, progress in disaster management will be very difficult to achieve. Currently, programs in disaster management are mostly oriented towards providing response actions during disasters, hardly ever preventive actions, and, furthermore, are not connected with the integral paradigm of sustainable development. The new promising agency in disaster management in Indonesia should enhance an integrative approach with the public, universities, businessmen, and other non-government stakeholders. The central challenge of the new agency is to ensure that decentralisation becomes a positive force to: promote disaster management as a key issue in the local agenda; develop an integrated program for disaster activities; and increase local budget allocation for disaster mitigation and management.

4.6 The Importance of Integrated Seismic Risk Management in Indonesia

4.6.1 Background

Due to rapid economic growth and complex socio-economic and technical problems in developing countries, Corpuz (1990) highlights that earthquake-resistant construction in the high seismic regions is challenging because: (a) cities have experienced explosive urbanisation, (b) most of the population lives in informal housing and slums, which pose a relatively low standard of living, (c) seismic codes/standards have been poorly implemented, and (d) many buildings and other structures are very old and weak. Countries like Indonesia need effective solutions that are unique to their local needs. It is clear that many new residential buildings in cities are still widely needed to accommodate a large population. Thus, the increasing number of non-engineered buildings constructed with non-seismic resistance prepares the way to the next disaster.

Nepal and India, for example, as developing countries have initiated and incorporated seismic risk management activities together with a sustainable development process. These activities address seismic risk management as a pro-active rather than re-active approach. In contrast, currently, seismic risk management in Indonesia seems to be unsystematic and incomprehensive. Ngoedijo (2003) highlights that most development planning in government agencies is left to sectoral departments without intensive co-ordination and involvement with other sectors, even non-government agencies. It seems to be a lack of uniformity in policy approach regarding the various aspects of disaster and risk management. Aceh's and Yogyakarta's tragic events in 2004 and 2006 respectively, for example, illustrate the inadequacy of seismic risk management capability in major Indonesian cities.

People do not implement seismic codes in their houses, probably because they do not recognise the existing local seismic risk and the importance of seismic codes or perhaps they are just being negligent. In general, communities consider implementing seismic codes through voluntary and regulatory approaches as well as by a combination of the two. Lay people who are living in high seismic areas attempt voluntarily to incorporate seismic codes in their homes if they have a high awareness about seismic risk; however, in most cases, they do not have any adequate information about seismic hazard and the importance of seismic codes in their areas to improve their awareness. At the same time, government agencies often do not have adequate resources to enforce seismic codes through regulation in actual construction. In addition, petty contractors, foremen, masons, and carpenters who build most residential buildings in grass root communities never implement seismic features because of a lack of training and information access. In certain cases, researchers and scientists often leave their research findings on a shelf, without any concrete implementation (IUDMP, 2000; CEEDEDS, 2004; and Jain, 1998). These indicate that a variety of community members have their own specific circumstances, play different roles and exercise varying interests about seismic code implementation. These facts suggest that the problem of implementation of seismic codes in actual construction is not simple, and may even be extraordinary to solve.

It is true that what is needed tends to be an integrative approach that bridges the disciplines of science, engineering, politics, economic, and organisational and institutional analysis

(Petak, 2002). Therefore, establishing and improving integrated seismic risk management of non-engineered buildings, as a risk management tool for major cities, is extremely urgent in Indonesia. In addition, this would essentially contribute also to a reduction in poverty levels by enabling communities to be better prepared for facing the seismic risk in their city.

There are five crucial reasons why it is imperative to carry out integrated seismic risk management for the reduction of seismic risk in non engineered buildings in Indonesian cities, as follows:

a. Based on Indonesian Seismic Zonation (IUDMP, 2001), it is found that almost 60% of the cities and urban areas are located in the relatively high to very high seismic zone (290 out of 481 cities in Indonesia). A series of tragic events in Indonesia have once again opened a precious window of opportunity to remind the Indonesian community that major regions of Indonesia are located in a high seismic area (see Chapter II).
b. City levels indicate the existence of a highly concentrated, expanding population and tightly packed building stocks or infrastructures; most residential buildings in Indonesian cities are non-engineered buildings (Sarwidi, 2001). This is in line with the decentralisation process in Indonesia, at a local level. Local communities are the actual owners of the seismic risk management actions. They represent the greatest potential source of local knowledge regarding hazardous conditions, and are the repositories of many traditional coping mechanisms suited to their individual environment (UNCRD, 2003). Furthermore, a major earthquake similar to those in Aceh and Yogyakarta is just waiting to happen in the near future in Indonesia.
c. Similar to other developing countries with a high seismic zone, it is clear that, in Indonesia, there is a wide gap between massive death tolls and the existence of seismic codes. Progress has been made in the analysis of seismic risk and vulnerabilities clearly written in seismic codes. Yet, failures are often due to a lack of implementation of well-known seismic codes in actual construction, as precisely described in Chapter III.
d. Currently, disaster management programs in Indonesia are mostly oriented to provide response actions during disasters, hardly ever mitigation actions (Ngoedijo, 2003). This leads to a conviction that implementation of seismic risk management will give not only 'help' but also 'hope'.
e. There is no incorporating disaster management systematically and comprehensively within the wider context of development planning (Ngoedijo, 2003). It is based on policies that allow cities to include the knowledge of the risk and the consequent measures in their development plans to reduce such a risk, in order to preserve the wellbeing of communities and avoid sudden regress of the development process.

Based on the conviction that development investment that fails to appropriately consider disaster risks could increase vulnerability, recognition of seismic risks as part and parcel of sustainable development can address some of these five reasons and barriers presented above. Much work should be done to help to facilitate integration of the different fields and varieties of stakeholder, who introduce new challenges and opportunities. Naturally, all stakeholders, including governments, non-government organisations, volunteers, the private sector, and the scientific community, speak different languages and bring new practices which need to be harmonised. Dissemination of the successful implementation of practices and results can also encourage more commitment to seismic risk reduction; however, achievements are not systematically assessed, recorded and monitored. As a result, how much seismic risk reduction is paying off is not yet supported by hard evidence. Furthermore, "what works and what does not and why" are not adequately known for informed advocacy, policy decisions, or strategic planning (UN-ISDR, 2002). Therefore, it is critically important that a widely agreed framework should be developed to help harmonise and systematise the field of integrated seismic risk management in Indonesia. The importance of developing a framework for seismic risk reduction is also emphasised by Shah (2002), Petak (2002), and IDEA (2005). It is true for Indonesia that there appears to be a notable absence in the frameworks of any attempts to reduce seismic risk of non-engineered buildings, for either national or local levels.

4.6.2 Why a Framework?

The critical investigation on Chapters II and III has described that coping with the seismic risk reduction of non-engineered buildings is one of the most critical challenges facing the Indonesian community. Moreover, the importance of strengthening cooperative and synergistic interactions among various stakeholders is also highlighted. Therefore, responding to the need to establish and improve integrated seismic risk management as a priority on a local community agenda in line with the decentralisation process in Indonesian cities, it is clearly imperative to develop a seismic risk management framework at a local level, as a first step towards integrated seismic risk management into sustainable development. This proposed framework, as a risk management tool, is designed to guide and monitor the seismic risk reduction of non-engineered buildings (SRRNEB) that can be useful and timely to address some of the issues raised above, and establish a global 'convention' that could be adapted to local context. Such a framework could also constitute the necessary backbone to collect information and data and capture good practices. It could help to analyse trends in seismic risk reduction practices and identify gaps and constraints for informed decisions (UN-ISDR, 2002).

By following a global 'conviction', the proposed framework to guide and monitor SRRNEB is based on ISDR (2003). The proposed novel framework is expected to:

a. provide a basis for effective political advocacy, as well as practical action and implementation, which facilitate the participation of the people related to non-engineered buildings in the decision process;
b. reflect the multidimensional and inter-disciplinary nature of seismic risk reduction;
c. assist a wide range of users in determining roles, responsibilities and accountabilities for their own contexts, without any duplication of work, as necessary and in-line with the government decentralization process in Indonesia;
d. provide the basis for setting goals and targets, adapted to different circumstances and contexts, against which progress can be measured and gaps can also be identified.

In all, the actions of look-assess-commit-act-monitor-measure-record are the framework's hallmark. Obviously, the proposed framework is based on truly Indonesian local resources and is authentically Indonesian.

4.6.3 What is in the Proposed Framework?

The proposed framework as a risk management tool has to identify the following core issues that underpin the understanding and practice of seismic risk reduction. It is hoped that the content of the proposed framework can address five main impediments in disaster risk reduction, as identified by Wenzel (2006), i.e. poor governance structures, lack of multi sectoral, interdisciplinary work culture, inefficient use of resources, lack of awareness and poor knowledge of risk, and poor professional standards and ethics. As already described in previous chapters and sections, specifically, the content of the proposed framework is unique by:

a. focusing on non-engineered buildings and all seismic risks associated with them,
b. embracing three phases within the seismic risk management approach as follows: (1) seismic hazard analysis (as risk identification), (2) seismic risk assessment (as risk assessment), and (3) seismic risk response (as risk response),
c. involving as many active and multidisciplinary stakeholders as possible, to represent shared risk and adopt or adapt to their specific circumstances,

d. increasing capacity at a local level, supported by a wider network of resources from regional, national, and global jurisdictions. Moreover, an efficient co-operation should be aimed, not only at the transfer of technologies, but mostly to the transfer of methodologies based on local resources, so that the approaches are common and the solutions are local.
e. Incorporating the poverty factor, as a common problem in developing countries

The detail within the proposed framework is a unique and a great challenge, which will be originally identified and scrutinised through this study, to provide landmark guidance on SRRNEB. As an increasingly complex issue in seismic risk management, it is important that community members are encouraged to translate the five core issues mentioned above in their environment with creativity and a desire to innovate. At the same time, however, their initiatives should be directed in providing shared responsibility and an effort to maintain continuous movement in seismic risk management actions. Achieving this balance is what the content of this proposed framework is all about.

4.6.4 What are the Potential Benefits of Using the Proposed Framework?

By systematically compiling information about seismic reduction initiatives using an agreed framework to guide and monitor SRRNEB, benefits are expected to include abilities to:

a. Relate and integrate seismic risk management issues into development planning;
b. Establish generic standards and guidelines for seismic risk reduction;
c. Help establish priorities within the domain of seismic risk reduction;
d. Develop systematic, comprehensive data and information about seismic risk reduction;
e. Provide a basis for research in seismic risk reduction;
f. Compare approaches and analyse trends;
g. Identify existing gaps and address them through new or improved programmes, policies, or plans.

The above benefits would essentially also contribute to poverty reduction by enabling communities to better operate mitigation of non-engineered buildings in their territory.

4.6.5 How Can the Proposed Framework be Used?

The proposed framework is just not enough without any concrete implementation complemented with a high commitment from all community members, government and non-government organisations. Users should be able to utilise the proposed framework according to their own needs and situations. UN-ISDR (2002) highlights that political advocacy and the promotion of risk reduction in a coherent fashion will be an overarching role in disaster reduction. A lack of wider political commitment to disaster reduction is the main barrier to progress in implementation. It is clear that what is still required is the demonstration of the political will to carry out commitments already made and to implement strategies and programmes already worked out. Setting goals and targets can offer a means to accelerate the pace of implementing disaster reduction and measuring results. Widely agreed goals and targets can force governments and organisations to be accountable for what they will promise to achieve through these targets. These goals and targets are expected to be set at the local level, defining local priorities and action plans in order to meet them, but also linked to regional and national level.

4.7 Summary

Risk management can be seen as a formal process whereby risks are systematically identified, assessed, and provided for; it should be considered to be advanced preparation for a possible adverse future event, rather than responding as it happens. The risk management approach adopted in this research embraces three phases within the seismic risk management approach as follows: (a) seismic hazard analysis (as risk identification), (b) seismic risk assessment (as risk assessment), and (c) seismic risk response (as risk response).

The management of seismic risk poses several problems for decision-makers, particularly because (a) they impact on all residents of a risk-prone community, (b) the methods needed to solve problems of seismic risk require a continuing process of collective learning, rather than control, to support collective action, (c) the capacity of a community to mobilize collective action in response to perceived risk depends directly upon the degree of awareness, level of skills, access to resources, and commitment to informed action among its members prior to the occurrence of a damaging event, (d) interdependencies among technical, organizational, cultural, and other types of systems affect a community's capacity to both mitigate and respond to disaster.

Some countries have employed seismic mitigation as a seismic risk management tool based on a belief that investment in mitigation is much more cost effective than expenditure on relief and rehabilitation. The three essential factors captured from good practices in such countries are: multidisciplinary stakeholder involvement, strengthening of local capacity, and consideration of poverty. The multidisciplinary stakeholder involvement means that all stakeholders need to develop a sense of responsibility to reduce seismic risk daily. The length and importance of the three factors should be cornerstones and influence each other to ensure continuous movement of seismic risk management actions, particularly within non-engineered building in developing countries

Currently, disaster management programs in Indonesia are mostly oriented to provide response actions during disasters, hardly ever in mitigation, and, furthermore, are not connected with the integral paradigm of sustainable development. The central challenge of the new promising agency, as approved on the 29th March 2007, in disaster management organisation is to ensure that government decentralisation becomes a positive driving force to: promote disaster management as a key issue in the local agenda; develop an integrated program for disaster activities; and increase local budget allocation for disaster reduction.

Recognition of seismic risks as part and parcel of sustainable development can address some problems in Indonesia. Some evidence shows that seismic risk reduction of non-engineered buildings needs an integrative approach within various stakeholders. At the same time, links with different fields and a variety of stakeholders introduce new challenges. Apparently, all multi-sector stakeholders speak different languages and bring new practices, which need to be harmonised. A widely agreed framework can help to harmonise and systematise the field of integrated seismic risk management. It is true for Indonesia that there appears to be a notable absence in the frameworks of any attempt to reduce seismic risk of non-engineered buildings, either at national or local levels.

Responding to the need to establish and improve seismic risk management as a priority on a local community agenda in line with the decentralisation process in Indonesian cities, it is clearly urgent to develop a seismic risk management framework at a local level. The proposed framework can be a stepping stone towards integrated seismic risk management into sustainable development. Obviously, the proposed framework is truly based on Indonesian local resources and is authentically Indonesian.

Chapter V
Review of Existing Frameworks in Disaster Risk Reduction, Preliminary Analysis, and Emerging Issues for Primary Data Investigation

Previous chapters have critically investigated the conceptual issues extracted from an in-depth literature review that was clearly the initial task in developing a framework for guiding and monitoring seismic risk reduction of non-engineered buildings (SRRNEB). Besides studying wider literature, in order to achieve a strong and solid foundation for the data collection phase, it is important to study, analyse, and evaluate the existing frameworks in disaster reduction worldwide, since there is notable absence of any endeavor to reduce seismic risk of non-engineered buildings through an integrated framework in Indonesia. Therefore, the beginning of this chapter will study in-depth some existing frameworks in disaster reduction and will present an overview of the origin and content of these existing frameworks and their surrounding commentary. The following section compiles preliminary analysis raised from the in-depth review of both literature and existing frameworks. The end of this chapter serves to present some emerging issues for primary data investigation drawn from combining wider literature and the existing frameworks. This segment is the principal section in this chapter, before deciding research methodology and gathering research data, which is then called 'the first draft of the proposed framework'.

5.1 Review of Existing Frameworks in Disaster Risk Reduction

Currently, a number of 'frameworks' for reducing disaster risk are in existence. The idea for developing such frameworks seems to follow the United Nations International Decade for Natural Disaster Reduction, which ran from 1990-1999. Three of the frameworks, which will be reviewed as a part of this study, were published around 2000 and 2003. These are:

a. Framework for guiding and monitoring of disaster risk developed by UN-ISDR in 2003
b. Framework for reducing the earthquake threat in the Kathmandu Valley, developed by Government of Nepal in 2000
c. Framework for urban earthquake vulnerability reduction developed by the Government of India in 2002

All of the frameworks, as they are termed collectively here, have a variety of origins and differ in terms of the purpose for which they were derived. Yet, all had a primary concern, which was the reduction of disaster risk. Each author gives definitions of an indicator or benchmark in their framework articles. These range from fairly brief descriptions of the indicator to more detailed expositions of its foundation and philosophical perspective.

5.1.1 Framework for Guiding and Monitoring of Disaster Risk Reduction (ISDR, 2003)

The International Strategy for Disaster Reduction (ISDR) Secretariat and UNDP have developed a framework for guiding and monitoring disaster risk reduction at all levels. The ultimate goal of this collective and iterative endeavour was to encourage and increase appropriate, effective disaster reduction practices. The framework provided a starting point to guide and monitor disaster risk reduction. Five core areas were identified that underpin the understanding and practice of disaster risk reduction: (a) governance, (b) risk identification, (c) knowledge management, (d) risk management applications, and (e) preparedness and emergency management. These complementary areas describe the essential components of disaster reduction. The framework was expected to guide global political advocacy as well as practical action at all levels. Users at all levels should be able to adapt and utilise it according to their own needs and specific situation.

The Framework as given in Table 5.1 will also be used for developing specific goals and targets to be achieved in all five-core areas. It will also provide the structure for national reporting and global monitoring of progress of these goals and targets. This process should result in increased commitment for action in disaster risk reduction by governments and other stakeholders.

Table 5.1 Framework for Guiding and Monitoring Disaster Risk Reduction (ISDR, 2003)

Thematic areas/ Components	Characteristics	Criteria for benchmarks (very tentative)
Thematic Areas 1: Political Commitment And Institutional Aspects (Governance)		
Policy and planning	• Risk reduction as a policy priority • Risk reduction incorporated into post-disaster reconstruction • Integration of risk reduction in development planning and sectoral policies (poverty eradication, social protection, sustainable development, climate change adaptation, desertification, natural resource management, health, education, etc)	• National risk reduction strategy • Disaster reduction in Poverty Reduction Strategy Papers, in National MDG reports • Disaster reduction in National Adaptation Plan of Action (for LDCs countries) • Follow up on WSSD Plan of Implementation
Legal and regulatory framework	• Laws, acts and regulations • Codes, standards • Compliance and enforcement • Responsibility and accountability	• Requirement of compliance by law • Codes and standards exist and updated • Existence of systems to control compliance and enforcement • Existence of watchdog groups
Resources	• Resource mobilisation and allocation: financial (innovative and alternative funding, taxes, incentives), human, technical, material	• Evidence of budgetary allocation • Staffing allocation
Organisational structures	• Implementing and co-ordinating bodies • Intra and inter-ministerial, multidisciplinary & multisectoral mechanisms • Local institutions for decentralised implementation • Civil society, NGOs, private sector and community participation,	• Existence of an administrative structure responsible for disaster reduction • Sectoral programmes in line ministries • Consultation, and role for civil society, NGOs, private sector and the communities.
Thematic Areas 2: Risk Identification		
Risk assessment	• Hazard analysis: characteristics, impacts, historical and spatial distribution, multi-hazard assessments, hazard monitoring including of emerging hazards • Vulnerability and capacity assessment: social, economic, physical and environmental, political, cultural factors • Risk monitoring capabilities, risk maps, risk scenarios	• Hazards recorded and mapped • Vulnerability and capacity indicators developed and systematically mapped and recorded • Risk scenarios developed and used • Systematic assessment of disaster risks in development programming

Table 5.1 continued

Impact assessments	• Loss analysis, • Socio-economic and environmental impact assessment • Cost-benefit, cost-effectiveness assessment	• Systematic impact and loss analysis after disasters
Early warning systems	• Monitoring and forecasting • Risk scenarios • Warning and dissemination • Response to warning	• Dissemination channels and participation at local level • Effectiveness of response to warnings
Thematic Areas 3: Knowledge Management		
Information management and communication	• Information and dissemination programmes and channels • Public and private information systems (including disaster, hazard and risk databases & websites) • Networks for disaster risk management (scientific, technical and applied information, traditional/indigenous knowledge),	• Documentation and databases on disasters • Professionals and public networks • Dissemination and use of traditional/indigenous knowledge and practice • Information centres and networks
Education and training	• Inclusion of disaster reduction at all levels of education (curricula, educational material), training of trainers programmes • Vocational training • Dissemination and use of traditional/indigenous knowledge. • Community training programmes.	• Educational material and references on disasters and disaster reduction • Specialised courses and institutions • Trained staff • Evidence of systematic capacity development programmes
Public awareness	• Public awareness policy , programmes and material • Media involvement in communicating risk	• Coverage of disaster reduction related activities by media • Public accessed and informed • Visibility of disaster reduction day
Research	• Research programmes and institutions for risk reduction • Evaluations, and feedback • National, regional and international co-operation in research, science and technology development.	• Existence of a link between science and policy (evidence-based policy) • Indicators, standards and methodologies established for risk identification • Regional and international exchange

Table 5.1 continued

Thematic Areas 4: Risk Management Applications/Instruments		
Environmental and natural resource management	• Interface between environmental management and risk reduction practices, in particular in coastal zone, wetland and watershed management, integrated water resource management; reforestation, agricultural practices, ecosystem conservation	• Use of wetland or forestry management to reduce flood risk • Trends in deforestation rate • Use of environmental impact assessments in disaster reduction planning
Social and economic development practices	• Social protection and safety nets • Financial instruments (involvement of financial sector in disaster reduction: insurance/reinsurance, risk spreading instruments for public infrastructure and private assets such as calamity funds and catastrophe bonds, micro-credit and finance, revolving community funds, social funds) • Sustainable livelihood strategies	• Access to social protection and safety nets as well as micro-finance services for disaster risk reduction • Use of safety nets and social protection programmes in recovery process • Insurance take up.
Physical and technical measures	• Land use applications, urban and regional development schemes • Structural interventions (hazard resistant construction and infrastructure, retrofitting of existing structures, drought, flood and landslide control techniques) • Soil conservation and hazard resistant agricultural practices	• Construction reduced/zoning plans enforced in floodplains and other mapped hazard- prone areas • Compliance of public and private buildings with codes and standards. • Public buildings (health facilities, schools, lifelines, etc) at high risk retrofitted • Regular maintenance of hazard control structures
Thematic Areas 5: Preparedness And Emergency Management		
	• Contingency plans (logistics, infrastructure) • National and local preparedness plans • Effective communication and coordination system • Rehearsal and practice of plans	• Testing and updating of emergency response networks and plans(national/local, private/public) • Coverage of community training and community based preparedness • Emergency funds and stocks

It can be seen in Table 5.1 that the framework has a broad context of disaster risks, from natural to man-made, and consists of a set of principles that can be applied to any country in the world. It is highlighted here that the 'political commitment and institutional aspect' referred to is definitely in line with UNDP (2004) findings.

The framework develops a way of capturing progress qualitatively and quantitatively. The Internet site www.unisdr.org (ISDR, 2003) suggests that the framework is provided as a starting point for an initial core set of principles and goals to understand, and thus guide and monitor, disaster risk reduction. Thus, the framework does not indicate clearly how the users wish to take the process forward, considering the diversity of disaster risk they have faced.

The framework appears most suited to application at a national scale. For application specific in seismic risk reduction of non-engineered buildings at a local scale, the core set of principles can be adopted, but much more explanation needs to be developed in detail, both within its characteristics and its benchmark.

5.1.2 Framework for Reducing the Earthquake Threat in the Kathmandu Valley, Nepal (ADPC, 2000)

This framework was designed for the Kathmandu Valley Earthquake Risk Management Project (KVERMP) funded by the Government of Nepal and GeoHazard International/GHI, USA (Table 5.2). KVERMP started in September 1997 and continued through to the end of February 2000. The situation in the field of earthquake risk management in the Kathmandu Valley, and in Nepal as a whole, could briefly be described as given below:

a: Seismic hazard assessment performed earlier under the Building Code Development Project (1992-1994) did conclude that the earthquake risk in the Kathmandu Valley was identified as very high. The level of awareness towards earthquake hazard and risk was very low among the population, as well as among the decision-makers and municipal authorities. Despite this threat, there was no institution within the Kathmandu Valley to assess earthquake hazards or promote an earthquake risk management program to develop an organised approach towards reducing the earthquake risk. People asked two important questions, notably, (i) what will happen to the Kathmandu Valley if an earthquake similar to the one in 1934 strikes again? and (ii) what should be done to reduce the earthquake disaster? However, these questions remained unanswered.

b. National Society for Earthquake Technology (NSET) Nepal was created in 1993, and it tried to work in this direction. Yet, in those days, NSET was simply a group of enthusiastic professionals. It did not have any office or physical infrastructure, nor any permanent staff. Institutionally, it was very weak. Thus, despite the potential of it contributing to earthquake risk reduction, it was unable to deliver significant results due to a lack of resources and support.

c. The technical information about the earthquake risk in the Kathmandu Valley was incomplete and scattered among several governmental agencies. It was not synthesized, was not applied to the infrastructure of modern day Kathmandu Valley, and was not presented in a form that the public and government officials could digest.

d. The National Seismological Center of the Department of Mines and Geology conducted monitoring of Himalayan seismicity, and was implementing a project for expansion of the network to 17 stations.

e. Draft of the national building code was prepared, but it was just lying on a shelf, unimplemented.

f. It was obvious that there were four fundamental elements necessary to reduce the earthquake threat in the Kathmandu Valley:

   i. An estimation, using all information currently available, of the probable consequences of a repeat of the 1934 earthquake on modern day Kathmandu Valley. This estimation should be expressed in non-professionals' terms so as to be readily understood by the public, business leaders and government officials. This will provide a factual basis for a sound public policy concerning earthquake safety.

   ii. A comprehensive set of earthquake risk management recommendations based on the expected consequences of a large earthquake, which is developed by local and international specialists in government, city planning, urban infrastructure, and emergency services and addresses the most significant aspects of the Valley's risk.

   iii. A properly constituted and equipped organisation, in which government, business and academic leaders collaborate to foster earthquake risk management and incorporate earthquake disaster mitigation strategies into the Kathmandu Valley urban development process. This organisation would also be vital to facilitate, monitor, and assist in the implementation of risk management programs.

   iv. A demonstration project in which the earthquake risk of some critical, vulnerable element of society is reduced. Such a project should not only accomplish a tangible improvement (to leave something more than reports and organisations), but also contribute to the training of local people.

Table 5.2 Framework for Reducing the Earthquake Threat in Kathmandu Valley, Nepal (ADPC, 2000)

Activities and Sub-activities	Comments	Indicators
1. Development of an earthquake scenario and earthquake risk management action plan for Kathmandu Valley		
1.1 Assess earthquake risk of Kathmandu Valley	Included literature review, review of historic earthquakes, compilation of data, selection of scenario earthquake, superimposition of the intensities of 1934 Earthquake on modern day infrastructure of Kathmandu Valley, preparation of risk maps	a. Number of institutions that have incorporated earthquake risk reduction as a permanent or significant part of their operations as a result of this project.
1.2 Interview operators of critical facilities	Included development and revision of interview schedule, interview managers of 31 emergency response and critical facilities, explaining to them the risks, assessment of the possible impact to the facility and response system by the scenario earthquake, and the present capacity to respond and possible risk management measures.	b. Number of earthquake disaster risk reduction plans committed to occur as a result of the project. c. Amount of funding committed to earthquake risk reduction projects following the start of this project by non-AUDMP sources
1.3 Scenario workshop	a. Participants included representatives from the 32 institutions, plus other government officials, business leaders, community representatives, few international experts including RADIUS experts b. The workshop generated two products: i. An earthquake scenario for Kathmandu Valley that is supported by the workshop participants ii. A list of suggested activities to reduce Kathmandu Valley's earthquake risk	d. Number of informational articles, television presentations, lectures, etc. about earthquake risk and/or how to reduce earthquake risk conducted by the project or as a result of the project. e. Number of awareness materials published and distributed by NSET/KVERMP as a result of the project.
1.4 Write & publish scenario document	Scenario document prepared and published in Nepal and English describing the likely consequence of a large earthquake on Kathmandu Valley.	f. Number of training programs about general earthquake risk and/or general earthquake risk and/or how to reduce earthquake risk conducted by the project or as a result of the project.
1.5 Develop Action Plan	a. Map out institutions with responsibilities of disaster management (about 80 institutions) b. Organise mini-workshops with select institutions for developing objectives, implementation strategies, and for selecting initiatives c. Develop a consensus Action Plan in a workshop with all related institutions	g. Number of substantive meetings with high-level decision-makers about earthquake risk and/or how to reduce earthquake risk conducted by the project. h. Number of people (approx.) given educational materials distributed by the project.
1.6 Publish and distribute Action Plan Document	Action Plan (and Scenario) released by the Prime Minister on the occasion of the First Earthquake Safety Day, January 1999. Both documents sent to all participating institutions, all donor agencies/diplomatic missions operating in Nepal.	i. Number of risk reducing action plans created as a result of the project.
2. School Earthquake Safety (SES)		
2.1 Establish School Earthquake Safety Advisory Subcommittee	a. SES Advisory Committee established with Director, Central Region Education Directorate as chairman. b. Regular meeting of the SES Advisory Committee held	j. Number of professionals that have an improved technical or other expertise relating to risk expertise relating to risk reduction as a result of the project who are currently active in risk reduction activities.

Table 5.2 continued

2.2 Survey of Earthquake Vulnerability of Kathmandu Valley Public Schools	a. Developed improvised method for survey involving school headmasters b. Designed survey form (questionnaire), subjected to international review c. Conducted Pilot Seminar with school headmasters to test survey form; modify survey form d. Conducted a series of 15 seminars with school headmasters to educate them on earthquake risk to school and to teach them on survey conduction e. Headmasters conducted survey. Forms collected, data entered into Database, analysed. f. Field verification of survey data, conducted additional Survey for missing/inappropriate data g. Vulnerability assessment of school building classes, development of conceptual retrofit design, review by National/international experts, cost estimation h. Conduct detailed survey of ten school buildings, prepare detailed retrofit design for one school, and design verification by international expert.	k. Number of institutions where KVERMP initiated skills/training and professional development courses are institutionalised. l. Number of policies established or revised to facilitate action, regulation, enforcement and or incentives m. Number of risk reducing projects occurring or committed to occur as a result of the project.
2.3 Funds for school retrofit	Fund raising done nationally and internationally	
2.4 Implement Retrofit of one school building	Additional activity. Retrofit of the main building of Bhuwaneshwory Lower Secondary school completed	
2.5 Implement seismic resistant reconstruction of another school building	Additional activity. An additional building of the school demolished and reconstructed with seismic – resistant elements in place	
2.6 Report to School Authorities	Extended activities under the SES program and close interaction with the education authorities, and specially, development of a sense of ownership by the Education offices as well as by the schools did not require any specific report to be prepared, as the general report on SES program would suffice.	
2.7 Prepare and Submit Proposals for School Retrofit	The Report on SES replaced this activity.	
2.8 Prepare Report on SES	A Comprehensive Report on SES was prepared.	
2.9 Design Earthquake Preparedness Curriculum Element	Changes in the SES program required development of curriculum for masons' training, Manual for Teachers for Training the Children (Earthquake Kit), and School Earthquake Emergency Response Plan.	
3. Public Awareness		
3.1 Establish Earthquake Safety Day	At NSET's request, Government of Nepal declared January 16 as the Earthquake Safety Day of Nepal, and established an Earthquake Safety Day National Committee for observing the Day annually throughout Nepal.	
3.2 Public talks about Kathmandu Valley's Earthquake Risk	a. The extent of this activity increased several times over during project implementation. Conducted numerous talk programs, meetings, discussions, interviews on FM/AM Radio Programs (including with BBC), Television (National as well as international such as Young Asia Television), Newspapers, and Journals etc b. Held 2 symposia and several seminars with international participation	

Table 5.2 continued

3.3 Write & publish report for public	NSET generated, in association with partnering institutions, several types of awareness raising materials including handbooks and posters, videos etc. All these materials have been widely distributed resulting in a significant increase in awareness level in Kathmandu Valley and the country.	
4. Institution Building		
4.1 Municipalities – Disaster Management Office	a. The newly established disaster management office of Kathmandu Municipality was assisted by providing two-week long services of an experienced emergency response official from the US. b. The expert provided training to the staff of the Disaster Management Unit of KMC. Officials from other municipalities also participated in the training.	
4.2 Grant writing awards for reducing earthquake risk of privately owned buildings	This activity was considered not necessary at the moment, and the resource was used for other more important activities/additional activities.	
4.2 Institutional Strengthening of NSET	a. Attendance in International Conferences: Several NSET staff participated in international conferences/workshops abroad. Expenses for such participation was largely from outside the KVERMP budget. b. Visit to similar institutions in other countries: NSET key project professionals visited several institutions in Japan, US, New Zealand, India, Philippines, Thailand.	
5. Training		
5.1 National training on Disaster Management	NSET assisted NPTIs to develop curriculum for UDM training. The training program will be conducted shortly.	
5.2 Participation in AUDMP/ADPC Regional training programs	a. Three NSET staff participated in Regional training program of AUDMP. b. NSET facilitated participation of Nepalese professionals from partnering institutions in 1) Technological Disaster Management, 2) Urban Flood Management, 3) PEER TFI c. NSET staff participated in the international training program conducted under RADIUS.	
5.3 Conduction of Training Programs on Disaster Management	a. NSET organised several training programs, especially community-based, in the wards of Kathmandu & Lalitpur municipalities. b. NSET organised several training programs for media people on Disaster management and how to report disaster events (disaster journalism).	

The Kathmandu Valley Earthquake Risk Management Project was designed to meet four objectives:

a. Evaluate earthquake risk and prescribe an action plan for managing that risk;
b. Reduce the public schools' earthquake vulnerability;
c. Raise awareness of the public, of Nepalese government officials, of the international community resident in the Kathmandu Valley, and of influential organisations abroad concerning Kathmandu Valley's earthquake risk; and
d. Build local institutions that can sustain the work launched in this project.

The framework in Table 5.2 has a broad context in seismic risk management steered from a national level. For detailed implementation on a local level, the framework needs to be developed and suited to local needs. The indicators in the framework are clearly obsessed with a quantitative measure that is easy for the assessor to measure the progress and achievement, especially around ideas of sustainability. The order of the framework tends to follow seismic risk management methodology developed by SCEC (2002), starting with seismic hazard analysis and seismic risk assessment, and then following with developing strategic mitigation. This is very useful to replicate within development of the proposed framework.

Starting with an earthquake scenario as a seismic hazard analysis and risk assessment was successful in implementation because (ADPC, 2000):

a. It was prepared with the active involvement of all concerned (stakeholders)
b. It took place through the process of interaction, interviews, workshops
c. Loss estimates were used to initiate and sustain the dialogue/discussion
d. Simple laminated maps were very effective to sustain the dialogue
e. Respective institutions involved assessed their own institutional capabilities for recovery

Moreover, the earthquake scenario can be used as an effective awareness promotion tool (ADPC, 2000):

a. To buy-in authorities, to develop an Action Plan
b. Provide the required motivation to seek/identify actions
c. The scenario was effective because the stakeholders were involved in its preparation
d. The scenario provided the motivation: risk reduction ideas started coming in from officials, when the institutions were formally requested to identify actions that could help reduce the risk.

5.1.3 Framework for Urban Earthquake Vulnerability Reduction in India (MHA, 2004)

The framework for urban earthquake vulnerability reduction was a structure of national initiative to reduce the vulnerability of communities in some of the most hazard prone districts of India (169 districts and 17 states); it was developed by the Government of India and UNDP under the Disaster Risk Management Programme in 2002-2007 (Table 5.3). Their aims were: to contribute to the social and economic development goals of the National and State Governments, enable them to minimise losses to development gains and to reduce their vulnerability to natural disasters. The overall goal was a sustainable reduction in earthquake risk in the most earthquake-prone urban areas across the country. The programme relied upon a community based approach to disaster management, and sought to build the capacities of communities, government functionaries at all levels, and other stakeholders in disaster management, at all levels, in an organised manner. The Ministry of Home Affairs was the executing agency with the support of UNDP Country Office for implementation.

This project is essentially aimed at strengthening the capacities of communities, urban local bodies and the administration in mitigation, preparedness and response in 38 cities in India. These cities have been chosen on the criteria of being located in Seismic Zones 3, 4, or 5, with a population of more than half a million. The project is a suitable model for the mainstreaming of earthquake risk management initiatives at all levels and help to reduce earthquake risk in the most earthquake-prone urban areas in India.

Urban Planning Institutions and Agencies in the selected cities would be directly involved in the planning process to ensure the sustainability of these initiatives. A wide representation of women was envisaged in this project during the planning process and also in the capacity building component, not just to be prepared in the event of a disaster, but also to act as disaster managers and to focus on the special needs of women in disasters. This project worked closely with relevant Government departments and institutions at the National and State levels. Knowledge from this initiative fed into the national capacity building programmes of the Government of India, and helped to mainstream training in disaster management in all regular training programmes of the Government.

Table 5.3 Framework for Urban Earthquake Vulnerability Reduction in India (MHA, 2004)

Objectives	Activities	Indicators
1. Awareness Generation		
Objective 1: Create awareness among government functionaries, technical institutions, NGOs, CBOs and communities about earthquake vulnerability and possible preventive Actions.	Activities under Objective – 1 a. Consultations with national and state governments, City development authorities, Urban Local Body/ULBs, Non-Government Organisation/NGOs, training institutions, practising engineers, architects, real-estate firms, builders, contractors, etc. for city-specific earthquake risk management and mitigation strategies. b. Formulation of city specific awareness campaign strategies. c. Awareness generation programmes for i. Voluntary organisations and students on earthquake management and mitigation ii. The community through workshops/seminars/training, use of media (radio/TV/ articles in common magazines, posters/leaflets in local language and observation of earthquake risk management day/week) iii. School children on safety measures through audio-visual programmes, competitions, mock drills, etc iv. Institutions of Engineers/Architects, stakeholders in the real estate market, builders associations, contractors associations, etc. through workshops and orientation programmes. d. Development of 'Ready reckoners' and user-friendly manuals on i. Design and construction of earthquake-resistant houses/retrofitting ii. Earthquake risk management and response plans. iii. Dissemination of accurate warning, search and rescue operations, first aid, Restoration of services- water & sanitation, shelter management, counselling and damage assessments for early recovery and response, proper utilisation and better co-ordination of relief materials during crisis. iv. Documentation of appropriate retrofitting techniques and sharing of best practices, conference proceedings and articles in popular magazines. v. Newspaper advertisements in National and local newspapers	**The indicators of achievement of this goal would be:** a. Risk reduction factor in rapid disaster recovery b. Disasters mitigated and development gains protected. c. Disaster risk considerations mainstreamed into development. d. Community-led enforcement of preparedness activities e. Gender equity in disaster preparedness.

Table 5.3 continued

2. Development of Preparedness and Response Plans at the Community and Administrative Levels		
Objective 2: Development and Institutionalising of Earthquake Preparedness and Response Plans and practise these through mock drills	Activities under Objective – 2 a. Identification and networking of nodal agencies and partners at different levels for implementation of the programme. b. Formation of City and Ward level Disaster Management Teams [DMT] including the concerned Government Depts. Senior citizens, National Cadet Corps (NCC)/National Social Service (NSS), Rotary and Lions Clubs, Bhagidaris (Delhi)/City Nagarik Committees/resident welfare associations, elected members, NGOs and other civil society response groups. c. Development of city and ward level earthquake preparedness and response plans. d. Development of an inventory of resources at all levels for speedy response during emergencies and establishing linkages with the India Disaster Resources Network (IDRN) portal being commissioned by MHA. e. Development of response structure from ward to city level. f. Specialised training of Disaster Management Teams [DMTs.] at ward and city levels. g. Preparedness drills at all levels- national, city and ward levels.	
3. Development of a Techno-legal Regime for the States		
Objective 3: Development of regulatory framework (techno-legal regime) to promote safe construction and systems to ensure compliance	Activities under Objective – 3 a. Orientation for policy makers to enforce legislation for registration and regulation of builders, promoters, and real estate developers for creation of safe habitat. b. Orientation of govt. officials in Urban Local Bodies - Development Authorities/Municipalities/Town Planning Departments/Housing Societies/Housing Boards, etc. towards the earthquake hazard, risk evaluation and possible mitigation measures. c. Developing systems for city specific Audit of safe building practices d. Constitution of empowered committees at the national and apex bodies at the state level to review the zoning regulations, building codes & byelaws and regulatory mechanisms at National, State and City levels (for newly developed areas, old 'core' areas of the city and slums) for earthquake vulnerability reduction. e. Creating a framework for compulsory certification system for engineers and architects to set standard levels of competence among all practitioners. f. Developing course curriculum for compulsory certification of practising engineers and architects through a national level committee to be constituted by MHA. g. Setting up of Institutional framework for a National/State Ombudsman to ensure compliance of safe building byelaws and construction practices h. Consultations and partnerships with Financial Institutions and Insurance Agencies to work out modalities for ensuring disaster resistant features in new as well as extension of existing constructions while giving loans and policies. i. Using vulnerability databases for risk and vulnerability analysis as decision support instruments to enhance national and state policy on earthquake risk management.	

Table 5.3 continued

4. Capacity Building at all levels		
Objective 4: Capacity building for certification by Government functionaries and professionals (engineers and architects)	Activities under Objective – 4 a. Building capacities of students of Engineering & Architecture for awareness generation, mitigation measures and in the development of the preparedness plans. b. Strengthening of local academic institutions as Key Resource Institutions for earthquake risk management. c. Training and orientation programmes for National and State Government functionaries, Functionaries of development authorities, ULBs, NGOs, training institutions, private sectors (real-estate firms, builders, contractors, etc.) in the process of development of community based earthquake risk management and response plans; d. Training of selected engineers from prominent government engineering departments (such as PWD, MES, the Urban Development Authorities) on seismic resistant constructions, codal provisions, safety and evaluation techniques, retrofitting etc. in collaboration with the National Programme on Earthquake Engineering Education (NPEEE) . a programme of the Ministry of Human Resource Development. e. Providing technical support, training and periodic assessments on earthquake vulnerability through the research/knowledge hub at national level. f. Constitution and capacity building of Quick Response Teams (QRTs) in disaster preparedness and response by international experts in the field. g. Partnerships with research/resource institutions at National and City levels for review of existing earthquake preparedness and response plans. h. Support for formation/development of a Resource Center in each city for capacity building and technology transfer i. Training programmes for resident welfare associations in hazard, social and resource mapping and development of earthquake preparedness and response plans. j. Sensitisation and training of policy makers and local self-governments in the development of the Incident Command System for dealing with emergencies.	
5. Knowledge Networking on International and National Best-Practices among all the Cities and Urban Centers in the Programme		
Objective 5: Networking knowledge on best practices and tools for effective earthquake risk management, including creation of information systems containing inventory of resources for emergency operations.	Activities under Objective – 5 a. Developing a web-based portal on knowledge sharing, inter-city co-operation on earthquake vulnerability reduction initiatives, a forum for city representatives, project co-ordinators, and national advisors to share experiences and learning on urban earthquake risk and risk management for linking the practitioners involved in the programme. b. Research and documentation on earthquake risk management index for each city, and sharing of the same. c. National database on earthquake risk management and earthquake preparedness and response plans at various levels. d. Capability assessment and national training plan for earthquake risk management. e. Development of Risk and Vulnerability Indices and annual reports. f. Documentation and sharing of best practices of India for earthquake risk management for wider circulation as part of training curriculum. g. Inter-city exposure visits for city managers for mutual learning.	

Using the framework, the project envisaged the following five broad objectives, as follows:

a. Awareness generation
b. Development of preparedness and response plans at community and administrative levels
c. Development of a techno-legal regime for the States
d. Capacity building at all levels
e. Knowledge networking on International and National best-practice among all the cities and urban centres in the programme.

The following were the expected direct outcomes of the programme:

a. Enhanced capacities in the Ministry of Home Affairs for disaster risk management
b. Administrative and institutional framework for earthquake risk management in the most vulnerable urban centres of the country
c. Capacity building in earthquake risk management at National, State, District, City, Ward/Community level, including strengthening of resource institutions and establishing of linkages.
d. Development of an Earthquake Scenario document for each city so as to know the consequences of an earthquake (estimation of damage probabilities, etc.) and preparation of an Action Plan for the purpose of emergency planning and preparedness for the 38 cities.
e. A comprehensive earthquake risk management framework and recovery plan for each of the 38 cities.
f. Awareness of earthquake risk among functionaries of Urban Local Bodies
g. Disaster resource inventory prepared for the cities covered under the programme.
h. Sectoral Preparedness plans for all nodal agencies in the ULBs and for the residents welfare associations of the city
i. An aware and informed community, students and teachers, key government functionaries, masons and engineering institutions, policy makers etc.
j. Compulsory certification course for practising engineers and architects, including detailed course curriculum.
k. Training and capacity building for engineers/architects and builders in safe-building practices and retrofitting techniques.
l. Awareness of safe building practices among practising architects/engineers/builders.
m. Support to generate awareness among school students and scheduling of drills in disaster prevention and response for schools and the promotion of programmes such as the School Earthquake Safety Programme.

n. Institutionalisation of regular preparedness drills at various levels including all stakeholders
o. Capacity building activities for all stakeholders including civil society organisations in the search and rescue, first aid, relief and restoration in post earthquake recovery situations.
p. Risk analysis of key public utilities, prioritisation of the same in terms of the need for retrofitting and resource (finance, manpower, etc) plan.
q. Review & amendment of the existing zoning regulations, building codes and byelaws and sensitisation of building experts about the same, and review of enforcement mechanisms for the byelaws etc.
r. Adoption of preventive maintenance policies and action towards earthquake safety in hospitals and key public institutions.
s. Dissemination of cost effective retrofitting technologies for hazard resistant housing
t. Enhanced capacity of women as disaster managers in first aid, shelter management, search and rescue, trauma counselling etc.
u. Manuals, training modules, SOPs and awareness strategies to be made available for replication in other areas.
v. Enhanced capacity of the training institutions for training in seismic hazard mitigation and risk management.
w. Knowledge networks for better involvement of stakeholders
x. The development of a National and State database on natural disaster risk management.
y. Integration of vulnerability reduction into development programmes to allocate resources more effectively based on needs.
z. A web-based portal on knowledge sharing and inter-city co-operation on earthquake vulnerability reduction initiatives

The following were the expected indirect outcomes of the programme:

a. Reduction of expenditure on disaster relief and reconstruction with an increased investment in preparedness measures.
b. Sharing of disaster relief cost by the community.
c. Self-reliant urban local bodies for preparedness.
d. Linkages of earthquake preparedness plan to urban development plans.
e. An increase of people's awareness and participation.
f. Access to information by the people.
g. Development of highly trained construction personnel.
h. Strengthening of academic/key resources institutions.

The framework in Table 5.3 has demonstrated complete and comprehensive seismic risk management and response in order to reduce urban earthquake vulnerability in 38 cities with a high seismic risk around the regions of India. It appears that the success of the programme of national initiative relies upon a community based approach to disaster management and a building of capacity for communities, government agencies at all levels and other stakeholders, in an organised manner. The compulsory certification course for practising engineers and architects; training and capacity building for engineers, architects and builders in safe-building practices and retrofitting techniques; dissemination of cost effective retrofitting technologies for hazard resistant housing, and the strengthening of local academic institutions are good examples in seismic risk reduction that can be applied in the proposed framework. In the framework, the expected outcomes have mentioned the probable consequences of an earthquake for the purpose of emergency planning and preparedness.

Based on the explanation from the three existing framework, all three frameworks have generally implemented three key characteristics of a successful disaster reduction framework in their contents: generating political will, flexibility (particularly in their indicators that are not rigidly or prescriptively applied), and the ability to encourage ownership (Mitchell, 2003). Generating political will is the first key characteristic, in line with the conviction that lack of wider political commitment to disaster reduction is often stated as the main barrier to progress in implementation (UNDP, 2004). Secondly, the framework must be flexible enough to adapt all aspects within community life and their socio-economic situation and also to incorporate local knowledge on risk and vulnerability according to socio-cultural diversity. This second key characteristic is closely related to multidisciplinary stakeholder involvement and the strengthening of local capacity, as precisely described within three important factors of effective seismic risk management of non-engineered buildings in Chapter IV. Thirdly, the framework must be able to encourage ownership, since a sense of ownership is really needed, not only to encourage and maintain actions voluntarily in order to generate a culture of prevention, but also to make community members feel part of the effort. As a result, people will actively make contributions to reduce vulnerability. Through a high sense of ownership, people tend to recognise that seismic risk reduction needs shared responsibility and shared effort. This is also underpinning what Lustig (1997) has found: for a disaster-management system to be sustainable, it should be designed not only to convey the message to the members of the disaster-prone community that they are in control, but also that the system is actually under their control.

Referring to the two frameworks from Nepal and India, which represent developing countries, attention is called to the most vulnerable countries where disaster risks and chronic vulnerabilities are closely linked, and are part of the poverty cycle. Without proactive and effective involvement of the donor countries, it may be unrealistic to expect poor countries to make significant progress on many aspects of disaster reduction.

5.2 Shortfalls in the Three Existing Frameworks

In recent years, there has been increasing pressure on reducing disaster risk. Some countries and organizations have developed a strategic framework for reducing disaster risk. The frameworks from UN-ISDR, Nepal, and India which have been examined in the previous sub-section represent good example frameworks in this matter. All three frameworks above have demonstrated their specific area of interest in reducing disaster risk. It is widely agreed that consensus building and transparency among a wide range of stakeholders are vital to its success.

Although there is much strength in these frameworks, some shortfalls are still remained. The framework from UN-ISDR describes very broad areas of disaster ranging from natural to man-made disaster, whereas the frameworks from Nepal and India focus on earthquake disaster management. All seem to focus on national level, where the consideration of local wisdom, practice, and belief do not emerge clearly. In relation to their benchmark to measure the progress of implementation, the UN-ISDR's framework develops several indicators qualitatively and quantitatively, whereas the Nepal's and India's framework give a few, relatively simple measures and likely to be focused on quantitative measures.

There is relatively little explicit reference to the method to which the three frameworks above apply, for example, a number include specific indicators concerning generated data (for example: interview, focus group). There is still considerable variation in the density of the frameworks in terms of the number of specific features of indicators that are included for appraisal. To some extent, this is related to the particular focus of the framework. Although there is some degree of consensus about a broad quality of criteria, different emphasis is placed on specific features of content, depending on the purpose of the framework, any core concepts or principles within which it operates and the way it is formulated.

Mitchel (2003) mentions that the choice to use qualitative indicators allows everybody to form an opinion on the 'grading' of such indicators and does not necessary require extensive data collection. Moreover, there is general agreement that a qualitative benchmark encompasses a wide array of approaches. As a result, qualitative rather than quantitative indicators are preferred as a way to engage as many parties as possible. In certain cases, sometimes, many projects focus on short-term outputs such as the programme in Nepal, rather than long-term outcomes, due to funding constraints and pressure to provide quick evidence of project success. In this situation, quantification is not completely abandoned. Quantification of sub-indicators can help to inform broader qualitative indicators examining the quality of disaster mitigation.

In order to overcome the above shortfalls, this research proposes an integrated framework equipped with advantages of both qualitative and quantitative indicators. Some elements in the proposed framework provide the demanding consideration from local level as an important part of seismic risk reduction as well as the national level. Unlike the Nepal's and India's framework, this research focuses particularly on non-engineered buildings as the biggest cause for the earthquake disaster.

5.3 Preliminary Analysis from the Review of Literature and Existing Frameworks

This section seeks to appraise the salient points of the review of both the literature and existing frameworks presented in the preceding sections, particularly focusing on the development of the proposed framework within the Indonesian local community. This appraisal makes a robust background for the following section that identifies the focus and direction of the next phase of the research.

a. Most Indonesian Regions Located in High Seismic Areas

An earthquake event is unstoppable. Strong-major earthquakes have long been feared as one of nature's most terrifying and devastating events. On account of its geological conditions, the Indonesian regions are highly prone to earthquakes with the potential to inflict huge losses on lives and property. Earthquakes pose a real threat to Indonesia, with almost 60% of the cities and urban areas located in the relatively high to very high seismic zone. The Aceh and Yogyakarta earthquakes clearly demonstrated the seismic vulnerability of Indonesian areas. Considering the area's historic seismicity, population density, and building and infrastructure stocks, it is clear that major Indonesian cities will suffer considerable seismic consequences in terms of public safety and economic impact in the near future.

b. The Collapse of Non-Engineered Buildings as the Biggest Cause of Human Deaths

Findings from many of CEEDEDS's investigations in earthquake damaged regions, after the jolts around Indonesia, showed that non-engineered buildings dominated in number and always suffered most. Human deaths and injuries, as well as damage to property during earthquake, were mostly caused by the failure of such buildings. This situation is very similar to other circumstances around the globe, particularly in developing countries. Conversely, the few buildings that were constructed according to the modern building code were able to survive the earthquakes.

Some of the evidence shows that non-engineered buildings are still being constructed by self-build owners, builders, and local engineers within medium-low-income populations in Indonesia. Although these buildings will gradually be eliminated by natural ground shaking and be substituted with better construction, it is widely accepted that they will remain the single greatest source of existing seismic risk for the foreseeable future. Therefore, this gives a stronger urgency to the introduction of seismic resistance to non-engineered buildings, both for existing and new building stocks; this is imperative in order to reduce death tolls in future earthquakes.

c. A Wide Gap between Massive Deaths and the Existence of Seismic Codes

The catastrophic earthquakes around the globe have reminded the world communities of the importance of understanding earthquake facts. Lessons learned from past earthquakes have clearly indicated that non-engineered buildings will suffer most during earthquakes. This is especially true in the developing world, for example, Indonesia, where most residential buildings are low rise and non-engineered. Evidence shows that earthquakes will still claim massive death tolls in the future as long as many non-engineered buildings without seismic features still exist in high seismic areas.

At the same time, most developing countries in high seismic areas such as India and Indonesia have developed seismic features/codes for low-rise buildings for self-built owners, builders, and local engineers. Implementation of seismic features helps to improve the behaviour of structures, so that they may withstand the earthquake effects at the appropriate levels of ground motion. Seismic features are contained within characteristics of structure, including structural and architectural configuration, design, material, quality of construction and maintenance. Due to the nature of the ground shaking, installation of reinforced concrete bands at the plinth, lintel, and roof level are the most important items in seismic features.

The key role of the bands is to ensure a desirable 'box-like' building behaviour during earthquakes and also to reduce the chance of walls tilting due to out-of-plane seismic actions.

All professionals and people who have embraced seismic reduction find the high death tolls emotionally wrenching and simply unacceptable. Professionals in many countries have the seismic codes to save lives and human suffering. It is evident from many examples that progress has been made in the analysis of risk and vulnerabilities, or knowledge of how to reduce these risks. Yet, earthquakes still continue to claim thousands of lives every year. Obviously, it is widely accepted that there is a wide gap between massive deaths and the existence of seismic codes. The number of deaths could have been reduced, perhaps even avoided, if an understanding and implementation of seismic codes had been enforced and employed properly. In fact, failures are often due to a lack of action to combat even the known risks or a lack of enforcement of well-known solutions, seismic codes. The most important thing is that the key to ensuring earthquake safety lies in having a robust mechanism that enforces and implements these design code provisions in actual construction.

d. The Importance of Integrated Seismic Risk Management of Non-Engineered Buildings in Indonesia to Bridge the Gap

Due to the rapid economic growth, complex socio-economic and technical problems in developing countries, it is well known that earthquake-resistant construction in developing countries is challenging. Countries like Indonesia need effective solutions that are unique to their local needs. Good practices in countries elaborate three factors that contribute significantly in maintaining continuous seismic risk management activities within non-engineered buildings. These are: multidisciplinary stakeholder involvement, strengthening of local capacity, and the incorporation of the poverty factor.

Nepal and India, for example, as developing countries, have initiated and incorporated seismic risk management activities, together with a sustainable development process (ADPC, 2000 and NDMD, 2004a). These activities place seismic risk management as a pro-active rather than reactive approach. In contrast, disaster management in Indonesia is currently a problem. It is unsystematic, not planned, and incomprehensive. The awareness level of the public and officials is really low. (Ngoedijo, 2003)

To bridge the gap between massive death tolls and the existence of seismic codes, enforcement and implementation of these seismic codes for non-engineered buildings is the key to ensure earthquake safety. The implementation of seismic features in actual construction is not simple. Integrative approaches are needed to bridge the disciplines of science, engineering, politics, economic, and organisational and institutional analysis (Petak, 2002). Based on good practices in various countries, this can be achieved through an approach of integrated seismic risk management. Therefore, establishing and improving integrated seismic risk management of non-engineered buildings, as a risk management tool for major cities, is extremely urgent in Indonesia.

e. A Novel Framework for Guiding and Monitoring Seismic Risk Reduction of Non-Engineered Buildings as a Starting Point to Reduce Seismic Risk

Currently, there is a growing recognition that multidisciplinary stakeholders should be involved in solving the problem within seismic risk management mentioned above. All stakeholders introduce new challenges, bring new practices and speak different languages, which need to be harmonised. A widely agreed framework can help to harmonise and systematise the field of integrated seismic risk management (UN-ISDR, 2003).

Responding to the need to establish and improve seismic risk management as a priority on local community agendas, in line with the decentralisation process in Indonesia, it is clearly imperative to develop an integrated seismic risk management framework at a local level. This would be a first step toward integrated seismic risk management to reduce seismic risk in Indonesia. Therefore, the principal aim of this research is to develop an integrated novel framework for guiding and monitoring SRRNEB in Indonesia, using a risk management approach. It is true for Indonesia that there appears to be a notable absence in the frameworks of any attempts to reduce seismic risk of non-engineered buildings

Given the nature of the research aim, the principles within the proposed framework draw heavily on the wider literature, the existing frameworks, and on the contribution of those who will take part in the study. Moreover, the proposed framework has to be flexible to adopt the concept that sustainability may differ among different types of people and organisations. A community needs to overlap and integrate its social, environmental, and economic spheres. Each sphere or system has many components, and in every community, the quality, quantity, importance, and balance may be different (UNCRD, 2003).

5.4 Emerging Issues Arising from the Review of Literature and Existing Frameworks for Primary Data Investigation

This section mentions some emerging issues arising from the review of literature and existing frameworks for primary data investigation, in order to develop the 'Framework for Guiding and Monitoring Seismic Risk Reduction of Non-Engineered Buildings in Indonesia'. These encompass a literature review in Chapters II, III, and IV as well as the review of the three existing frameworks in Section 5.1 as elaborated above. This is also the launching pad for the next stage of this study, hereinafter called 'the first draft of the proposed framework' for guiding and monitoring seismic risk reduction of non-engineered buildings (SRRNEB).

Firstly, from the exploration of the critical review of literature and the existing frameworks, all common risk-based issues associated directly or indirectly with non-engineered building and seismic code implementation were captured, identified, and arranged within the three steps of seismic risk management approach adopted in this research. The overall purpose of this stage was to identify critical and glaring issues and areas for potential improvements. With all common risk-based issues identified, the extent of the principles in 'the first draft' would be easier to establish and embrace a wide variety of Indonesian social and culture. The established links between discipline, scientific, and indigenous sources of knowledge develop the capacity to move from knowledge to action. It was hoped that the approach would be common, but the solution local. A local solution means that one cannot simply adopt the ordinance, program, or approach of a community in one seismic area and expect that it will be technically appropriate or useful in a different community in another seismic area.

In all, the principles of 'the first draft of the proposed framework' contain many common aspects of non-technical and technical measures usually facing a community and in line with the research topic. The principles deal with the comprehensive regulatory, technical, social, and economic issues involved in seismic risk management activities, inside which the role of various stakeholders such as researcher, scientist, contractor, foreman, government, businessman, educator, NGO, community leader and reporter lie.

The structure of 'the first draft' is divided into three headings, which correspond with the three steps in seismic risk management approach adopted in this research. These are: seismic hazard analysis, seismic risk assessment, and seismic risk response. Twelve core areas were identified that underpin the understanding of seismic risk reduction of non-engineered buildings. The length or relative importance of each core area might vary, depending largely on the needs of users. Each core area provides statements consisting of characteristics and their indicators. Characteristics are the breakdown of core areas, which relate to guiding elements to SRRNEB comprising the full set of components in current community activities, such as individuals, organizations, policies, and technical resources. The characteristics highlight important areas to reduce significantly the seismic risk of non-engineered buildings, moving from knowledge to action. Whereas, indicators are elements to monitor and measure the progress of implementation, as well as to address existing resources, capacities, and/or attitudes. The indicators were designed to be achievable, desirable, and measurable. The procedure used to develop elements (i.e. headings, core areas, characteristics, and indicators) in 'the first draft' is structurally depicted in Figure 5.1.

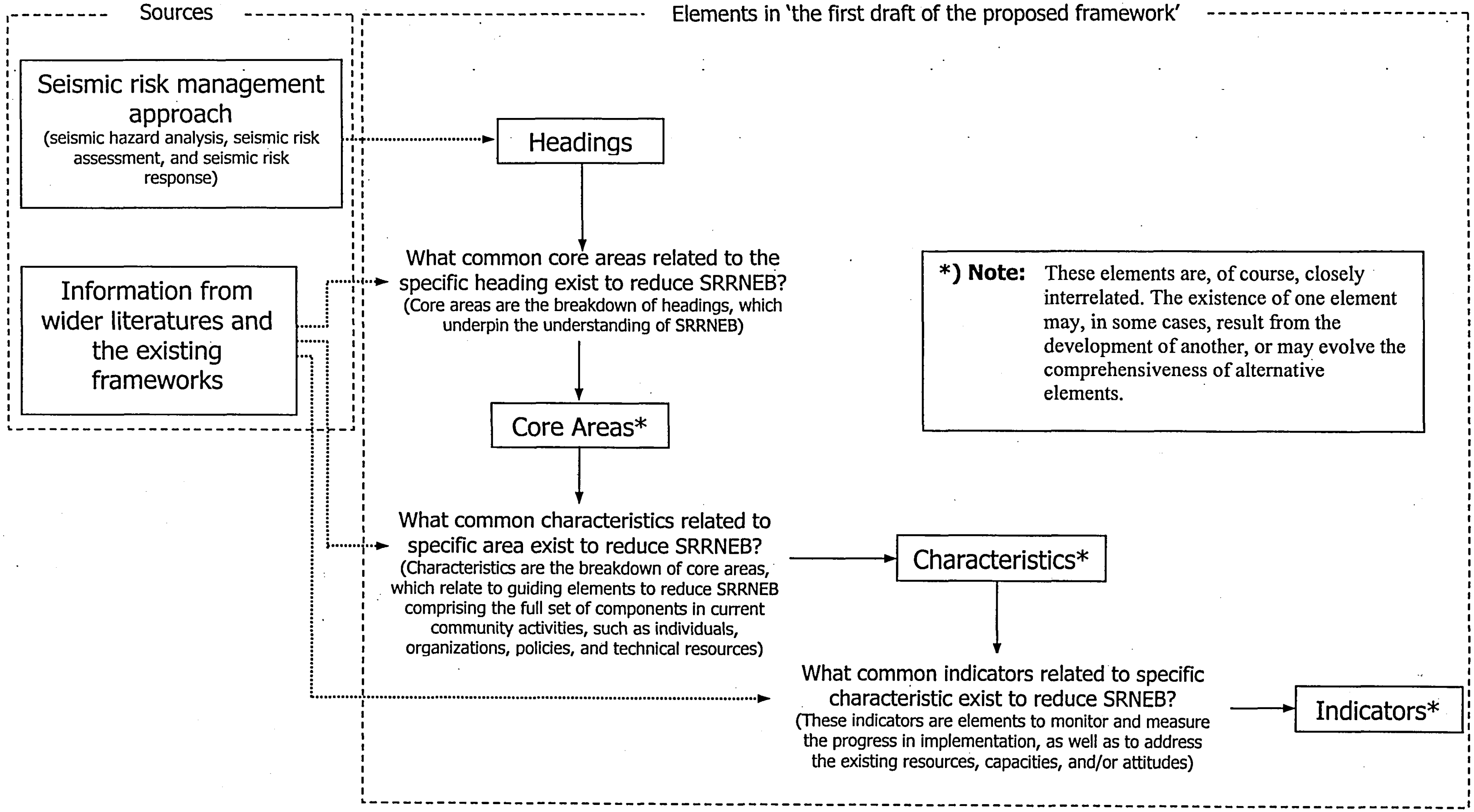

Figure 5.1 The procedure used to develop elements (i.e. headings, core areas, characteristics, & indicators) of 'the first draft of the proposed framework'

The initial result of development of 'the first draft of the proposed framework' via Figure 5.1 is then described in Sections 5.3.1, 5.3.2, and 5.3.3 below. The terms F-I, F-II, and F-III represent the frameworks in Section 5.1.1, 5.1.2, and 5.1.3 respectively. A symbol tick (√) represents the source of the relevant statement within F-I, F-II, and/or F-III. The higher number in relevant references in each statement does not correspond with the higher level of importance in the relevant statement. These references are merely to indicate that 'the first draft' heavily relied upon both wider literature and the existing frameworks for clear justification and sound theory.

5.4.1 Headings Related to Seismic Hazard Analysis

Table 5.4 Characteristics to 'seismic hazard analysis'

Characteristics	References related to the characteristics			
	F-I	F-II	F-III	Literature
1. Earthquake occurrence data: their history, spatial distribution, characteristics, and impacts	√			(FEMA, 2001), (Tantala et al., 2001)
2. Earthquake scenario data				(Gould, 2003), (FEMA, 2001), (Tantala et al., 2001)

Table 5.5 Indicators to 'seismic hazard analysis'

Indicators	References related to the indicators			
	F-I	F-II	F-III	Literature
1. Data recorded, mapped, and updated regularly	√			(FEMA, 2001), (Tantala et al., 2001)
2. Existence of earthquake data to conduct deterministic earthquake scenario				(FEMA, 2001), (Tantala et al., 2001)
3. Existence of systematic analysis of return period of earthquake occurrence to conduct probabilistic earthquake scenario				(FEMA, 2001), (Tantala et al., 2001)

5.4.2 Headings Related to Seismic Risk Assessment

Table 5.6 Characteristics to 'seismic risk assessment'

Characteristics	References related to the characteristics			
	F-I	F-II	F-III	Literature
1. Inventory data: geology/soil profiles and buildings				(FEMA, 2001), (Tantala et al., 2001)
2. Building fragility curves	√			(Gould, 2003), (FEMA, 2001), (Tantala et al., 2001)
3. Damage assessment	√			(GREAT, 2001)

Table 5.7 Indicators to 'seismic risk assessment'

Indicators	References related to the indicators			
	F-I	F-II	F-III	Literature
1. Geology/soil profiles and buildings inventory data are recorded, mapped, and updated regularly as necessary, particularly in order to calculate the quantitative number of non-engineered buildings and their spatial distribution	√			(FEMA, 2001), (Tantala et al., 2001)
2. Existence of building fragility curves: updated regularly and associated with the newest data	√	√	√	(Gould, 2003), (FEMA, 2001), (Tantala et al., 2001)
3. Existence of systematic damage assessment of the possible economic impact to buildings using seismic risk scenario both deterministic and probabilistic approach	√			(GREAT, 2001)

5.4.3 Headings Related to Seismic Risk Response

Table 5.8 Characteristics to 'policy and planning'

Characteristics	References related to the characteristics			
	F-I	F-II	F-III	Literature
1. Seismic risk reduction of non-engineered buildings (SRRNEB) as a policy priority	√			(Jain, 1998), (Shah, 2002)
2. Integration of SRRNEB in development planning and sectoral policies (including poverty eradication)	√			(UNDP, 2004), (UN-ISDR, 2002)
3. Responsibilities of SRRNEB		√		(CEEDEDS, 2004)

Table 5.9 Indicators to 'policy and planning'

Indicators	References related to the indicators			
	F-I	F-II	F-III	Literature
1. Existence of SRRNEB commitment and strategy in city level (including collaboration with donor agencies) in relation to the context of decentralization)	√			(Comartin et al., 2004)
2. Established or revised policies to facilitate action, regulation, enforcement, and/or incentives		√		(Hays, 2001), (UNDP, 2004)
3. Map out institutions with responsibilities of SRRNEB		√		(Hays, 2001)

Table 5.10 Characteristics to 'legal and regulatory framework'

Characteristics	References related to the characteristics			
	F-I	F-II	F-III	Literature
1. Seismic codes	√			(DPU, 2002), (IITK-BMPTC, 2002)
2. Laws and regulations	√			(Petak, 2002)
3. Compliance and enforcement	√			(Shah, 2002)
4. Certification system for engineers, architects, and foreman			√	(Sarwidi, 2001), (CEEDEDS, 2004)
5. Responsibility and accountability	√			(UNDP, 2004)

Table 5.11 Indicators to 'legal and regulatory framework'

Indicators	References related to the indicators			
	F-I	F-II	F-III	Literature
1. Seismic codes (socially acceptable, written in simple language, easy to implement, and economically feasible) are in existence and updated	√			(DPU, 2002), (IITK-BMPTPC, 2002)
2. Existence of administrative and institutional mechanism framework for implementation of seismic codes			√	(Petak, 2002)
3. Existence of regulation of builders and real estate developers for creation of seismic resistant buildings			√	(Shah, 2002)
4. Existence of regulation of Financial Institution for ensuring seismic resistant features in new and extension of existing constructions while giving loans and insurance			√	(Kunreuther, 2000)
5. Existence of systems to control compliance and enforcement in actual practices	√			(UNDP, 2004)
6. Existence of compulsory certification system for engineers, architects, and foreman			√	(IUDMP, 2001), (CEEDEDS, 2004)
7. Existence of watchdog groups	√			

Table 5.12 Characteristics to 'organizational structures'

Characteristics	References related to the characteristics			
	F-I	F-II	F-III	Literature
1. Implementing and co-ordinating bodies	√			(UNDP, 2004)
2. Intra and inter-ministerial, multidisciplinary & multisectoral mechanisms	√			(UNDP, 2004), (Petak, 2002)
3. Civil society, NGOs, private sector and community participation	√			(UNDP, 2004)

Table 5.13 Indicators to 'organizational structures'

Indicators	References related to the indicators			
	F-I	F-II	F-III	Literature
1. Existence of an administrative structure responsible for disaster reduction	√	√		(UNDP, 2004)
2. Existence of sectoral programmes in line ministries	√			(UNDP, 2004), (Petak, 2002)
3. Existence of consultation, and role for civil society, NGOs, private sector and the communities.	√			(UNDP, 2004)
4. Existence of groups or individuals that have incorporated earthquake risk reduction as a permanent or significant part of their operations and commitment		√		(IUDMP, 2000)

Table 5.14 Characteristics to 'resources'

Characteristics	References related to the characteristics			
	F-I	F-II	F-III	Literature
1. Resource mobilisation and allocation: financial (innovative and alternative funding, incentives), human, technical, material	√			(Ngoedijo, 2003)

Table 5.15 Indicators to 'resources'

Indicators	References related to the indicators			
	F-I	F-II	F-III	Literature
1. Existence of disaster management office		√		(Ngoedijo, 2003)
2. Evidence of permanence budgetary allocation	√			(Ngoedijo, 2003)
3. Expert staffing allocation	√			(Ngoedijo, 2003)
4. Existence of established link with donor organizations				(UNDP, 2004)

Table 5.16 Characteristics to 'information management and communication'

Characteristics	References related to the characteristics			
	F-I	F-II	F-III	Literature
1. Information and dissemination programmes and channels	√			(BSSC, 1995)
2. Networks for seismic risk management (scientific, technical, and applied information, traditional/indigenous knowledge),	√		–	(UNDP, 2004)

Table 5.17 Indicators to 'information management and communication'

Indicators	References related to the indicators			
	F-I	F-II	F-III	Literature
1. Existence of dissemination media through web-site	√	√	√	(BSSC, 1995)
2. Existence of documentation and databases on seismic risk	√	√		(SCEC, 2002), (Kunreuther, 2000)
3. Continuity of dissemination channels and participation down through grass-root communities and use of traditional/indigenous knowledge and practice	√			(SCEC, 2002), (Kunreuther, 2000), (UNDP, 2004)
4. Existence of multidiscipline stakeholders networks in seismic risk management	√		√	(UNDP, 2004)
5. Existence of information centers and networks in seismic risk management		√		(UNDP, 2004)
6. Existence inter-city exposure visits for city managers for mutual learning			√	(EERI, 1999)
7. Existence of pro-active sharing of best practices for earthquake risk management for wider circulation			√	(EERI, 1999)

Table 5.18 Characteristics to 'education and training'

Characteristics	References related to the characteristics			
	F-I	F-II	F-III	Literature
1. Inclusion of seismic risk reduction at all levels of education (curricula, educational material)	√		√	(UNDP, 2004)
2. The role of teachers through school activities			√	(NDMD, 2004), (UNDP, 2004)
3. Training of trainer (TOT) programmes	√			(UNDP, 2004)
4. Local, National, and International training program	√			(UNDP, 2004), (IUDMP, 2001)

Table 5.19 Indicators to 'education and training'

Indicators	References related to the indicators			
	F-I	F-II	F-III	Literature
1. Existence of appropriate curricula in seismic risk reduction	√			(UNDP, 2004)
2. Existence of the role of teacher to disseminate and apply seismic codes in the real practice through their student activities (including collaboration with other parties)	√			(UNDP, 2004)
3. Existence of TOT for community leaders periodically		√		(UNDP, 2004)
4. Existence of training for development authorities, Community Organization, NGOs, group of foreman, private sectors: real-estate firms, builders, small-medium contractors in safe-building practices and retrofitting techniques			√	(UNDP, 2004)
5. Existence of apprentice programmes in seismic risk management for government disaster management staff	√		√	(UNDP, 2004)

Table 5.20 Characteristics to 'public awareness'

Characteristics	References related to the characteristics			
	F-I	F-II	F-III	Literature
1. Public awareness policy, programmes, and material	√			(UNDP, 2004)
2. Dissemination and use of traditional/indigenous knowledge through media involvement in communicating seismic risk	√		√	(Vickridge, 1996)
3. Earthquake Safety Day		√		(ADPC, 2000)
4. Documentation	√			(UNDP, 2004)

Table 5.21 Indicators 'public awareness'

Indicators	References related to indicators			
	F-I	F-II	F-III	Literature
1. Existence of city specific awareness campaign strategies in seismic risk.	√		√	(UNDP, 2004)
2. Availability and accessibility of information (handbook, poster, newspaper, exhibition, talk show, etc) in introducing seismic features of buildings with simple technical approaches understandable to the layperson, including the existence of several model houses with low-cost and simple seismic features in neighbouring areas		√	√	(EERI, 1999)
3. Tradesman involvement in producing and circulating the seismic features information				(IUDMP, 2000)
4. Existence of a mechanism to monitor the increasing number of aware and informed community members such as students and teachers, key government functionaries, construction actors and engineering institutions, policy makers etc.		√	√	(UNDP, 2004)
5. Existence of community-based informal meeting discussing good practices in seismic features of buildings				(Comfort, 1999)
6. Visibility of Earthquake Safety Day through: school activities, audio-visual programmes, competitions, mock drills, etc			√	(ADPC, 2000)
7. Existence of document of appropriate cost effective retrofitting techniques and sharing of best practices, conference proceedings and articles in popular magazines			√	(UNDP, 2004)

Table 5.22 Characteristics to 'research'

Characteristics	References related to the characteristics			
	F-I	F-II	F-III	Literature
1. Cost-effectiveness research in application of seismic features.	√			(ADPC, 2000)
2. Interdisciplinary research between science and policy				(UNDP, 2004)
3. Evaluation and feedback	√			(UNDP, 2004)
4. Local, National, and International co-operation in research, science and technology development	√			(UNDP, 2004)

Table 5.23 Indicators to 'research'

Indicators	References related to the indicators			
	F-I	F-II	F-III	Literature
1. Existence of cost-effectiveness research in application of seismic features both for new and existing buildings (retrofitting)	√			(UNDP, 2004)
2. Existence of reducing seismic risk through Interdisciplinary research between science and policy (evidence-based policy) comprehensively	√	√		(UNDP, 2004)
3. Existence of indicators, standards and methodologies for seismic hazard analysis and assessment, unique to their local needs			√	(UNDP, 2004), (Vickridge, 1996)
4. Providing technical support, training, and periodic assessments on earthquake vulnerability through the research/knowledge at all community levels.			√	(UNDP, 2004)
5. Existence of local academic institutions as Key Resource Institutions for earthquake risk management	√			(GREAT, 2001)
6. Existence of Local, National, and International exchange				(UNDP, 2004)

Table 5.24 Characteristics to 'social and economic development practices'

Characteristics	References related to the characteristics			
	F-I	F-II	F-III	Literature
1. Pro-poor strategy and sustainable livelihood strategies	√			(UNDP, 2004), (Timmer, 2004)
2. Financial instruments	√			(Kunreuther, 2000)

Table 5.25 Indicators to 'social and economic development practices'

Indicators	References related to the indicators			
	F-I	F-II	F-III	Literature
1. Existence of information that introducing seismic features in buildings is low-cost and simple (not burdensome) down through to the grass root communities				(Arya, 2004), (BSSC, 1995)
2. Existence of incentive strategy for new buildings with seismic features				(Kunreuther, 2000)
3. Existence of earthquake insurance initiatives	√		√	(Morrow, 1999)

Table 5.26 Characteristics to 'physical measures'

Characteristics	References related to the characteristics			
	F-I	F-II	F-III	Literature
1. Land use applications	√			(Tantala et al., 2001)
2. Introducing seismic codes in new and existing buildings	√			(Tantala et al., 2001)
3. Good examples of real constructions				(EERI, 1999)

Table 5.27 Indicators to 'physical measures'

Indicators	References related to the indicators			
	F-I	F-II	F-III	Literature
1. Existence of seismic risk map using Geographic Information System (GIS)	√			(Tantala et al. 2001)
2. Compliance of public and private buildings with seismic codes and standards	√			(BSSC, 1995)
3. Existence of retrofitting program for public buildings (health facilities, schools, lifelines, etc) at high seismic risk	√			(BSSC, 1995)
4. Existence of regular maintenance of seismic features in structures	√			(GREAT, 2001)
5. Existence of a number of model houses with seismic features, low-cost, and simple as well as ready to be replicated in other areas			√	(EERI, 1999)

All Tables, 5.4 to 5.27, are then combined into Table 5.28 as follows, representing 'the first draft of the proposed framework', consisting of 57 pairs of characteristic-indicators. Moreover, each pair related to technical intervention is coded with '*/star'.

Table 5.28 'The first draft of the proposed framework', consisting of fifty-seven pairs of characteristic-indicators

Seismic Hazard Analysis		
	Characteristics	Indicators
	Core area: Seismic Hazard Analysis	
	1. Earthquake occurrence data: their history, spatial distribution, characteristics, and impacts *	Data is recorded, mapped, and up-dated regularly
	2. Earthquake scenario data *	Existence of earthquake data to conduct deterministic earthquake scenario
	3. Earthquake scenario data *	Existence of systematic analysis of return period of earthquake occurrence to conduct probabilistic earthquake scenario

Table 5.28 continued

Seismic Risk Assessment

Core area: Seismic Risk Assessment	
4. Inventory data: geology/soil profiles and buildings *	Geology/soil profiles and buildings inventory data are recorded, mapped, and up-dated regularly as necessary, particularly in order to calculate the quantitative number of non-engineered buildings and their spatial distribution
5. Building fragility curves *	Existence of building fragility curves: up-dated regularly and associated with the newest data
6. Damage assessment *	Existence of systematic damage assessment of the possible economic impact to buildings using a seismic risk scenario both the deterministic and probabilistic approaches

Seismic Risk Response

Core area: Policy and Planning	
7. Seismic risk reduction of non-engineered buildings (SRRNEB) as a policy priority	Existence of SRRNEB commitment and strategy on a city level (including collaboration with donor agencies, in relation to the context of decentralization)
8. Integration of SRRNEB in development planning and sectoral policies (including poverty eradication)	Established or revised policies to facilitate action, regulation, enforcement, and/or incentives
9. Responsibilities of SRRNEB	Map out institutions with responsibilities of SRRNEB
Core area: Legal and Regulatory Framework	
10. Seismic codes *	Seismic codes (socially acceptable, written in simple language, easy to implement, and economically feasible) are in existence and updated
11. Laws and regulations	Existence of an administrative and institutional mechanism framework for the implementation of seismic codes
12. Compliance and enforcement	Existence of regulation of builders and real estate developers for the creation of seismic resistant buildings
13. Compliance and enforcement	Existence of regulation of Financial Institutions for ensuring seismic resistant features in new buildings and extension of existing constructions while giving loans and insurance
14. Compliance and enforcement	Existence of systems to control compliance and enforcement in actual practice
15. Certification system for engineers, architects, and foreman	Existence of compulsory certification system for engineers, architects, and foremen
16. Responsibility and accountability	Existence of watchdog groups

Table 5.28 continued

	Core area: Organizational Structure	
	17. Implementing and co-coordinating bodies	Existence of an administrative structure responsible for disaster reduction
	18. Intra and inter-ministerial, multidisciplinary & multisectoral mechanisms	Existence of sectoral programmes in line ministries
	19. Civil society, NGOs, private sector and community participation	Existence of consultation, and role for civil society, NGOs, private sector and the communities to reduce seismic risk
	20. Civil society, NGOs, private sector and community participation	Existence of groups or individuals that have incorporated earthquake risk reduction as a permanent or significant part of their operations and commitment
	Core area: Resources	
	21. Resource mobilization and allocation: financial (innovative and alternative funding), incentives, human, technical, material	Existence of disaster management office
	22. Resource mobilization and allocation: financial (innovative and alternative funding, incentives), human, technical, material	Evidence of permanent budgetary allocation
	23. Resource mobilization and allocation: financial (innovative and alternative funding, incentives), human, technical, material	Expert staffing allocation
	24. Resource mobilization and allocation: financial (innovative and alternative funding, incentives), human, technical, material	Existence of established link with donor organizations
	Core area: Information Management and Communication	
	25. Information and dissemination programmes and channels	Existence of dissemination media through web-sites
	26. Information and dissemination programmes and channels	Existence of documentation and databases on seismic risk
	27. Information and dissemination programmes and channels	Continuity of dissemination channels and participation down through grass-root communities and use of traditional/indigenous knowledge and practice
	28. Networks for seismic risk management (scientific, technical, and applied information, traditional/indigenous knowledge),	Existence of multidisciplinary stakeholder networks in seismic risk management
	29. Networks for seismic risk management (scientific, technical, and applied information, traditional/indigenous knowledge),	Existence of information centers and networks in seismic risk management
	30. Networks for seismic risk management (scientific, technical, and applied information, traditional/indigenous knowledge),	Existence of inter-city exposure visits for city managers for mutual learning
	31. Networks for seismic risk management (scientific, technical, and applied information, traditional/indigenous knowledge),	Existence of pro-active sharing of best practices for earthquake risk management for wider circulation

Table 5.28 continued

	Core area: Education and Training	
	32. Inclusion of seismic risk reduction at all levels of education (curricula, educational material)	Existence of appropriate curricula in seismic risk reduction at all levels of education
	33. The role of teachers through school activities	Existence of the role of teacher to disseminate and apply seismic codes in real practice through their student activities (including collaboration with other parties)
	34. Training of trainer (TOT) programmes	Existence of TOT for community leaders periodically
	35. Local, National, and International training programmes	Existence of training for development authorities, Community Organizations, NGOs, groups of foremen, private sector: real-estate firms, builders, small-medium contractors in safe-building practices and retrofitting techniques
	36. Local, National, and International training programmes	Existence of apprentice programmes in seismic risk management for government disaster management staff
	Core area: Public Awareness	
	37. Public awareness policy, programmes, and material	Existence of city specific awareness campaign strategies in seismic risk.
	38. Dissemination and use of traditional/indigenous knowledge through media involvement in communicating seismic risk	Availability and accessibility of information (handbook, poster, newspaper, exhibition, talk show, etc) in introducing seismic features of buildings with simple technical approaches, understandable to the layperson, including the existence of several model houses with low-cost, and simple seismic features in neighbouring areas
	39. Dissemination and use of traditional/indigenous knowledge through media involvement in communicating seismic risk	Existence of tradesman involvement in producing and circulating the seismic features information
	40. Dissemination and use of traditional/indigenous knowledge through media involvement in communicating seismic risk	Existence of a mechanism to monitor the increasing number of aware and informed community members such as students and teachers, key government functionaries, construction actors and engineering institutions, policy makers etc.
	41. Dissemination and use of traditional/indigenous knowledge through media involvement in communicating seismic risk	Existence of community-based informal meetings discussing good practices in seismic features of buildings
	42. Earthquake Safety Day	Visibility of Earthquake Safety Day through: school activities, audio-visual programmes, competitions, mock drills, etc
	43. Documentation	Existence of documents of the appropriate cost of effective retrofitting techniques and sharing of best practices, conference proceedings and articles in popular magazines
	Core area: Research	
	44. Cost-effectiveness research on the application of seismic features *	Existence of cost-effectiveness research in the application of seismic features both for new and existing buildings (retrofitting)

Table 5.28 continued

	45. Interdisciplinary research between science and policy *	Existence of reducing seismic risk through interdisciplinary research between science and policy (evidence-based policy) comprehensively
	46. Evaluation and feedback *	Existence of indicators, standards and methodologies for seismic hazard analysis and assessment, unique to their local needs
	47. Local, National, and International co-operation in research: science and technology development	Providing technical support, training, and periodic assessments on earthquake vulnerability through research/knowledge at all community levels.
	48. Local, National, and International co-operation in research: science and technology development	Existence of local academic institutions as Key Resource Institutions for earthquake risk management
	49. Local, National, and International co-operation in research: science and technology development	Existence of Local, National, and International exchange
	Core area: Social and Economic Development Practices	
	50. Pro-poor and sustainable livelihood strategies	Existence of information that introducing seismic features in buildings is low-cost and simple (not burdensome) down trough to the grass root communities
	51. Financial instruments	Existence of an incentive strategy for new buildings with seismic features
	52. Financial instruments	Existence of earthquake insurance initiative
	Core area: Physical Measures	
	53. Land use applications *	Existence of seismic risk map using Geographic Information System (GIS)
	54. Introducing seismic codes in new and existing buildings *	Compliance of public and private buildings with seismic codes and standards
	55. Good examples of real constructions*	Existence of a retrofitting program for public buildings (health facilities, schools, lifelines, etc) at high seismic risk
	56. Good examples of real constructions*	Existence of regular maintenance of seismic features in structures
	57. Good examples of real constructions*	Existence of the number of model houses with seismic features, low-cost, and simple as well as ready to replicate in other areas

*) The pairs are close to the technical intervention

Table 5.28 gives clear evidence that the above 57 pairs of characteristic-indicators are divided into 15 technical intervention and 42 non-technical intervention. Although the framework is designed to guide and monitor SRRNEB, in fact, non-technical aspects serve as the bulk of the 57 pairs of characteristic-indicators. Thus, it can be summarised that, while technical interventions within non-engineered buildings are important, non-technical measures are an essential element in guiding and monitoring SRRNEB. This evidence is in line with UNDP findings (2004) that human aspects tend to dominate the barriers in reducing disaster. In a broader context, this translates into the need for much greater attention to non-technical measures in order to reduce disaster. In addition, the contents of what are in 'the first draft of the proposed framework' show that, although the proposed framework is designed for non-engineered buildings, most of the principles stated herein will apply to engineered buildings as well with equal force.

It is widely believed that the earthquake event itself is uncontrollable, thus the overall elements in seismic risk management in Table 5.28 are designed in such a way that people can control them to reduce seismic risk. For example, implementation of seismic codes and public education to seismic risk are controllable. Generally, some elements in Table 5.28 reveal a wide and interrelated set of issues that interweave seismic risk management with issues of seismic risk responses, such as risk absorption, risk mitigation, and risk transfer.

Some pairs of characteristic-indicators are related to the government functions that need to be reformed toward effective seismic risk management. This includes three levels: individual level, organisational level, and system level. The needs to be reformed in government on an individual level are, for example, in pairs 23, 28, 30, and 36. Whereas, the urgent reform on an organisational level are, for example, in pairs 17, 18, and 21. The bulk of the capacity reforms on a system or policy level are, for example, in pairs 7, 8, 9, 11, 12, 13, 14, and 37. The above three levels are closely related to the building capacity in the government decentralisation process. Turner, et.al. (2003) mentions that capacity building in the government decentralisation process has to include three levels of intervention in order to be effective and sustainable, as follows.

a. The systems level, i.e. the regulatory framework and policies that support or hamper the achievement of certain policy objectives
b. The institutional or entity level, i.e. the structure of organizations, the decision-making processes within organizations, procedures and working mechanisms, management instruments, the relationships and networks between organizations.
c. The individual level, i.e. individual skills and qualifications, knowledge, attitudes, work ethics and motivations of the people working in organizations.

Figure 5.2 presents the 'the first draft of the proposed framework', complemented by three important factors of effective seismic risk management of non-engineered buildings:

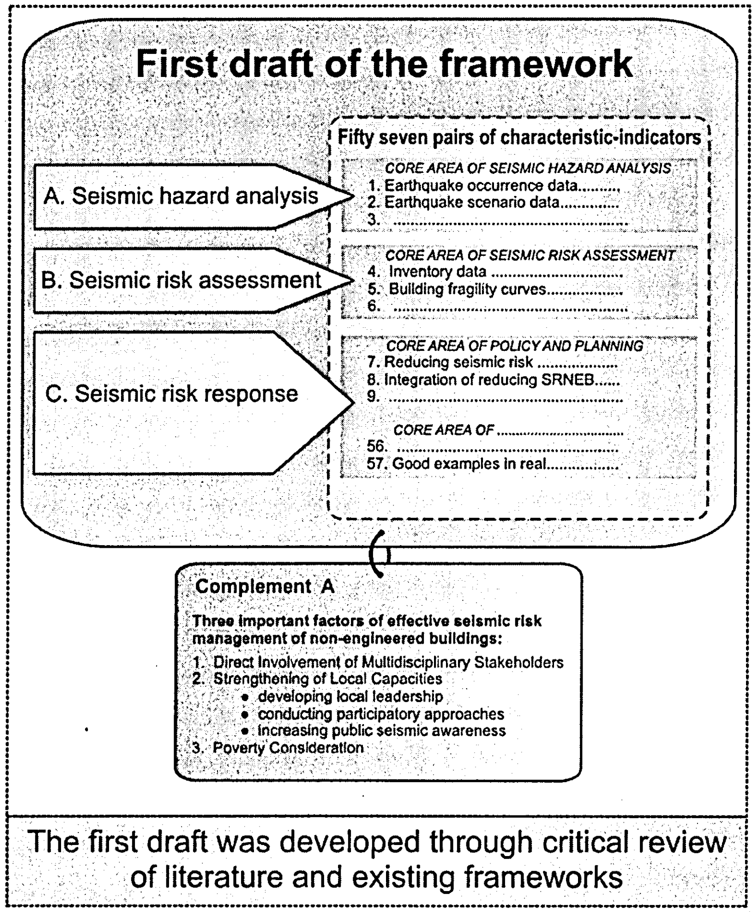

Figure 5.2 'The first draft of the proposed framework' complemented by three important factors of effective seismic risk management of non-engineered buildings.

5.5 Summary

The, beginning of this chapter presented an overview of the origin and content of three existing frameworks and their surrounding commentary. All had a primary concern with reducing disaster risk; however, they demonstrated their specific area of interest. There was still considerable variation in the density of the frameworks in terms of the number of specific features of indicators that were included for appraisal. Most of their principles comprised many aspects of structural measures (for example: damage assessment, structural intervention, implementing and retrofitting of important buildings) and non-structural measures (for example: public awareness, institution building, organizational structure).

Preliminary analysis from the literature review discovered the following facts: (a) most Indonesian regions are located in high seismic areas, (b) the collapse of non-engineered buildings is the biggest cause of human deaths, (c) there is a wide gap between earthquake facts and the existence of seismic codes, (d) the importance of integrated seismic risk management of non-engineered buildings in Indonesia to bridge the gap, (e) a novel framework for guiding and monitoring seismic risk reduction of non-engineered buildings as a starting point to reduce seismic risk.

Finally, the end of this chapter elaborated emerging issues arising from the literature review for primary data investigation, which encompass: (a) headings related to seismic hazard analysis (b) headings related to seismic risk assessment (c) headings related to seismic risk response. This is 'the draft of the proposed framework' which is complemented by three important factors of effective seismic risk management of non-engineered buildings and is intended to be the cornerstone for the next stage of this study. Consisting of 57 pairs of characteristic-indicators, dominated mainly by non-technical measures, the proposed framework gives strong evidence that whenever technical interventions are important, non-technical measures are the substantial element in SRRNEB. Three levels of government function that needed to be reformed, i.e. individual level, organisational level, and system level, also emerged. This is very similar to the capacity building in government decentralisation, as mentioned by Turner et al (2003). The next chapter will present research methodology for the research work.

Chapter VI
Research Methodology

This chapter constitutes the pivotal part of the study, which explains how the research problem is being investigated, and describes the tool being used to make the investigation. In general, the chapter aims to describe, explain, and justify the methodological process adopted for this research. The chapter begins with a description of the methodological framework of the research. It then provides the logic and rationale for the selected approach. Next, the discussion moves to explore the research techniques used; a critical analysis of the research design adopted is also included. The following explanation covers data measurement and its analysis. Finally, this chapter mentions anticipated findings and key quality issues, as well as ethical concerns adopted in this study.

6.1 Definition of Research

Burns (2000) describes research as a systematic investigation to find answers to a problem. More elaborately, as suggested by Blaxter et al. (1996), research is a planned, cautious, systematic, and reliable way of finding out or deepening understanding. For the social scientists or researcher in applied fields, research is a process of trying to gain a better understanding of the complexities of human experience and, in some genres of research, to take action based on that understanding. Through systematic and sometimes collaborative strategies, the researcher gathers information about actions and interactions, reflects on their meaning, evaluates, arrives at conclusions and eventually puts forward an interpretation, most frequently in written form (Marshall & Rossman, 1999).

Research can be conducted in many ways. Blaxter et al. (1996) maintains that even a brief review of literature on research will uncover a lengthy and potentially baffling list of types of research. Some examples of methods of research are as follows:

a. Pure, applied, and strategic research
b. Descriptive, explanatory, and evaluation research
c. Market and academic research

d. Exploratory, testing-out, and problem solving research
e. Covert, adversarial, and collaborative research
f. Basic, applied, instrumental, and action research

Basically, all the different kinds and views of research share the same characteristics given in the definitions earlier (Blaxter et al., 1996). Moreover, there is no hard and fast process model available for every research project to follow. A research process should be reflexive, operating through every stage. In its most simplistic term, Naoum (1998) describes the research process in Figure 6.1:

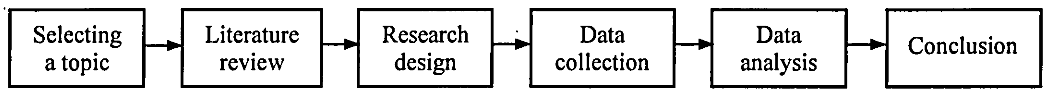

Figure 6.1 Simplistic term of research process (Naoum, 1998)

6.2 Methodological Framework Adopted for the Research

Nachmias and Nachmias (1996) mention that the use of a methodological framework in research provides rules for communication, reasoning, and inter-subjectivity. In general, Blaxter et al., (1996) distinguish two divergent paths of basic research concept, i.e. positivism or a scientific approach, leading to deductive research, and naturalism or a phenomenological approach, leading to inductive research. A deductive approach involves the testing of already established ideas, theories, and hypotheses using data collected specifically for this purpose. In contrast, an inductive approach involves deriving ideas and opinions directly from research data to enhance understanding of an issue or situation. Typically, the inductive approach involves a qualitative methodology and the deductive approach utilises a quantitative methodology. Here, both approaches are briefly compared.

To determine the methodological framework, it is useful to describe the preliminary study from the in-depth literature review in Chapters II, III, and IV. This started with the assertion that most Indonesian regions are located in high seismic areas. Lessons learned from past earthquakes indicated that the collapse of non-engineered buildings has been the biggest cause of human deaths. On the other hand, it is evident from many examples that progress has been made in the knowledge of how to reduce these risks using the implementation of seismic codes. An unacceptable number of human deaths could have been reduced if seismic codes had been implemented rigorously in actual non-engineered construction.

At present, there is a widespread recognition that the implementation of seismic codes in actual construction in developing countries, for example, in Indonesia, encounters complicated barriers. This is not a simple matter, because it comprises all kinds of issues, i.e. physical, financial, educational, and administrative problems. Subsequent to the extensive use of risk management practices in many countries with successful results, it is important to carry out integrated seismic risk management of non-engineered buildings in Indonesia to solve these issues by the involvement of multidisciplinary stakeholders in the decision process. Finally, the evidence elaborated from the literature review (Chapters II, III, and IV) pointed to research to focus on the development of an integrated framework among multidisciplinary stakeholders for seismic risk reduction of non-engineered buildings (SRRNEB) as a starting point to reduce seismic risk in Indonesia.

Next, the research stage moved onto studying and evaluating some existing frameworks in disaster reduction from around the globe, as outlined in Chapter V. This activity gave a general picture of frameworks generated by other institutions to reduce the disaster. A combination of the literature review and analysis of the existing frameworks has formed 'the first draft of the proposed framework' for guiding and monitoring SRRNEB as a robust foundation for the next research stage.

It is clear that the research seems to explore and understand seismic risk management practices for non-engineered buildings, working towards a reduction in seismic risk. It is, therefore, an exploratory research study, with a principal aim of developing an integrated framework for guiding and monitoring SRRNEB. The research intends to provide a foundation to expand knowledge in seismic risk management practice, for future quantitative and qualitative research. The methodology adopted satisfies the need for exploration, insight, depth, and knowledge. Given the nature of the research project, an inductive approach has been identified as appropriate for the research.

6.3 Research Strategy Adopted for the Research

In general, research strategy can be divided between two categories, i.e. quantitative and qualitative. Historically, there has been a heavy emphasis on quantification in science.; the quantitative approach sometimes garners more respect, reflecting the tendency to regard science as related to numbers and implying precision (Berg, 1998). Quantitative research is regarded as ''objective'' in nature. This is based on testing a hypothesis or a theory composed of variables, measured with numbers, and analysed with statistical procedures, in order to determine whether the hypothesis or theory hold true (Naoum, 1998).

Conversely, qualitative research is considered "subjective" in its origin. Nachmias and Nachmias (1996) hold that qualitative research attempts to understand behaviour and institutions by analysing values, rituals, symbols, beliefs, and emotions. The approach emphasises meanings, experiences (often verbally described), description and so on (Naoum, 1998). Qualitative methods are stereotyped with a narrative response from the respondent and, in addition, allow flexibility. Thus, the responsiveness of the individuals' and organisations' conceptualisation of themselves is also related to a willingness to formulate a new hypothesis and alter existing ones as the research progresses, in the light of emerging insights (Cassell and Symon, 1994). However, the popularity, status and use of qualitative methods still vary among different social and behavioural sciences. In addition, Marshall and Rossman (1999) and Gummesson (2000) agree that the qualitative methodology provides powerful tools for research in management subjects, including general management, organisation, corporate strategy, and more.

The quantitative and qualitative approaches differ fundamentally in their philosophies, aims, and abilities. Qualitative research is not about providing statistical evidence for its findings, it is about providing insight and depth; it is typically an iterative rather than a linear process and often involves a researcher moving back and forth between sources of data and ongoing data analysis. Although there are considerable distinctive features between the two strategies, the relationship between the theory/concepts and research strategy in terms of verifying the theory/concept against proffering theory to emerge from the data is not as clear-cut as is sometimes implied (Naoum, 1998). Table 6.1 compares the differences between two research strategies from different perspectives:

Table 6.1 Some differences between quantitative and qualitative research (Naoum, 1998)

	Quantitative	Qualitative
1. Role	Fact-finding based on evidence or records	Attitude measurement based on opinions, views and perceptions measurement
2. Relationship between researcher and subject	Distant	Close
3. Relationship between theory/concepts and research	Testing/confirmation	Emergent / development
4. Nature of data	Hard and reliable	Rich and deep

The research work for this project is focused on multidisciplinary stakeholders' perspectives and their cultures and strategies. Clearly, it requires a deeper understanding of the intentions underlying the action. As explained in the research strategy characteristics mentioned above, the qualitative approach makes more sense and tends to dominate the research process. Relying only on a rigorous qualitative approach does not necessarily provide all the data needed in order to embrace the various backgrounds of multidiscipline participants. Consequently, the subject matter in this research did not lend itself easily to the qualitative approach, so the quantitative method was also employed to pose the statistical analysis, in order to estimate the distribution of characteristics in the population obtained from the postal questionnaire survey. Therefore, this research process used both qualitative and quantitative approaches, which also proved how these two different research approaches can be integrated to develop the proposed framework. Combining different positive attributes in the two methods could result in gaining the best of both research worlds.

6.4 Research Question Adopted for the Research

Usually, quantitative research is designed to test or validate a hypothesis or a conceptual theory; hence, a hypothesis of at least one sentence needs to be established, which should clearly and specifically state the position for the argument or investigation. On the other hand, qualitative research is generally designed to develop a theoretical framework, then a number of 'research questions' need to be formulated, which should determine the direction for the study (Naoum, 1998).

According to the methodological framework evaluated in Section 6.2, this research has used an inductive approach, with mainly qualitative methodology, thus it needs to generate a 'research question'. It is true that the methodological foundation of any research project depends largely on research questions; as highlighted by Morse (1994), the wording of the research question determines the focus and scope of the study. Designing a good research question is considered to be the most difficult task of a researcher (Stake, 1995). Furthermore, Blaxter et al. (1996) mention that research questions are more like objectives than aims: they should contain within themselves the means for assessing their achievement.

Marshall and Rossman (1999) suggest the need for flexibility in the research questions, so that data gathering can satisfy in the refining of the research questions, especially in the qualitative approach, which is uniquely suited to uncovering the unexpected and exploring new avenues. However, it should be sufficiently clear to be adequately evaluated for practicality; on the other hand, it should reserve the flexibility that is the hallmark of qualitative methods. This suggests that the research question should be general enough to permit exploration, but focus on research objectives.

Here, the main research question for this research project, after carrying out the critical review of the literature and existing frameworks, has been identified as follows:

"How can multidisciplinary stakeholders in Indonesia set up a seismic risk reduction of non-engineered buildings via a seismic risk management approach that works well?"

Fundamentally, the research is about the understanding and developing of integration from the multidisciplinary stakeholders' perspective within a seismic risk management approach. Further to this, the research not only describes intentions, but also evaluates in-depth and analyse the integrated seismic risk management of non-engineered buildings for the development of an implementation framework, as a starting point to reduce seismic risk of non-engineered buildings in Indonesia.

In order to answer the main research question, the research project had to look at things like how other countries have done it and what were the surrounding commentaries. The research also gathered information from a wide range of respondents around Indonesia, and talked with some of them to find out the practical solution in order to break the problem. Therefore, the following research sub-questions were emerged.

a. What kinds of seismic risk reduction program have other countries set up, and what are their surrounding commentaries?
b. What kinds of important activities on SRRNEB based on wider literature and other countries' program?
c. What do multidisciplinary stakeholders in Indonesia respond and say the important activities on SRRNEB and what ideas do they have for making it work well?
d. What particular aspects should stakeholders in Indonesia emphasise to make significant impact in SRRNEB?

The above first two sub-questions have been critically accomplished in Chapter V, whereas the next sub-questions are further examined in Chapters VIII and IX through primary data collection.

6.5 Research Design of the Project

The research design is the guide that enables the researcher to come up with solutions to the research problems (Nachmias and Nachmias, 1996). It is a pathfinder to the process of collecting, analysing, and interpreting observations. Moreover, it details the procedures necessary for obtaining the information and data needed to achieve the research aim. Research design also elaborates the details of implementing the research process.

The number of methods of research design is countless in variation. Research design involves the concrete steps that the researcher needs to take in order to do the research. Research design covers the various issues which should be borne in mind when carrying out a research project. Thinking through and writing up a research design perspective helps a researcher to decide which type of research he/she wants to do, helps to choose an approach to data collection and analysis and how to write up findings (Gilgun, 2004), thus arriving at an appropriate and sound research methodology.

Research design adopted for this research project is elaborated in Figure 6.2. The design consists of the following four main steps: (1) developing 'the first draft of proposed framework' through critically reviewing the literature and existing frameworks, (2) refining 'the first draft' to be 'the second draft' via a pilot study, postal questionnaire survey, and interview method, (3) refining 'the second draft' into 'the final proposed framework' by conducting a workshop event and (4) validating the final framework through two workshop events and drawing the conclusion. It may be helpful to define the above steps as discussed below, together with the accompanying further explanation:

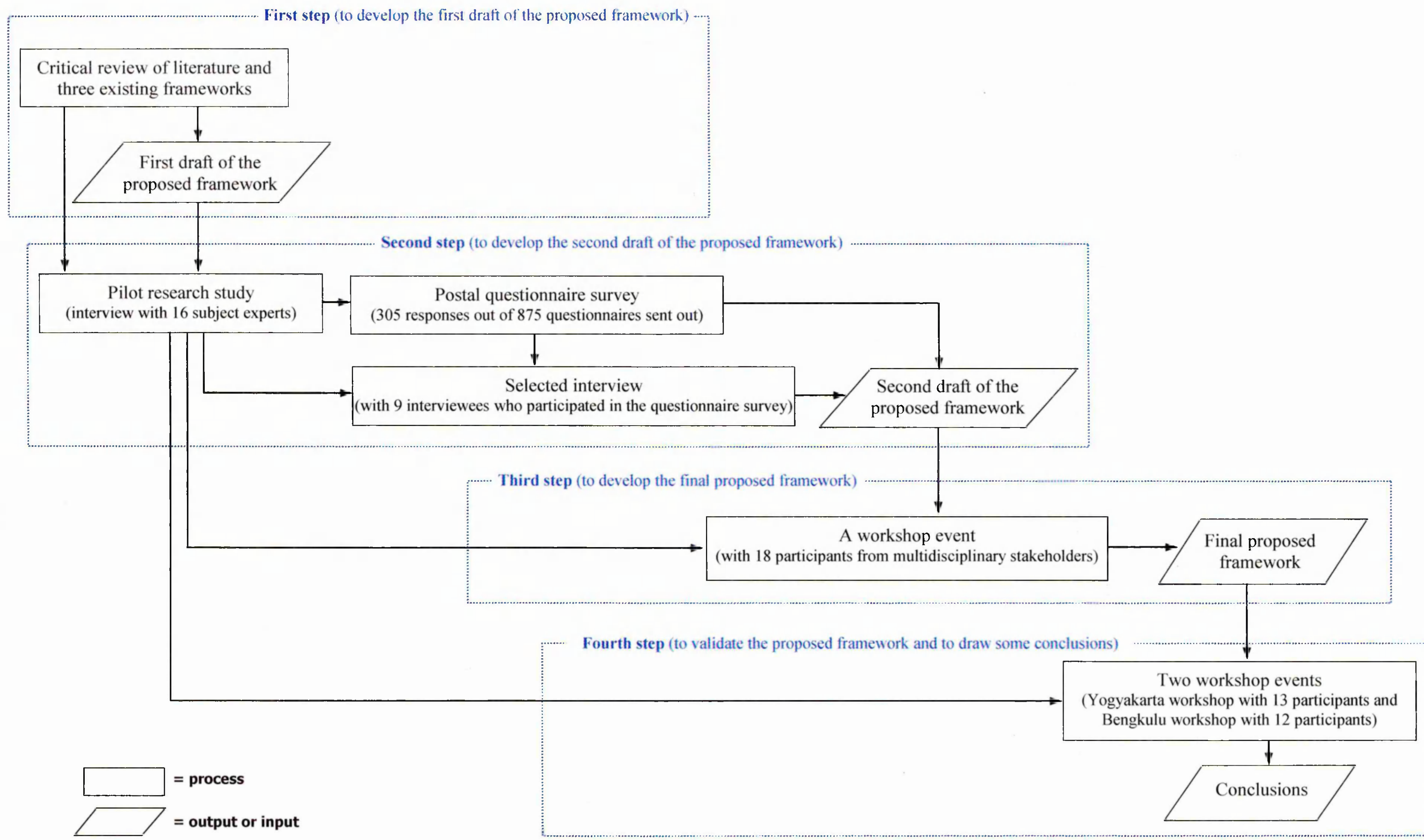

Figure 6.2 Design for the research

179

a. Developing 'the first draft of the proposed framework'

Keeping in mind the aim and objectives of this research project, a thorough desk-based review of literature and existing frameworks was conducted as the first step of the research design. It is one of the earliest stages in the research process and it amounts to a significant proportion of research content as a strong foundation for the next stage of the study. The literature and existing framework review as secondary data involved reading, mapping, and criticising what other people have written about the research subject area. This was not only descriptive, in that it described the work of previous authors, but also analytical, in that it critically scrutinised the contribution of others, with the view of identifying similarities and contradictions made by previous writers. This shows the quality of references that indicate familiarity with key literature.

This critical literature review generated comprehensive information on (1) the high seismic areas in Indonesia, (2) the human deaths caused by the collapse of non-engineered buildings, (3) the wide gap between massive death tolls caused by the collapse of non-engineered buildings and the existence of seismic codes, (3) the widespread use of seismic risk management practices, and finally, (4) the focus on developing an integrated framework for guiding and monitoring SRRNEB as a starting point to reduce seismic risk in Indonesia. The critical literature review was given in Chapters II, III, and IV. In the beginning of Chapter V, there was a review of three existing frameworks in disaster reduction.

Relying heavily upon the wider literature and the existing frameworks as secondary data, this first research design was able to explain and list some emerging issues for primary data investigation; this was then called 'the first draft of the proposed framework'. This first draft provides a launching pad for the next stage of the research process.

b. Refining 'the first draft' to be 'the second draft'

This was the second step of the research design, which aimed to refine 'the first draft of the proposed framework'. This consisted of a pilot study and primary data collection through a postal questionnaire survey and interview. The pilot study was conducted by interviewing 16 important people from various background to help refine the data collection plans and to recognise any potential flaws and inadequacies with regard to both the contents of the data and the procedures. It could also be used for adding or subtracting some elements in the initial research design. This also allowed the researcher to develop an understanding with participants. Chapter VII covers further details of the pilot study and its findings.

Given the nature of the research aim and objectives, 'the first draft', drawn merely from secondary data, was not enough to embrace the common cultural diversity and its origin in Indonesia, which should be factored into the proposed framework. It should be highlighted here that the proposed framework should embrace as many common issues and characteristics related to the daily activities of Indonesian people as possible. Thus, the next step after the pilot study was primary data collection via a postal questionnaire survey and interview method. The use of a postal questionnaire and interview were employed in the process of collecting primary data from a sample of people who were selected to represent a larger population.

As stated in previous chapters, a number of multidisciplinary stakeholders were identified for this research topic as the main actors in a seismic risk management programme of non-engineered building. These were: researchers/scientists, small-medium contractors, foremen, government officials, businessmen, educators, NGO and community leaders. It was important to invite their contribution to refine 'the first draft' based on their level of knowledge and expertise as primary data. The final number of multidisciplinary stakeholders involved in this research was justified through a pilot study detailed in Chapter VII. In general, the stakeholder criteria used for primary data collection were as follows:

i. The important person in each stakeholder organisation was identified to be the main contact person for the primary data collection
ii. He/she was actively involved in and formed policy issues

Data collection phase was conducted in Indonesia. During the data collection phase, the author organized a research committee consisting of two senior Civil Engineering university lecturers, one construction professional and four Civil Engineering students. Duties and responsibilities of the research committee are as follows:

i. to help the researcher in organising the data collection phase
ii. to advise the researcher on the research strategy in order to stimulate creative activity and liaise with many agencies
iii. to review the proposed research findings with an independent review of the facts and free of vested personal or professional interest in the general and specific objectives to obtain adequate and appropriate group decision.

The first and foremost data collection method was a postal questionnaire survey in order to gather primary data from a potentially large number of stakeholders as respondents in Indonesia within a limited timeframe, to achieve a generalised result, which was extracted from respondents' opinions. Because the principal issues and characteristics for primary data collection ('the first draft of the proposed framework') were already stated in Section 5.3, the aims of the postal questionnaire were (1) to describe the distribution of characteristics in the population, (2) to capture some additional characteristics, comments, or feedback not stated in the questionnaire to refine 'the first draft' through leaving adequate space for respondents to write in and (3) to estimate the correlation in ranking opinion.

875 questionnaires were circulated to a wide variety of respondents, representing multidisciplinary stakeholders in Indonesia, and 305 were returned. The list of name and address of the respondents was collected from government agency and private organisation base data. In this research, a stratified random sampling method was adopted.

The second primary data collection method was by interview. In this sense, an interview was conducted with those involved in the previous postal questionnaire survey, and there were 9 interviewees. The aim of conducting an interview at this stage was particularly to explain 'why' the questionnaire findings took place and to find some answer for certain questions emerging from the questionnaire survey. Through this method, a narrative response was achieved because the respondents had greater freedom of expression. Furthermore, the respondents were able to qualify their answers. Furthermore, the interview was important to validate the postal questionnaire findings.

The rationale of why these types of data collection were used, the numbers of questionnaires, and the sampling method mentioned above were chosen is further explained in the subsequent section. Chapter IX elaborates further on the postal questionnaire and interview data collection and their findings.

c. Refining 'the second draft' into 'the final framework'

The aim of this step was to develop 'the final framework' based on 'the second draft of the proposed framework'. The workshop event, attended by 18 multidisciplinary stakeholder representatives, was conducted to serve this stage, the core of the research aim. This method was selected, based on the assumption that each workshop participant wished to share and exchange common experience and knowledge about existing barriers and possible solutions directly and openly (Andrew, 2004). The workshop participants were the people who had particularly taken part in the questionnaire survey and who held an important position within each stakeholder organisation, regardless of their regency, city, provincial, or national work scope level.

Through the formal workshop, stakeholder representatives were invited to present their experiences, their needs, and their aspirations to refine 'the second draft' and to identify many aspects that were needed for further work. Because stakeholders would definitely implement the framework, they were expected to be full participants in its development; this needed to be flexible and simple using clear language to ensure open channels of communication. The detail rationale for conducting the workshop is explained in the subsequent section.

Two people from each stakeholder representative were invited and participated in the workshop. The research committee carried out the workshop activities, and the researcher acted as a workshop facilitator. At the beginning of the workshop, the workshop facilitator presented the findings of the postal questionnaire and interview (or 'the second draft of the proposed framework') first as it then stood, and next, participants discussed the structure and content of the framework and issues in a small group and plenary session, which they felt required further development. With this interactive effort, the workshop was able to provide a sound proposed framework for guiding and monitoring SRRNEB. Chapter X presents the details of the development of the final framework through the workshop event.

d. Validating 'the final framework' and drawing the conclusion

Having achieved the final framework, based on the outcome of the workshop, the research committee then implemented the developed framework in two Indonesian cities located in high seismic areas as a validation media, through another workshop. The workshop participants were different and independent people from the previous workshop participants in order to achieve a robust framework validation. They were actively involved in policy issues in certain levels of city work scope located in high seismic areas in Indonesia. In addition, it was particularly that they had already taken part in the questionnaire survey and were important within their own stakeholder organisation. The pilot study in Chapter VII determined the two cities (Yogyakarta City and Bengkulu City) where the framework validation workshop should be carried out. The method of conducting this second workshop was analogous to the first workshop. With this synergetic effort, the workshop served a feasible empirical testing of the proposed framework successfully.

The final stage of this research was to draw firm conclusions ranging from the literature review to the framework validation. The framework validation is presented in Chapter XI, and Chapter XII gives the research conclusion and limitations as well as recommendation for further research.

6.6 Approaches to and Techniques for Data Collection Adopted for the Research

6.6.1 Approaches to Data Collection

The data collection approach adopted for research depends on the nature of the research question, and the type of data and information that is required and available. Most literature suggests that the data collection approach in general inductive research can be conducted in two ways, namely fieldwork for primary data collection and desk study for secondary data collection (Naoum, 1998). Primary data (first hand data) collected from fieldwork can be associated with three practical approaches, as follows:

a. Survey approach. Surveys are used to gather data from a relatively large number of respondents within a limited time frame. They are thus concerned with a generalised result, when data is abstracted from a particular sample or population.

b. Case study approach. Case studies are utilised when the researcher intends to support his/her argument by in-depth analysis of a person, a group of persons, an organisation or a particular project. As the nature of the case study focuses on one aspect of a problem, the conclusion drawn will not be generalised but rather related to one particular event.

c. Problem solving approach (action research). With the survey and the case study approach, the researcher tends not to affect or interfere with that which is being studied. In the problem-solving approach (also named action research), the researcher reviews the current situation, identifies the problem, gets involved in introducing some changes to improve the situation and possibly, evaluates the effect of his/her changes. This type of research is more attractive to practitioners, industrialists and students from a professional background who have identified a problem during the course of their work and wish to investigate and propose a change to improve the situation.

On the other hand, the desk study approach uses secondary data obtained from other sources, which can be stored either in a statistical or descriptive format. Secondary data has some distinctive advantages over the efforts needed for primary data collection related to time and cost. In general, it is much less expensive and takes less time to use secondary data, than to conduct a primary research investigation. If stringent budget and time constraints are imposed on primary research, secondary data may provide a useful comparative tool.

Having explained the approach to data collection and research design described above, the fieldwork approach was judged best to be able to obtain the information needed in the research. Fieldwork with a survey approach gave sound rationale to a primary data approach, in order to gather data from a large number of multidisciplinary stakeholders within the broader culture of Indonesian people. Using this survey enabled the researcher to reach an objective conclusion by sampling a broad spread of participants.

6.6.2 Techniques for Data Collection

According to the fieldwork adopted in this research, this section presents the main features of three research data collection techniques available to elicit primary data and information from respondents, i.e. a postal questionnaire survey, interview method, and workshop event. The decision to determine data collection technique depended on the judgement as to which methods or techniques best obtained the information needed in order to achieve the purpose of the research. The discussion below gives principal characteristics of the three data collection techniques in relation to the research design:

a. Postal questionnaire survey

Naoum (1998) highlights that postal questionnaires have been widely used for descriptive and analytical surveys in order to discover facts, opinions and views on what is happening, who, where, how many, or how much for data collection. When using the questionnaire survey method, data is not deliberately controlled,it is described as it naturally exists. The response rates for postal surveys usually range between 40-60 percent depending on certain situation. The survey is able to serve qualitative and quantitative research. The two main advantages of postal questionnaires are:

i. Economy. Postal questionnaires are perceived as offering relatively high result validity because of their wide geographic coverage. As a result, this technique is suited to assembling a mass of information at a minimum expense in terms of finance, human, and other resources.

ii. Speed. Postal questionnaires are certainly a quick method of conducting a survey. If administered properly, the bulk of the returns will probably be received within two weeks; however, time must be allowed for late returns and responses to follow-up attempts.

However, there are limitations to postal questionnaires, as follows:

i. Must contain simple questions. The postal questionnaire is only suitable for simple and straightforward questions, which can be answered with the aid of easy instructions and definitions. The questions should be very carefully worded and free from faults such as ambiguity, vagueness, technical expression, and difficulty. These faults can affect the results of the postal questionnaire even more seriously than when conducting any other method.

ii. Inflexible technique. Inflexible in this sense means that postal mail questionnaires do not allow the opportunity for probing. In other words, the answers have to be accepted as final and there is no opportunity to clarify ambiguity or to appraise the non-verbal behaviour of respondents, though the latter sometimes creates bias.

iii. Accuracy. Respondents may answer generally when the research questions are seeking a response on a specific level of analysis. People may also answer according to what they think the researcher wants to hear. Moreover, they may answer according to their public profile rather than the underlying corporate reality.

iv. No control over respondents. This means that although there is a clear statement in the questionnaire that a particular person should complete the questionnaire (such as a policy maker or community leader), there is no guarantee that this statement will ensure that the right person completes the questionnaire. However, this is less of a problem that not getting a response at all.

v. Industry fatigue. Companies receive a steady stream of questionnaires and the pressures of modern business mean that, for many organisations and individuals, students' questionnaires are of less priority.

b. Personal interview

The personal interview is another major technique for collecting factual in-depth information, opinions, or the story behind a participant's experiences (Naoum, 1998). It is a face-to-face interpersonal role situation in which the researcher asks an individual a series of questions designed to elicit answers pertinent to the research topic. The questions, their wording, and their sequence define the structure of the interview. The interview technique is suitable under the following circumstances:

i. When the people being interviewed are homogenous and share the same characteristics.

ii. When the researcher knows enough about the interviewee to concentrate on important questions and know how to ask them.

iii. When an interpersonal encounter is essential to explain and describe the questions

iv. When a case study needs to investigate a certain detail, asking questions such as how and why things had happened the way they did.

v. When the research requires an explanation as to why the respondents are answering or feeling the way they do, i.e. requires more than a 'Yes or No' or 'Agree or Disagree' answer.

The nature of interview responses allows respondents greater freedom of expression, and results in a richer set of data, in-depth analysis of individual experiences, and a more enhanced understanding of the problem. Therefore, this technique is often used in the qualitative approach. Unlike postal questionnaires, the interviewer has the opportunity to probe or ask follow up questions. As a result, the interview technique can be useful to follow-up or further investigate the postal questionnaire responses (Naoum, 1998). However, this method is time consuming and tends to be resource intensive.

There are three types of interview method, i.e. unstructured, semi-structured, and structured interviews (Naoum, 1998). The form of unstructured interview uses 'open ended' or 'open questions' and the questionnaire is often pitched at a very general level, so that the researcher can see in which direction the interviewee takes their responses. The semi-structured interview is more formal than the unstructured, in that there are a number of specific topics around which to build the interview. This method uses 'open' and 'closed-ended' questioning but the questions are not asked in a specific order and no schedule is used. Through this approach, the task is to discover as much as possible about specific issues related to subject area. In the semi-structured interview, the interviewer has a great deal of freedom to probe various areas and to raise specific queries during the course of the interview. Lastly, in the structured interview, the questions are presented in the same order and with the same wording to all interviewees. The interviewer will have full control of the questionnaire throughout the entire process of the interview. In this technique, the questioning may start with some 'open' questions, but will soon move toward a 'closed' question format (Naoum, 1998).

c. Workshop Event

With the postal questionnaire technique and interview data collection, respondents do not affect or interfere with each other to argue their opinion, position, and argument. In data collection via workshops, each participant gets involved directly in introducing his/her opinion, position, and argument as well as appraising verbal behaviour during the event. The workshop is highly interactive, combining presentations, exercises and discussions in small and plenary sessions. Moreover, each participant contributes significantly to the formulation of the workshop results, which are usually held in plenary session. This type of data collection is more relevant to formulate and solve multiple dimensions of the problem from different perspectives. According to the nature of workshop events, the qualitative approach is suitable for its analysis.

Spencer et al. (2003) mention that one research strategy for developing a framework after conducting the literature review and survey is utilisation of the workshop method to explore the participants' reactions to the initial framework developed by the researcher. In the area of disaster reduction, Mitchell (2003) highlights the importance of the workshop method as a forum for stakeholders to argue their policy positions and consider the arguments of other participants. The idea is to explore the ground where a range of resource people can agree on a policy direction, but for different reasons. Multidisciplinary stakeholders' participation can be effective as a means of formulating citizen grievances, ideas, interest, opinions, and views and feeding them into the policy process. In addition, the workshop method can fit various participants who possess the ability and resources to adopt and implement the results (Andrews, 2004). It is also important to conduct a workshop on the development of a seismic risk management framework, when enhancing seismic risk reduction is inherently a political process with many players, each with different worldviews, struggling to reach some modest agreement on what constitutes the problem and what constitutes a workable solution (Petak, 2002).

As discussed earlier, however, the data collection strategy is determined by the nature of the research question. As Denzin and Lincoln (1998) affirm, data collection strategies are merely tools; it is the researcher's responsibility to understand the variety available and the different purposes of each strategy, to appreciate in advance the ramifications for selecting one method over the other and to become astute in the selection of one method over another. Each qualitative strategy offers a particular and unique perspective that illuminates certain aspects of reality more easily than others and produces a type of results more suited for some applications than others.

The above explanation of data collection techniques highlights a number of specific features of each technique. The postal questionnaire survey, selected interview, and workshop event mentioned above were identified as the best techniques in order to obtain necessary data and to achieve the purpose of the research. The rationales for choosing the three techniques were as follows:

a. As there were a potentially large number of multidisciplinary stakeholders as respondents with an enormous diversity in background from around Indonesia, it was important to collect primary data from a sample of them, as they were selected to represent a larger population. Therefore, a generalised result extracted from a larger number of respondents was needed. Based on the nature of fieldwork survey, the postal questionnaire survey was best judged to be the first and foremost data collection technique, in order: (1) to describe the distribution of characteristics in the respondent opinions, (2) to refine 'the first draft of the proposed framework' by leaving adequate space for respondents to make a comment or provide feedback not captured by the questionnaires, and (3) to estimate the correlation in ranking opinion. The benefit of its economy and speed constituted the major factors in choosing this technique; however, to overcome its deficiencies in opportunities for probing, the interview method was definitely needed in the next technique, as described in point (b) as follow.

b. It was important to follow the questionnaire survey with the interview method, because this technique gave the opportunity for probing 'why' the questionnaire findings took place. Another reason was to validate the postal questionnaire findings. Through this powerful technique, in-depth investigation of causality was achieved. Therefore, misleading conclusions could be avoided because the respondents were able to qualify their responses e.g. *'Yes, but....'* or *'It depends....'*. While the interview technique provides the comprehensive solution to obtain the causality of the questionnaire findings, the lack of interactive response between each respondent still existed, because each respondent worked individually in the two techniques mentioned above. It would have been very hard to solve the multiple dimensions of seismic risk management problems by only using these methods, when competing multidisciplinary worldviews are influential. Therefore, the synergetic and interactive effort of the workshop method was vital, as discussed in point (c) as follows:

c. The workshop event provided answers to overcome the deficiencies of the postal questionnaire and interview techniques. The powerful features of the workshop provided closer contact and interactive discussion in small groups and plenary sessions among participants. This strategy was used in the development of 'the final framework' and the validation media. The purpose of the workshop was to formulate and solve multiple dimensions of the problem from the different perspectives of the multidisciplinary stakeholders, raised by the postal questionnaire and interview, as suggested by Spencer et al. (2003), Mitchell (2003), Andrews (2004), and Petak (2002). In this sense, the event provided a unique platform to discuss and assess achievements, identify challenges and concrete future action to reduce seismic risk of non-engineered buildings in Indonesia.

Characterised by open and substantive discussions in a cordial and co-operative atmosphere, the framework was discussed openly and agreed by the stakeholder forum, and the workshop ended on a positive and successful note.

The types of data collection techniques were substantiated through pilot study in Chapter VII.

6.7 Sampling Method Adopted for the Research

Selecting the research sample is very important and great care must be taken when choosing the type of sample design. This is to ensure that the characteristics of the sample are the same as its population and act as representatives of the population as a whole. Usually, the means of drawing a representative sample is done either randomly or non-randomly. The term 'random' means selecting subjects (respondents) arbitrarily and without purpose (Naoum, 1998). Designing the research sample can take many forms, each of which is suitable to a particular situation. The explanation below describes three types of sampling: simple random sampling, stratified random sampling, and selected sampling extracted from Naoum (1998) and StatPac (2005):

a. Simple random sampling. This method is the basic sampling technique to select a group of subjects (a sample) for research from a larger population. Each individual is chosen by chance and each member of the population has an equal chance of being included in the sample. This sampling can be used when specifics about the characteristics of the sample are not essential, such as the background of respondents, size of company, and type of work, and so on. In other word, the population is homogeneous.

b. Stratified random sampling. There may be often be factors that the researcher wants to examine, not only the result from the overall population, but also the differences between key demographic subgroups within the population. This can be achieved through stratified random sampling, which involves dividing the heterogeneous population into homogenous subgroups and then taking a simple random sample from each subgroup. The process is slightly more time consuming, but this technique can be very valuable

c. Selected sampling. This type of sampling begins with choosing a list of names and addresses of participants with specific characteristics, for example, the top contractors who are offering alternative procurement methods and undertaking refurbishment work for commercial clients. All other contractors will be excluded from the survey.

In this study, a stratified random sampling was thought to be more appropriate than a simple random sampling and selected sampling due to the various characteristics of the multidisciplinary stakeholders as respondents. In this sense, because each respondent seemed different in characteristics, philosophy, and experience, the stratified random sampling was chosen to accommodate the heterogeneous population. It was also in line with research design, which required comparing the views of many stakeholders from different backgrounds.

6.8 Method for Data Measurement and Analysis

6.8.1 Method for Data Measurement

The foundation of all questionnaires in research, whether postal or to be used for interviews as well as workshops, should be analysed. Questionnaires are classified into two types, i.e. closed and open (Naoum, 1998), whereas, measurements in the questionnaire can be categorised into 'fixed response' for the closed form of questions and 'narrative response' for the open, as well as a combination of the two. The 'fixed response' is closely related to quantitative questions, while the 'narrative response' is for qualitative.

In the quantitative area, measurement is a procedure in which a researcher assigns numerals (numbers or other symbols) to empirical properties (variables) according to rules. 'Fixed response' questions are easy to ask and quick to answer, they require no writing by either respondent or interviewer, and their analysis is straightforward (Nachmias and Nachmias, 1996). In general, quantitative data measurement is divided into four levels of measurement, namely nominal, ordinal, interval, and ratio (Naoum, 1998), as follows:

a. Nominal scale. Nominal numbering implies belonging to a classification or having a particular property and a label. It does not imply any idea of rank or priority. Nominal numbering is also conventional integers; that is, positive. This may well be due to the fact that most statistics are analysed by computer which handles numbers more easily than letters or strings.
b. Ordinal scale. This is a rating or a ranking of data, which normally uses integers in ascending or descending order. The rating scale is one of the most common formats for

questioning respondents on their views or opinions of an object, event, or attribute. In this sense, the respondent has the choice to express his/her degree of agreement or disagreement and assess importance on a particular scale. The ranking format is used when the respondent is asked to place a set of attitudes or objects in order, indicating their importance, priorities, or preferences.

c. Interval scale. The numbering system in the nominal and ordinal measurement is purely an arbitrary label for identifying each type of person. If there is a set of observations or data where the distance between each observation is constant, this type of measurement is called an interval level of measurement. Examples often used are minutes, kilograms, the number of words recalled in a memory test, or percentage marks in an exam.

d. Ratio scale. The ratio scale is similar to the interval scale, except it involves the type of numerical scale which has a natural zero, such as age, salary, time, and distance.

Conversely, in qualitative questions, data is presented in a 'narrative response', which allows respondents greater freedom of expression. Once the respondent understands the theme of the investigation, he/she can let thought roam freely, unencumbered by a prepared set of replies (Naoum, 1998).

According to 'the first draft of the proposed framework' in Table 5.28, there are 57 pairs of characteristic-indicators. This means that the postal questionnaire consists of a lot of questions and the respondent should freely give his/her opinion. Therefore, the responses will be time consuming if the question is open ended and respondent becomes bored and fatigued. To overcome this matter, a 'fixed response' postal questionnaire, where the question is easily answered, was adopted in this research. A five-point rating scale (an ordinal scale) was used to test the degree of importance of each characteristic, together with its indicators. Meanwhile, during the interview and workshop event, the research data input from participants was definitely captured in a 'narrative response'. As a result, qualitative analysis was utilised in this manner.

6.8.2 Methods for Data Analysis

Once research data is collected, the next research stage is to analyse the results to determine the direction of the study. It is true that this research will gather a lot of information, which makes it difficult to present all of it. This section elaborates the rationale for deciding methods of analysis that are used to summarise and organise both the ordinal data and narrative data in most effective and meaningful way. All the data collected was analysed with the use of a computer aided software programme i.e. SPSS to analyse the quantitative data and NVivo to assist organisation and analysis of the narrative data.

a. Method of analysis for ordinal data

The ordinal data was captured from the postal questionnaire survey, which consisted of a number of factors/characteristics. This data was then used in two ways: (1) to determine a general picture of every pair of characteristic-indicators and (2) to measure whether the difference in opinion between stakeholder groups is significant or not.

According to Nauom (1998), in order to measure the difference in opinion (ordinal data) of a number of factors between two groups, the Spearman rank correlation coefficient method is the answer. The SPSS software programme was used in this stage. Steps to be carried out in the Spearman correlation method are as follows (Naoum, 1998):

i. Formulate the research hypothesis (H_A) in terms of the predicted results.

The hypothesis adopted in this analysis is 'there is a correlation in ranking opinion between the two stakeholder groups toward characteristics and their indicators within the proposed framework'.

ii. State the null hypothesis (H_o).

The null hypothesis is a statement which is the antithesis of the research hypothesis. Therefore, the null hypothesis adopted in this study is 'there is no correlation in ranking opinion between the two stakeholder groups toward characteristics and their indicators within the proposed framework'.

iii. Calculate the ranking and *'rho'*.

Step-1: Calculate the ranking by converting the score value into rankings.

Step-2: Calculate 'rho' (ρ) through the following simple formula

$$rho = 1 - \frac{6\sum di^2}{n(n^2-1)}$$

Where, di = the difference in ranking between each pair of characteristic-indicators

n = number of pairs of characteristic-indicators

iv. Decide whether there is a high positive correlation

Look up the critical value (r_o) in the Spearman '*rho*' table in Appendix-1. Compare the calculated value (rho) with the critical value (r_o). If the calculated value is larger than the critical value, it means that the research hypothesis is accepted and null hypothesis is rejected, meaning that there is no significant difference in opinion between the data sets. Finally, the correlation among all stakeholder opinions can be arranged in matrix format, in order to provide a general overview of the result.

Most statisticians consider 20 plus to be the minimum number of data required in order to apply the Spearman correlation method (Naoum, 1998).

b. Method of analysis for narrative data

The narrative data was collected from interview and workshop events. Analysis of the narrative data can be rather complicated and not as straightforward as a close-ended questionnaire. The best way to analyse narrative data is to code the information in terms of ideas, patterns, and themes (Naoum, 1998). The purpose of coding such questions is to reduce the large number of individual responses to a few general categories of answer that can be assigned a numerical code. Coding is the process of identifying and classifying each answer with a numerical score or other character symbol. It usually involves entering the data for analysis or for computer storage. The coding categories should be exhaustive and provide for all possible responses. They should be mutually exclusive and independent so that there is no overlap among categories. This process is generally referred to as post-coded. This means that the categories are assigned after the data has been collected. After establishing the coding, the descriptive statistics method was employed to provide a general overview of the result. NVivo software programme was utilised at this stage.

6.9 Anticipated Findings

There were three primary data collection techniques, which were extensively utilised in this research in order to obtain data from multidisciplinary stakeholders as respondents, i.e. a postal questionnaire, interview, and workshop event. In order to bring together all of the necessary expertise and all relevant public and private interests, it was believed that issues related to the seismic safety of non-engineered building could be resolved. Each had specific positive attributes, which conformed to the data and information needed in order to solve the research problem. Here, anticipated findings for each technique are presented as follows:

a. Postal questionnaire

The questionnaire asked respondents to give their opinion according to three sections, as follows:

i. Assign a level of importance to each pair of characteristic-indicators

In this section, respondents were asked to give their opinion on the importance of each pair of characteristic-indicators already written in the questionnaire. The anticipated findings were that most stakeholders assigned a high priority or ranking to technical intervention in the proposed framework, although the distribution of opinions would tend to be scattered.

ii. Comment or feedback from respondents not captured in the questionnaire

The critical literature review referred to the fact that the current situation in Indonesian disaster management displays a lack of adequate activities in risk management, as they are mostly focused on disaster response activities. The anticipated findings in this section were therefore that the 57 pairs of characteristic-indicators in Table 5.28 were comprehensive enough from a respondent's point of view and only a few respondents would write additional ideas, comments, or feedback in the space available in the questionnaire.

iii. An estimation of the correlation in the ranking of opinion

In this section, based on the respondents' preferences of importance for each pair of characteristic-indicators, the anticipated findings were that there would be a high positive correlation in the ranking of opinion between each stakeholder group toward characteristics-indicators within the proposed framework.

b. Interview method

The interview method was primarily designed to answer 'why' the questionnaire findings took place. The anticipated finding was that most people consider that the common activities or characteristics in a seismic risk management framework should be balanced between technical activities and non-technical activities.

c. Workshop event

Through the workshop event, each participant shared direct discussion with other participants based on the findings from the postal questionnaire and interview. It was very much hoped that the workshop event would achieve the best resolution in the proposed framework from the multidisciplinary stakeholder point of view when they shared their experiences, perspectives, and needs directly. Based on the findings from previous activities, together with both the benefit of the research for the community as a whole and the positive features of the workshop method, the anticipated findings of this workshop were that the final proposed framework would be agreed by workshop participants, including as many characteristics and their indicator(s) as possible in seismic risk management of non-engineered buildings. In addition to the fact that most of the failures were often in the concrete implementation of seismic codes within non-engineered buildings rather than the existing seismic codes itself, the additional anticipated findings were that the human aspect was one of the major problems in the implementation of seismic codes, particularly the lack of activities that hardly generated political commitment from government. This led to a conclusion that technical intervention was not in the highest ranking in seismic risk management activities in Indonesia. Furthermore, this anticipated finding was similar to common global problems in developing countries (UNDP, 2004).

6.10 Key Quality Concerns Adopted for the Research

Analogous to research conducted by Spencer et al, (2003), the following four guiding principles of the study were key quality concerns and were adopted. The research needed to be: contributory, defensible in design, rigorous in conduct, and credible in claim. The purpose of this section is to show that the research findings are the product of conscious analysis. The explanations are as follows.

a. Contributory in advancing wider knowledge or understanding.

The findings of this research definitely showed its relevance or contribution to wider knowledge. The following displays evidence of this:

iv. The developed framework, as the principal research aim, was the main contribution to the wider knowledge and understanding for the Indonesian community as a whole. to the wider knowledge and understanding for the Indonesian community as a whole. Through its proper utilisation, this would have considerable impact and would be useful to the future of building work, particularly in Indonesia, but also for other developing countries as necessary. Chapter IX presents the framework in detail.

v. Some of the research contributions have been presented in the section of contribution to wider knowledge in Chapters VII and IX. This included new understanding or insight and creative interpretations, which were probably neglected or under-researched in the past.

vi. Moreover, the research findings were linked to, strengthen, and/or complement the existing research and theory

b. Defensible in design

This research was designed by providing a sound research strategy to ensure that it addressed the aim and objectives. The following displays evidence of this:

i. The underpinning research methodology was clearly in place to facilitate the successful achievement of the research aim and objectives.
ii. A clear rationale for the research question was developed in Section 6.3
iii. A defensible rationale for the choice of data collection methods was presented in Section 6.4
iv. A defensible sampling strategy, a logical and clear sample selection criteria, and comprehensive and balanced sample coverage were highly elaborated in Section 6.6.
v. Detailed sample profiles of each data collection phase were tabulated in the beginning of every primary data collection chapter.

c. Rigorous in conduct

The research was carried out through the systematic and transparent collection, analysis, and interpretation of quantitative and qualitative data. This procedure is often associated with the term 'reliability or notion of consistency'. The following displays evidence of this:

i. The research methodology was developed with a plausible argument by considering the many strengths and weaknesses of appropriate techniques and selecting the most appropriate method for the research purpose.
ii. In-depth research data was collected through two methods: (1) from secondary data collection through desk-based critical literature review and analysis of the three existing frameworks around the globe, and (2) from primary data collection through a postal questionnaire survey, selected interviews, and a workshop event.
iii. Data was recorded carefully and analysed with the assistance of SPSS and NVivo software to minimise error during the statistical and qualitative data analysis.
iv. The correlation analysis was calculated with a manual calculation first and then cross-checked with the assistance of SPSS software.
v. Some pictures were utilised to clearly aid conceptualism and explain the phenomenon investigated.
vi. The emerging issues were always interwoven with the previous findings or the existing theory.
vii. During primary data collection in Indonesia, the author formed a research committee to facilitate and maintain validity and reliability in accomplishing the research, and also particularly to guide the data collection, analysis, and interpretations in the right direction.

d. Credible in claim

The research offered well-founded and plausible arguments about the significance of the data generated. This procedure is associated with the term 'validity'. The following displays evidence of this:

i. The developed research data instrument was carefully checked and piloted.
ii. The data source was triangulated to conceptualise the research problem and to arrive at the research findings.
iii. A statistical test was administered to confirm the validity of the findings.
iv. Emergent issues and findings were always guided by views of the existing theory or literature.
v. Two senior university lecturers were involved in the significance of data generated, analysed, and interpreted as part of the research committe.
vi. The respondents were important people or a key person in their organisation and involved in decision making to maintain the high quality data achieved and to avoid bias.
vii. The findings were linked between different assertions and conclusions.
viii. The final research findings were then validated through two workshop events.

6.11 Ethical Consideration of the Research

The aim of this section is to confirm that the conduct, management, and administration of this research are framed in a way which is consistent with ethical codes. These codes are concerned with the definition of the substantive questions being considered for investigation and also with the decisions made concerning the conduct of the research, the methodologies employed and the people and organisations involved. The codes are also to ensure the harmonisation of people and organisations. As mentioned below, these codes were in line with the Sheffield Hallam University's research principles (available at www.shu.ac.uk), and can be summarised as follows:

a. Beneficence and Non-Malfeasance

i. The research aim, which proposed an integrated framework for guiding and monitoring SRRNEB, was widely agreed to be scientifically sound. Moreover, the benefit of this research originally contributed to wider knowledge in relation to risk management practice in developing countries.

ii. While the importance of these research objectives was clearly intended to benefit communities at all levels, there was no inherent risk in the subject.

iii. Adequate research procedures were identified so as not to bring about any potentially harmful effects of participating.

iv. In conducting the research procedures, the researcher was always respectful toward the participants and respected the subject's wishes.

b. Informed Consent

i. The research respondents were adequately informed of the aims, methods, and anticipated benefits, mostly by a face-to-face meeting and a letter before they contributed to the research process.

ii. The documentation given to potential participants was made as comprehensible as possible to facilitate a clear understanding of the significance of the research for people as a whole.

iii. There was an opportunity for participants to raise any issues of concern or to make complaints by contacting the researcher's address or telephone number stated in the research documentation. This meant that the researcher always shared what was already created with them.

iv. Organisation consent was in writing, and records of consent were maintained.

v. Potential participants were able to withdraw their consent to participate at any time.

c. Confidentiality/Anonymity

i. Details that would allow individuals to be identified were not be published, or made available, to anybody not involved in the research unless explicit consent was given by the individuals concerned (in particular for workshop participants), or such information was already in the public domain.

ii. Within the covering letter for the questionnaire and the introduction of the interview and workshop process, there was text to assure respondents that the information provided was held in strict confidence. This step succeeded in overcoming any resistance or prejudice the participants might have against the research data collection process.

6.12 Summary

The chapter highlighted the methodological approach adopted to obtain the information necessary for this study to solve the research problem. As this was one of most important parts of the research work, different methodological concepts and approaches were explained in detail. It was evident from the critical literature review early on that the type of research inquiry identified could be best explored, explained, and analysed by an inductive approach, mainly employing a qualitative methodology. The explanation of different data collection methods in the chapter justified that, among the different research strategies available, the suggested postal questionnaire survey, interview, and workshop methods were best suited to the research question and to the objectives of the research. Although this research mainly consisted of qualitative method, the quantitative approach was also employed in order to accommodate statistical analysis, particularly from questionnaire survey data. The research design section in the chapter stipulated in detail the data collection and analysis approaches adopted for the project. The anticipated findings from the three data collection methods were also mentioned in the following explanation. Next, the four guiding principles of key quality issues were adopted for the research, i.e. it should be contributory, defensible in design, rigorous in conduct, and credible in claim. The chapter ends with the ethical concern adopted in this research, i.e. beneficence and non-malfeasance, informed consent, and confidentiality/ anonymity. The following chapter discusses the pilot research study.

Chapter VII
Pilot Research Study

This chapter presents the pre-data collection phase of the pilot study after developing the research methodology section in Chapter VI. It starts with an introduction to the pilot studies, including their importance in the study and then follows the pilot study design for this research. Subsequent sections mention the list of objectives set out to achieve from the study; the presentation of findings from this chapter also constitutes an important part. This leads to initial contribution to wider knowledge and, finally, refinement of the research design.

7.1 Introduction to Pilot Study

A pilot study can be described as a study that involves a small-scale investigation or trial of the materials and methods adopted in searching for the study's general objective(s) (Cassell et al., 1994). Blaxter et al., (1996) opines that a researcher may think they know enough, but things never work quite the way they are envisaged, even if done many times before. If a pilot study is not carried out, the initial period of data collection would probably turn into a pilot in any case.

Many advantages can be achieved through conducting a pilot study. A pilot study helps to refine the data collection plans with respect to both the contents of the data and the procedures. Janesick (1994) maintains that the pilot study allows the researcher to focus on particular areas that may have been unclear previously. In addition, the pilot may be used to test certain questions. This initial period allows the researcher to develop an understanding with participants. Some insight into the shape of the study that was not previously apparent might also be uncovered by reviewing the records and documents.

According to the definition mentioned above, when conducting a research project, it is good practice to run a trial of the methods and procedures to be employed before the start of the main data collection. This helps to recognise any potential flaws and inadequacies in the designed methods. Important time, which could be wasted in modifying the methods later, is saved. Moreover, it authenticates the relevance and practicality of the research issues and methods early in the research. In addition, research is an arduous and significant time commitment and would be better preceded by a pilot (Janesick, 1994).

As described broadly in Section 6.2, because the research methodology adopted satisfies the need for exploration, insight, depth, and knowledge, an inductive approach has been identified as appropriate for the research, with mainly qualitative methodology. As a result, the pilot study conducted in this step is closely related to the nature of pilot inquiry. A pilot inquiry can be much broader and less focused than the ultimate data collection plan, covering both substantive and methodological issues (Yin, 1994). Effective use of time, participant issues, and researcher issues are some matters to be decided in a pilot study. Janesick (1994) recognises the usual unpredictability of fieldwork. The qualitative research must be ready to adjust schedules, to be flexible about interview times and about adding or subtracting observations or interviews. In addition, the pilot reports should be explicit about the lessons learned for both research design and field procedures. The pilot reports might even contain sub-sections on these topics (Yin, 1994).

7.2 Pilot Study Design for the Research

The nature of the research question in this work, as precisely elaborated in Section 6.3, provided clear evidence that qualitative research constitutes the bulk of the data collection plan, whereas a quantitative approach is also utilised in order to analyse the statistics from the questionnaire findings. It is well known from the previous chapters that developing a framework for guiding and monitoring seismic risk reduction of non-engineered buildings (SRRNEB) needs an integrative approach that combines stakeholders' perspective. Section 4.3.1 also mentioned the eight types of stakeholders involved in the decision process in SRRNEB, i.e. researchers or scientists, small-medium contractors, foremen, policy makers (within government agencies), businessmen, educators, non-government organisations (NGOs), and community leaders.

As a part of the research strategy, this pilot research study substantiated the relevance and practicality of the research issues and confirmed some conceptual clarification for the early research design. The latter conformed to the contents of the data and the procedures. In order to conduct the pilot research inquiry, Naoum (1998) suggests utilising an exploratory interview method, where the questionnaire is often pitched at a general level, covering substantive and methodological issues. Therefore, it was decided to conduct a pilot research study by in-depth interviews with 16 people, consisting of two people for each stakeholder, with different organisation between the two. The stakeholder criteria used for selecting interviewees for the pilot study were as follows:

a. The important person in each stakeholder organization is identified to be the main contact person for the pilot assessment.
b. He/she is actively involved in and forms policy issues
c. He/she has been a permanent resident in a high seismic area in Indonesia since his/her birth, particularly living on Jawa island (the most densely populated island in Indonesia), so that he/she has their own experience in living with seismic event(s).

The first interview was conducted with the first person from each stakeholder and is aimed at a broader assessment of the issues identified from the critical literature review to the early research methodology described in Chapter VI. The second interview was then employed to crosscheck, consolidate, and authenticate findings from the first interview. According to Naoum (1998), the powerful attributes of the semi-structured interview was judged best suited in this pilot study. The next section gives the details of the lines of discussion followed in interviews.

7.3 Objectives of the Pilot Study

There are four main objectives for the pilot study that are primarily related to the main study. Objective one relates to the research background and research objective one, while objective two corresponds to research objectives two, three, and four. Objective three conforms to the research aim, objectives, and research methodology, including research objective five as a whole. Finally, objective four accords to the framework validation as precisely described in research objective six. The objectives for the pilot study were as follows:

Objective 1:

An assessment of the current state of non-engineered building collapse during earthquakes and the existing seismic codes in Indonesia, which is explained as follows:

a. High death tolls caused by the collapse of buildings due to earthquakes.
b. The collapse of buildings, mostly dominated by non-engineered buildings
c. The existing seismic codes for the improvement of seismic resistance of non-engineered buildings
d. The implementation problems of seismic codes in actual construction.

Objective 2:

An evaluation of seismic risk management practices for non-engineered buildings towards seismic risk reduction, which is explained as follows:

a. Understanding of integrated seismic risk management (seismic hazard analysis, seismic risk assessment, and seismic response) as a tool to implement seismic codes in actual construction.
b. Understanding of many stakeholders involvement, strengthening of local community, and poverty factor incorporation as key factors within integrated seismic risk management of non-engineered buildings
c. Problems faced in seismic risk management practices for seismic codes implementation
d. Desirable level of seismic risk management practices

Objective 3:

The proposed framework for guiding and monitoring SRRNEB as a starting point to reduce seismic risk as a whole (output of this research project), which is explained as follows:

a. Feasibility and relevancy of the research aim, objectives, and research methodology (as precisely described in Chapter VI)
b. Desirable characteristics and indicators for the suggested framework
c. Support of the stakeholders for the research project

Objective 4:

The implementation of the proposed framework for validation, which is explained as follows:

a. Selection of cities for the implementation
b. Available material related to the implementation of the proposed framework in actual life (data, procedures, manual, reports, etc)

7.4 Profiles of Pilot Stakeholder Organisations

Personal identifications of each interviewee are not described clearly in this report to protect their confidentiality. In connection with the research topic, a stakeholder from the 'businessmen' category is taken from a real estate developer, which produces residential building in their business activity. Detail profiles of pilot stakeholder organisations are described in Table 7.1 as follows:

Table 7.1 Profiles of interviewees from various stakeholder organisations

No	Stakeholders	Stakeholder A	Stakeholder B
1	Government organisations	Activity: Disaster Management at Provincial Level Position: Assistant of Officer	Activity: Infrastructure Management Position: Staff of Public Building Development
2	Researchers or Scientists	Activity: Earthquake Engineering Position: University Researcher/Lecturer	Activity: Civil Engineering and Disaster Management Position: University Researcher Lecturer
3	Small-medium Contractors	Activity: House Builders Position: Director	Activity: House Builders and Civil Works Position: Director
4	Foreman	Activity: House Builders Position: individually	Activity: House Builders Position: individually
5	Businessmen	Activity: Real Estate Developer Position: Director	Activity: Real Estate Developer Position: Marketing Manager
6	Educators	Activity: Primary school teacher Position: individually	Activity: High school teacher Position: individually
7	NGOs	Activity: Disaster Management Position: Director	Activity: Poverty Alleviation Position: Director
8	Community Leaders	Activity: Youth activities Position: Leader	Activity: Neighbourhood Administrative and Religion activities Position: Secretary

7.5 Findings from the Pilot Study

Interviewees possessed many skills and attributes, from educational practices to technical expertise, and they gave freely their views and aspirations. Generally, most of them appreciated that the research topic had a new paradigm within the context of sustainable development, embracing many types of stakeholders. The research area was relatively new and unfortunately, not enough information was available in the literature and actual practices. Many terms and aspects related to the research topic were partially recognized by interviewees, particularly along with step-by-step seismic risk management definitions; because there were many new terms within the interviewees' vocabulary, the researcher, as an interviewer, should often explain the definitions first when asking questions.

It was widely agreed by the stakeholders that the primary organization activities in Indonesia associated with disaster were to coordinate the response to disasters in all phases, hardly ever to mitigate activities before the disaster strikes. This meant that almost all of the interviewees, except government staff and researchers/scientists, did not give a clear opinion for each pilot study objective. According to the findings, generally, the second interviewee from each stakeholder gave an opinion which was in line and/or strengthened by the first. The findings from pilot research study are described below:

7.5.1 Earthquake Effects, Seismic Codes, and Non Engineered Buildings

It is generally concluded that earthquake effects, particularly from collapsing buildings and their components, can cause losses to life and property. Generally, all the interviewees agreed that the failures result from buildings with deficiencies in design, poor quality in construction, and a lack of maintenance. However, the definition of a non-engineered building was not known among them, indeed, it was only recognized by researchers/scientists.

Interviewees from government staff, researchers/scientists, contractors, and foremen admitted that information on building using seismic codes with seismic features exists and can be accessed by those who need it. For example, the formal seismic codes for concrete structures began to be published by the government for academic and practice purpose in 1971 (PBI 1971) and a manual of seismic resistance for residential houses designed for lay people was available in 1978, and revised periodically (as necessary). In reality, the seismic codes are not implemented widely, particularly within non-engineered buildings, which belong to medium-poor people. From the point of view of contractors and foremen, it was true that there were regulations with limited enforcement and no accountability. The government has not been able to implement even the existing seismic codes because of a lack of suitable implementation mechanism and limited resources for building inspection and control. Self-builders, foremen, and small-medium contractors currently tend to construct buildings which are spontaneously and informally constructed in the common traditional manner.

On the other hand, the people who are represented by the community leaders, NGOs, teachers, and businessmen said that the building code was not disseminated down through to the grass root communities. At the moment, most people who build their own house just want primarily to have a space to live and/or work and do not consider their safety from seismic hazard through the implementation of seismic codes. As a result, non-engineered buildings as vulnerable buildings continue to be built and this would continue the risk for the foreseeable future.

Common to all, the opinions above show that, in many rapidly growing cities, earthquake risk considerations have not been factored into the building and planning process. Governments have not been capable of regulating building in a way that reduces seismic risk, although the seismic codes exist. Finally, this indicates that there is a wide gap between the existence of seismic codes and their implementation.

7.5.2 Practices of Seismic Risk Management

A definition of seismic risk management was categorized as a new word within interviewees' terminology. After an explanation by the researcher, almost all of the interviewees agreed that reducing seismic risk within non-engineered buildings could be done using the implementation of a step-by-step seismic risk management concept before the big one happens. However, the implementation was hardly ever passed down through to the community level in Indonesia. There are many reasons why implementation was rare or very slow. Discussion among the interviewees summarised such factors: (1) a big seismic event is generally a long term, low-visibility process, with no guarantee of tangible rewards in the short term, (2) seismic safety consideration is not a priority within their daily life activities, (3) there is no integrated involvement of many actors within seismic risk management, (4) A big seismic event in Indonesia is often used by politicians to gain kudos from being associated with humanitarian responses, (5) local communities who actually suffer the disaster are never empowered appropriately.

Interviewees suggested that the implementation of seismic risk management practices should embrace the role of technology, the media, and interdisciplinary stakeholders in the communication of seismic risk information. Obviously, this must be integrated and there is a need to continue to expand knowledge of how people and organisations perceive and react to seismic risk management practices, making the information more useful to end-user communities. This leads to the conclusion that the reporters/journalists who drive the information through mass media should also be considered in the decision making process and convey the seismic risk management practices to end-user communities.

The suggestion from most of the interviewees described above was to add reporters as key stakeholders as well, to act beside the eight stakeholder organisations already mentioned. Finally, the number of stakeholder organisations who engaged in this research was to be nine. These are: government agencies, researchers/scientists, small-medium contractors, educators, foremen, NGO's, businessmen, community leaders, and reporters. The nine stakeholder organisations listed above represented nine groups of respondents in order to collect the research data.

Interviewees from government staff suggested that very few government agencies have performed a formal risk assessment or developed plans to reduce building vulnerabilities. This type of disaster management system is not currently integrated, thus each type of disaster is managed by a separate command centre, which does not share actions with other centres. This can illustrate the inadequacy of disaster prevention capability and require concerted effort across departments to co-ordinate and communicate key information on the initiative in Indonesia. Such good practices in other countries can be studied and altered to suit current conditions in Indonesia.

Interviewees from the categories of contractors and foremen opined that the improvement of seismic risk management practices concerning non-engineered buildings could be achieved through (1) improving the mechanism of control over building construction, (2) dissemination of new understandable seismic codes using workshops and training, and (3) adequacy of certification for civil engineers, architects, and foremen. Specifically, interviewees from the category of researchers/scientists elaborated that the use of science in seismic risk management is not only in order to develop technologies that ultimately serve the goal of disaster loss reduction but also to provide the means for society to become more resilient to disaster. Yet, at the moment, the mechanism to make society more resilient is very unsystematic and needs an integrated approach.

More generally, interviewees from NGOs, community leaders, teachers and businessmen suggested that effective development of seismic risk management is a 'community based', 'bottom up' approach, looking from a 'socio economic perspective', focusing on the 'process and product' of built environment formation with an emphasis at local level. They were tired of seeing millions of rupiahs spent on research and studies without any implementation of actions.

All descriptions of seismic risk management practices in this pilot study suggest that the outcome of an effective integrated seismic risk management plan should be a balance between improvements to public safety and to organizational effectiveness. This can be achieved by ensuring that the actors are the right people, with the right skills, doing the right things, in the right place, at the right time.

7.5.3 The Proposed Framework for Guiding and Monitoring SRRNEB

The above description about earthquake effects, seismic codes, and seismic risk management practices gives a clear understanding that there is no established and sustainable framework for guiding and monitoring SRRNEB in Indonesian cities. Therefore, developing a framework for these circumstances by embracing all stakeholder views and aspirations was extremely favourable to them. Most of them said that the proposed framework requires that all stakeholders change their perception and behaviours to place a high priority on safety in planning and development. In order for such a change to take place, prevention and mitigation programming must be sustainable and must provide a sense of ownership to the community. Moreover, the proposed framework should be designed as a flexible tool for many types of organizations in Indonesia. The proposed framework should allow each actor to fit their own strategies for risk management into the overall corporate objectives of their organization. In broad perspective, many elements of the proposed frameworks might overlap with other aspects of engineered buildings and other relevant features without any contradictions.

At the early stage of this study, the researcher developed 'the first draft of the proposed framework', combining an in-depth review of literature and existing frameworks around the globe. Having read 'the first draft', all interviewees realised that many stakeholders could contribute to the refinement of the first draft of the proposed framework, in order to shape it to suit the current condition of the cities in Indonesia. Therefore, the second step in developing the proposed frameworks is to gather ideas and initiatives from many forms of stakeholders within Indonesia. In developing a method to refine the first draft of the proposed framework, the different levels of readiness and experience of all stakeholders knowledge, as well as variations in available resources, need to be recognized. As a result, most interviewees suggested that methods need to be flexible and simple, using clear language to ensure open channels of communication.

Moreover, all interviewees agreed that, to cover the diversity of their opinions, the questionnaire survey was more appropriate in order to gain more and more input from stakeholder representatives. Using postal questionnaires to cope the variety of stakeholder addresses within a limited period is economic in terms of both money and time. All interviewees predicted that all respondents from each stakeholder would participate, because, they would hopefully understand that the benefit of the research is for the Indonesian community as a whole. In order to make the circulation path of the survey easier, respondents could be triggered to contribute to the survey using the formal administrative structure umbrella from their own organizations. Using the formal letter from their leader or manager, respondents could be urged to complete and return the questionnaire.

At the same time, interviewees from researchers/scientists and government staff urged the researcher to add a selected interview beside the questionnaire surveys. The reason was based on the fact that not all respondents would understand the exact meaning of the questionnaire contents, and might need face to face clarification. However, if there were a lot of respondents who wanted to meet the researcher to clarify queries from the questionnaire, it would certainly take a lot of time. This is the reason why the selected interviews are appropriately planned. Other interviewees did not have any comments on this matter.

At the next stage, all interviewees agreed that 'the second draft of the proposed framework' formulated from the questionnaire survey (and selected interviews) needed to be brought to the formal workshop event attended by stakeholder representatives. Using the workshop, stakeholders would be invited to present and discuss their experiences directly and openly, their needs, and their aspirations for the refinement of 'the second draft of the proposed framework' to achieve a final framework.

Having read the first draft of the proposed framework, developed using the literature and existing frameworks, all interviewees said that the characteristics and their indicators included in the draft have comprised most aspects that need to be integrated. It could represent the ideal framework. Considering the current situation in Indonesia, interviewees from government staff and researchers/scientists realised that, to achieve the actual integrated implementation within the framework, all community components would need to do a lot of work. However, all interviewees gave strong support to the research aim in order to create a starting point to make city communities more resilient to seismic risk. To achieve community resilience, it is important to make seismic risk reduction mainstream by actively marketing the value of the framework as a tool benefiting all parties. High commitment and integrated actions from all people, especially within government organisations, are needed to market the proposed framework down through to the grass root communities. The role of reporter in conveying the straightforward information in the right direction is very important. This is also the reason why most interviewees agreed that reporters should also be respondents in this research.

7.5.4 Validation Media for the Proposed Framework

All interviewees agreed that validation of the final framework could be carried out using a workshop event. More specifically, interviewees from the category of researchers/scientists gave full attention to the cities where the final framework would be applied, using workshop events. Interviewees from the researchers gave strong support to the choice of Bengkulu City as the first city for the validation. The city was chosen by the interviewees because a big earthquake occurred there in 2000. The earthquake caused a lot of non-engineered buildings to collapse. The workshop would then be attended by stakeholders with real earthquake experiences embedded in their memories from the modern era.

In the beginning, Yogyakarta City was selected to be the second city for application and validation because it has a high potential of seismic risk in the near future, as described in the literature review. This would validate the new results because the workshop would be presented by stakeholders without any experience of big earthquakes in recent decades, even in their life, but whose city is very vulnerable to seismic risk. The selection of Yogyakarta City was made before the tragic Yogyakarta earthquake on 27th May 2006. As the earthquake had already occurred by the date of the workshop, the framework validation was therefore conducted in two cities that had both experienced the most devastating event of the modern era, a strong earthquake. The first city was Yogyakarta, and then the second was Bengkulu.

In conclusion, the above findings of the pilot study have been successful in substantiating the essential issues of the research project. It is amazing how many lessons can be learned from the findings. In general, all interviewees agreed that the research topic is very interesting and all communities would gain much benefit from the research aim. Thus, it is widely agreed that a lot of stakeholders would not mind participating in this study if they are appropriately informed of the right direction of the research aim. It is true that ideas, opinions, aspirations, and support from the stakeholders as respondents and workshop participants are paramount as a key to successfully achieve the research aim.

7.6 Emerging Issues from Combining the Critical Review of Literature and Existing Frameworks and Pilot Study Findings

This section lists many issues that have been identified from the analysis of the review of literature and existing frameworks and the pilot study, as follows;

a. Implementation of Seismic Codes within Non-Engineered Building Practices

   i. Seismic codes written for academic purposes and in a simple language exist in Indonesia, whose many cities are located in high seismic areas, yet they need to match unique local resources, according to the enormous diversity of the Indonesian region, economy, and culture. The seismic codes should be suited appropriately so that they are socially acceptable, at reasonable cost, and easily absorbed into local construction methodologies.

   ii. The implementation of seismic codes in practice encounters complicated problems associated with many factors such as: limited enforcement and no accountability in regulations, lack of a suitable implementation mechanism, limited resources for building inspection and control, and lack of public awareness.

   iii. Such problems mentioned above currently lead self-builders, foremen, and small-medium contractors to construct buildings which are spontaneously and informally constructed in the common traditional manner, categorised as non-engineered buildings, in order to fulfil the high demand for housing and buildings in developing countries.

   iv. Non-engineered buildings are particularly vulnerable and belong to medium-low income communities; they are still being constructed, which will accumulate foreseeable future risk in Indonesia and then prepare for the next disaster.

b. Current SRRNEB in Indonesia

   i. The reduction of seismic risk can be achieved through the implementation of seismic codes within non-engineered buildings to bridge the wide gap between high death tolls and the existence of seismic codes, moving from knowledge into action.

   ii. The implementation of seismic codes within non-engineered buildings is not easy. It embraces many factors such as: the involvement of many actors, the involvement of the local community, and incorporation of the poverty factor.

   iii. The concept of integrated seismic risk management can be used as an easier path to the implementation of seismic features within non-engineered buildings.

iv. Many definitions within seismic risk management are unfamiliar and recognised only partially by most Indonesian people. Enhancing all concerned stakeholders' awareness about seismic risk management could reduce a hindrance to implement the codes in order to reduce seismic risk.

v. The practices of seismic risk management are not currently integrated in Indonesian cities. None of the primary stakeholders seems to be discussing the problem in any common forum comprehensively. This illustrates the inadequacy of seismic prevention capability and requires concerted effort within multidisciplinary stakeholders.

vi. Much of the evidence gives a clear understanding that there is no established and sustainable framework for guiding and monitoring SRRNEB in Indonesia.

vii. It is clearly imperative to develop a seismic risk management framework for guiding and monitoring SRRNEB in Indonesia as a stepping stone towards integrating seismic risk management into sustainable development.

c. The Proposed Framework for Guiding and Monitoring SRRNEB in Indonesia

i. The proposed framework should be based heavily on the review of in-depth literature, existing frameworks, and multidisciplinary stakeholders' perspectives, so that it will suit the current conditions in Indonesia.

ii. The proposed framework should be designed as a flexible tool for any organizations in Indonesia, as a starting point to reduce seismic risk comprehensively.

iii. The proposed framework should allow each actor to fit their own strategies for risk management into the overall corporate objectives of their organization.

iv. Characteristics and indicators within the proposed frameworks might overlap with other aspects of engineered buildings and other relevant features without any contradictions.

v. It is important to market the value of the framework as a tool benefiting all parties.

7.7 Contribution to Wider Knowledge

The critical literature review and the findings of the pilot study suggest that the damage to human life and property by the collapse of non-engineered buildings, particularly residential houses, during strong earthquakes has been increasing in recent decades. The greater need for housing for a growing population, together with the inadequacy of seismic risk prevention strategies in developing countries, means the number of non-engineered buildings with non-seismic resistance has expanded. A current percentage estimation of non-engineered urban building stock in developing countries is about 90%; this figure is even higher in rural areas. These conditions drive the increase in exposure and vulnerability of human society to the impact of strong earthquakes. Because seismic risk is a real fact for people who live in seismic prone areas and the occurrence of seismic events may not be predictable or avoidable, it is not a wise solution to force them to leave their beloved homeland even if it is a hostile area, therefore the people should learn to live harmoniously with the seismic risk. They should be able to develop a sense of place and feel at home there, with feelings of belonging for the place being an anchor for people's identity. One of the strategic solutions is to carry out mitigation actions aimed at reducing losses through the implementation of seismic codes on non-engineered buildings; in these circumstances, seismic codes are available and can be easily found.

Based on a general assessment, the implementation of seismic codes on non-engineered buildings is not only related to physical measures, but also to all forms of activities, multiple organizations, and citizens at different levels of understanding, commitment, and skill. This comprehensive perspective of reducing seismic risk and also disaster risk as a whole should merge into development planning completely. It is true that, for a developing country like Indonesia, after the basic poverty issues (food, shelter, health, and education), the priority is to protect life and property from devastation caused by natural disasters such as earthquakes. Three suggested important factors to comprehensively reduce seismic risk of non engineered buildings in developing countries are concerted effort among many actors, the strengthening of local capacities, and poverty consideration.

There is an integrative need to bring the full range of technical, social, and political consideration to bear on each seismic risk responsibility, with a fuller appreciation of their mutual inter-dependence to gain significant levels of hazard reduction and increasing resilience. Many actors should be involved in step-by-step seismic risk management practices in order to reduce seismic risk, representing shared effort and a sense of responsibility among all community members. Finally, developing an integrative framework for guiding and monitoring SRRNEB is essential, as it can be used as a starting point or a stepping stone to incorporate seismic risk management into development planning in developing countries in order to achieve change.

The ideal framework should guide strategic conversation between various stakeholders and cover many characteristics and indicators to define and/or point to more significant issues.

These are selected from a greater mass of information, to capture common and global conventions of seismic risk reduction of non-engineered buildings in developing countries. It is also conceivable that the characteristics and indicators may not only embrace aspects within non-engineered buildings, but also within engineered buildings and other relevant factors. While geography seems likely to influence relevance, the various common characteristics and indicators should be scrutinised comprehensively in the proposed framework to cover many areas where the community is living in terms of its social cohesion and spirit. However, the proposed framework is just a tool. The next important thing is to build popularity for mainstreaming seismic risk reduction by actively marketing the proposed framework as a clear, unambiguous tool for achieving incremental improvements.

7.8 Refinement for the Research Design

The emerging issues outlined earlier show the significance of the critical review of literature and existing frameworks and the pilot study. Where the preliminary research has an insight and understanding of the current seismic risk situation around the globe, at the same time, it has pointed out essential issues according to the present situation in Indonesia, developing a framework for guiding and monitoring SRRNEB in Indonesia. Combining the research methodology section and the findings of pilot study, there are some refinements for the research design, which was formulated in the previous chapter. The methodological approach adopted by this research still uses a qualitative approach. This research would be able to explore and provide insight on the necessary theoretical, cultural, structural and political issues associated with the integration of seismic risk management within multidisciplinary stakeholders. Some refinements to the research design are as follows (Table 7.2);

a. It is widely agreed that many stakeholders mention that seismic risk management is a previously unrecognised term. Therefore, questionnaire survey was designed so that there is an opportunity for the respondent to choose a 'not known ' answer after 'the fixed responses of the importance level of each statement' as described early in Section 6.8.1.
b. Due to the introduction of the new term, not all the respondents would understand the exact meaning of the language used in the questionnaire statements; it is possible that they have their own ideas in accordance with the questionnaire findings, which can hopefully complement the proposed framework. This situation led the researcher to discover factual stories by face to face discussion with the respondents. Therefore, the

purpose of the interview method, as described early in Section 6.4, is not only to explain 'why' the questionnaire findings took place, but also to discover respondents' opinions in a clear, unambiguous fashion, and particularly to achieve a comprehensive picture of the proposed framework. This is the justification for the interview with selected important people after the findings of the postal questionnaire.

c. In addition to the 8 types of stakeholder organisations, reporters were important stakeholders in this circumstance as well. They drive the information through the mass media are also important stakeholders in the decision making process and convey the seismic risk management practices to end-user communities. Finally, the number of stakeholder organisations who would engage in this research is to be nine. These are: researchers/scientists, small-medium contractors, foremen, government agencies, businessmen, educators, NGO's, community leaders, and reporters. The nine stakeholder organisations listed above would represent nine groups of respondents as a wider sample.

d. The cities selected for the implementation of the proposed framework as validation media are Yogyakarta City and Bengkulu City, via workshop events. Both of the cities suffered the tragic experience of a strong earthquake recently.

Table 7.2 Some refinements to the research design after conducting the pilot study

No	Descriptions	Research Design	
		Before Pilot Study	After Pilot Study
1	The type of questionnaire survey	Fixed response	Fixed response with an opportunity for respondent to choose 'not know' answer
2	The interview method	In order to explain 'why' the questionnaire findings took place only	Not only to explain 'why' the questionnaire findings took place, but also particularly to achieve comprehensive picture of the proposed framework.
3	The number of stakeholder organisations who would be targeted to participate in this research	Eight	Nine (including reporters)
4.	The cities selected for implementation the proposed framework as validation media	Not yet decided	Yogyakarta City and Bengkulu City

7.9 Summary

This chapter created a foundation for the primary data collection of the research in order to authenticate the rationale behind the research topic and the data collection plans. A brief introduction to the pilot study was given in the beginning. This emphasised the importance of pilot studies in any research project. The introduction covered the general criteria for the selection of pilots, followed by the broader issues. The chapter further outlined the pilot study design for this research. The exploratory interview method stood out as the apparent choice for a pilot tool.

It was identified earlier that the research objectives would be best achieved using a qualitative methodology. The selection criterion for the pilot organisations was also given in the chapter. The criteria were successfully met in finding the pilots. Then, the broader objectives set out for the study followed; these objectives reflected the analysis of the research topic and research design. In order to relate the pilot study findings to the background of the stakeholders, the profile of pilot organisations was presented. Stakeholders selected for the pilot studies were not identified by their names, but with the fictitious names of Stakeholder A and Stakeholder B for reasons of confidentiality. This was followed by the all-important section of the findings from the pilot studies. These findings are critical for the research, as they authenticated and consolidated the issues, and unmasked those that did not show in the literature review. Some essential findings from the pilot study have been utilised to refine the research design, i.e. the type of postal questionnaire, the interview method, the number of stakeholder organisations, and the cities for the proposed framework implementation.

Based on these findings, this chapter then listed the emerging issues for the next research stage. The list would be very helpful in giving a initial contribution to wider knowledge and refinement for the research design. The final research design was then utilised to obtain primary data from the wider sample, through postal questionnaire surveys, selected interviews, and workshop events, as detailed in the subsequent chapter.

Chapter VIII
Questionnaire Survey and Selected Interview Data Collection and Analysis

Once 'the first draft of the proposed framework' has been developed and the research design has been detailed, the next stage moves to the collection of some primary data. There are three phases of the data collection for the research project, i.e. a questionnaire survey, selected interviews, and a workshop event. The principal aim of the three data investigations and their analysis is to refine 'the first draft of the framework', which was extracted through a review of literature and existing frameworks (as mentioned in Chapter V), to be the final framework suitable for Indonesian cities, as per the main research aim.

The data was collected from respondents who represented a range of the different kinds of multidisciplinary stakeholders from a wide cross-region of Indonesia with differing levels of experience and expertise, and with varying roles. Although they were not fully representative of the whole Indonesian region, they nevertheless gave an indication of Indonesian diversity of policy and provision. During the data collection phase in Indonesia, the established research committee facilitated and maintained the validity and reliability of the data in accomplishing the research, and also particularly guided the right direction for the data collection and analysis.

This Chapter presents details of the questionnaire and interview data collection and analysis, whereas Chapter IX will report workshop data collection and analysis as the final phase of the primary data collection. The main aim of this chapter is to refine 'the first draft of the framework' into 'the second draft of the framework' and also to validate the emerging findings from the previous chapter. Generally, this chapter is divided into three sections. These are: (1) questionnaire data collection and analysis, (2) selected interview data collection and analysis, and (3) refinement of 'the first draft of the framework'. Finally, this chapter concludes with a summary.

8.1 Questionnaire Data Collection and Analysis

The questionnaire survey is the first phase of the data collection for the research project. The survey was conducted primarily to validate and authenticate 'the first draft of the proposed framework'. This chapter begins with the rationale for the questionnaire. The average rate of response and a detailed break down of responses from different categories of respondent are given. Generally, this section also describes three methods of analysis that are employed to summarize and organize the data in the most effective and meaningful way. These are (1) the descriptive statistics method of analysis to describe a general overview of the research sample, (2) the inferential statistics method of Spearman '*rho*', ranking correlation to measure the difference in ranking among respondents' opinion by category, and (3) the exploratory data analysis to scrutinize open-ended answers from the questionnaire. The analysis is presented under the same order used in the questionnaire. The end of this section elaborates emerging questions arising from this analysis.

8.1.1 Rationale for the Questionnaire Survey

The content of 'the first draft of the proposed framework' revealed some interesting issues, headings, characteristics, and indicators, as given in Chapter V. However, because of the many terms extracted from around the globe and the limited sources of information available from Indonesia when arranging 'the first draft of the framework', it necessitated a mechanism where the content of 'the first draft of the framework' could be authenticated and validated by a large number of key decision makers in Indonesia, and explored further for better understanding. Hence, it was decided to conduct a postal questionnaire survey in Indonesia.

The questionnaire is related to the common global aim of seismic risk management of non-engineered buildings and current issues in relation to reducing seismic risk. It is taken from 'the first draft of the proposed framework' as formatted in Table 5.28, and then simply depicted in Figure 5.1. 'The first draft of the framework' consisted of three section headings: seismic hazard analysis, seismic risk assessment, and seismic risk response. Among the three headings, there were twelve core areas that underpin the understanding of seismic risk reduction of non-engineered buildings (SRRNEB). Core areas were the breakdown of headings, which are a global concern in SRRNEB. The twelve core areas comprised 57 statements or pairs of characteristic-indicators. The 57 statements then were divided into 15 technical intervention and 42 non-technical intervention statements, as elaborated in Table 5.28, Chapter V. In addition to the content of the questionnaire, blank space was also provided at the end of the each section of the questionnaire to allow the respondent to write additional ideas or information if necessary. The sample of the questionnaire is attached as Appendix-2.

The draft of the questionnaire was already piloted by a variety of key people by interviewing 16 important people from many organizations to ensure that questions were simple, clear, and unambiguous (see Chapter VII). This was particularly important, since it was anticipated that certain terms might not be understood by the respondents. Nevertheless, the 'don't know' answer was provided in the questionnaire to accommodate this matter. The questionnaire was issued in the Indonesian language, since they were distributed in Indonesia. A covering letter outlining the purposes of the survey and requesting co-operation in completing the document accompanied the questionnaire.

The questionnaire was then circulated to a large number of respondents, who were asked to grade the importance of the 57 seismic risk management statements, to be carried out in Indonesian cities located in high seismic hazard, by ticking the appropriate box and by writing any additional ideas or information if they consider important in the blank space provided. Here, the descriptive dimension of importance scale was converted into numerical value using the five-point bipolar importance scale, with contrasting adjectives at each end (i.e. 5=very important; 4=important; 3=neither; 2=not important; 1=absolutely not important; 0= don't know). Hence, the respondents could be forced to declare their opinions and, in addition, the score of 3 would serve as a neutral position, avoiding the two extreme positions. The '0' or 'don't know' response was designed to accommodate terms unfamiliar to the respondent when answering the questionnaire.

8.1.2 The Research Sample

Altogether, 875 questionnaires were distributed among the nine types of stakeholders involved in the decision process in SRRNEB: researcher or scientist, small-medium contractors, foreman, policy maker (within government agencies), businessmen, educators, non-government organizations (NGOs), community leaders, and reporters around Indonesia region. The level of expertise or criteria of each respondent was: (1) he/she was the important person in each stakeholder organization and (2) he/she was actively involved in and shaped policy issue. The names and addresses of the respondents were selected from several sources, particularly from their associated organizations. The leader or director in many organizations was approached to get a permit for distributing the questionnaire to appropriate management positions, as attached in Appendix-3.

There were 305 responses from many part of the Indonesian region. Most of the researchers came from the Civil Engineering university department. Key staff from the Building Division of Infrastructure Department, Regional Development Board, and Regional Information Board represented the government officials whom contributed largely in the survey. Important people from several real estate firms represented businessmen; most educators who were involved in the survey were school headmasters. The other respondents were targeted from various organizations in a similar manner. Particularly, respondents from the category of foremen were selected from the participant list of seismic resistant building training conducted by CEEDEDS during 2004-2005 because they did not have a trade association or organization. Most questionnaires were sent by post, while a few were distributed by direct survey due to the fact that the author had a close relationship with the respondents, formed over several years.

Each questionnaire was coded to assess the rate of return and facilitate the analysis. In total, 305 questionnaires were returned, attaining a 34.9% response rate. All the returned questionnaires were usable. The reasons for this comparatively good response rate may be the close relationship base, the third-person contacts, and the telephone contacts, which were established prior sending out the questionnaire. The lowest response is from businessman category, which is only 26.7%. Based on further investigation, some businessmen mentioned that they felt less enthusiastic to participate in the questionnaire survey due to the pressure of every day work schedule, and student's questionnaire is of less priority. Some other mentioned that the research topic was far from their business goal. The detailed breakdown of the questionnaire return is given in the Table 8.1:

Table 8.1 Number and rate of response by category

No	Respondents by Category	Questionnaire Issued	Responses*	% Responses
1	Researcers/Scientists	50	31	62**
2	Contractors	110	49	44.5
3	Foremen	95	34	35.8
4	Government	100	30	30
5	Businessmen	120	32	26.7
6	Educators	100	36	36
7	NGOs	100	30	30
8	Community Leaders	100	30	30
9	Reporters	100	33	33
		875 (Total)	**305** (Total)	**34.9** (Average)

*) 92% of the responses were received by postal survey and 8% of the responses was reached by direct survey
**) This high response was due primarily to the fact that the author had a close contact base which was formed during the professional placement

8.1.3 The Data Collected and Analysis of the Results

The principal narration of data collected and analysis for this section is divided into four headings as follows:

a. The descriptive statistics method to describe the characteristics of the sample
b. The inferential statistics method to measure the Spearman 'rho' correlation in ranking among respondents' opinions
c. The exploration method for the descriptive open-ended answer
d. The emerging specific research questions for further investigation

8.1.3.1 The Characteristics of the Sample

This section mentions the descriptive statistics method of analysis, which provides a general overview of the results of how the data is distributed on all the items of the investigation, particularly in mean, percentage, and rank. Indeed, altogether there are 305 respondents and each respondent graded the importance of 57 statements. Therefore, this survey comprises 305 x 57 data, which is equal to 17,385 of data or values; it is certainly not necessary to list every single value and analyse them value by value because the output would be extremely long. This method collects the descriptive information on all data in one go, providing summary statistics such as mean, percentage, and rank.

Broadly speaking, a mean score is the average of all the responses in a set of data. In this research, the mean score of each statement in each category of respondent was calculated by adding all the respondents' opinions or scores in the same category within the related statement and then dividing by the number of respondents, excluding the number of respondents who stated '0' or 'don't know' response(s). The overall mean score then was calculated in the same manner. The rank of each statement in each category of respondent was assigned by converting the highest of mean score in the same category among 57 statements into ranking number one, the second highest was ranking number two, and so on. The overall ranks were arranged in the same method. As two or more statements shared the same average of mean scores, apparently they shared the same ranking. The range of the ranks was assigned from 1 to 57. Besides the means and ranks, the number of '0' or 'don't know' responses was analysed in percentages.

Table 8.2 presents an example of raw data gathered from foremen, comprising the responses, the means, the ranks, and percentage of responses which stated '0' or 'don't know'. The complete raw data is attached in Appendix-4.

Table 8.2 Raw Data of Foremen's Opinion to Seismic Risk Management Statements

Respondent Number	Statement Number 1	Statement Number 2	Statement Number 3	Statement Number 4	Statement Number 5	Statement Number 6	Statement Number 7	Statement Number 8	Statement Number 9	Statement Number 10	Statement Number 11	Statement Number 12	Statement Number 13	Statement Number 14	Statement Number 15	Statement Number 16	Statement Number 17	Statement Number 18	Statement Number 19	Statement Number 20
1	5	4	4	5	5	5	5	5	5	5	5	5	5	5	5	4	4	4	4	4
2	5	4	4	4	3	4	4	4	5	5	4	5	5	5	4	4	5	4	4	4
3	4	4	3	4	4	4	4	4	4	5	4	5	4	4	5	3	5	4	4	3
4	5	5	5	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
5	4	4	4	5	4	5	5	5	4	4	3	4	4	4	4	3	4	3	3	4
6	4	4	4	4	4	4	5	5	5	5	5	5	5	5	5	5	5	3	4	4
7	4	4	4	3	4	4	3	3	3	4	4	4	4	4	3	4	3	3	4	4
8	4	5	5	4	4	4	4	5	4	5	4	5	4	0	5	4	5	4	5	4
9	4	0	4	3	4	4	3	3	2	5	4	5	4	4	4	3	4	3	4	2
10	3	4	0	5	4	4	4	4	4	5	4	5	5	5	4	4	5	4	5	4
11	5	5	5	5	5	4	4	4	4	3	3	3	3	3	2	4	4	4	4	3
12	5	4	5	4	4	4	4	4	5	4	4	4	3	4	4	4	5	5	4	4
13	5	4	4	4	4	3	4	5	4	5	4	4	4	5	3	4	4	5	4	3
14	0	5	5	4	5	5	5	5	5	4	5	5	5	5	5	5	4	5	5	4
15	5	4	4	5	4	3	4	4	3	4	4	5	5	5	4	5	5	4	4	4
16	5	5	5	4	4	4	4	4	3	5	4	4	3	4	3	3	5	4	4	3
17	5	5	4	5	4	5	4	4	5	5	5	5	4	4	4	5	5	5	4	4
18	5	4	5	5	5	5	4	5	5	5	5	5	4	5	5	5	5	5	5	4
19	4	5	5	5	5	5	5	5	5	4	4	5	4	5	4	2	5	5	4	5
20	5	4	4	5	4	4	4	5	4	4	4	5	4	5	4	5	4	3	4	5
21	5	4	4	4	5	4	4	5	4	4	0	5	5	4	5	4	5	4	5	5
22	4	4	4	4	2	0	4	4	5	4	4	4	4	4	4	2	4	4	2	2
23	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
24	4	4	4	4	2	3	4	4	3	3	2	5	2	3	5	4	2	2	4	3
25	5	5	5	4	5	5	5	5	5	4	4	4	5	4	4	4	5	4	4	4
26	4	4	3	3	4	4	4	4	4	0	4	4	4	4	3	3	4	4	4	4
27	4	4	4	4	3	4	4	2	3	5	4	5	5	5	4	2	4	3	3	3
28	4	4	4	4	4	4	5	4	4	5	4	4	4	4	4	3	4	4	4	3
29	4	5	5	5	4	4	5	4	4	5	4	5	4	5	5	4	5	4	4	4
30	4	5	5	5	4	5	5	4	4	5	4	5	4	5	5	4	5	4	4	0
31	4	4	4	2	4	4	5	5	4	4	4	4	4	4	5	4	5	4	4	3
32	4	5	4	5	4	5	5	5	5	3	4	5	5	5	4	4	5	4	4	4
33	5	4	4	5	4	4	4	4	4	5	4	4	4	5	5	3	4	4	3	3
34	2	2	4	2	4	4	5	4	2	5	2	2	4	4	4	5	5	2	3	4
Average to each statement*	4.333	4.273	4.273	4.176	4.029	4.182	4.294	4.265	4.059	4.424	3.970	4.471	4.147	4.394	4.176	3.824	4.441	3.882	3.971	3.697
Ranks	13	20	20	26	36.5	24	17.5	22	33	8	44	5	29	11	26	51	6.5	49	41.5	55

Respondent Number	Statement Number 21	Statement Number 22	Statement Number 23	Statement Number 24	Statement Number 25	Statement Number 26	Statement Number 27	Statement Number 28	Statement Number 29	Statement Number 30	Statement Number 31	Statement Number 32	Statement Number 33	Statement Number 34	Statement Number 35	Statement Number 36	Statement Number 37	Statement Number 38	Statement Number 39	Statement Number 40
1	4	4	5	5	4	4	5	4	4	4	4	5	5	4	5	5	4	4	5	4
2	5	5	5	4	3	4	4	4	4	3	4	3	3	3	4	5	5	4	4	3
3	4	4	5	4	5	4	5	4	4	4	4	5	5	4	5	4	4	4	5	4
4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
5	4	4	5	4	3	4	4	4	4	5	4	3	3	4	4	4	4	4	3	4
6	5	3	4	4	5	5	5	5	4	4	4	5	4	4	4	4	4	4	4	4
7	4	5	5	5	4	4	4	3	3	3	4	4	4	5	4	4	4	4	4	3
8	4	5	5	4	4	4	5	4	5	5	5	5	5	5	5	5	5	4	4	4
9	3	3	5	4	3	3	5	4	4	5	3	3	3	5	5	4	3	5	3	4
10	5	4	5	5	4	4	5	5	4	5	5	5	5	4	5	4	5	5	4	4
11	4	3	4	4	4	4	4	4	4	3	4	3	4	4	4	3	4	5	3	5
12	3	4	4	4	3	4	5	4	4	5	4	4	4	5	5	4	4	4	4	4
13	4	4	4	5	5	4	5	4	4	5	5	5	4	0	5	4	4	5	4	3
14	5	4	5	5	4	5	5	4	2	5	5	5	2	2	5	2	5	5	2	5
15	5	5	5	4	4	4	4	4	4	5	5	4	4	0	4	4	4	4	4	4
16	4	4	4	4	4	5	4	5	4	4	3	4	4	3	4	3	4	5	4	5
17	5	4	5	5	4	5	5	5	4	5	5	4	4	4	5	4	5	5	4	4
18	5	5	5	5	5	5	4	5	5	5	5	5	5	5	5	4	4	5	5	5
19	5	4	5	5	4	5	5	4	3	5	5	5	3	3	5	3	5	5	3	4
20	5	4	5	5	4	4	5	5	4	5	4	4	4	3	5	4	3	4	4	3
21	5	5	5	5	5	5	5	5	5	5	5	5	5	4	5	4	5	5	5	5
22	4	2	4	4	2	2	2	2	2	4	2	4	4	2	4	4	4	4	4	4
23	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
24	2	4	5	4	3	4	5	4	4	2	5	4	3	4	5	3	0	5	5	0
25	5	5	5	5	4	4	4	4	4	5	4	4	4	4	5	4	4	4	4	4
26	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	3	3	4
27	4	4	4	3	4	4	4	4	4	4	4	4	5	4	4	4	4	4	4	4
28	4	4	4	4	4	4	4	4	4	4	4	3	4	4	4	3	4	4	4	4
29	5	4	5	5	5	5	5	3	3	5	4	5	4	4	5	4	4	5	4	4
30	5	4	5	5	5	5	5	3	3	5	4	5	4	4	5	4	4	5	4	4
31	4	4	5	4	4	4	4	3	4	5	4	4	4	3	4	5	2	4	4	4
32	5	5	5	5	4	4	5	5	5	5	5	4	4	0	5	4	4	4	5	4
33	4	4	4	4	4	4	4	4	4	4	4	4	0	4	5	4	3	4	3	4
34	5	4	4	5	4	2	4	3	2	5	2	3	3	2	4	4	2	2	3	2
Average to each statement*	4.324	4.088	4.618	4.412	4.000	4.118	4.441	4.029	3.824	4.412	4.147	4.176	3.970	3.806	4.559	3.912	4.000	4.294	3.912	3.970
Ranks	14	32	1	9.5	39.5	31	6.5	36.5	52	9.5	29	26	44	53	2	47	39.5	17.5	46.5	44

Respondent Number	Statement Number 41	Statement Number 42	Statement Number 43	Statement Number 44	Statement Number 45	Statement Number 46	Statement Number 47	Statement Number-48	Statement Number 49	Statement Number 50	Statement Number 51	Statement Number 52	Statement Number 53	Statement Number 54	Statement Number 551	Statement Number 56	Statement Number 57
1	4	3	5	4	5	4	5	5	5	5	4	4	4	4	5	4	4
2	5	4	5	2	3	3	4	5	4	4	5	2	5	3	4	3	4
3	5	4	4	4	4	5	4	5	5	4	4	5	5	4	4	4	4
4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
5	4	3	4	3	4	4	3	4	4	5	4	4	4	4	5	5	4
6	4	4	4	4	4	4	4	4	4	5	2	3	4	4	4	4	5
7	3	3	4	4	4	4	5	4	4	5	5	4	4	4	3	3	5
8	5	4	5	5	4	4	5	4	5	5	5	3	5	4	4	4	4
9	3	2	3	2	0	0	4	2	4	5	4	3	4	4	3	2	4
10	5	4	4	5	4	3	4	4	5	5	4	4	4	5	4	4	5
11	4	4	4	5	2	2	4	5	5	5	3	3	5	4	4	3	5
12	4	4	5	4	3	4	5	3	4	5	4	3	4	4	5	4	4
13	4	4	5	4	4	4	3	4	5	5	3	4	4	4	5	4	5
14	5	2	4	5	2	1	5	4	5	3	5	4	5	5	5	5	5
15	4	4	4	4	4	4	5	4	5	4	4	4	4	4	4	4	4
16	4	4	4	3	4	4	5	5	4	4	5	3	4	4	5	3	5
17	4	5	5	5	4	4	4	4	4	5	5	5	4	5	5	5	5
18	5	5	5	4	5	4	5	5	5	5	5	5	5	5	5	5	4
19	5	5	5	5	1	1	5	3	5	5	5	2	5	4	5	5	5
20	4	4	4	3	4	2	4	3	5	4	1	4	4	5	4	4	4
21	5	4	4	4	5	4	5	5	5	5	5	5	3	3	0	5	5
22	4	2	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
23	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
24	4	2	4	4	3	4	4	2	5	5	2	4	4	3	4	3	3
25	4	3	5	4	4	4	5	4	5	5	4	4	5	4	4	4	5
26	4	3	3	3	3	3	3	3	4	4	4	3	3	4	4	3	3
27	5	4	4	5	5	4	4	4	4	4	4	4	4	5	3	4	4
28	4	3	4	4	4	3	4	4	4	4	4	4	4	4	4	4	4
29	4	4	5	4	4	4	5	4	5	5	4	5	5	4	5	4	4
30	4	4	5	4	4	4	5	4	4	4	5	5	4	4	5	4	5
31	4	4	4	5	4	4	4	4	5	5	4	4	5	4	5	4	5
32	4	3	5	5	4	3	5	2	5	0	0	0	4	4	5	5	5
33	4	3	4	4	4	4	4	4	4	5	4	5	5	4	4	4	4
34	2	0	2	4	2	0	4	2	4	4	4	5	0	2	4	4	5
Average to each statement*	4.147	3.606	4.235	4.029	3.727	3.455	4.324	3.853	4.500	4.545	4.030	3.909	4.273	4.029	4.303	3.971	4.382
Ranks	29	56	23	36.5	54	57	15	50	4	3	34	48	20	36.5	16	41.5	12

Note:
1. The statement numbers correspond to the order of the questionnaire
2. Respondents were asked to rate 57seismic risk management statements they consider important to be carried out in Indonesian cities located in high seismic hazard (5=v.important;4=important;3=nor;2=not important;1=absolutely not important;0=don't know)
3. 1.19% of responses stated '0' (don't know)

*) The mean score of all statements is 4.137 (between important and very important)

Table 8.3 describes a summary of overall means and percentage of '0' or 'don't know' responses, whereas Table 8.4 presents a summary of ranks among respondents by category. The descriptive analysis in this research uses table format to compare items of various groups in terms of mean scores, ranks, and percentages.

Table 8.3 Summary of average respondents' mean scores and percentage of '*don't know*' responses

Statement Number	Researchers/ Scientists	Contractors	Foremen	Government	Businessmen	Educators	NGOs	Community Leaders	Reporter	Overall mean score**
S1*	4.903	4.714	4.333	4.700	4.813	4.556	4.833	4.633	4.545	**4.699**
S2*	4.414	4.396	4.273	4.448	4.567	4.353	4.483	4.222	4.031	**4.415**
S3*	4.393	4.396	4.273	4.536	4.567	4.353	4.536	4.214	4.469	**4.443**
S4*	4.516	4.306	4.176	4.400	4.281	4.143	4.733	4.367	4.212	**4.368**
S5*	4.207	4.122	4.029	4.300	4.188	4.028	4.400	4.000	4.182	**4.169**
S6*	4.194	4.184	4.182	4.333	4.188	4.194	4.633	3.966	4.344	**4.256**
S7	4.258	4.143	4.294	4.448	3.967	4.147	4.700	4.300	4.576	**4.332**
S8	4.161	4.163	4.265	4.300	3.833	4.086	4.633	4.133	4.424	**4.247**
S9	4.226	3.918	4.059	4.379	4.125	4.088	4.467	3.967	4.455	**4.197**
S10*	4.645	4.551	4.424	4.367	4.469	4.083	4.533	4.033	4.333	**4.417**
S11	4.290	4.143	3.970	4.143	4.156	4.200	4.448	3.767	4.030	**4.168**
S12	4.290	4.490	4.471	4.500	4.156	4.343	4.586	4.357	4.273	**4.418**
S13	4.032	4.163	4.147	4.250	4.188	4.250	4.467	4.069	3.636	**4.216**
S14	4.233	4.347	4.394	4.345	4.094	4.194	4.429	4.267	3.758	**4.302**
S15	4.065	4.286	4.176	4.267	4.156	4.417	4.567	4.167	4.485	**4.303**
S16	3.710	3.755	3.824	3.862	3.750	4.143	4.400	3.800	4.000	**3.947**
S17	4.097	4.000	4.441	4.200	4.219	4.222	4.467	4.167	4.485	**4.257**
S18	3.903	3.939	3.882	4.034	3.774	4.222	4.133	3.833	4.121	**3.997**
S19	3.903	3.857	3.971	3.933	4.063	4.114	4.241	3.933	4.121	**4.033**
S20	3.710	3.592	3.697	3.750	3.774	3.944	3.800	3.433	4.061	**3.773**
S21	4.226	4.102	4.324	4.133	4.063	4.278	4.400	4.200	4.212	**4.238**
S22	4.129	4.082	4.088	4.133	4.031	4.306	4.500	4.167	4.424	**4.214**
S23	4.419	4.396	4.618	4.333	4.438	4.500	4.633	4.286	4.333	**4.485**
S24	4.258	4.041	4.412	4.100	4.438	4.400	4.500	4.133	3.939	**4.265**
S25	4.000	4.224	4.000	4.367	4.219	4.278	4.333	3.767	4.545	**4.211**
S26	4.387	4.388	4.118	4.467	4.375	4.194	4.533	4.033	4.545	**4.352**
S27	4.355	4.327	4.441	4.367	4.438	4.167	4.533	4.100	4.545	**4.389**
S28	4.323	4.265	4.029	4.267	4.281	4.222	4.433	4.067	4.515	**4.280**
S29	4.161	4.306	3.824	4.100	4.375	4.265	4.467	4.167	4.515	**4.258**
S30	3.806	3.939	4.412	3.833	3.875	4.057	4.533	3.833	4.091	**4.053**
S31	4.065	4.082	4.147	3.867	4.094	4.171	4.267	3.767	4.152	**4.099**
S32	4.419	3.918	4.176	4.100	3.938	3.778	4.433	3.833	4.121	**4.079**
S33	4.194	3.857	3.970	4.100	3.875	3.806	4.200	3.967	4.182	**4.017**
S34	3.774	3.837	3.806	3.900	3.969	4.000	4.207	3.655	4.061	**3.936**
S35	4.065	4.163	4.559	3.933	4.125	4.083	4.533	4.000	4.273	**4.207**
S36	3.968	3.816	3.912	3.966	3.969	3.912	4.214	3.500	3.636	**3.922**
S37	4.258	4.000	4.000	4.034	3.875	4.111	4.133	4.000	4.424	**4.103**
S38	4.387	4.347	4.294	4.267	4.000	4.200	4.467	4.367	4.364	**4.314**
S39	3.903	4.224	3.912	4.133	3.844	4.028	3.933	4.067	4.152	**4.046**

Table 8.3 continued

S40	4.194	4.082	3.970	4.103	3.844	3.917	4.276	4.179	4.212	**4.107**
S41	4.000	3.918	4.147	4.067	3.938	3.824	4.167	4.033	4.212	**4.040**
S42	3.581	3.750	3.606	3.867	3.938	3.943	4.067	3.793	3.939	**3.866**
S43	4.194	4.245	4.235	4.133	3.906	4.139	4.267	3.800	4.212	**4.148**
S44*	4.065	4.265	4.029	4.100	4.063	3.972	4.333	3.967	4.091	**4.118**
S45*	3.710	4.061	3.727	3.900	3.719	3.972	4.300	3.733	3.909	**3.927**
S46*	3.774	4.000	3.455	4.067	3.750	4.000	4.167	3.733	3.636	**3.913**
S47	4.194	4.167	4.324	4.133	4.031	4.083	4.267	3.933	4.242	**4.168**
S48	4.161	3.875	3.853	3.867	3.844	3.833	4.300	3.933	4.152	**3.983**
S49	4.129	4.224	4.500	4.167	4.125	4.114	4.533	4.233	4.152	**4.254**
S50	4.452	4.449	4.545	4.300	4.531	4.371	4.667	4.433	4.545	**4.505**
S51	3.355	3.816	4.030	3.900	3.781	3.886	4.233	3.793	3.636	**3.850**
S52	3.500	3.898	3.909	3.767	4.000	4.028	4.133	4.200	3.848	**3.947**
S53*	4.355	4.388	4.273	4.467	4.313	4.306	4.552	4.333	4.333	**4.395**
S54*	4.133	4.143	4.029	4.133	4.063	4.000	4.367	4.000	3.939	**4.117**
S55*	4.194	4.490	4.303	4.400	4.406	4.250	4.167	4.345	4.424	**4.383**
S56*	3.968	4.188	3.971	4.100	4.125	4.194	4.333	4.167	4.000	**4.159**
S57*	4.194	4.265	4.382	4.333	4.313	4.333	4.600	4.333	4.485	**4.368**
Average	**4.132**	**4.145**	**4.137**	**4.170**	**4.109**	**4.140**	**4.399**	**4.184**	**4.308**	**4.187**
% of '0' responses	0.62%	0.36%	1.19%	0.99%	0.55%	1.36%	0.88%	1.11%	2.55%	**1.05%**

*) technical intervention statements

**) The overall mean score was calculated by adding all the respondents' opinions or scores within the related statement and then dividing by the number of respondents, excluding the number of respondents who stated '0' or 'don't know' response(s).

Table 8.4 Summary of average respondents' ranks

Statement Number	Researchers/ Scientists	Contractors	Foremen	Government	Businessmen	Educators	NGOs	Community Leaders	Reporter	Overall rank**
S1*	1	1	13	1	1	1	1	1	4	1
S2*	7	7	20	6.5	2.5	6.5	21	13	44	7
S3*	8	7	20	2	2.5	6.5	12	14	12	4
S4*	3	14.5	26	8.5	14.5	29.5	2	3.5	28	11.5
S5*	22	33	36.5	19	19	42	32	33.5	31.5	31
S6*	26	25	24	16	19	23.5	6	39	19	22
S7	17	31	17.5	6.5	40	28	3	9	1	14
S8	31	28	22	19	51	36	6	23.5	15.5	24
S9	20.5	46	33	10	25.5	35	24	37	13	30
S10*	2	2	8	12	5	38	15.5	30	21	6
S11	14.5	31	44	27	22	20.5	27	51	45	32.5
S12	14.5	3.5	5	3	22	8	9	5	23.5	5
S13	41	28	29	24	19	15.5	24	26	55.5	26
S14	19	11.5	11	14	28.5	23.5	30	11	53	17
S15	38.5	16	26	22	22	3	10	20	10	16
S16	53	55	51	54	55.5	29.5	32	46.5	46.5	49.5

Table 8.4 continued

S17	36	41	6.5	25	16.5	18	24	20	10	21
S18	47	43.5	49	43.5	53.5	18	53	44	38	47
S19	47	50.5	41.5	46.5	31.5	32.5	44	41	38	45
S20	53	57	55	57	53.5	49	57	57	42.5	57
S21	20.5	34	14	30.5	31.5	12.5	32	15.5	28	25
S22	34.5	36	32	30.5	34.5	10.5	19.5	20	15.5	27
S23	5.5	7	1	16	7	2	6	10	21	3
S24	17	39	9.5	37.5	7	4	19.5	23.5	49	19
S25	42.5	22	39.5	12	16.5	12.5	36	51	4	28
S26	9.5	9.5	31	4.5	10.5	23.5	15.5	30	4	13
S27	11.5	13	6.5	12	7	27	15.5	25	4	9
S28	13	18	36.5	22	14.5	18	28.5	27.5	7.5	18
S29	31	14.5	52	37.5	10.5	14	24	20	7.5	20
S30	49	43.5	9.5	55	46	40	15.5	44	40.5	42
S31	38.5	36	29	52	28.5	26	42	51	34.5	40
S32	5.5	46	26	37.5	42	57	28.5	44	38	41
S33	26	50.5	44	37.5	46	56	48	37	31.5	46
S34	50.5	52	53	49	38.5	45	15.5	55	42.5	51
S35	38.5	28	2	46.5	25.5	38	17	33.5	23.5	29
S36	44.5	53.5	47	45	38.5	52	46	56	55.5	53
S37	17	41	39.5	43.5	46	34	53	33.5	15.5	39
S38	9.5	11.5	17.5	22	36.5	20.5	24	3.5	18	15
S39	47	22	46.5	30.5	49	42	56	27.5	34.5	43
S40	26	36	44	34	49	51	40	17	28	38
S41	42.5	46	29	41.5	42	55	50	30	28	44
S42	55	56	56	52	42	50	55	48.5	49	55
S43	26	20	23	30.5	44	31	42	46.5	28	35
S44*	38.5	18	36.5	37.5	31.5	47.5	36	37	40.5	36
S45*	53	38	54	49	57	47.5	38.5	53.5	51	52
S46*	50.5	41	57	41.5	55.5	45	50	53.5	55.5	54
S47	26	26	15	30.5	34.5	38	42	41	25	32.5
S48	31	49	50	52	49	54	38.5	41	34.5	48
S49	34.5	22	4	26	25.5	32.5	15.5	12	34.5	23
S50	4	5	3	19	4	5	4	2	4	2
S51	57	53.5	34	49	52	53	45	48.5	55.5	56
S52	56	48	48	56	36.5	42	53	15.5	52	49.5
S53*	11.5	9.5	20	4.5	12.5	10.5	11	7.5	21	8
S54*	33	31	36.5	30.5	31.5	45	34	33.5	49	37
S55*	26	3.5	16	8.5	9	15.5	50	6	15.5	11.5
S56*	44.5	24	41.5	37.5	25.5	23.5	36	20	46.5	34
S57*	26	18	12	16	12.5	9	8	7.5	10	10

*) technical intervention statements

**) The overall rank was assigned by converting the highest overall mean score (see Table 8.3) into ranking number one , the second highest was ranking number two, and so on.

In a more general way which is easier to assess, the nine categories of respondents are then divided into two main groups according to the nature of their duties, Groups A and B. Group A are researchers/scientists, contractors, and foremen who might closely relate to technical intervention statements (those who are somewhat familiar with the concept of building construction, design, and seismic phenomena), whereas Group B are government staff, businessmen, educators, NGOs, community leaders, and reporters who might closely relate to non-technical intervention statements. From Table 8.5, they can be arranged further to be the 'fifteen most important seismic risk management statements' (Table 8.5) and the 'fifteen least important seismic risk management statements' (Table 8.6), that all community members in Indonesian cities should take into consideration.

Table 8.5 Fifteen most important of seismic risk management statements

Stat. No	Pair of Characteristic-Indicator		Group A		Group B		Overall	
	Characteristics	Indicators	I	II	I	II	I	II
S1	Earthquake occurrence data: their historical, spatial distribution, characteristics, and impacts *	Data recorded, mapped, and up-dated regularly	4.655	1	4.725	1	4.699	1
S50	Pro-poor and sustainable livelihood strategies	Existence of information that introducing seismic features in buildings are low-cost and simple (not burden) trough down to the grass root communities	4.478	3	4.521	2	4.505	2
S23	Resource mobilization and allocation: financial (innovative and alternative funding, incentives), human, technical, material	Expert staffing allocation	4.469	4	4.495	3	4.485	3
S3	Earthquake scenario data *	Existence of systematic analysis of return period of earthquake occurrence to conduct probabilistic earthquake scenario	4.358	8	4.494	4	4.443	4
S12	Compliance and enforcement	Existence of regulation of builders and real estate developers for creation of seismic resistant buildings	4.430	5	4.411	8	4.418	5
S10	Seismic codes *	Seismic codes (socially acceptable, written in simple language, and economically feasible) existed and updated	4.540	2	4.344	15	4.417	6
S2	Earthquake scenario data *	Existence of earthquake data to conduct deterministic earthquake scenario	4.364	7	4.446	5	4.415	7
S53	Land use applications *	Existence of seismic risk map using Geographic Information System (GIS)	4.345	10	4.426	6	4.395	8
S27	Information and dissemination programmes and channels	Continuity of dissemination channels and participation through down grass-root communities and use of traditional/indigenous knowledge and practice	4.407	6	4.379	11.5	4.389	9
S55	Good examples in real constructions *	Public buildings (health facilities, schools, lifelines, etc) at high seismic risk retrofitted	4.354	9	4.401	9	4.383	10
S57	Good examples in real constructions *	Existence of the number of model houses with seismic features, low-cost, and simple as well as ready to replicate in other areas	4.281	15.5	4.421	7	4.368	11.5
S4	Inventory data: soil profiles and buildings *	Soil profiles and buildings inventory data recorded, mapped, and up-dated regularly as necessary, particularly in order to calculate the quantitative number of non-engineered buildings and their spatial distribution	4.325	13	4.394	10	4.368	11.5
S26	Information and dissemination programmes and channels	Existence of documentation and databases on seismic risk	4.307	14	4.379	11.5	4.352	13
S7	Seismic risk reduction of non-engineered buildings (SRRNEB) as a policy priority	City SRRNEB commitment and strategy existed (including collaboration with donor agencies) and associated with decentralization process	4.257	17	4.378	13	4.332	14
S38	Dissemination and use of traditional/indigenous knowledge through media involvement in communicating seismic risk	Availability and accessibility of information (handbook, poster, newspaper, exhibition, talks show, etc) in introducing seismic features of buildings with simple technical approaches and understandable to the laypersons, including the existing of model houses with seismic features, low-cost, and simple in neighboring areas	4.342	11	4.296	21	4.314	15

*) technical intervention statements Note: Group A are researchers, contractors, & foremen (closely related to technical intervention statements) & Group B is closely related to non-technical intervention
I = average of respondents' opinion and II = rank

Table 8.6 Fifteen least important of seismic risk management statements

Stat. No	Pair of Characteristic-Indicator		Group A		Group B		Overall	
	Characteristics	Indicators	I	II	I	II	I	II
S20	Civil society, NGOs, private sector and community participation	Existence of group or individual that have incorporated earthquake risk reduction as a permanent or significant part of their operations and commitment	3.655	57	3.844	57	3.773	57
S51	Financial instruments	Existence of incentive strategy for new buildings with seismic features	3.752	55	3.909	56	3.850	56
S42	Earthquake Safety Day	Visibility of Earthquake Safety Day through: school activities, audio-visual programmes, competitions, mock drills, etc	3.661	56	3.989	52	3.866	55
S46	Evaluations and feedback *	Indicators, standards and methodologies established for seismic hazard analysis and assessment, unique to their local needs	3.813	51	3.973	53	3.913	54
S36	Local, National, and International training program	Existence of apprentice programmes in seismic risk management for government disaster management staff	3.886	49	3.945	55	3.922	53
S45	Interdisciplinary research between science and policy *	Existence of reducing seismic risk through Interdisciplinary research between science and policy (evidence-based policy) comprehensively	3.867	50	3.963	54	3.927	52
S34	Training of trainers (TOT) programmes	Existence of TOT for community leaders periodically	3.811	52	4.011	50	3.936	51
S52	Financial instruments	Existence of earthquake insurance initiatives	3.795	53	4.037	48.5	3.947	49.5
S16	Responsibility and accountability	Existence of watchdog groups	3.763	54	4.059	42.5	3.947	49.5
S48	Local, National, and International co-operation in research, science and technology development	Existence of local academic institutions as Key Resource Institutions for earthquake risk management.	3.947	46	4.005	51	3.983	48
S18	Intra and inter-ministerial, multidisciplinary & multisectoral mechanisms	Existence of sectoral programmes in line ministries	3.912	47	4.048	45	3.997	47
S33	The role of teachers through school activities	Existence of the role of teacher to disseminate and apply seismic codes in the real practice through their student activities (including collaboration with other parties)	3.982	45	4.037	48.5	4.017	46
S19	Civil society, NGOs, private sector and community participation	Existence of consultation, and role for civil society, NGOs, private sector and the communities to reduce seismic risk	3.904	48	4.112	38	4.033	45
S41	Dissemination and use of traditional/indigenous knowledge through media involvement in communicating seismic risk	Existence of community-based informal meeting discussing good practices in seismic features of buildings	4.009	44	4.059	42.5	4.040	44
S39	Dissemination and use of traditional/indigenous knowledge through media involvement in communicating seismic risk	Tradesman involvement in producing and circulating the seismic features information	4.044	42.5	4.047	46.5	4.046	43

*) technical intervention statements   Note: Group A are researchers, contractors, & foremen (closely related to technical intervention statements) & Group B is closely related to non-technical intervention
I = average of respondents' opinion and II = rank

From analysis of the results shown in the above Tables 8.2, 8.3, 8.4, 8.5, and 8.6, the following comments and interpretations emerge:

a. Based on the general responses and their mean scores, most respondents attached a high or very high importance to the seismic risk management statements to be carried out in Indonesian cities. This evidence is gathered from the following findings:

   i. In total, based on overall responses of 17,385 (see Appendix-4), the number of responses which have a score of 4 (important) and a score of 5 (very important) to statements mentioned in the questionnaire is 14,666 or about 84.36%. Moreover, the overall average mean score is 4.187, between important and very important.

   ii. Taking an average of the mean scores over all fifty-seven statements, it reveals that every group of respondent has an average mean score of more than or equal to 4 (see Table 8.4). The highest average mean score is 4.399, which came from Non-Government Organizations; on the other hand the lowest is 4.109, which came from businessmen. Surprisingly, the difference in average mean scores amongst nine groups of respondents is very small and there is not a very extreme result in the overall responses.

   iii. According to the summary mean scores in each statement, the highest mean is 4.699, which is in 'earthquake occurrence data' (S1). In contrast, the lowest mean is 3.773, which is in 'civil society, NGOs, private sector and community participation' (S20). Although the mean score of 3.773 is the lowest, the number of respondents who placed score 4 or 5 in S20 were 200 out of 305, or about 65,6% (see Appendix-4). This means that most respondents still assigned high importance to S20, even though the statement is in the lowest rank.

   The three findings above have proved that the content of 'the first draft of the proposed framework' which consists of 57 statements, has been highly validated or authenticated by 305 respondents and the respondents have placed a high importance on all the statements to be carried out in Indonesian cities.

b. Going back to Table 8.4, the majority of the respondents expressed '0' or 'don't know' responses in response to only a very few questions, i.e.182 out of 17,385 responses or 1.05% (see Appendix-4). The lowest percentage came from small-medium contractors, which is 0.36%, on the other hand the highest came from Reporters, which is 2.55%. This low percentage of 'don't know' responses might be related to the simple language used in the questionnaire, so most respondents were able to easily understand when answering the questions and only 1.05% of responses were'don't know'.

c. According to the ranks in Table 8.5, the most interesting result comes from 'earthquake occurrence data' (S1). Seven groups of respondents out of nine generally agreed that S1 was ranked first. Only Foremen and Reporters indicated the first rank was not S1, but S23 ('resource mobilization for expert staffing allocation') and S7 ('reducing seismic risk as a priority policy') respectively. In overall, S1 was ranked first. In a similar vein, four groups of respondents ranked S20 last and, in overall, S20 is indeed ranked last. Between the first and last ranks, the remainder of ranks for each statement were scattered fairly and evenly with no evidence of a pattern.

d. Based on Tables 8.6 and 8.7, comparison to mean scores between Group A and Group B, the difference is definitely very small. Similar results to the above 'Point c' apply to both Group A and Group B, who ranked S1 ('earthquake occurence data') and S20 (' civil society, NGOs, private sector and community participation') first and last respectively. Further analysis of this result will be conducted in the next section: Spearman '*rho*' ranking correlation.

e. Based on Table 8.6, most respondents considered that the most important statement is S1 (a technical intervention statement): i.e. 'earthquake occurrence data' and the average mean score is 4.699. This finding might be influenced by the current situation; earthquake data is never disseminated to people in Indonesia, as elaborated by Chandra et al (2004). Therefore, people are very eager to understand the seismic hazard in detail and therefore put this statement at the highest priority.

f. Surprisingly, 'existence information for pro-poor strategies', S50 (a non-technical intervention), is in the second rank. Probably, the high proportion of poor in the communities who are very vulnerable to disaster hazards in Indonesia are easy to find in every city. This might be why most respondents assign this matter a very high priority; however, reverse is true for government staff, whom do not regard it as highly important and assigned a low rank of 19.

The following interpretations are based only on Table 8.6 (the 15 most important statements):

a. Among the 15-most important statements in Table 8.6, there are eight statements related to technical intervention (out of 15 technical intervention statements) and seven statements related to non-technical intervention (out of 42 non-technical intervention statements). Most of the eight technical intervention statements came from core areas of 'Seismic Hazard Analysis' and 'Physical Measures'. Indeed, it might indicate that most people in Indonesia assign the highest priorities to such technical intervention activities to be implemented in Indonesian cities, whilst non-technical interventions were also an important factor to be carried out. Traditionally, in order to reduce the physical vulnerability of non-engineered buildings by introducing seismic features, it is well known that researchers, scientists, contractors, foremen, and construction workers should be in the forefront of change. Today, a new paradigm shift has proved that a combination of technical and non-technical intervention is an important factor as a fundamental element in the wider context of disaster reduction; even political commitment, as a non-technical measure, should be of the highest importance (UNDP, 2004). Here, the combination of the two has emerged clearly, even though technical intervention is still in the majority.

b. As mentioned in UNDP (2003): a 'lack of wider political commitment to disaster reduction is often stated as the main barrier to progress in implementation', hence it was expected that the importance of government commitment (S7) as a non technical intervention would be in the highest rank. Here, the findings are that only Reporters assigned the highest rank to the importance of government commitment (rank number one), and the overall responses to S7 as 'government commitment' gave it little support, attaining the low rank of 14. It is true that the structure of the Indonesian government is still fragile. Everyday needs of citizens may detract attention from this circumstance and definitely, when discussing the implementation of seismic features, people tend to focus more on physical measures of seismic risk reduction and seismic codes (technical intervention) rather than on political issues. This finding ties in closely with the earlier result in 'Point a'.

c. From the 15 most important statements in Table 8.6, it is generally accepted that many statements need a strong engagement and large responsibility from the government, researchers, scientists, small-medium contractors, and foremen in the actual actions. The role of government is very crucial in many areas, e.g. 'generating political will', 'pro-poor and livelihood strategies', 'compliance and enforcement of seismic codes', and 'dissemination programmes'. The involvement of researchers/scientists in 'earthquake data', 'earthquake scenario', 'seismic code', and 'land use application' is very urgent, while contractors and foremen can participate actively in 'good examples in real construction'.

d. In a similar way, it was expected that 'damage assessment', S6 would be considered of high importance, as demonstrated by the good example from the Government of Nepal (see Chapter V), who made this activity their first action and the foundation for reducing the earthquake threat in the Kathmandu Valley (ADPC, 2000). Here, the importance of 'damage assessment' is considered to be a little lower: it is ranked at number 22 and only Non-Government Organizations accorded it high importance, giving it a high rank of 6. The reluctance of most respondents to give 'damage assessment' a high importance may, presumably, be based on a lack of knowledge as to the purposes and scope of the statement in real activity. Based on the literature available in Indonesia, it is widely agreed that damage assessment prior to a strong earthquake event is relatively new to seismic researchers or scientists, even for the community as a whole.

e. There was significant disagreement between Groups A and B on 'seismic codes', S10. Group A assigned it as highly important, according it the rank of 2, while Group B regarded it with little support in the rank of 15.

f. Among the 15-most important statements, many were arranged at the end section of the questionnaire, such as Statement Numbers 50, 53, 55, and 57, and in fact, the responses to the statements were very high. This might indicate that respondents were not fatigued when answering the questionnaire and the data could be considered to be high quality.

The following comments are focused only on Table 8.7 (the 15 least important statements):

a. According to the 15 least important statements, there is no significant disagreement between Group A and B regarding the ranking. S20: 'Civil society, NGOs, private sector, and community participation' was assigned the least rank and the mean score is 3.731. In general, the majority of the 15 least important statements appear to illustrate an aspect of non technical intervention, where the involvement of many related parties, excluding government officials such as civil societies, NGOs, the private sector, and teachers in reducing seismic risk is reasonably less important. Although the statements in Table 8.7 are the 15 least important statements, their mean scores are still high, and most repondents (more than 65%) still considered that it is important or very important to be carried out in Indonesia (see Appendix-4).
b. Other unfavourable statements within Table 8.7 are financial instruments such as incentive strategies and insurance initiatives (S51 and S52). Both Group A and B expressed the same view. The low level of importance in this matter might come from the fact that safety consideration of seismic risk is still not a high priority among people in Indonesia and, obviously, they are overwhelmed with basic needs such as food, shelter, and health in the first place rather than focusing on rare visitations of earth tremor.
c. Also, the respondents in this survey assigned less importance to seismic safety programmes as an integral part of school awareness strategies (S33 and S42). On the other hand, based on the general assessment from the majority of literature, the understanding of this is increasing in many countries.

In conclusion, extracted from the findings from 15-most and 15-least important statements, the content of 'the first draft of the framework' clearly reflects the multidimensional and inter-disciplinary nature of seismic risk reduction as a substantial key to sharing efforts and responsibilities before disaster strikes. In this respect, more actions are assigned high importance in technical intervention than non-technical. Although the content of the questionnaire is designed for non-engineered buildings, most of the principles stated herein will also conform to engineered buildings with equal importance.

8.1.3.2 Calculation of Spearman '*rho*' Correlation among Respondents by Category

This section focuses on the inferential statistics method, where analysis entails the comparison of results for different categories of data collected, particularly to carry out a statistical significance test on the difference between the proportions. According to the ordinal number employed in the scoring value, the Spearman '*rho*' correlation is employed to provide an indication that there is a relationship between the two categories of respondent. Because there are nine categories of respondents, obviously, there are 36 pairs of correlation between each two categories of respondent. The step-by-step calculation of the Spearman '*rho*' correlation between contractors and foremen is selected, for example (Table 8.8), and the assistance of SPSS software is employed in this matter. The overall correlation is shown in Table 8.9 as the output of SPSS software.

Moreover, distinguishing between technical and non-technical intervention, the nine categories then are divided into two groups, Groups A and B. Firstly, researchers/scientists, contractors, and foremen are formed into Group A, as their main duties are closely related to the term of the technical intervention. Secondly, government officials, businessmen, educators, NGOs, community leaders, and reporters are arranged into Group B where non-technical activities are most suited to their duties. Here, the two groups are compared and analyzed. The comment and interpretation of this correlation output is then discussed in the next explanation.

a. Correlation between contractors and foremen as an example

The research question:

Is there any correlation between Contractors' and Foremen's opinions towards 'Seismic Risk Management Statements' as stated in the questionnaire?

The research hypothesis (H_A):

There is a correlation in opinions between contractors and foremen with regard to 'Seismic Risk Management Statements'. These correlations are related to 'Seismic Hazard Analysis', 'Seismic Risk Assessment', and 'Seismic Risk Response'.

The null hypothesis (H_o):

There is no correlation in ranking for 'Seismic Risk Management Statements' between contractors' and foremen's opinions.

Here, the calculation is formed in two ways: i.e. the manual method and by SPSS software (to crosscheck the result of manual method). Table 8.7 presents the calculation by the manual method and Figure 8.1 depicts the output of SPSS software.

Table 8.7 Calculation of Spearman '*rho*' correlation between contractors and foremen

Statement Number	Contractors ranks (1)	Foremen ranks (2)	Difference in ranks (di) (3)=(1)-(2)	Difference in ranks square (di^2) (4)=(3)*(3)
S1	1	13	-12	144
S2	7	20	-13	169
S3	7	20	-13	169
S4	14.5	26	-11.5	132.25
S5	33	36.5	-3.5	12.25
S6	25	24	1	1
S7	31	17.5	13.5	182.25
S8	28	22	6	36
S9	46	33	13	169
S10	2	8	-6	36
S11	31	44	-13	169
S12	3.5	5	-1.5	2.25
S13	28	29	-1	1
S14	11.5	11	0.5	0.25
S15	16	26	-10	100
S16	55	51	4	16
S17	41	6.5	34.5	1190.25
S18	43.5	49	-5.5	30.25
S19	50.5	41.5	9	81
S20	57	55	2	4
S21	34	14	20	400
S22	36	32	4	16
S23	7	1	6	36
S24	39	9.5	29.5	870.25
S25	22	39.5	-17.5	306.25
S26	9.5	31	-21.5	462.25
S27	13	6.5	6.5	42.25
S28	18	36.5	-18.5	342.25
S29	14.5	52	-37.5	1406.25
S30	43.5	9.5	34	1156
S31	36	29	7	49
S32	46	26	20	400
S33	50.5	44	6.5	42.25
S34	52	53	-1	1
S35	28	2	26	676
S36	53.5	47	6.5	42.25
S37	41	39.5	1.5	2.25
S38	11.5	17.5	-6	36
S39	22	46.5	-24.5	600.25
S40	36	44	-8	64
S41	46	29	17	289

Table 8.7 continued

S42	56	56	0	0
S43	20	23	-3	9
S44	18	36.5	-18.5	342.25
S45	38	54	-16	256
S46	41	57	-16	256
S47	26	15	11	121
S48	49	50	-1	1
S49	22	4	18	324
S50	5	3	2	4
S51	53.5	34	19.5	380.25
S52	48	48	0	0
S53	9.5	20	-10.5	110.25
S54	31	36.5	-5.5	30.25
S55	3.5	16	-12.5	156.25
S56	24	41.5	-17.5	306.25
S57	18	12	6	36
		Total di^2		12216.75

$$rho = 1 - \left[\frac{6 * \sum di^2}{n(n^2 - 1)} \right]$$

where,
rho = Spearman '*rho*' correlation coefficient
di = the difference in ranking between 2 respondents' opinion
n = number of statements

$$= 1 - \left[\frac{6 * 12216.75}{57(57^2 - 1)} \right] = 0.604$$

Based on earlier analysis, the positive direction of correlation seems to make sense, indicating that a high ranking in one variable corresponds to a high ranking in the other. Therefore, one tail test of significance was chosen for this case in order to have a reason to support a positive direction. In relation to the boundaries of a confidence intervel, conventionally, the confidence level is set at 95% to coincide with the 5% convention of statistical significance in hypothesis testing (or 95% confidence limits). In fact, these research data is able to produce 99% confidence limits (as the result from SPSS software), or the probability of the result being due to chance is less than one percent or 1 in 100 ($P<0.01$).

Statement of hypothesis testing

Concerning the tail test of significance and $P<0.01$, the critical value (r_o) for the Spearman '*rho*' correlation is 0.432 adopted from the Spearman '*rho*' table (see Appendix-1). The above results shows that *rho=0.604* > r_o=0.432: hence, the research hypothesis is accepted and the null hypothesis can be rejected, concluding that contractors and foremen have a significant correlation or do not perceive the 'Seismic Risk Management Statements' differently. The calculation also describes an overall agreement between both examples toward 'Seismic Risk Management Statements' (*rho*=0.604). This indicates that the high ranking given by contractors to the 'Seismic Risk Management Statements' correspond to high ranking given by foremen to the same statements, and vice versa. Figure 8.1 presents the result from SPSS software to crosscheck the '*rho*' value and significance level:

Correlations

			CONTRACT	FOREMEN
Spearman's rho	CONTRACT	Correlation Coefficient	1.000	.604**
		Sig. (1-tailed)	.	.000
		N	57	57
	FOREMEN	Correlation Coefficient	.604**	1.000
		Sig. (1-tailed)	.000	.
		N	57	57

**. Correlation is significant at the .01 level (1-tailed).

Figure 8.1 The result '*rho*' coefficient from SPSS software between Contractors and Foremen

b. The Summary of Overall Correlation

Analoguous to the above example, the critical value is also the same, which is r_o= 0.432. Here, overall correlation among each pair of respondents is described in Table 8.8; Figure 8.2 mentions the SPSS software result regarding the correlation between Group A and Group B.

Table 8.8 The overall correlation coefficient (*rho*) among respondents

	Researchers-Scientists	Contractors	Foremen	Government	Businessmen	Educators	NGOs	Community Leaders	Reporters
Researchers-Scientists									
Contractors	0.681								
Foremen	0.591	0.604							
Government	0.757	0.805	0.570						
Businessmen	0.650	0.733	0.579	0.709					
Educators	0.469	0.657	0.506	0.608	0.711				
NGOs	0.592	0.575	0.644	0.643	0.602	0.566			
Community Leaders	0.593	0.691	0.618	0.658	0.572	0.607	0.555		
Reporters	0.547	0.534	0.440	0.617	0.489	0.484	0.516	0.475	

Correlations

			GROUPA	GROUPB
Spearman's rho	GROUPA	Correlation Coefficient	1.000	.875**
		Sig. (1-tailed)	.	.000
		N	57	57
	GROUPB	Correlation Coefficient	.875**	1.000
		Sig. (1-tailed)	.000	.
		N	57	57

**. Correlation is significant at the .01 level (1-tailed).

Figure 8.2 The result of '*rho*' coefficient from SPSS software between Group A and Group B

c. Comments and Interpretations

Based on the above analysis of the Spearman '*rho*' correlation, the following findings are made:

i. It can be seen clearly in Table 8.8 that all coefficient correllations '*rho*' are higher than the critical value r_o = 0.432. This indicates that high rankings given by each group of respondents to the 'Seismic Risk Management Statements' correspond significantly to high ranking given by another group of respondents to the same statements, and vice versa.

ii. The highest correlation coefficient (*rho* = 0.805) is between the government and contractors and the lowest correlation coefficient (*rho* = 0.440) is between foremen and reporters.

iii. Surprisingly, the correlation coefficient between Group A and B (*rho* = 0.875) is higher than the correlation coefficient between the government and contractors (*rho* = 0.805). This indicates that the formation of researchers, contractors, and foremen into Group A and the rest into Group B renders a stronger correlation.

iv. In summary, there is significant agreement from every group of respondents concerning the rank of the 57 seismic risk management statements stated in the questionnaire. Furthermore, when discussing the level of importance of the seismic risk management statements, there is no significant difference in opinion among researchers/scientists, contractors, foremen, government officials, businessmen, educators, NGOs, community leaders, and reporters. Broadly speaking, all the respondents are relatively homogenous and share the same characteristics. In addition, the configuration of Group A and B has confirmed homogeneity in the same characteristics within members of each group, rather than within the respondents grouped in each category.

8.1.3.3 Additional Ideas Collected from Open-Ended Answers

At the end of each section of the questionnaire, there was a blank space to accommodate the respondent expressing some additional ideas or issues if necessary. The exploratory descriptive analysis is employed in this section. Drawn from 305 returned questionnaires, the number of respondents who gave an open ended answer in the space provided was only 48 out of 305. Respondents who took part usually wrote one or more additional ideas. Therefore, more than 48 responses or statements were gathered from 48 respondents.

There were a wide variety of ideas and information received. It would be an extremely long sentence if every additional idea captured from the questionnaire was written as the original. Therefore, in this exploratory analysis, the additional ideas are stated in a typical statement with a general meaning. In general, this can be divided into three categories, i.e. (1) typical additional ideas related to 57 statements or pairs of characteristic-indicators, (2) typical additional ideas related to the respondent's expectation of further dissemination of the findings, and (3) typical miscellaneous additional ideas, which are not considered further. A summary of the additional ideas and their analysis is described in Table 8.9 below:

Table 8.9 Summary and exploratory analysis of the additional ideas

No	Typical additional ideas by categories	Exploratory analysis
A	**Typical additional ideas related to the 57 statements**	
	1. Comments from two community leaders, a educator, and a reporter: "Regular dissemination of earthquake data, mechanism, and effect"	This typical idea was already elaborated in Statement Number 1 and was added further to the statement
	2. Comments from two educators and a businessman: "It is hoped that community as a whole can understand easily how to construct seismic resistant houses"	This idea supported Statement Number 10
	3. Comments from two NGOs and a foreman: "Since Indonesia is a developing country, this research should focus on the method of construction of a simple house with seismic resistance, as the number of them are predominant"	This idea supported Statement Number 10
	4. Comments from two contractors and a foreman: "The existence of 'punishment' mechanisms for peple who compromise seismic features in their houses"	This idea supported Statement Number 12
	5. Comments from two reporters and a contractor: "It is necessary to deliberately enforce the building law"	This idea supported Statement Number 12
	6. Comment from a contractor: "In fact, the construction certification is only 'a normative credential' and it can be easily afforded with a little cash. Sometimes, the credential is not required for design and construction".	Although this idea gave low support to the 'certification' (Statement Number 15), overall responses still gave high importance with a mean score of 4.303 (Table 8.4). Therefore, the idea of certification was not deleted.

Table 8.9 continued

	7. Comment from a NGO: "The implementation of government budget allocation is supervised in detail"	This idea supported Statement Number 16
	8. Comment from a NGO: 'Please socialize/disseminate the existing earthquake resistant house through NGO'	This idea supported Statement Number 20
	9. Comment from a reporter and a community leader: "A further consideration is the scarcity of government budget and low awareness from a political perspective"	This idea supported Statement Number 24 and 7 respectively.
	10. Comment from a community leader: "Clear information will give useful 'feed back' to the government and many parties to minimize the losses"	This idea supported Statement Number 26 and/or 29
	11. Comments from two government officials, a educator, a businessman, and a reporter: "The important thing is to deliver the information to the larger society so that they completely understand what they should do if the adverse event happens"	This idea supported Statement Number 27
	12. Comments from two researchers and a contractor: "The implementation of seismic features needs a wider involvement and co-operation from many parties"	This idea supported Statement Number 28
	13. Comments from a foreman and a reporter: "A short program in public or private TV about the importance of seismic features in house"	This typical idea was already mentioned in Statement Number 38 and was added further to the statement
	14. Comment from a community leader: "Conduct an audiovisual program to the community more intensively"	
	15. Comment from a foreman: "A simple example of a seismic resistant house can be applied to a post patrol ('*gardu ronda*') in the neighbourhood area"	This typical idea was already mentioned in Statement Number 57 and was added further to the statement
B	**Typical additional ideas related to the respondent's expectation of further dissemination of the findings**	
	There were 36 responses; some examples are noted below:	These additional ideas were merely respondents' expectations of the aspects of 'dissemination', therefore there was no further analysis.
	1. "The next important thing after this research is the implementation of the findings in high seismic hazard areas"	
	2. "The findings of the research shall be publicised to all community members to anticipate the earthquake disaster".	
	3. "Although a seismic event is very rare in Indonesia, the dissemination mechanism and its practice should be conducted and not left in the research report only".	
	4. "Hope this can be implemented within the grass roots community!"	
	5. "Do not do only in 'research', please make it'reality'."	
	6. "Hope everything can be carried out in real actions!"	
	7. "We wait for the follow-up of the findings"	
	8. "Please publicize the findings in common language!"	
	9. "Please apply it to Yogyakarta city!"	

Table 8.9 continued

C	**Typical miscellaneous additional ideas**	
	There were 15 responses and some examples are noted below:	
	1. "The importance of understanding seismic risk for effectiveness in the long term".	These additional ideas were merely miscellanious and/or beyond the research aim and thus were not considered further.
	2. "The scope of the research is very large"	
	3. "Be successful in your research!"	
	4. "The seismic problem is very important to be understood because it relates to human safety"	
	5. "I hope the dissertation is able to give useful input to the community as a whole in order to reduce seismic risk in Indonesia"	
	6. "Please remember God, since the earthquake belongs to Him!"	
	7. "Please can the foreign terms in the questionnaire be translated into common Indonesian language, so that it is understandable to foremen."	

Table 8.9 can be summarised as follows:

a. There are only three refinements for the pair of characteristic-indicators, i.e. Statement Numbers 1, 38, and 57

b. Many respondents assigned a high emphasis to the area of dissemination. This finding also validates Statement Numbers 27 and 38 about 'dissemination' in the 15 most important statements.

In general, open-ended answers from respondents have demonstrated critical review to the content of 'the first draft of the proposed framework', although only three refinements have been agreed after detailed collating. Furthermore, the dissemination issue is very important in this sense due to the 36 responses. It is also strengthened the 15-most important statements (Table 8.5), as two of them concern the dissemination issue. Based on 36 responses regarding the dissemination and research aim, it is very useful to investigate further on dissemination issues of the seismic features in real construction (particularly in residential houses) in an effective and easy way in Indonesia. It is expected that the content of the proposed framework will not only cover many approaches of dissemination, but also many basic guiding principles to assist a wide range of users for their own contexts.

8.1.3.4 Emerging Questions Arising from the Questionnaire Survey

Quite a lot of information was generated as a result of this questionnaire survey. Many issues emerge from the findings; however, only a few will be investigated due to the research aim and time pressure of the project. Generally, underlying all the above questionnaire findings is some form of important technical intervention and seismic feature dissemination. In particular, the follow-up question of the technical intervention issue stems from the findings in Table 8.5, where most respondents rated technical intervention as important, while the dissemination issue of seismic codes is due to results from the open ended question. Therefore, it is very useful to discover the answer or story behind the two principal emerging questions arising from this questionnaire survey. These are:

a. Why do people tend to assign a higher priority to technical intervention than non-technical issues when discussing the implemetation of seismic features?
b. What is the best way to disseminate and familiarize the seismic features in real construction (particularly in grass root residential houses) in a sustainable, effective, and easy way?

8.2 Interview Data Collection and Analysis

Data collection via an interview is the subsequent phase of the above postal questionnaire survey. This section begins with the rationale for the interview data collection method. The research sample, including the profile of the interviewees, then follows. The major part of this section contains the presentation of different themes or patterns emerging from the analysis of the interview data.

8.2.1 Rationale for the Interview, the Research Sample, and the Questions

The findings of the questionnaire survey has brought to light two inviting principal questions, i.e. the importance of technical intervention and seismic feature dissemination to the lay person, in order to comprehensively understand the research aim. Indeed, the answer to the two questions is fully related to the full set of components in current community activities, such as individuals, organizations, policies, and technical resources. The activities of the community represent a continuing process, in which the components interact with one another to adapt to the demand and resources of their environment more efficiently. Therefore, the answer to the two questions needs a fresh perspective from the factual story behind people's experience, where much of the accurate information might not be available from a reference book. As a result, it was decided to conduct interviews to elicit a richer and in-depth story as well as dynamic patterns according to the two questions, which were not fully investigated during the initial data collection.

A similar impediment to the interview conducted in the pilot study (see Chapter VII) arose, as it was not easy to comprehensively discuss the definition of seismic risk management with people, as the research topic was relatively new in their mind. In order to overcome this barrier, therefore, this interview was conducted with those involved in the previous postal questionnaire survey, in order to follow the flow and logical thinking of the research topic, without having to make a huge effort to familiarise interviewees with the details of the research topic at the beginning of the interview.

For this course of action, nine interviewees were selected and approached from the number of respondents involved in the previous questionnaire survey, giving a representative reflection of the nine multidisciplinary stakeholders in the research arena. Since the current disaster risk management hardly embraces a multidiscipline approach, and this is also rarely incorporated into development planning in Indonesia, the mix of interviewees' backgrounds is a fair representation of multi angle perspectives. The interviewees were selected from middle to high management in each organization, as the area of expertise of interviewees would facilitate the validity and significance of the data generated. Table 8.10 gives the general description and profile of the interviewees participating in the interview. The interviewees were categorized to remove names or any reference made to any other organization or person by name.

Table 8.10 Profiles of the interviewees

Number	Interviewees
1	Category: Researcher Position interviewed: University lecturer and practitioner in Structural Engineering
2	Category: Small-Medium Contractor Position interviewed: Director of a medium contractor
3	Category: Foreman Position interviewed: Individual foreman
4	Category: Government Position interviewed: Middle management government staff of Infrastructure Department
5	Category: Businessman Position interviewed: Middle management staff of a real estate firm
6	Category: Educator Position interviewed: Headmaster of a school
7	Category: Non Government Organization Position interviewed: Director of a national NGO
8	Category: Community leader Position interviewed: Head of a village administrative structure
9	Category: Reporter Position interviewed: Deputy Editor of a local newspaper agent

As mentioned in the earlier section, there are two main questions for further investigation. These are related to the importance of technical intervention and sustainable and effective methods of dissemination of seismic features. The interview method was conducted with a semi structured approach, not only focusing on the topics for discussion but also allowing the interviewee to explore the subject and express opinions and evaluations, since these may reveal previously unidentified issues or ideas or new perspectives on existing risks.

With reference to the result of the Spearman '*rho*' correlation (see the above Section 8.1.3.2), there is a homogenous nature which shares the same characteristics between nine types of respondents when discussing the seismic risk management statement. This indicates that the nine interviewees will respond to the two questions with equal force and then all the answers can be analysed and compared in one go, regardless of their backgrounds.

Prior to the interview, the author communicated the invitation to the interviewees by telephone. This focused on the purpose and importance of the interview, requested co-operation, assured confidentiality, mentioned the key topics to be addressed during the interview, and confirmed the time and place. Sometimes the agreed interview events were delayed or rescheduled due to a matter of great urgency to do with the interviewees' work or due to a sudden change in timetable, since the interviewees were all important people within their organisations. Hence, this part of the research was problematic, especially when combined with other interview appointments where the respondent's address was geographically remote and in light of the time pressure on research.

8.2.2 Analysis of the Results of the Collected Data

The interview took place over a period of about a month. The interviews were digitally recorded using a digital voice recorder, i.e. a Mustek PVR-A1, loaded onto a PC, and transcribed. The data was then analyzed, using NVivo software, version 2.0. The software helped to code the data and identify themes and/or patterns generated. The interview was carried out in Indonesia in the Indonesian language and the original data was also written in the same manner, so the translation to English might cause a slight irregularity in syntax.

In general, interviewees inspired many new ideas when responding to the two questions, although the respondents did not keep their responses focused only on the main questions. Because it is widely agreed that the interviewees' backgrounds were different, it seemed the respondents were expressing the activities of a range of goals they had in mind, instead of restricting themselves only to the questions. As a result some of the respondents comments included in the discussion covered more general reactions.

Matched to the two questions, the findings from this interview are also categorized into two main topics, i.e. influential factors of the importance of technical intervention and seismic feature dissemination principles.

8.2.2.1 Influential Factors of the Importance of Technical Intervention

Three influential factors that drove respondents to assign a high level of importance to intervention from technical actors in seismic risk reduction through the implementation of seismic features emerged in this interview. They are: (1) closeness to physical building/house vulnerability reduction, (2) lack of public knowledge about government functions and their commitment to maintaining public safety from seismic disaster, and (3) the importance of earthquake data.

The first reason that technical intervention is very important in reducing seismic risk is linked with the relative closeness to a reduction of the vulnerability of physical buildings/houses. It is all too easy to understand. All interviewees conveyed a sense of confidence that seismic risk was widely influenced by the level of building/house vulnerabilities. At this discussion, they principally urged that petty contractors, foremen, masons, and/or carpenters should be at the forefront during residential house construction. The quality levels of residential houses or low-story buildings and whether or not they are seismic resistant depends largely on the knowledge and workmanship of such builders. As the community leader said:

> "...I think people easily understand that most of the problems during an earthquake event are due to the collapse of residential houses or buildings........this points that those who are involved in the process of building a house in the community as a whole should be highlighted to reduce the same tragic event in the future...........".

In a similar vein, the government staff stressed:

> "...As you know, in general, the greater vulnerability of the house is the higher of seismic risk to be exposed, isn't it? It is simply because masons and carpenters (*tukang*) who are building a residential house as usual don't know how to build a seismic resistant structure......".

Furthermore, the real estate firm staff commented:

> "....I agree that the houses including those I am selling could be vulnerable to ground shaking. People see no surprise that in the current earthquake, many houses collapsed because the houses were too weak against strong shaking.......However, the details are completely upon the mason and carpenter....".

While the close interrelation between the importance of technical intervention and the level of vulnerability of a house/building was widely recognized, interviewees from the categories of contractor, reporter, researcher, and foreman augmented the above finding from a different angle. They also argued that most people probably do not have any understanding, information, or knowledge that the government should be responsible for public safety, including protecting the population from seismic tremor. If most people understood that the fundamental root problem of poor seismic risk management stemmed from the absence of political commitment, as highlighted by UNDP (2003), not necessarily only from technical problems, they would acknowledge quite precisely that political commitment is probably of the highest importance. In fact, it is easy to find that most people point to the vulnerability of structure as the main source of overwhelming seismic risk, rather than political commitment itself. Many people would never have thought to ask and take a careful look at the basic issue of disaster risk reduction, thus raising the question of why the government poorly organizes public safety, along with disaster risk management systems, following the latest tragic, disastrous events? In conclusion, a lack of public knowledge of government functions justifies the second factor of why most people focus on technical intervention when dealing with seismic risk reduction.

This evidence was acquired during an interview with the contractor, as follows.

> "....For example, if there are many public school collapses during an earthquake, people place the blame directly on us as builders........From a public point of view, most lay people don't know that the government is certainly also responsible..."

In addition, the reporter elaborated:

> ".....Because of a lack of public education about what are the government's duties, community members don't have any idea to blame government, but they tend easily to point to contractors as the main cause of the collapse of public buildings. In my opinion, the government should provoke in the first line".

In a different pattern, the educator also mentioned a third factor, i.e. the importance of earthquake facts, as follows:

> ".....As you said, scientists such as geologists who are analyzing earthquake data are included in the technical group, I also guess people want to understand first the characteristic of historical earthquake data over time and also the existing fault line, and take reflection on that matter for further activities......."

From the above explanation, these findings confirm that the three factors contribute largely to why people tend to assign a high priority to technical intervention when dealing with seismic risk reduction through seismic feature implementation. The three factors are summarized as follows:

a. Direct relationship with physical vulnerability

Certainly, it is clear and easy to understand that intervention from technical actors in seismic risk reduction is very closely related to a reduction in physical vulnerability. The improvement of technical ability of builders, such as small-medium contractors, foremen, masons, and carpenters play an important factor in non-engineered construction practice. Ultimately, they are the major factor in governing whether seismic features are implemented in the construction of non-engineered structures. Obviously, the higher the workmanship of such builders in real non-engineered construction, the lower the exposure to seismic risk will be.

b. Lack of people's understanding of government functions

If people understood that one of the government's main duties is to maintain public safety, people would probably show no surprise that physical vulnerability is intrinsically linked with government political commitment. In reality, people's understanding of government functions is very low and weak, and also is far from the desired goal. Certainly, this commitment should be in the forefront. The skill improvement of contractors, foremen, masons, and carpenters, who are primary technical actors in real non-engineered construction, is easily achieved under the umbrella of good and clean government. It is hoped that government awareness of the degree of seismic risk is soon translated into concrete action rather than contemplation. Furthermore, it is quite surprising that the researchers, contractors, and foremen, who are closely involved in the technical measures, commented about the importance of political commitment (non-technical measures). This may indicate that the technical actors' duty of care to reduce seismic risk is fully in the right direction, then they look at the inadequacies of overall government initiatives, which need to be seriously improved.

c. The importance of earthquake data

Based on its nature, earthquake data is included in the technical statement. Better understanding and correct information on earthquake data constitutes a foundation for people to become proactively involved in seismic risk management activities, since without this knowledge, seismic risk is simply thought to be negligible. All too often, scientific knowledge of the geological conditions and seismic history had not been incorporated into local planning or community awareness programs. Based on larger literature, this data is widely available from many sources, and is even up-to-date, but this is never disseminated to the lay people in a timely manner, in order to trigger a sense of shared risk. Although only one respondent mentioned the earthquake data as being the influential factor of the importance of technical intervention, this assertion authenticates the finding of the questionnaire survey, where this statement was placed in the highest rank (see Statement Number 1 in Table 8.4)

Broadly speaking, the above findings reveal the important issues of improving the skill of builders, government political commitment, and earthquake data dissemination in seismic risk reduction. The role of builders appears to be very important, while respondents did not mention the role of scientists and researchers as a crucial factor, as well as the other stakeholders, such as community leaders, educators, reporters, businessmen, and NGOs. Surprisingly, the role of government is increasing more critical to this matter, as one interviewee stated: the government should appear in the first line.

Corresponding to the questionnaire survey result, the above findings may also indicate an increasing concern over the issue of government commitment (Statement Number 7 in Table 8.4) at a much higher level; whereas the survey findings only award this issue a rank of 14. Also, from the reporters' point of view alone, this factor definitely authenticates the findings of questionnaire survey, where Statement Number 7 about political commitment was placed at the highest rank (see Table 8.4).

8.2.2.2 Guiding Principles of Sustainable and Effective Dissemination in the Grass Root Initiatives

The explanation for this section corresponds with the second question about sustainable and effective dissemination of seismic codes in grass root initiatives, as many respondents raised many aspects of this issue. It is not a surprise because grass root residential houses always suffer most during strong ground shaking, as elaborated by CEEDEDS (2004). The reasoning is that a series of costly earthquakes have proven that there is a widespread persistence of grass root communities not to implement seismic codes or perhaps an inability to learn from past earthquakes. Furthermore, the implication of a general assessment of people at the grass roots level is that the manual of seismic features is understood in different ways and not through standard curricula.

While most respondents mentioned some dissemination methods already listed in the questionnaire, such as posters and newspapers (Statement Number 38), three sustainable dissemination principles were raised throughout, when respondents were asked about an easy, sustainable, effective, successful, and streamlined way towards the dissemination of seismic features among the community members, particularly at the grass roots level, with considerable effects. These are: (1) the government should act as a proactive backbone of the dissemination initiative, (2) the dissemination mechanisms should use the existing social bond and/or indigenious method, and (3) the dissemination message should convince the community member that the implementation of seismic codes is easily achievable under their control.

a. Government should enact as a proactive backbone of the dissemination initiative

To disseminate the benefits of seismic features in real construction successfully and continuously, all respondents mentioned the importance of the government's role, and even mentioned it as the most important factor. This emphasis comprises many aspects of activities, particularly the dissemination project initiated by the government as well as by the community group itself and the enforcement of seismic code mechanism. Although the government are not necessarily solely resposible for disseminating information regarding seismic features, and there is a new opportunity for multidisciplinary involvement in this matter, nevertheless, the government itself should act as a proactive backbone of the dissemination initiative. It means that, while dissemination initiatives may come from any other source of people and organizations, the government's role is central to encourage and invite more and more people to engage in this issue. The ability of government to listen, respect, encourage, and motivate grass root programs initiated by community groups is indispensable. At the same time, the government should generate campaigns or dissemination programs down to the community members to motivate people to gradually prepare for the next disaster, highlighting a shared risk and also enforcing seismic codes. The government's role is to be the focal point for communication, coordination, programme monitoring, delivery of knowledge, and accountability.

One respondent from the category of contractors believed that the government could carry out a pilot project about a seismic resistant model houses, in collaboration with many other organizations. By visiting the model houses during their construction phase, people can better understand how to implement seismic features correctly, using real construction as a dissemination media. In addition, the construction process can be filmed for wider circulation, changing construction practice, and replicating success in other areas. This film can facilitate seismic code enforcement, as the contractor suggested:

> "....I believe that exemplary model house can encourage people to implement seismic features as a dissemination tool. It is a good idea to invite people or, probably, students in the construction field to see directly. If government wants to enforce seismic codes through their regulation, such implementation can be documented in film format as a pilot to increase people's understanding on how to implement the codes. Probably, due to the decentraliation process, the government can begin these activities in wealthy districts as pilot projects. Because they have many resources, they can conduct it in many easy ways...."

It is believed that, if the government makes a huge effort to rigorously enforce seismic features today in many model houses so people see what they look like and feel very proud, many more model houses would soon be replicated everywhere. When a strong earthquake strikes, the government will make only a little effort in response because the collapse of buildings/houses would be rare, even avoided. Furthermore, it would ensure faster recovery and reconstruction.

The researcher felt the government could play a very important role in helping communities who have recently built their new houses to adjust to the new design of seismic resistant houses, through a steady flow of government campaigns, as follows.

> "......Clearly, the procedure to include it in common residential houses is long and widespread...... If the government has such easy accessible information for people to begin understanding the degree of risk and then to build their own house with such codes and in line with the existing regulations, I think it is very important and an easier path for a safer environment..."

The greater need for a proactive government in this sense was also suggested by the community leader, underscoring a 'bottom-up' approach, as follows:

> "...For my point of view, it depends absolutely on the government.......Government staff responsible for public safety should make more visits and have more face-to-face discussion with the group to acquire the community need directly..."

b. The dissemination method should utilize existing social bonds and/or indigenous methods. Three out of nine respondents stated the importance of social bonds and indigenous methods when dealing with communal grass root dissemination. This finding argues that when government staff, researchers, scientists, and/or other disaster management experts gather to elucidate the lay people, this process will be effective if it uses or merges into the formal or informal existing tradition of community meetings. Innovative initiatives, new synergies, and networks are easily absorbed over those already established. This will fit into the existing community structures without any friction and also value everybody's unique contribution.

People will be comfortable, happier, and less worried about being involved in the dissemination process if they are among people they have worked with in the past and with whom they have developed a long-term relationship and have similar beliefs. This approach also emphasizes the importance of sustainability. This process breaks powerful psychological barriers and continues to build up trust amongst them and also acts as encouragement for others who have not been involved in any initiatives in the past. It is a better and less expensive method for including communal actions. At last, this method makes it easier to enforce proper maintenance of community based disaster-management systems.

Perhaps, the current dissemination method initiated by government officials uses government standards which are often not flexible enough to adjust to various people's needs. The government tends to be just interested in promoting their own status, and the use of existing social bonds is often greatly neglected. This section explains that successful adaptation to changing circumstances can be enhanced through the availability of existing social cohesion. Learning to live with seismic risk can be assisted by uniting current good practices of seismic features with people's own societal practices. Evidence of this conclusion has been conveyed by respondents as follows:

The reporter said:

> ".......Sometimes people who disseminate, such as government officials or university lecturers, fail to identify that the community leader has a totally different approach of delivering programs and on the other hand, lay people have a different style of learning in a particular environment..."

The respondent from the NGO said:

> ".....It is helpful for people who will give a speech or advice to the community member, if they go to available neigbourhood meetings. People are very welcome and voluntarily involved in this situation, not surprisingly, the meetings receive high attendances..."

In addition, the community leader said:

> "........ our community is clever enough to revitalize themselves as long as there are co-operative networks or efforts, funding, and support from local officials........ I think our community likes to move at their own pace...."

The above explanation confirms the importance of the use of the existing social bond and indigenious technique for succesfull adaptation in delivering any dissemination initiatives and also for addressing citizens' needs more effectively and efficiently. In this way, the role of community leader is substantial, as the community leaders have traditionally taken on consistent long-term relationships in steering social practice. If billions of people do as the leaders tell them, it could have a real effect. Yet, it is not an easy task to persuade low educated people to take part in sound seismic risk management. Probably, the community leader should first establish people's interest at the first point of contact, secondly: encourage and support them, at the same time introducing them to good practices of seismic features which they may not have been aware of.

In addition, the existing social bond has shaped the community's capacity in their daily lives. Through this bond, community members can better adjust their own practices to improve performance. If this dissemination mechanism is well done and streamlined over time before disaster strikes, obviously this channel will be sustainable and will also work well in the critical stages of disaster response. Community members help one another, sharing information and resources as it becomes available.

The above discussion is about channeling dissemination by giving a talk or elucidation to grass root communities. This dissemination technique is conducted by 'visiting' the community group. On the other hand, the dissemination technique by 'inviting' individuals to the meeting, discussion, or seminar is very suitable for people from medium-top management in organizations who have experienced better education because they have an appropriate level of expertise and knowledge. This is why the dissemination to the grass root community by 'inviting' them to a formal forum, such as a discussion in government offices, always fails to motivate them into concrete action. This is likely to be because the prescriptive mechanisms are not compatible with their beliefs. To achieve the best result, the government officials should 'visit' the community directly.

Therefore, this finding confirms that one reason why community members do not implement seismic codes persistently is because the disseminators never 'visit' the grass root community and merge with the existing social practices, where most grass root community members in a developing country are relatively poorly educated. This approach is completely different from those who have higher education. As long as the dissemination method for most lay people corresponds with their existing social spirit and cohesion, and it is compatible with people driven practices, and they have an opportunity for interaction, then considerable effects can be achieved easily. Here, it should be understood that the existing number of dissemination channels and methods, beside giving talks and face-to-face communication in the long tradition of the community, are virtually endless. However, current studies have shown that once a certain level of prosperity is passed, more economic growth actually erodes personal satisfaction and social wellbeing in most cities, and then the above principle is less attention.

c. The message should be achievable under control of the people

After the correct dissemination channel is diligently decided, here, two respondents stated that the message about the implementation of seismic features should be achievable under the control of the people. This finding underpins what Lustig (1997) has found: that for a disaster-management system to be sustainable, it should be designed not only to convey the message to the members of the disaster-prone community that they are in control, but also that the system is actually under their control.

Although the seismic event itself, when it occurs and how big the magnitude will be, is uncontrollable, most of the components of seismic risk people face are absolutely controllable. Community members who are living in a seismic hazard prone area can control the suffering from seismic tremor, for example, through implementing such codes in their houses/buildings and making any other appropriate preparations. If people rationalize that the implementation of seismic features in their own houses is the most effective strategy for minimizing losses, and at the same time, perceive it is practical, possible and achievable and they can control it, this strategy will have a tremendous effect on how well they can cope with it.

It is an unwise solution to force people to leave their homeland because of the high level of uncertain but inevitable threats of an earthquake event, as an inconvenient truth. Thus, the dissemination message should convince people to devote themselves to living harmoniously with seismic risk through matters they perceive they can control. The ideal solution is to give people a better understanding about seismic hazard and risk in a reasonable and rational manner and then convince them they can cope and control it with the proper implementation of seismic codes. As a result, people become happier and do not worry about living in seismic prone areas because they have some control over events. Better understanding of seismic hazard and risk will encourage people to implement seismic features voluntarily without coercion. In similar way, it can be compared to a person who is driving a motorcycle on a motorway and is voluntarily wearing a helmet to prevent a fatal road accident. Although disseminating new ideas to people is not welcomed at first, even fought against, efforts must be made to present persuasive arguments of the soundness of the protective and cost-effective measures.

The foreman said:

> "......I think a common house owner can overcome this matter positively.....It is good if people have a desire to be involved...."

The community leader argued:

> "......If they are persuaded with respect, their confidence goes up, and they feel that their activity is part of the government program. If you can capture their basic trust, I think it is better. ....As you know, last time, the government launched a 'family planning initiative' to overcome overpopulation in Indonesia. This is quite successful because people own it and can gain the benefit, isn't it?...."

It is important to educate people that the implementation of seismic codes is simple, economically feasible, and achievable, and culturally acceptable to obtain their sense of control over their destinies. If people have a sense of control and are clever enough to implement seismic features properly, then they can also achieve a sense of ownership. This sense of ownership is really needed, not only to encourage and maintain actions voluntarily in order to generate a culture of prevention, but also to make community members feel part of the effort. As a result, people will actively make contributions to reduce vulnerability. Through a greater sense of ownership, more people tend to recognize that reducing seismic risk needs shared responsibility and shared effort.

Indeed, delivering such dissemination messages so that people feel in control largely depends on the individual who conveys the message. This person should have the ability to deliver the knowledge precisely and timely in relation to the people's need. In addition, it is greatly recommended that the disseminators have intelligence and sometimes a sense of humour to intersperse the odd good joke during the course of dissemination. Failure to attract the people's sense of control could hamper the process.

In conclusion, the above finding suggests three guiding principles for a sustainable and successful dissemination process, which may have been greatly neglected in the past. The above three principles confirm that: (1) the government role is the backbone of the dissemination initiative, (2) the dissemination channel through the existing social bond is imperative, and (3) the message should convince people that they have control over the implementation of seismic codes. If the three principles are applied rigorously, the dissemination process will obtain great achievement. This is truly beyond technical capacity. However, sometimes the key government officials and the disseminators, who are usually from a wealthy background, do not persevere in conducting dissemination to the low-medium income population, as they are not on the 'poor' people's side and also do not gain any clear financial and political benefit.

In particular, the first principle confirms heavily that the government role emerges as being essentially in the critical component of shared seismic risk, which should stand at the very top of the agenda for change, in line with UNDP (2003). As seismic risk reduction is intrinsically linked with the development of government related issues, in general, most the decisions are made either explicitly or implicitly in regard to political considerations.

Principle number 2 is closely related to the idea of a sense of place, meaning that feeling is attached to a place, and feeling secure in all the things that make life truly meaningful is important for people's identity as mentioned by Coveny and Dutson (2006) and Lynas (2007).

The government should be more accommodating to people's needs and understand what works in one region is unlikely to work in another. In addition, to address the persistent inability of grass root communities to implement seismic features, the dissemination should engage many actors with local wisdom, complemented with many opportunities and strategies by developing a sense of responsibility for all community members. Finally, these three principles are also designed to convince people not to deny the problem and to eliminate apathy as the most frustrating factor. Figure 8.3 depicts the findings of the interview, with the assistance of NVivo software:

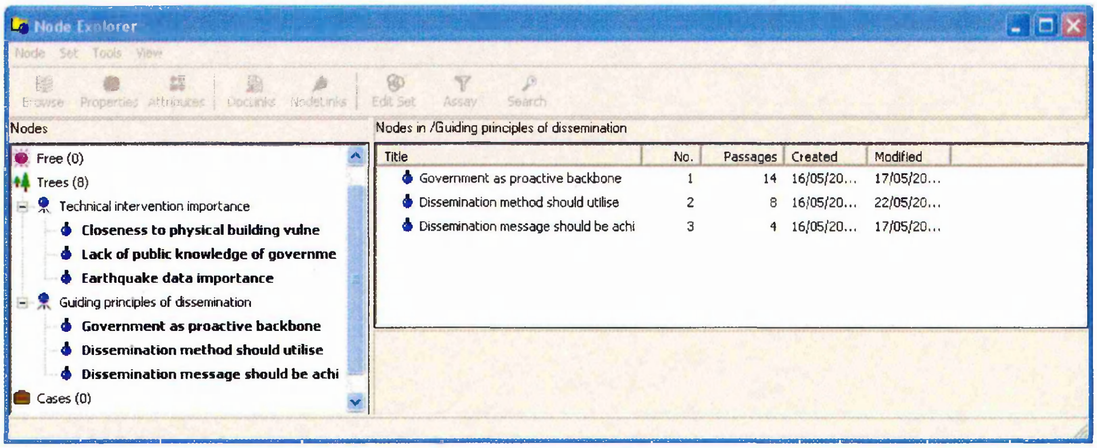

Figure 8.3 NVivo screen display of the nodes created from the interview

8.3 Refinement of 'the First Draft of the Proposed Framework'

Drawn from the above questionnaire survey and interview findings, this section describes some refinements to make 'the first draft of the framework' into 'the second draft'. 'The first draft of the framework' was formed in Figure 5.1 (complemented by three important factors of effective seismic risk management of non-enginered buildings). 'The first draft' consisted of 57 pairs of characterictic-indicators (or statements). There are three refinements to 'the first draft of the framework', the first extracted from the questionnaire survey, the second summarised from selected interviews, and the third produced from a combination of the two.

A critical analysis of the open-ended answer in the questionnaire survey constitutes the first refinement, which deals with the additional ideas within the pairs of characteristic-indicators numbers 1, 38, and 57 (see Table 8.9); there are no refinements at all for the remainder of the pairs of characteristic-indicators. Thus, the overall number of pairs of characteristic-indicators is exactly constant at 57 pairs. Particularly seen in Statement Number 1, the additional word is not only'to disseminate the risk' but also 'to communicate the risk' as suggested by the community leader: "government staff responsible for public safety should make more visits and engage more face-to-face discussion with the group to directly discover the community need".. Also, the educator added: 'the fault line' to the characteristic in Statement Number 1. At a different time, the researcher was urged to add: 'a number of houses made of different material, extendable houses' in relation to Statement Number 57. Table 8.11 describes the refinements for the pairs of characteristic-indicators, numbers 1, 38, and 57:

Table 8.11 The refinements for the pairs of characteristic-indicators numbers 1, 38, and 57.

Statement number	Characteristics	Indicators
S1	Earthquake occurrence data: their history, spatial distribution, characteristics, impacts, and ***the existing fault line.***	Data recorded, mapped, up-dated, ***disseminated and communicated**** regularly
S38	Dissemination and use of traditional/indigenous knowledge through media involvement in communicating seismic risk	Availability and accessibility of information (handbook, poster, newspaper, exhibition, talks show, ***short TV program, audiovisual program*,*** etc) in introducing seismic features of buildings with simple technical approaches understandable to the laypersons, including the existence of model houses with seismic features, low-cost, and simple in neighbouring areas
S57	Good examples of real constructions	Existence of a number of model houses with seismic features, low-cost, and simple as well as ready to be replicated in other areas. ***For example: a number of houses made of different materials, extendable houses, and a post patrol ('gardu ronda') in the neighbourhood area****

*) the refinements (written in bold and italic letter)

According to Table 8.11, the above three refinements do not seem to be significant enough to upgrade the essential content of 'the first draft of the proposed framework'. However, the above finding, which is no subtraction or removal on all pairs of characteristic-indicators, has confirmed that the content of 'the first draft of the proposed framework', consisting of the 57 pairs, has been highly approved by respondents to be carried out in Indonesian cities.

The second refinement comes from data collected from selected interviews. This refinement focuses on three basic guiding principles in the dissemination of seismic features to the grass roots community in order to complement the overall 57 pairs of characteristic-indicators. These three principles are: (1) the government role is the backbone of the dissemination initiative, (2) a dissemination channel through existing social bonds is imperative, and (3) the message should convince people that they have control over the implementation of seismic codes.

The third refinement is drawn from the findings of both the questionnaire survey and interview. This maps out multidisciplinary stakeholders as agents of change, highlighting a shared risk and responsibility and focusing on grass root initiatives with local wisdom, as later elaborated in Figure 8.4. This refinement also complements the overall 57 pairs of characteristic-indicators. Based on the data collected and the general facts, many forms of people and organizations can act as agents of change and have unique roles, which are highly varied due to the their nature of duty of care. Therefore, it is important to depict the influence level of many stakeholders as agents of change in good seismic risk management of non-engineered buildings. The principal aim of this depiction is to give a better understanding that many people or organizations have an important stake in steering the seismic risk management process, although their influence levels vary due to their nature of duty. It is hoped that a full spectrum of tasks and activities and broad banded partnerships in relation to the implementation of seismic codes to non-engineered buildings are well done and assimilated continuously, integratively, and harmoniously by a new configuration of various people and organizations to ensure a new generation of sustainable seismic risk management. Then, more and more non-engineered buildings with seismic resistance will grow and flourish everywhere.

Most arguments in the interview state directly that the government's role greatly influences the successful seismic risk management of non-engineered buildings. In particular, the top management in local government, together with the legislative council, has the authority and the power to give approval or disapproval for all development related issues. The top local authority can communicate with different department heads and can make them act on issues of seismic risk which need to be accomplished. In this case, they should make important and strategic decisions with regard to the implementation of seismic codes to mainstream seismic risk management initiatives under their principal aim of public safety in general.

Essentially, local government should rigorously disseminate and communicate their local seismic risk and the benefit of seismic codes by educating people to implement them voluntarily; at the same time, they should enforce the codes through effective regulation. In addition, this includes rules for the control of development, land use regulations, and suitable compliance mechanisms for building construction. The quality of their leadership is an indispensable component of success. They serve as a source of hope. Here, the role of the government appears to be as major contributors to the successful seismic risk management of non-engineered buildings. Finally, the role of the government (together with the role of the legislative council) and their concrete actions in disaster reduction remain the biggest challenge for effective seismic risk management today.

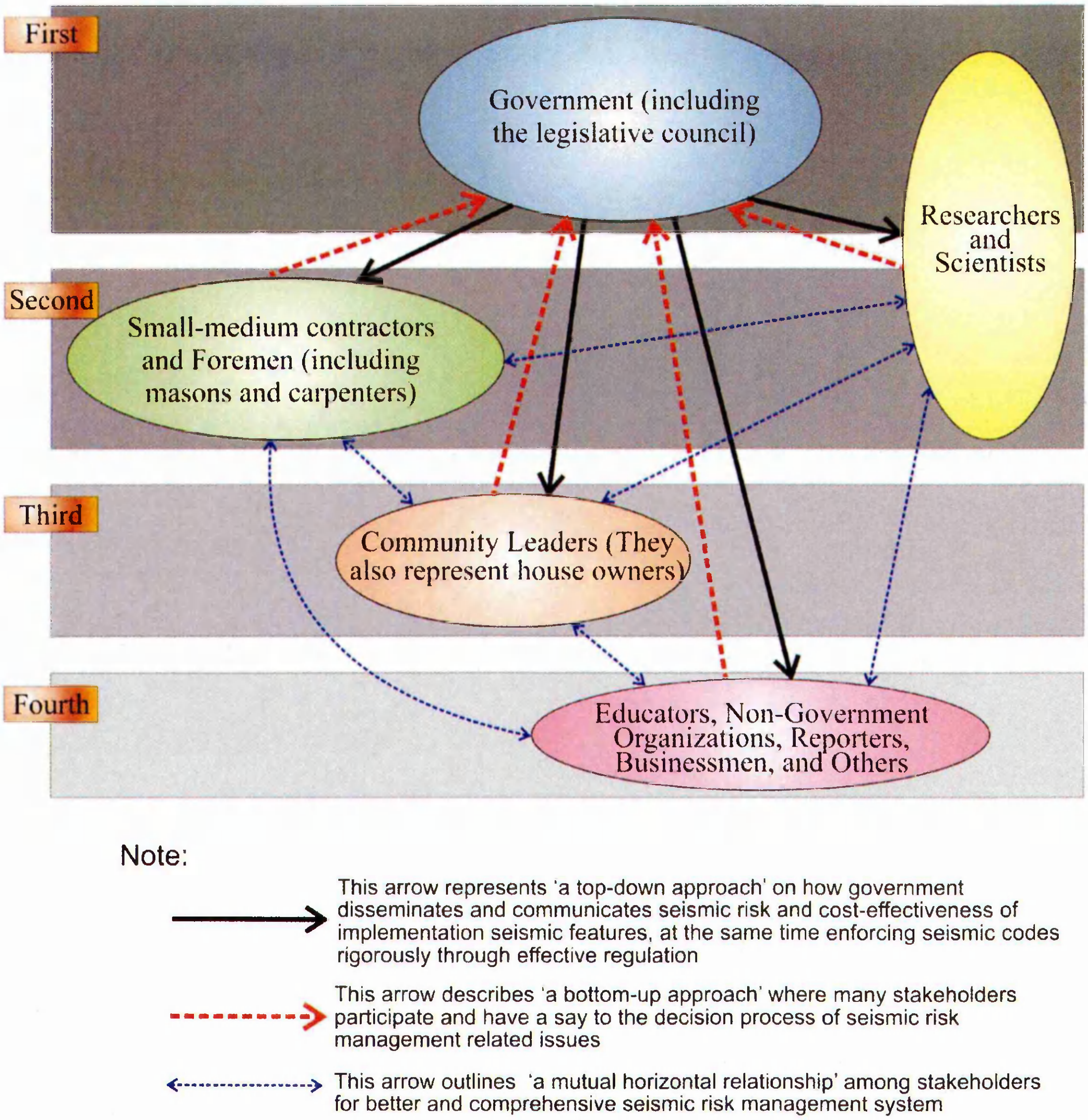

Figure 8.4 Putting multidisciplinary stakeholders together as agents of change to share the seismic risk of non-engineered buildings

As mentioned in Table 8.5 with regard to the 15 most important factors in seismic risk management and the importance of technical intervention summarised from the interview stage, the role of builders such as contractors, foremen, masons, and carpenters is very influential, as they are at the forefront in the actual construction of non-engineered buildings. In addition, sometimes difficulties appear when they have to change their traditional approach to fall in line with a new technique of seismic feature implementation. As one foreman said: "...I found many times that traditionally experienced masons and carpenters are reluctant to familiarize themselves with this new method, coming from young trained foremen, as they feel that it is not respectful to their seniority...". Therefore, changing the practice of builders is very necessary to make more seismic resistant buildings/houses and, as a result, they constitute the second agent of change.

On the other hand, researchers and scientists can be both the first and second agents of change. For example, the researcher/scientist role was ranked as the most important of the earthquake data (Table 8.4) and was the first agent of change in this sense. The researcher who conducts the cost-effectiveness of seismic feature implementation can perform at the second level after the government role to support law enforcement of seismic codes. Researchers and scientists can inspire many aspects of good seismic risk management of non-engineered buildings, such as the development of seismic features suited to the specific area, introducing earthquake facts for land use planning and a seismic awareness program. Moreover, social and psychology researchers can innovate on how to deliver information, leading to a change in attitude and a change in behavior. They also can serve as a source of new knowledge and inspiration for those implementing the changes.

When discussing the effectiveness of social bonds and how to break psychological barriers of community perception to achieve a feeling of control (as mentioned in the interview findings), it is clear that the role of community leader is very important to explain the whole thinking process. In certain cases, the construction process of residential houses/buildings is directly under the guidance of the owner, who often doesn't have sufficient skill in the concept of seismic features or neglects the workmanship of the builders due to the time completion pressure and the overwhelming need for steel reinforcement. One foreman said: "..Indeed, often they (house owners) were intractable to accept new ideas...". Again, in this situation, the community leader can contribute to the education of those people and also act as an intermediary between the government and the house owner when government staff enforces seismic features during the construction process of the residential house. In certain cases, the house owner often acts as a self-builder due to limited funding available. Here the community leaders (who also represent the house owner) are the third agent of change.

The last agent of change belongs to the groups of educators, NGOs, businessmen, reporters, and others, since the general assessment of the 15 least important statements of seismic risk management (Table 8.6) appeared to illustrate aspects of non technical intervention, where the involvement of many parties related to non-technical intervention (excluding government officials) was reasonably less important.

Obviously, the picture of the agents of change in Figure 8.4 is merely a general assessment as an indicative explanation drawn from the data collected. Probably, certain cases will illustrate different patterns of the degree of the influence within larger parties as conditions change over time. Subsequent investigation is truly needed to explore further for better understanding and to validate against any misunderstanding or bias due to interviewees strong personal opinions.

In conclusion, the three refinements have improved 'the first draft of the proposed framework' into 'the second draft'. It is argued that the second and third refinements are pivotal to complement the proposed framework more comprehensively and will also be easily implemented. Now, 'the second draft of the proposed framework' comprises 57 pairs of characteristic-indicators complemented by (A) three important factors of effective seismic risk management of non-engineered buildings, (B) three guiding principles of dissemination, and (C) a map of multidisciplinary stakeholders as agents of change. Figure 8.5 depicts the comparison between 'the first draft of the proposed framework' and 'the second draft of the proposed framework'.

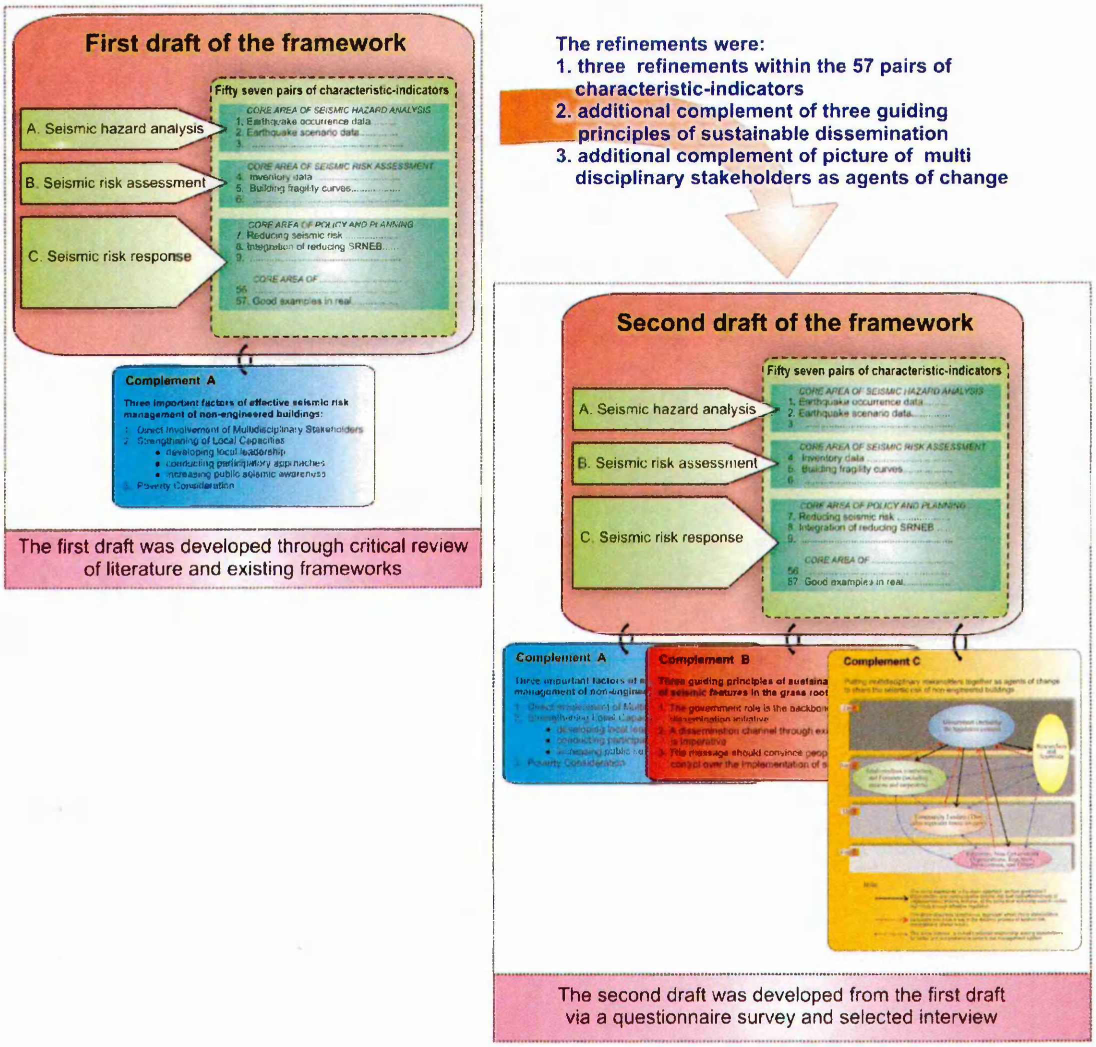

Figure 8.5 Comparison between 'the first draft of the framework' and 'the second draft of the framework'

8.4 Summary

A postal questionnaire survey and interview were conducted in order to refine the content of 'the first draft of the proposed framework', to be authenticated and validated by a large number of key decision makers in Indonesia and explored further for better understanding. Altogether, 875 questionnaires were distributed among nine types of stakeholder and 305 were returned, equating to a response rate of 34.9%. Surprisingly, 84.36% of respondents assigned all statements in the questionnaires as important or very important with an average mean score of 4.187. In general, there was strong agreement among respondents as to the highest and lowest importance of the statements in the questionnaire, and all respondents were relatively homogenous and share the same characteristics.

The fifteen most important statements of SRRNEB to be carried out in Indonesia include: earthquake occurrence data dissemination, existence of information for pro-poor strategies, resource mobilization for expert staffing allocation, existence of deterministic and probabilistic earthquake scenario, existence of regulation of builders, existence of seismic codes with simple language, existence of seismic risk map using Geographic Information System, continuity of dissemination channels, good examples in real constructions, existence of inventory data: soil profiles and buildings, existence of seismic risk reduction as a policy priority, availability and accessibility of information in introducing seismic features of buildings.

Two questions about the importance of technical intervention and the sustainable dissemination issue emerged as a result .of the questionnaire survey. The selected interviews with nine respondents was carried out to elicit a richer and in-depth story as well as dynamic patterns according to the two questions. The interview course revealed three reasons why people tend to assign high importantance to technical intervention i.e. (1) a direct relationship with physical vulnerability, (2) people's lack of understanding of government functions, and (3) the importance of earthquake data. In addition, three guiding principles of sustainable dissemination also emerged, i.e. (1) the government should act as a proactive backbone of the dissemination initiative, (2) the dissemination mechanisms should use existing social bonds and/or indigenious method, and (3) the dissemination message should convince the community member that the implementation of seismic codes is easily achievable under their control. The interview revealed that the government role was very crucial, and was even given the highest importance according to the successful seismic risk management of non-engineered buildings via a pro-active approach of informing, motivating, and engaging grass root communities in all aspect of SRRNEB in their own local circumstances.

Combining the results of the questionnaire survey and interview, 'the first draft of the proposed framework' was then refined to be 'the second draft'. The refinements from the questionnaire survey were only three additional ideas in Statement Numbers 1, 38, and 57. In addition, the three guiding principles of the sustainable dissemination of seismic features to the grass root community and a map of multidisciplinary stakeholders as agents of change were quite essential to complement the proposed framework more comprehensively and will also easy to implement.

Chapter IX
Workshop Event for Data Collection and Analysis, and Contribution to Wider Knowledge Drawn from Overall Data Collection

The questionnaire survey and interview data collection was presented in the previous chapter. This chapter mentions the subsequent phase of primary data collection, i.e. the workshop event. The workshop topic was 'Seismic Risk Management of Non-Engineered Buildings'. The primary aim of this chapter is to describe data collection methods using the workshop event and to analyse the results in order to refine 'the second draft of the proposed framework' into 'the final framework'. This is also conducted to validate and authenticate the findings that emerged from the previous chapter. This chapter starts with a rationale of the workshop and then moves to describe the workshop structure. The subsequent section is the core of this chapter, describing its result and analysis. The framework refinement then follows. A section of contribution to wider knowledge drawn from overall data collection and the summary section provide the conclusion. This summary provides brief background information on the workshop, describes the facilitation processes used in the discussion, and summarises the results of the discussion.

9.1 Rationale for the Workshop Event

Two data collection methods were already utilised, in which each respondent expressed their opinion individually. Since the complex, interdependent, and dynamic problem of seismic risk is subject to evolution over time, developing the framework for guiding and monitoring SRRNEB is better achieved not only through individual respondent's opinions, i.e. a questionnaire survey and interview, but also through a complementary method, whereby various stakeholders can share and argue their opinion and position directly and openly, and also consider the ideas of others. This type of data collection is more relevant to formulate and solve multiple dimensions of the problem from different perspectives. Therefore, a workshop event is highly selected because it is highly interactive, combining presentations and exercises, discussion in small groups and a plenary session. In addition to the previous two data collection techniques, this method also facilitates well-founded and plausible arguments about the significance of the data generated in order to confirm the sense of validity to arrive at comprehensive, overall research findings.

9.2 Workshop Structure

The primary aim of this workshop was to bring together many stakeholders in a discussion forum in order to evaluate and refine 'the second draft of the proposed framework', which was already structured coherently through a review of literature and three existing frameworks and an analysis of the questionnaire survey and selected interviews, into 'the final framework'. The notion was that the stakeholders were better equipped to formulate the complicated future risk than theoretical approaches and an extrapolation of trends; also, they had both the appropriate knowledge and problem solving skills. The workshop aim was not to lead to a kind of consensus, but rather to critically identify elements in 'the second draft' which needed to be improved or refined. This focused on finding relevant arguments, rather than focusing on the specific output. Therefore, the brainstorming technique constituted the major activity during the workshop.

The event took place on Friday, 22nd September 2006 under the name 'Workshop on Seismic Risk Management of Non Engineered Buildings' at the Centre of Earthquake Engineering, Dynamic Effect, and Disaster Studies (CEEDEDS), Islamic University of Indonesia (UII). It was administered in association with the Faculty of Civil Engineering and Planning, UII. An established research committee served as a workshop committee; the author acted as the workshop facilitator. Those participated in the workshop included 18 people, who represented a mix of nine types of stakeholders. The participants were specifically selected from the people who had taken part in the questionnaire survey and/or interview and were an important person within each stakeholder organisation, regardless of their regency, city, province, or national work-scope levels. The participants were categorised to remove names or any reference made to any other organisation or person by name, as described in Table 9.1.

Table 9.1 Profiles of the workshop participants

No	Categories	Workshop participants
1	Researcher A	Position: University lecturer and practitioner in Residential Architecture
2	Researcher B	Position: University lecturer and practitioner in Disaster Management
3	Contractor	Position: Director of Medium Contractor
4	Foreman A	Position: Individual foreman
5	Foreman B	Position: Individual foreman
6	Government A	Position: Government Staff in Meteorology and Geophysics Board
7	Government B	Position: Government Staff in Disaster Management
8	Businessman A	Position: Research and Development Staff of Real Estate Association
9	Businessman B	Position: Real Estate Firm Staff
10	Educator A	Position: School Headmaster
11	Educator B	Position: High School Teacher
12	NGO A	Position: Director of Community Development NGO
13	NGO B1	Position: Disaster NGO staff
14	NGO B2	Position: Disaster NGO staff
15	Com. Leader A	Position: Head of a neighbourhood administrative structure
16	Com. Leader B	Position: Head of a village administrative structure
17	Reporter A	Position: Deputy Editor of a local newspaper agent
18	Reporter B	Position: Senior reporter of a national newspaper agent

In addition, like the previous interviews, it was believed that introducing the term of systemic seismic risk management of non-engineered buildings to the Indonesian people was not an easy task due the non-existence of preventive culture to reduce seismic risk in all Indonesian regions. To overcome such identified problem, prior to the workshop, every prospective person who was targeted to participate in the workshop was approached and properly briefed in a small face-to-face discussion (about 1-3 weeks prior to the workshop date) in order:

a. to receive a bundle of workshop material (i.e. an invitation letter, workshop time table, a list of prospective workshop participants, a copy of 'the second draft of the proposed framework', 3 pieces of blank paperwork, each with an instruction for the participants to write additional ideas in relation to 'the second draft', and a map to find the workshop)
b. to introduce the purpose of the overall workshop event (also to inform who will be involved, and what the benefit, value, and feedback will be to the participants and the others)
c. to stimulate brainstorming ideas by asking them to read and study carefully 'the second draft of the framework' and then to write as many additional ideas as possible for the evaluation or refinement of 'the second draft' on the paperwork available as homework and to bring it to the event. This was to ensure that the participants were properly briefed as to their duties.

Because 'the second draft of the framework' was structured area-by-area, using work-breakdown-structure, in clear and simple language to be understood easily, the workshop participants conducted the initial structured brainstorming session in their home in order to utilise the workshop time effectively. The overall workshop activities are presented in Figure 9.1:

Prior to the workshop

Every prospective person who was targeted to participate in the workshop was approached and properly briefed (about 1-3 weeks prior the workshop date) in a small face-to-face discussion in order to

- to receive a bundle of workshop material (including "the second draft of the proposed framework")
- to introduce the purpose of the overall workshopevent
- to stimulate brainstorming of ideas by asking them to read and study carefully 'the second draft of the framework' and then to write as many additional ideas as possible for the evaluation or refinement of 'the second draft' on the paperwork available as home-work and to bring it to the event

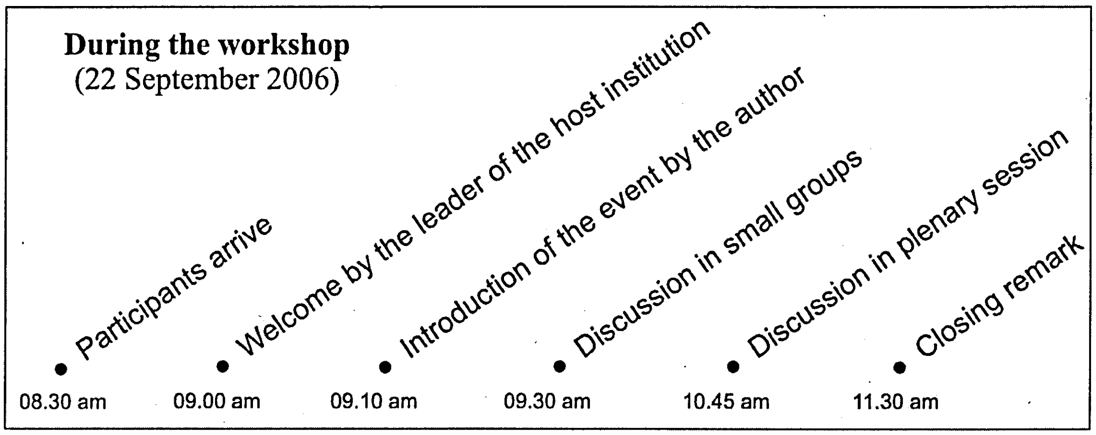

Figure 9.1 Workshop program: activities prior to and during the workshop

One copy about enlightening example of framework for seismic risk management in India and Nepal was circulated to all participants, as additional workshop material. In the beginning, there was an introductory presentation by the author, introducing the purpose of the event and including a presentation on the recent adoption of seismic risk management strategies in Nepal and India as a good example of two case studies. The presentation provided a short, high-level briefing on 'the second draft of the framework', as this matter had been already introduced to the participants prior to the event, the rules of discussion, and the proposed time. This also highlighted that the input required from the participants was their opinion or comments for the evaluation and/or refinement of 'the second draft', the output was the agreement for the refinement achieved, and the next step would be a suggestion for further concrete action to many parties, particularly for government agencies; it also served as the author's PhD data collection.

The following session was the main part of the workshop. The core of the workshop was divided into two phases, i.e. a small group discussion and a plenary session. Because the participants had already prepared and exercised the workshop information before attending the event, the discussion did not need any other exercise and thus time usage during the workshop was very effective. There were two principal rules employed in the discussion, i.e. (1) criticism was disallowed to permit unique and individual opinions to emerge and (2) freewheeling and improvement were welcomed to allow individuals to offer differing perspectives and to generate better ideas by building upon the other ideas.

In the small group discussion, the participants were divided into two groups, each reflecting the mix of professions in the room. One graduate from the Civil Engineering Department and the author facilitated this session, each accompanied with a person as documenter. The documenter was responsible for recording important outcomes of the discussion in the blank paperwork. The session aimed to obtain some unique ideas from the participants on how to reduce seismic risk comprehensively on non-engineered building, particularly on residential houses with regard to the content of 'the second draft of the framework'. As much as possible, the discussion environment was situated using flexible, simple, and clear language to ensure open channels of communication. The participants presented their argument and also considered other perspectives; most of their comments were based on the previous brainstorming exercise at their home, which had been already written in their paperwork. This facilitation tool generated many productive ideas and also the available amount of workshop time was able to be used effectively.

The next session was the plenary session, where all respondents met together in the same room to discuss what had been achieved from the previous small discussion. It began with the two documenters reiterating the important outcomes of the small discussion; again, the participants discussed openly and synergistically. The last session was the concluding remark where the facilitator outlined some the workshop deliverables, which were presented meaningfully and reflected exactly what the participants 'built' in the workshop. They were also motivated to further participate by disseminating the value from the information they received and the expected result of the process. To manage time effectively, there was no break for tea. A light snack and juice was served during the session.

After the closing of the event, some of the participants left their paperwork (as their homework), explaining the logic of their ideas to the committee for further confirmation of their comments. As a general assessment, each participant contributed significantly to the formulation of the workshop results and participants did not seem fatigued by the discussion over a productive time for about three hours. In general, the participants commented on matters that were already included in the content of 'the second draft'; only a few items were added to the refinements.

9.3 Workshop Results, Analysis, and Findings

Altogether there were 18 people participating in the workshop, in both Group A and B as well as in the plenary session. Overall discussion was digitally recorded using 'Coolsoft Power MP3 Sound Recorder' software and transcribed. According to the nature of workshop event, the qualitative approach was chosen as being suitable for analysis. The data was then analysed using NVivo software, version 2.0. The software helped to code the data and identify themes and/or patterns generated. The analysis is presented under the same order as used in 'the second draft of the proposed framework' (see Table 5.28). Table 9.2 presents the distribution comments, which are related to the 57 statements (pairs of characteristic-indicators) already written in 'the second draft'. In addition to Table 9.2, Tables 9.3 and 9.4 describes the additional and new ideas achieved from the discussion respectively. Statement Number 1 is coded by S1, Statement Number 2 is assigned by S2, and so on.

It is needed to highlight that this workshop event was a technique for qualitative data collection adopted for the research. Generally, the essence of qualitative assessment is its dependence upon people judgement. Good people are the key to good qualitative assessment. Thus, selection of appropriate personnel, proper orientation of them for the assessment, and effective management of their assessment are crucial for credible and reliable assessment. Besides the people judgement, some other research findings or literature can also strengthen the qualitative findings. At last, an approach is needed to encourage more formal processes in qualitative assessment so that their findings will be less subject to individual prejudice and bias, and so that findings from such assessment will be more repeatable (a characteristic of valid assessment).

In order to achieve some valid workshop findings and less subject to individual bias, the researcher came up with a structured triangulation approach that two senior lecturer as the research committees already helped to evaluate and review the workshop findings, based on general agreement that any method that is used to help researcher to think more effectively and systematically would probably be useful in research formulation. Furthermore, the workshop participants were key important people, and the findings from previous questionnaire survey and interviews also strengthened the workshop findings. Therefore, the workshop finding validation as presented in Tables 9.2, 9.3, and 9.4 involved the use of some research data and two evaluators (i.e. workshop participants' comments, the questionnaire and interview findings, and the two senior lecturers serving as evaluators from the established research committee). The details of validation method for the workshop findings are presented in Table 9.5.

Table 9.2 Distribution of comments collected in accordance with 57 pairs of characteristic-indicators in the workshop

Workshop participants	Statement Number 1	Statement Number 2	Statement Number 3	Statement Number 4	Statement Number 5	Statement Number 6	Statement Number 7	Statement Number 8	Statement Number 9	Statement Number 10	Statement Number 11	Statement Number 12	Statement Number 13	Statement Number 14	Statement Number 15	Statement Number 16	Statement Number 17	Statement Number 18	Statement Number 19
Discussion Group A																			
Researc-A																			
Contract-A															√				
Forem-A										√			√						
Govemn-A							√			√		√	√						
Businss-A							√					√				√			
Educat-A							√		√										
NGO-A																√			
ComLead-A							√												
Report-A																			
Discussion Group B																			
Researc-B										√									
Forem-B										√									
Govemn-B	√						√			√									
Businss-B																			
Educat-B	√						√												
NGO-B1	√						√	√		√							√		
NGO-B2							√					√		√					
ComLead-B							√					√					√		√
Report-B	√									√		√		√			√		
Plenary Session																			
Researc-A	√	√					√												
Businss-A																			
Report-A																			
Govemn-B		√																	
NGO-B1								√									√		
Report-B																			
Number of comments	5	2	-	-	-	-	10	2	1	7	-	5	2	2	1	2	4	-	1

Workshop participants	Statement Number 20	Statement Number 21	Statement Number 22	Statement Number 23	Statement Number 24	Statement Number 25	Statement Number 26	Statement Number 27	Statement Number 28	Statement Number 29	Statement Number 30	Statement Number 31	Statement Number 32	Statement Number 33	Statement Number 34	Statement Number 35	Statement Number 36	Statement Number 37	Statement Number 38
Discussion Group A																			
Researc-A																			
Contract-A																			√
Forem-A								√		√								√	
Govemn-A	√							√					√			√			
Businss-A																			
Educat-A													√	√					
NGO-A								√											
ComLead-A								√								√			
Report-A								√											
Discussion Group B																			
Researc-B	√							√											
Forem-B								√											
Govemn-B								√											√
Businss-B								√											
Educat-B	√							√					√			√			
NGO-B1								√											
NGO-B2													√						√
ComLead-B								√											
Report-B			√					√											
Plenary Session																			
Researc-A								√								√			
Businss-A																			
Report-A								√											
Govemn-B								√											
NGO-B1																			
Report-B			√																
Number of comments	3	-	2	-	-	-	-	16	-	1	-	-	4	1	-	4	-	1	3

Workshop participants	Statement Number 39	Statement Number 40	Statement Number 41	Statement Number 42	Statement Number 43	Statement Number 44	Statement Number 45	Statement Number 46	Statement Number 47	Statement Number 48	Statement Number 49	Statement Number 50	Statement Number 51	Statement Number 52	Statement Number 53	Statement Number 54	Statement Number 55	Statement Number 56	Statement Number 57
Discussion Group A																			
Researc-A																			
Contract-A																			
Forem-A			√																
Govemn-A																			
Businss-A																			
Educat-A				√															
NGO-A																			
ComLead-A			√																
Report-A																			
Discussion Group B																			
Researc-B																			
Forem-B																			
Govemn-B																			
Businss-B																√			
Educat-B																			
NGO-B1																			
NGO-B2		√								√									√
ComLead-B																			
Report-B			√							√									
Plenary Session																			
Researc-A																			
Businss-A				√											√				
Report-A																			
Govemn-B																			
NGO-B1																			
Report-B																			
Number of comments	-	1	3	2	-	-	-	-	-	2	-	-	-	-	1	1	-	-	1

Note:
1. Symbol √ indicates a confirmation that the relevant statement was commented by participant, and probably needs to be refined or improved
2. The higher number of comments does not reflect to the higher importance level
3. Statements with no comment indicate that these statements are important and do not need refinements

Table 9.3 The four additional ideas collected from the workshop event

No	Additional ideas	Exploratory analysis
1	Additional idea of a 'building construction permit' As businessman A commented: ".....to fulfil the legal aspect, the regulation to get a 'building construction permit' mentions some requirements for structural analysis......." Moreover, government staff A stated: "....it should be highlighted here that the house owner should have a proper 'building construction permit'........."	This additional idea of a 'building construction permit' was added further to Statement Number 12 (S12)
2	Additional idea of 'city construction control committee' As the businessman A said: ".....for example: establishing a kind of 'city construction control committee' like in Jakarta, where there is a TPKB: Tim Pengendali Konstruksi Bangunan..."	This additional idea of a 'city construction control committee' was added further to Statement Number 14 (S14)
3	Additional idea of 'formal fit for sale certificate" As the businessman A commented: "....we will issue a kind of 'fit for sale certificate' to every product (house) we are selling ..."	This additional idea of a 'fit for sale certificate' was added further to Statement Number 12 (S12)
4	The additional idea about 'city-wide' As community leader A stated: "....if the government struggles to do this, for example through village administration....we as neighbourhood administration staff should be invited into the many initiatives such as physical development. I think it is not a difficult task". Moreover, foreman A elaborated: ".........There is an urgent need for the existence of a proper dissemination method which is more straightforward, going down through the grass roots community for better understanding......"	This additional idea of 'city wide' was added further to the Statement Number 17 (S17) and 37 (S37)

Table 9.4 The six new ideas collected from the workshop event (which were fully added in the proposed framework)

No	New ideas
1	Core areas: Seismic Risk Assessment Characteristic: Land use application Indicator: Existence of followed-up program of damage assessment in relation to the city spatial planning under 'the city spatial planning board' As businessman B said: "....he was dead because of the falling wall. I saw that their house stock was built very densely. On the other hand, they had a large property area....but they prefer to build their house closer to the others. I think it needs regional building stock planning, not just individual building..." Moreover, government B commented: "...at Jakarta, the access to their house is disorganised...therefore the evacuation process in the densely populated areas (during and after an earthquake event) is not easy. Thus the layout of the planning (in the region) should be considered..."
2	Core areas: Seismic Risk Assessment Characteristic: Land use application Indicator: Existence of balanced information between a 'geographic seismic risk map' and a 'geographic city economic development map' for a better understanding for public and investor As businessman A said: "....at the moment there is a map of fault line which is considered to be 'a daunting map'. Then, the daunting map is overlapped with a land use planning map, and also overlapped with a property land map belonging to the certain people who own the land, which is a productive paddy field located just over the fault line. .....Soon after the map of fault line is published, the economic value of the land will fall dramatically..."
3	Core areas: Seismic Risk Assessment Characteristic: Land use application Indicator: Community members and many stakeholders become involved in seismic risk map dissemination and communication As reporter A mentioned: "...it is very possible, very possible to publish it (seismic risk map) in the newspaper...." Moreover government staff B added: "...but if I release it (a map of fault line) openly to the public, this will cause a benefit or drawback. I prefer to give this to competent and responsible parties so that everything is clear...."

Table 9.4 continued

4	Core areas: Seismic Risk Assessment Characteristic: Building interior layout Indicator: Existence of information about a seismic resistant Interior layout: disseminated and communicated to the public As government staff B suggested: "...as long as a strong building can withstand the earthquake shaking, if the building interior layout is not proper, during the earthquake the building structure probably will not collapse, but this event can cause fatalities because of falling objects...."
5	Core area: Public awareness Characteristics: Monument of tragic earthquake event Indicator: Existence of monument to commemorate the tragic Event of an earthquake As foreman A stated: ".....I have seen many monuments on street corners to commemorate something. Perhaps, we can build a similar monument as well for this last earthquake occurrence...."
6	Core area: Public awareness Characteristic: Dissemination and use of traditional/indigenous knowledge through media involvement in communicating seismic risk Indicator: Existence of artist involvement in communicating Seismic features As foreman A said: "...I think it is possible to involve artists in communicating seismic risk through their shows and exhibitions..." Moreover, reporter A added: "....this idea (involvement of the artist) is brilliant, because our community like 'watching' rather than 'reading'...."

Table 9.5 Establishing the validity of the workshop findings

No	Workshop findings	How to validate the findings
1	**Table 9.2** Distribution of the workshop participants' comments	The findings were supported by a. The comments from workshop participants b. The questionnaire and interview findings c. The evaluation from the established research committee
2	**Table 9.3** The four additional ideas collected from the workshop event	The findings were supported by a. The comments from workshop participants b. The questionnaire and interview findings c. The evaluation from the established research committee
3	**Table 9.4** The six new ideas collected from the workshop event	The findings were supported by a. The comments from workshop participants b. The critical evaluation from the established research committee

Beside Tables 9.2, 9.3, 9.4, and 9.5, Figure 9.2 presents the findings of the workshop event with the assistance of NVivo software:

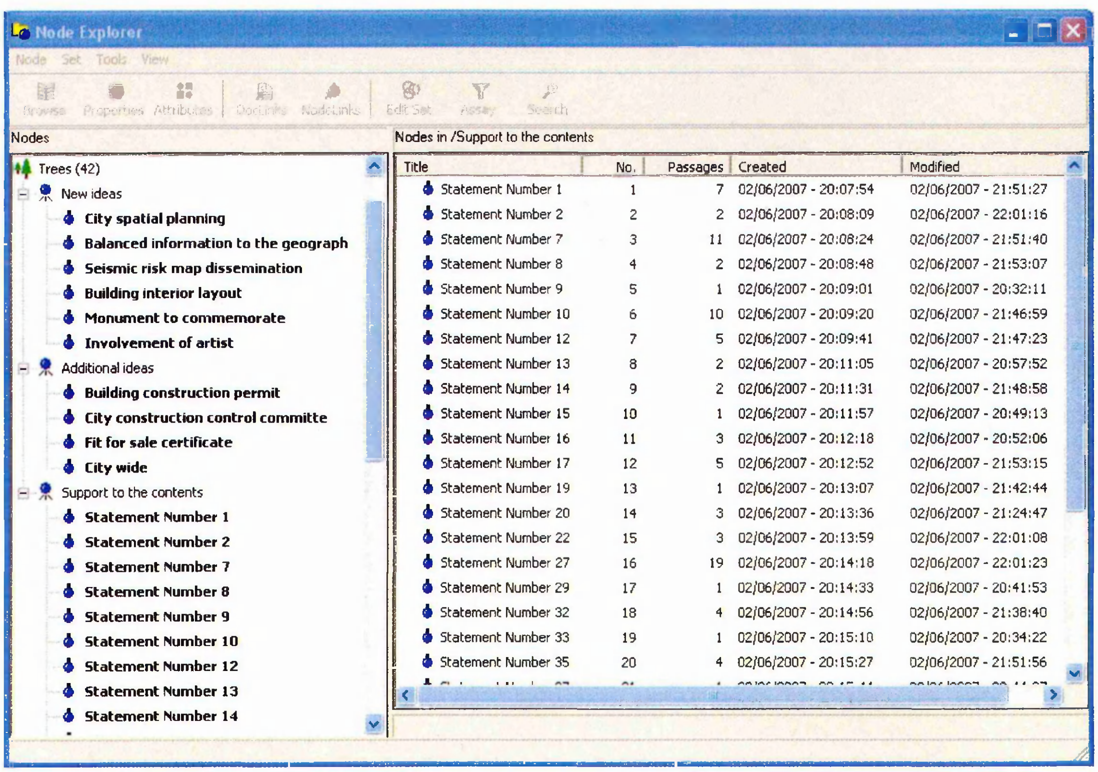

Figure 9.2 NVivo screen display of the nodes created from the workshop event

The following explanations and interpretations emerge from an analysis of the results shown in Tables 9.2, 9.3, and 9.4 as well as the additional participant comments gathered during the event.

a. In general, all participants reached a general agreement on some resolved fundamental principles and their associated elements in the proposed framework that could be applied on a common basis at a local level (as well as national) and institutional adaptation. All were unanimous in agreement with the value added from this exchange of ideas.

b. In discussing these elements of 'the second draft of the proposed framework', every participant seemed to comment on the information that was already included in the content of the proposed framework from their own special interest. Their comments were distributed, along with the 57 statements. The top four comments were in the areas of the dissemination of information (S27), political commitment (S7), seismic codes (S10), and law enforcement of seismic codes (S12). However, some statements did not receive any comment at all, such as the core area of social and economic development practices (S50, S51, and S53).

c. The discussion about dissemination emerged frequently among participants, about 16 times. This finding also verifies the finding of the open-ended question in the questionnaire survey. Because the idea of dissemination is very critical, it is urgent for three guiding principles for dissemination to the grass root communities (as the finding from the selected interviews) to be understood for the successful implementation of seismic codes. It is believed that if people had a high awareness about seismic risk and the importance seismic codes, then they would implement the code voluntarily. The additional idea of 'city wide' for dissemination also supports this finding. The issue of dissemination is probably raised very frequently (and also in the previous data collection) due to the fact that many hard copies of the implementation of seismic features are available to the public and are easy to access after the tragic events in Aceh, 2004 and Yogyakarta, 2006, but the mechanism to ensure people translate from the hard copy to real construction is still low. The most challenging part is not finding the tools, but realising that a seismic event is a real fact; we cannot predict when it will happen or how big the magnitude will be, and it is therefore better to grasp it rather than denying or ignoring it.

d. Again, a lack of political commitment (S7) was stressed as a challenge by participants. This situation is truly similar with the finding of the previous selected interviews, where decision-makers in government agencies and legislative council constituted the highest level of agents of change. Government staff A mentioned three main inhibiting factors in current disaster management activities, i.e. (1) frequent rotation of government key staff, (2) factors in relation to the decentralisation process, and (3) inadequacy of government capacity to cope with the complex problem of disaster management. The comment about 'frequent rotation' of key staff was captured as follows: "..........I am sometimes confused by the frequent senior key staff turnover in their position. Also, particularly, we see when our President change ministers, thus there are new policies which are different to the previous ones....". One of the possible solutions for the first factor is to develop a widely agreed 'grand master plan or road map for disaster management', so that everyone who is a key government decision maker should refer to it in order to accomplish a solution to the problem in the right direction in the same language. The NGO B1 commented: "........it is important to develop a comprehensive plan with integration between development planning and disaster management strategies...". In addition, government A stressed: "......very often we cannot coordinate the (disaster management) process with regency or city government because of the current decentralisation arrangement...". Following that theme, the NGO B1 said: "...BAKORNAS, SATKORLAK, and SATLAK should be revitalised totally. Their capacity is too low. The organisation is very weak and their staff knowledge is inappropriate....". The possible solution for this, drawn from the essence of the discussion, is to revitalise three essential levels of capacity in the disaster management organisation. The first is revitalisation in the systems level, i.e. the regulatory framework and policies, the second is revitalisation in the institutional level, i.e. the structure of organizations, and the third is revitalisation in the individual level, i.e. individual skills, qualifications, and knowledge. Moreover, community leader B stated: ".....one week after the last earthquake, no government agencies produced concrete actions.....".

e. The next key element that is essential to reducing seismic risk is the importance of seismic code and its enforcement. Here, the term 'building construction permit' was suggested to emerge clearly in the proposed framework, as pointed out by businessman A and government staff A. This finding confirms that the enforcement of the implementation of seismic codes should become a high priority of the many requirements for people in order to receive 'the building construction permit'. It is well believed theoretically that if the government rigorously enforces the regulation of a 'building construction permit', the seismic code will also be implemented by people. As a result, many and many more buildings will be equipped with seismic features. Furthermore, the exposure to seismic risk will dramatically decline. In reality, the success of this mechanism lies in the coalitions of city stakeholders around local government policy makers, who are in charge of the issuance of 'building construction permits' along with their management of urban growth and land use planning.

f. The inspiring findings come from the new ideas captured from this discussion. There are six new ideas focusing on the core area of seismic risk assessment and public awareness. These are: (1) city spatial planning, (2) balanced information on the geographic seismic risk map, (3) seismic risk map dissemination and communication, (4) building interior layout, (5) a monument to commemorate the dead, and (6) involvement of artists in communicating seismic risk. All the new ideas emerged during the plenary session, except for number four, which appeared during the small discussion and was then repeated in the plenary session. The involvement of artists emerged due to the fact that common people like 'watching' rather than 'reading'. Overall processes of capturing new ideas indicate that the second phase of the workshop, i.e. the plenary session, enabled participants to partake in a more intense discussion to generate new ideas.

g. The NGO B1 affirmed strongly that the key criteria of success would be the existence of a mixed government-public administrative structure responsible for disaster reduction. The existence of this mix-structure would identify, guide, and monitor the risk comprehensively, be less bureaucratic, and not too regimented. In addition to this, the allocation of a permanent, adequate budget dedicated to the implementation of disaster risk reduction was an essential challenge, as mentioned by reporter B. These comments support S17 and S22.

h. The NGO B1 also stressed, the integration of disaster reduction into development planning twice, both in the small discussion and the plenary session. This also highlights the importance of establishing linkages with relevant existing frameworks, such as the city decentralisation process, community development, and poverty reduction to ensure continuity and consistency for effective integration of disaster risk reduction into the comprehensive development process. This idea is in line with S8.

i. Discussion about the importance of seismic data in S1 also emerged, although the participants commented on it about five times. Nevertheless, the relatively high intense discussion on this matter supports the postal questionnaire findings, where an average of 305 respondents designated S1 as of the highest importance to be disseminated and communicated to all community members. In addition to the seismic data, the construction practice of non-engineered building emerged in the discussion, particularly about the importance of training in safe-building practices and retrofitting techniques.

In summary, the workshop event was successfully conducted by achieving feedback and comments for the refinement of 'the second draft of the proposed framework' into 'the final proposed framework'. Even though the term of systematic seismic risk management of non-engineered buildings was a relatively new initiative, all participants highly appreciated the content of 'the second draft', and there are six new ideas or statements which will be added to the refinement. Most of the comments so far conform to the previous findings from the questionnaire survey and selected interview. Some comments about activities within disaster responses, such as how to reduce stress after the disaster, also emerged in the discussion but this was ignored as being beyond the scope of the research work.

9.4 Refinement of 'the Second Draft of the Framework' into 'the Final Framework'

Given the findings of the above workshop event, this section elaborates on some refinements of 'the second draft of the framework' into 'the final framework'. 'The second draft of the framework' consisted of 57 pairs of characteristic-indicators and was complemeted by (1) three important factors of good seismic risk management of non-enginered buildings, (2) three guiding principles for dissemination, and (3) a map of agents of change, which was formed in Figure 8.4. Here, there are two principal refinements for 'the second draft of the framework'. The first refinements are the six new statements and the second refinements deal with the additional ideas within the pairs of characteristic-indicators.

The new six statements (or pairs of characteristic-indicators) are as follows:

a. Core area: Seismic Risk Assessment, i.e. (1) city spatial planning, (2) balanced information on the geographic seismic risk map, (3) seismic risk map dissemination and communication, (4) building interior layout,
b. Core area: Public Awareness, i.e. (1) monument to commemorate the dead, and (2) the involvement of artists in communicating seismic risk.

The nature of the new ideas they allude to four technical interventions and two non-technical interventions. Thus, the final number of pairs of characteristic-indicators in 'the final framework' are 63 pairs. The additional ideas within the 57 pairs of characteristic-indicators are in S12, S14, S17, and S37. The overall refinements are presented in Table 9.6:

Table 9.6 The refinements for 'the second draft of the framework'

No	Characteristics	Indicators
A	**New pairs of characteristic-indicators**	
	a. Core area: Seismic Risk Assessment	
	Land use application	Existence of followed-up program of damage assessment in relation to the city spatial planning under 'the city spatial planning board'
	Land use application	Existence of balanced information between a 'geographic seismic risk map' and a 'geographic city economic development map' for a better understanding for public and investors
	Land use application	Community members and many stakeholders become involved in seismic risk map dissemination and communication
	Building interior layout	Existence of information about seismic resistant interior layout: disseminated and communicated to the public
	b. Core area: Public Awareness	
	Monument of tragic earthquake event	Existence of monument to commemorate the tragic event of an earthquake
	Dissemination and use of traditional/indigenous knowledge through media involvement in communicating seismic risk	Existence of artist involvement in communicating seismic features
B	**Additional ideas within pairs of characteristic-indicators**	
	Statement Number 12: Compliance and enforcement	Existence of ***rigorous regulation of the issuance of a 'building construction permit' for builders and the issuance of the formal 'fit for sale certificate' for every house as a product of real estate firms for widespread**** creation of seismic resistant buildings
	Statement Number 14: Compliance and enforcement	Existence of systems to control compliance and enforcement in actual practices ***under the 'city construction control committee'****
	Statement Number 17: Implementing and co-coordinating bodies	Existence of a ***city-wide**** administrative structure responsible for disaster reduction
	Statement Number 37: Public awareness policy, programmes, and material	Existence of ***city-wide**** specific awareness campaigns and strategies in seismic risk.

*) the refinements for additional ideas (written in bold and italic letter)

In conclusion, the two principal refinements have improved 'the second draft of the proposed framework' into 'the final framework'. It is argued that the refinements are quite fundamental to increase the content of the proposed framework from 57 pairs to 63 pairs of characteristic-indicators. Now, 'the final proposed framework' comprises 63 pairs of characteristic-indicators complemented by (A) three important factors of good seismic risk management of non-engineered buildings, (B) three guiding principles of dissemination, and (C) a map of multidisciplinary stakeholders as agents of change. Within the 63 pairs, there are 19 technical interventions and 44 non-technical interventions. To achieve better clustering, Statement Number 53 about a 'seismic risk map using Geographic Information System' is moved to be included under the heading: Seismic Risk Assessment and core areas: Seismic Risk Assessment. The detail of the final framework is attached as Appendix-5.

Looking back at Chapter V, most of the above contents of 'the final framework' in this research project, after being validated and refined by a thorough analysis of questionnaire survey, interview, and workshop event, was in line with the referred existing frameworks published by ISDR (2003), ADPC (2000), and MHA (2004). To achieve the robust proposed framework, Chapter IX presents two other workshop events with different participants in Yogyakarta City and Bengkulu City specifically for the validation media.

9.5 Contribution to Wider Knowledge Drawn from Thorough Analysis of Overall Data Collection

Based on the wider critical review of literature and the existing frameworks, it is believed that people who are living in seismic vulnerable areas should be able to live harmoniously with the seismic risk by developing a sense of place. Due to the growing population, together with the expanding figure of non-engineered buildings in developing countries, for example, Indonesia, one of the primary solutions to reduce seismic risk is to carry out mitigation actions aimed at reducing losses through the implementation of seismic codes on non-engineered buildings. Yet, the implementation of the codes is not simply technical intervention. This should be intrinsically linked with development planning as a whole. The involvement of many stakeholders sharing risk in effort and responsibility to provide evidence that the seismic risk management of non-engineered building is everyone's business, strengthen local capacity to develop local leadership, to engage local community participation, to increase public seismic awareness, and poverty consideration; these are important factors to achieve continuous change in these circumstances. Therefore, developing an integrative framework for guiding and monitoring seismic risk reduction of non-engineered buildings is crucial as it can be used as a starting point or a stepping stone to incorporate seismic risk management into development planning in Indonesia.

Findings from overall primary data collections confirm that to break the reluctance of communities to implement seismic codes, the decision makers cannot simply give seismic code manuals or practical training to local builders and then ask them to rigorously implement it. High awareness of seismic risk with a better understanding of earthquake data: their history, spatial distribution, characteristics, impact, and the existing fault line, underlies every initiative to reduce seismic risk. If people learn to live harmoniously with seismic risk, they will automatically strive to implement seismic codes voluntarily. Also, a high awareness of government key staff and legislative council will set communities tirelessly on a better and safer development path through which they should disseminate and communicate the seismic risk and, at the same time, enforce seismic codes through their robust regulation.

The traditional approach, in which technical and physical intervention to reduce seismic risk is of the highest importance, has been shifted by a better combination of technical and non-technical measures to put integrated management for seismic risk into practice collaboratively. An integrated risk management approach ensures that the risks can be managed as a part of wider decision-making. Thus, current understanding confirms that a successful implementation of seismic codes through voluntary people initiatives or through regulation enforcement can be achieved by government political commitment in the first line. It is imperative to sensitise policy makers toward seismic risk, followed by the involvement of many technical and non-technical actors, such as researchers, scientists, contractors, foremen, masons, carpenters, businessmen, educators, NGOs, community leaders, reporters, and others. Wider recognition is needed that building a culture of disaster prevention should become everybody's duty of care on a daily basis to ensure sustainability. It means that, while initiatives and a share of the expenses may come from any other source of people and organizations, the central point and final decision on whether there is any progress of implementation mostly rests with the government, acting as public safety decision makers.

In reality, most vulnerability and disaster occurrences are manifested at a local level, where medium-low income populations and less educated people at grass root levels always suffer most during disasters, and at the same time, local authorities are responsible for land use planning and construction planning and control. It is vital for decision-makers at local government levels to constantly develop deeper dialogues with the grass root communities about the changes they need to make. In this sense, three guiding principles should be understood by many key stakeholders when conducting dissemination to them, i.e. (1) government involvement should act as a backbone in every initiative, (2) the use of social bonds and indigenous methods is imperative, and (3) the message should be achievable and under the control of the people. This confirms that, to achieve successful and effective dissemination, the disseminator (such as government officials or the science community) should visit the community group and attend existing social meetings. Innovative initiatives, new synergies, and networks are easily absorbed over those already established. This will fit into the existing community structures without any friction and also value everyone's unique contribution. This process breaks powerful psychological barriers and continues to build up trust amongst them and also emphasises the importance of sustainability. In relation to the dissemination message, if people rationalise that the implementation of seismic features in their own house is the most effective strategy for reducing or avoiding losses and at the same time they perceive it is practically possible and achievable and they can control it, this strategy will have a tremendous effect on how well they can cope with change. If people have a sense of control and are clever enough to implement seismic features properly, then they can also achieve a sense of ownership, building upon a community's collective strength and skills. This sense of ownership enables people to generate a culture of prevention and also makes community members feel part of the effort.

The implementation of the above principles can bridge the gap between scientific expertise and the concerned public, particularly lay people. This is far beyond technical capacity and these principles were probably greatly neglected in the past, as many people in grass root communities are not able to learn from disaster lessons over time. In addition, it is greatly recommended that the disseminator have the intelligence and the sense of humour to intersperse the odd good joke during the course. Failure to attract the people's attention and sense of control could hamper the process.

Construction in common houses is completely different from the mechanism of engineered construction, a modern technique practiced by many engineers; construction management, formal contract, quantity and quality control are usually employed in this environment. Non-engineered construction practice is often driven by the local notion of social cohesion and spirit. Small-medium contractors, foremen, masons, and carpenters, as the main actors in non-engineered construction practices, usually use the vernacular method, local resources, and labour intensive methods, even unwritten rule without any formal contract or arrangement. In certain cases, the homeowner sometimes has full control of the overall house construction process, and the builders have no bargaining power to implement a new approach if they have. They are often less educated, had less training, less access to information, and less attention from modern science and technology. They learn construction practice naturally by doing and watching neighbourhood practices. In fact, they are ultimately the major factor in governing whether the seismic features are implemented in the construction of non-engineered structures. Unfortunately, researchers tend to focus on research in engineered buildings, such as high rise buildings, and are less enthusiastic about studying the common practice of low-rise non-engineered buildings. Based on the above evidence, this is not a surprise, as poor design and construction are major and common problems for non-engineered buildings, which are responsible for a very large portion of the losses during a strong earthquake.

To achieve change among non-engineered construction actors by introducing a new concept of seismic resistance is not an easy task. The first initiative should begin with providing a better understanding of local seismic risk and then the second is to change their construction practice. Changing construction practice in the domain of non-engineered construction should focus on a better fit between a steady stream of dissemination and communication of local seismic risk and the skill improvement of individual non-engineered construction actors. Meanwhile, to achieve continuous change in a government body, there are three levels that should be revitalised. The first is a revitalisation of the systems level, i.e. the regulatory framework and policies, the second is the revitalisation of the institutional level, i.e. the structure of organizations, and the third is the revitalisation of the individual level, i.e. individual skills, qualifications, and knowledge.

In all, it is very hard, even impossible to build a culture of prevention without the enhancement of seismic risk awareness of government officials, construction actors, and community members as a whole. For grass root communities, understanding their beliefs and needs, social cohesion and spirit constitutes the foundation to achieve change continuously. Wide ranging reform in construction practice should be by a locally-adapted technique, culturally accepted and compatible, local resource-based, flexible, not burdensome, less bureaucratic, less normative, less standardised, not too regimented, not too authoritative, moral and ethics based, and more innovative and improvised in intervention mechanisms. It is like engineering beyond the engineer. The purpose is to provide non-engineered construction actors and homeowners with a proper understanding of seismic risk and the simple implementation of seismic codes, then they are capable of implementing the codes by themselves. Figure 9.3 depicts the fundamental elements to achieve change in government, non-engineered construction actors, and all community members and other organisations.

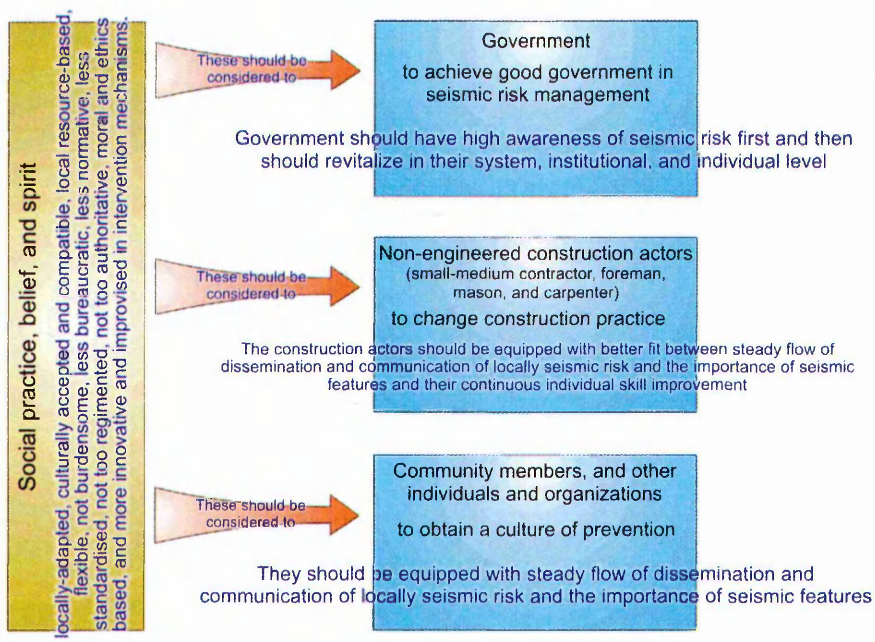

Figure 9.3 Fundamental elements to achieve change in the effective seismic risk reduction of non-engineered buildings, moving from knowledge to action

It is also recommended that dynamic audio-visual media such as films, shows, movies, and clips, be utilised to encourage people to implement seismic codes, rather than static media such as posters and brochures. This is due to the fact that people prefer watching to reading hence the suggestion of utilising visual media as an educational tool for the wider people in the domain of non-engineered construction practice, including those who self-build their home. Local authorities and others should work together in the implementation of seismic codes, to come up with dynamic and innovative solutions that meet their community's needs, rather than a centrally driven system that has a tendency to ignore local needs.

Looking at integrated seismic risk management of non-engineered buildings as an object of rapid change and high complexity poses new challenges. Indeed, the new challenges may seem daunting. Poor and vulnerable communities, who usually occupy non-engineered buildings, are often ignored by key decision-makers whose role is not to be on the side of the poor people; perhaps there may be no clear political and financial benefit for them to arrange this matter. Nonetheless, the fact that earthquakes continue to claim thousands of unnecessary deaths every year is our main reason to tackle the compelling subject. There have been encouraging best practices and no lack of brilliant local ideas for the future. All individuals, organisations, and agencies should face this politically sensitive challenge with the knowledge and resources that are available collectively.

Underlying the above explanation, the most challenging part of successful seismic risk management of non-engineered buildings is not finding the tools, but realising and accepting that a seismic event is simply a real fact for all people who live in a seismic prone area. We cannot predict when an earthquake will occur or how big the magnitude will be. In addition, a severe earthquake is low in probability, but has high consequences. Therefore it is better to grasp it rather than denying or ignoring it. The implementation of proper seismic codes in real non-engineered construction is the principal solution to make a substantial difference in seismic risk reduction. A balance should be struck between communicating local seismic risk and the importance of seismic codes to the people, and enforcing them to implement the codes; whilst some intense regulation is imperative, it should be non-prescriptive. Tomorrow's risk is a challenge for development.

9.6 Summary

The workshop event was carried out in order to comprehend research data generated after conducting a postal questionnaire and selected interview method by inviting various stakeholders to share and argue their opinion and position directly and openly, and also to consider the ideas of others. The event took place on the 22nd September 2006 under the name 'Workshop on Seismic Risk Management of Non Engineered Buildings' and was attended by 18 people, who represented a mix of nine types of stakeholder. Prior to the event, the workshop participants were asked to brainstorm ideas at their home by reading and studying carefully 'the second draft of the framework' and then writing as many additional ideas as possible for the evaluation or refinement of 'the second draft' on the paperwork, and to bring it along to the event. This event was successfully conducted in around three hours, and mainly consisted of two small group discussions and a plenary session.

In general, all participants reached a general agreement on some resolved fundamental principles and their associated components in the proposed framework that could be applied on a common basis at a local level (as well as national) and institutional adaptation. Their comments were distributed along with the 57 statements, with the top four most mentioned comments being in the area of the dissemination of information, political commitment, seismic codes, and law enforcement of seismic codes. The inspiring findings come from the six new ideas captured from this discussion, i.e. (1) city spatial planning, (2) balanced information on the geographic seismic risk map, (3) seismic risk map dissemination and communication, (4) building interior layout, (5) a monument to commemorate the dead, and (6) the involvement of artists in communicating seismic risk.

The workshop findings were used for both framework refinements and validation of the previous findings in the questionnaire and interview. There were two principal refinements for the proposed framework, i.e. (1) six new pairs of characteristic-indicators and (2) four additional ideas within the previous 57 pairs of characteristic-indicators. Now, 'the final proposed framework' comprises 63 pairs of characteristic-indicators, complemented by: (A) three important factors of effective seismic risk management of non-engineered buildings, (B) three guiding principles of dissemination, and (C) a map of multidisciplinary stakeholders as agents of change.

Through the critical analysis of the overall data collection, some propositions emerged as follows: (1) seismic risk management of non-engineered building should merge with overall development planning, (2) a high awareness of seismic risk with better understanding of the earthquake data underlies every initiative to reduce seismic risk, (3) a successful implementation of seismic codes through voluntary people initiatives or through regulation enforcement can be achieved by government political commitment in the first line and then followed by the involvement of many technical and non-technical actors, (4) constantly deeper dialogues with the grass root communities about the changes they need will encourage a sense of ownership that enables people to generate a culture of prevention and to feel part of the effort, (5) wide ranging reform in non-engineered construction practice should be based on locally-adapted techniques, culturally accepted and compatible, local resource-based, flexible, not burdensome, less bureaucratic, not too regimented, and not too authoritative, (6) the two fundamental elements to introduce a new concept of seismic resistance to the domain of non-engineered construction practice is to give a better understanding about local seismic risk and then to change their construction practice.

The following chapter will present two brainstorming workshop events conducted in Yogyakarta City and Bengkulu City in Indonesia for validation of the final framework achieved in this chapter as practical, sound evidence.

Chapter X
Framework Validation

In the previous chapter, the final framework for guiding and monitoring the seismic risk reduction of non-engineered buildings was developed through three phases, i.e. (1) a review of wider literature and existing frameworks, (2) questionnaire and interviews, and (3) a workshop event. This chapter presents two workshop events conducted in Yogyakarta City and Bengkulu City, which were intended to be a validation tool for the final framework. They were attended by many stakeholders, who are intended to be actually included in the framework users. This process is the final stage of the research project, which provides evidence that the final framework, as a result of the research project, is truly robust. The beginning of this chapter mentions the rationale and structure for the workshop events. Comments, feedback, and the response from workshop participants are then presented and analysed. The next section sums up the validation process, summarising the stakeholder views on the content of the final framework. A summary section concludes the chapter.

10.1 Rationale and Structure of the Workshop Event

It is true that 'the final framework' comprises 63 pairs of characteristic-indicators, complemented by (A) three important factors of effective seismic risk management of non-engineered buildings, (B) three guiding principles of dissemination, and (C) a map of multidisciplinary stakeholders as agents of change. There are plenty of core areas covered in 'the final framework' and each core area has comprehensive elements which stakeholders and community members can address for a better and safer future for non-engineered buildings, particularly in Indonesian cities. Therefore, validating all the core areas of 'the final framework' bit by bit will take an extremely long time. As a result, two workshop events were selected as a validation method by inviting many stakeholders in a discussion forum to assess 'the final framework' for its practicality and validity, for moderation, or any identifiable improvement requirements.

Similar to the rationale of the previous workshop, these two workshop events were highly favoured at this stage, because this method is very useful to tap into the group's knowledge, energy, creativity and different views, openly and directly on the complex, interdependent, and dynamic problem of the seismic risk reduction of non-engineered buildings. As the proposed framework was designed to suit the common Indonesian city environment, stakeholders from Yogyakarta and Bengkulu City in Indonesia were selected as workshop participants through an understanding of Indonesian seismic zoning, together with the findings of the pilot research study, as described in Chapter VII. Table 10.1 describes some of the characteristics of Yogyakarta and Bengkulu City. The distance between Yogyakarta and Bengkulu is around 1,030 km or 640 miles (see Figure 2.12 in Chapter II). Although the implementation of systematic and integrated seismic risk management in Indonesia is non existent nevertheless, some stakeholders who took part in these events were key people and at the leading edge of decision making within each city, in order to achieve the best validation.

Table 10.1 Some of the characteristics of Yogyakarta City and Bengkulu City

No	Characteristics	Yogyakarta City*	Bengkulu City
1	The location	Jawa island (the most densely populated island in Indonesia)	Sumatra island
2	The total area **	32.5 km^2	144.52 km^2
3	The population density in 2005**	± 15,545 person/km^2	± 2,491 person/km^2
4	The last tragic earthquake event	27 May 2006 (with more than 5,716 deaths)	4 June 2000 (with more than 90 deaths)

*) Yogyakarta City is well known as City of Education in Indonesia
**) Collected from www.jogja.go.id and www.bengkulu.go.id

The primary aim of these two workshops was to bring together many stakeholders in a discussion forum in order to obtain participant's feedback on the content of 'the final framework' in relation to the needs of many common Indonesian city stakeholders. This event focused on validating the relevant argument in relation to the city's unique features rather than focusing on specific output. Therefore, brainstorming techniques constituted the major activity during the workshop.

Yogyakarta's workshop took place on Monday, 26^{th} October 2006 under the name 'Workshop on Identification of Characteristic-Indicators of Seismic Risk Reduction of Non-Engineered Buildings to Implement Measures in Yogyakarta City' at the Master Program in Civil Engineering, Islamic University of Indonesia (UII) and administered in association with the same institution. Bengkulu's workshop was conducted on Thursday, 30^{th} November 2006 at the University of Bengkulu (UNIB) and administered in association with the Department of Civil Engineering UNIB, under the title 'Workshop on Identification of

Characteristic-Indicators of Seismic Risk Reduction of Non-Engineered Buildings to Implement Measures in Bengkulu City'. A previously formed, established research committe served as the workshop committee and the author acted as workshop facilitator. Particularly in Bengkulu's workshop, some lecturers and undergraduate students from the Department of Civil Engineering UNIB were primarily involved in the workshop committee.

The workshop participants were different and independent people from the previous workshop participants, were important people within each stakeholder organisation, and were actively involved in policy issues in each city work-scope. Also, most of them experienced the last tragic earthquake event that occurred in their region. Particularly in Yogyakarta's workshop, they were selected from the people who had taken part in the questionnaire survey and/or interview. The ideal local government officials who were targeted to participate in the workshop were in high management positions or the manager of a disaster management board, but at that time, the local Indonesian government of Yogyakarta and Bengkulu had no disaster management board concerned with disaster risk management. The non-structural local disaster management body (SATLAK) on local government only operates if a disaster occurs. Therefore, important people from the government agency involved in the decision on 'building construction permits' and building construction and control, and also important government staff from the geophysics board, were selected to be the workshop participants representing government officials.

About one month before the workshop event, the prospective workshop participants were contacted by telephone to check their availability to participate in the events. One-two weeks beforehand, the prospective person targeted to participate in the workshop was approached in order to be given a bundle of workshop material (i.e. an invitation letter, workshop timetable, a list of prospective workshop participants, a copy of 'the final framework', three pieces of blank paperwork, each with instructions for the participants to write additional ideas in relation to 'the final framework', and a location map for the workshop). Very often, when giving the documents, the research committe was able to meet the participants and discuss the purpose of the overall workshop event with them and ask them to brainstorm as many ideas as possible for the evaluation or refinement of 'the final framework' and bring the ideas to the event. This was to ensure that the participants were properly briefed as to their duties; however, a few of the prospective workshop participants did not attend because of several reasons. In the following explanation, the participants were categorised to remove names or any other reference made to any organisation or person. Table 10.2 presents the number of people who were invited and those who participated in the workshop events:

Table 10.2 The number of people who were invited and those who participated in the workshop events

No	Categories	Yogyakarta's workshop		Bengkulu's workshop	
		The number of people invited	The number of people participated	The number of people invited	The number of people participated
1	Researcher	4	3	4	4
2	Contractor	1	1	1	1
3	Foreman	1	-	1	1
4	Government	2	2	4	3
5	Businessman	1	1	1	-
6	Educator	1	1	1	1
7	NGO	2	2	1	1
8	Community Leader	3	2	1	1
9	Reporter	1	1	1	-
	Total	**16**	**13**	**15**	**12**

In general, the two workshops were conducted in similar manner: (1) a welcome speech, (2) a short, high-level presentation, (3) a discussion, and (4) closing remarks. On arrival, one copy of enlightening example of framework for seismic risk management in India and Nepal were circulated to all participants as additional workshop material. The workshop began with a welcome speech by the head of the host institution. This was followed by an introductory presentation by the author, introducing the purpose of the event and the results of the previous workshop, i.e. the final framework, including a brief presentation on best practice examples from Nepal and India, as they are developing countries, similar to Indonesia. The presentation provided a concise, high-level briefing on 'the final framework', the rules of discussion, and the proposed duration. Participants were also asked to open up areas of discussion and add to the issues according to their city's specific needs. The required input from the participants were their comments or feedback for the evaluation and/or refinement of 'the final framework', the output was the agreement for the refinement achieved, and the next step would be a suggestion for further concrete action, because they were actually framework users, in addition to the relevance to the author's PhD research project.

The following session was a discussion to obtain participant's feedback as the main part of the workshop. The participants gave their feedback, mostly coming from two consecutive sources: (1) their ideas as a result of their brainstorming session at their home, together with

(2) their further comments as result of discussion in the events. Introducing the copy of 'the final framework' before the events was critical, because the nature of the topic about seismic risk management of non-engineered buildings was a 'brand new initiative' in Indonesia. Moreover, current disaster management in Indonesia only responds after a disaster occurs. This situation lead to the people's lack of knowledge of the systematic seismic risk management of non-engineered buildings, including low participant's knowledge. Therefore, the question launched by the facilitator in the discussion was not as straightforward as to ask whether the framework was valid or needed to be improved; it was necessary to allow them to explore their own ideas first before the facilitator introduced the relevance and suitability of their comments within the context of 'the framework'. Here, each participant answered the question or gave their comments on: "How to reduce seismic risk comprehensively on non-engineered buildings, particularly on residential houses, from the participant's point of view and with respect to their city's needs in relation to the content of the final framework". The participants communicated many ideas synergistically, particularly based on the results of their initial structured brainstorming session in their home. The available amount of workshop time was able to be used effectively, and this session took around 120 minutes.

The last session was the closing remark, where the facilitator mentioned some of the workshop deliverables as what the participants 'built' in the workshop. Since they were viewed as frameworks users in their respective city, they were also invited to actively further participate by disseminating from the information the expected result of the process. To manage time effectively, there was no break for tea. A small box of light snacks and juice was served during the session. All workshop participants then took pictures and had lunch together.

As a general assessment, each participant discussed the topic with their own specific interest and proposed comprehensive, very positive, and encouraging feedback and suggestions on the content of 'the final framework'. Participants did not seem fatigued, discussing and arguing in a productive manner for approximately three hours. The participants widely welcomed the content of 'the final framework'. Nevertheless, some suggestions were made to further improve the framework.

10.2 Workshop Feedback and Analysis

Altogether, there were 13 people participating in the Yogyakarta workshop and 12 people in the Bengkulu workshop. Discussion was digitally recorded throughout using 'Coolsoft

Power MP3 Sound Recorder' software and transcribed. The result of discussion was then analysed using NVivo software, version 2.0. The software helped to code the data in relation to the content of 'the final framework'. The explanation of the 63 pairs of characteristic-indicators was presented under the same order used in 'the final framework', as attached in Appendix-5.

Indeed, the goal of the two workshop events was to provide enough evidence for a sound conclusion about the validity of the proposed framework. The following evidence of validity is outlined as follows:

a. The people who participated in the workshops were important people to ensure that individual's assessment was factual and logically sound.
b. Their feedback (mainly distributed in four areas: dissemination, government political commitment, seismic codes, and 'building construction permit' regulation) authenticates the similar conclusions with the 15 most important statements as presented in Table 8.5.
c. Although some of the elements did not receive comment at all, the previous pairs of characteristic-indicators had been rigorously validated by 305 respondents during the phase of the postal questionnaire; all respondents assigned a high degree of agreement to the initial pairs of characteristic-indicators.
d. Thorough research committee's evaluation of the research findings was conducted, so that the findings were supported by workshop participants on one side and the research committees on the other one.

The examples below mention some participant's feedback as agreement (particularly on the issues of dissemination, government political commitment, seismic codes, and 'building construction permit' regulation) to the content of 'the framework', as follows:

The dissemination issues gained the most feedback in these discussions, as it was stressed eight times in Yogyakarta's workshop and seven times in Bengkulu's workshop. This dissemination is closely related to the Statement Number 32. Government staff A in Yogyakarta's workshop mentioned: " .....We transfer our knowledge to the public who are currently building their houses. But sustainability would depend largely on the government budget available....". In wider issues, the community leader (Bengkulu's workshop) elaborated: "......Truly, the book (a copy of the final framework) which has been distributed to us and the paperwork that I handed in on my own are sufficient scientific matter according to their content.....Moreover, I reveal some issues (to be implemented in Bengkulu) as follows: (1) community participation.....in relation to the seismic matter... (2) creation of permanent disaster management organisation......(3) well organised distribution of aid during disaster...". The NGO in Bengkulu said: ".....what I can offer to this situation is, besides dissemination through formal education as the teacher said before, to hold dissemination through informal public education.....".

Another highlighted area was government political commitment. Discussed four times in Yogyakarta's workshop and three times in Bengkulu, this issue is relevant with both Statement Number 12 and the map of the agents of change. In Yogyakarta's workshop, researcher A said: ".....therefore, who should begin to the concrete action? Government. Because, people see that government is the central figure..." and government staff B stated: ".....perhaps political will in accordance with the permit issuance should be very very strict...". Researcher C in Bengkulu's workshop also stressed: ".......perhaps, first, there should be government will to achieve this risk management...".

The issue of existence of 'seismic codes' also emerged frequently, four times in Yogyakarta's workshop and three times in Bengkulu. This seismic code is closely related to Statement Number 15. The feedback below was that codes were already written and presented in common language, and the substitution of steel reinforcement with bamboo could be implemented in the low-rise houses. Government staff A (Yogyakarta's workshop) said: ..."There are procedures on how to connect steel reinforcement, how to make sloof, how to make ring balk, how to make stirrups, connections. All are available. People just need to copy it....". In Bengkulu's workshop, researcher B described: " ....but, I am very keen and very eager to give my contribution to Bengkulu.... they are not able to build seismic resistant houses because of one essential problem...that is poverty. They are not able to buy the steel bars...I have carried out research about bamboo to substitute the common use of steel bars...". The contractor also stated: "....the mechanism to build a seismic resistant structure is not difficult from contractors point of view. From an engineering perspective, I don't think it is a big deal...". This finding confirms that key stakeholders should disseminate and communicate on how to construct house safely using local materials and using low cost seismic resistant building technology, then low-income people have to learn and practice it.

The fourth highly agreed area was the rigorous 'building construction permit', as mentioned in Statement Number 17. Community leader A in Yogyakarta's workshop stated: "......and again, the 'building construction permit' is very important....The houses which were built in accordance with the correct 'building construction permit' requirements would be able to survive. The damage was very little......". In Bengkulu's workshop, the community leader said: ".......it is necessary to know whether the existing buildings in Bengkulu built by the government or private sector have complied with the concept of seismic resistant houses..... and that regulation of the 'building construction permit' should be implemented through the whole province...". Researcher B also commented: ".....therefore, in the future, we hope that high rise buildings in Bengkulu will be equipped with the 'building construction permit,' which is regulated with any recommendation from a competent expert...". Moreover, government staff B described: ".....but, on the other hand, the public awareness to take care of proper the 'building construction permit' is still low...". This confirms that the building construction permit process exists in municipal areas, but there is no way it could control the actual building production mechanism because of the lack of necessary resources, such as well-trained building inspectors.

The clear agreement to Statement Number 37 about school curricula was also mentioned by the teacher in Bengkulu's workshop as follows: ".....after reading the invitation bundle, particularly the core area of 'education', we agree very much that the matter of seismic risk reduction should be included in the school curricula and also the existence of the related subject...". Also researcher C said about the strong institutional basis for implementation or disaster management organisation (Statement Number 22): "....without good organisation (in disaster management), the product is nothing...". In relation to the multidisciplinary involvement, as described in the three important factors of effective seismic risk management of non-engineered buildings, government staff A said: "....Board of meteorology and geophysics can not work alone, without any involvement of the other parties.... we don't have any power to enforce development planning to comply with the seismic map. Our duty is just to give suggestions...".

Table 10.3 and 10.4 present the distribution of feedback and comments as agreements from the participants in relation to the 63 pairs of characteristic-indicators. Besides the above agreements, some feedback mentioned four additional ideas in relation to the 63 pairs (statements) of characteristic-indicators, which are presented in Table 10.5. These improvements then were added to the final framework, as attached in Appendix-5.

Table 10.3 Distribution of feedback collected in accordance with 63 pairs of characteristic-indicators in Yogyakarta's workshop

Workshop participants	Statement Number 1	Statement Number 2	Statement Number 3	Statement Number 4	Statement Number 5	Statement Number 6	Statement Number 7	Statement Number 8	Statement Number 9	Statement Number 10	Statement Number 11	Statement Number 12	Statement Number 13	Statement Number 14	Statement Number 15	Statement Number 16	Statement Number 17	Statement Number 18	Statement Number 19	Statement Number 20	Statement Number 21
Researc-A												√			√						
Researc-B												√									
Researc-C												√									
Contractor															√		√			√	
Govermn-A															√		√		√		
Govermn-B																					
Businssmn																					
Educator																			√		
NGO-A															√						
NGO-B																					
ComLead-A							√	√									√				
ComLead-B	√											√									
Reporter																					
Number of comments	1	-	-	-	-	-	1	1	-	-	-	4	-	-	4	-	3	-	2	1	-

Workshop participants	Statement Number 22	Statement Number 23	Statement Number 24	Statement Number 25	Statement Number 26	Statement Number 27	Statement Number 28	Statement Number 29	Statement Number 30	Statement Number 31	Statement Number 32	Statement Number 33	Statement Number 34	Statement Number 35	Statement Number 36	Statement Number 37	Statement Number 38	Statement Number 39	Statement Number 40	Statement Number 41	Statement Number 42
Researc-A										√	√					√					
Researc-B											√										
Researc-C											√							√			
Contractor																			√		
Govermn-A																					
Govermn-B											√		√								
Businssmn											√										
Educator																√	√				
NGO-A										√											
NGO-B											√					√			√		
ComLead-A											√										
ComLead-B	√																				
Reporter											√					√					
Number of comments	1	-	-	-	-	-	-	-	-	2	8	-	1	-	-	4	1	1	2	-	-

Workshop participants	Statement Number 43	Statement Number 44	Statement Number 45	Statement Number 46	Statement Number 47	Statement Number 48	Statement Number 49	Statement Number 50	Statement Number 51	Statement Number 52	Statement Number 53	Statement Number 54	Statement Number 55	Statement Number 56	Statement Number 57	Statement Number 58	Statement Number 59	Statement Number 60	Statement Number 61	Statement Number 62	Statement Number 63
Researc-A																					√
Researc-B																					
Researc-C													√								
Contractor																					
Govermn-A																		√			
Govermn-B																					√
Businssmn																					
Educator																					
NGO-A																					
NGO-B																					
ComLead-A																					
ComLead-B																					
Reporter																					
Number of comments	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1	-	-	2

Note:
1. Symbol √ indicates a confirmation that the relevant statement was commented by participant, and probably needs to be refined or improved
2. The higher number of comments does not reflect to the higher importance level
3. Statements with no comment indicate that these statements are important and do not need refinements

Table 10.4 Distribution of feedback collected in accordance with 63 pairs of characteristic-indicators in Bengkulu's workshop

Workshop participants	Statement Number 1	Statement Number 2	Statement Number 3	Statement Number 4	Statement Number 5	Statement Number 6	Statement Number 7	Statement Number 8	Statement Number 9	Statement Number 10	Statement Number 11	Statement Number 12	Statement Number 13	Statement Number 14	Statement Number 15	Statement Number 16	Statement Number 17	Statement Number 18	Statement Number 19	Statement Number 20	Statement Number 21
Researc-A												√									
Researc-B															√		√		√		
Researc-C												√					√			√	
Researc-D																	√				
Contractor															√					√	
Foreman												√									
Govermn-A				√									√		√						
Govermn-B	√																√				
Govemn-C																					
Educator																					
NGO																					
ComLeader																	√		√		
Number of comments	1	-	-	1	-	-	-	-	-	-	-	3	1	-	3	-	5	-	2	2	-

Workshop participants	Statement Number 22	Statement Number 23	Statement Number 24	Statement Number 25	Statement Number 26	Statement Number 27	Statement Number 28	Statement Number 29	Statement Number 30	Statement Number 31	Statement Number 32	Statement Number 33	Statement Number 34	Statement Number 35	Statement Number 36	Statement Number 37	Statement Number 38	Statement Number 39	Statement Number 40	Statement Number 41	Statement Number 42
Researc-A	√										√										
Researc-B													√								
Researc-C													√								√
Researc-D	√							√								√					
Contractor											√										√
Foreman											√								√		
Govermn-A		√									√										
Govermn-B																					
Govemn-C											√										
Educator											√					√					
NGO											√					√					
ComLeader	√																				
Number of comments	3	1	-	-	-	-	-	1	-	-	7	-	2	-	-	3	-	-	1	-	2

Workshop participants	Statement Number 43	Statement Number 44	Statement Number 45	Statement Number 46	Statement Number 47	Statement Number 48	Statement Number 49	Statement Number 50	Statement Number 51	Statement Number 52	Statement Number 53	Statement Number 54	Statement Number 55	Statement Number 56	Statement Number 57	Statement Number 58	Statement Number 59	Statement Number 60	Statement Number 61	Statement Number 62	Statement Number 63
Researc-A																					
Researc-B																					
Researc-C																					
Researc-D																					
Contractor																				√	
Foreman																					
Govermn-A												√	√								
Govermn-B																					
Govemn-C																					√
Educator																					
NGO																					
ComLeader																					
Number of comments	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	1	1

Note:
1. Symbol √ indicates a confirmation that the relevant statement was commented by participant, and probably needs to be refined or improved
2. The higher number of comments does not reflect to the higher importance level
3. Statements with no comment indicate that these statements are important and do not need refinements

Table 10.5 Four additional ideas in relation to the 63 statements

No	Some additional ideas	Exploratory analysis
1	Core areas: Research Characteristic: Local, National, and International co-operation in research: science, technology development, ***social, and culture**** As NGO A in Yogyakarta's workshop said: ".....So, I am also pleased that there were many comments, which were more or less similar with what I thought beforehand. Within the characteristic-indicators......there were many participants who mentioned the importance of social and culture. I see this core area of research is lacking in this......"	This additional idea of '*social and culture*' was added further to the relevant characteristic in the core area: Research
2	Core areas: Education and training Characteristic: Local, National, and International training program Indicator: Existence of training for development authorities, Community Organization, NGOs, group of foreman, private sectors: real-estate firms, builders, small-medium contractors in safe-building practices and retrofitting techniques, ***through various methods such as: elucidation, workshop, and learning by doing in real construction*.*** As researcher A in Yogyakarta's workshop suggested: "......When we taught them (traditional foremen and artisans), they didn't understand exactly. But, when we challenged them to do the skills in real house construction ...they can develop very fast....They feel that they are not being lectured by the young skilled trainer.."	This additional idea of '*various methods of training*' was added further to Statement Number 40.
3	Core area: Organizational Structure Characteristic: Civil society, NGOs, private sector and community participation Indicator: Existence of a group or an individual that have incorporated earthquake risk reduction as a permanent or significant part of their operations and commitment, ***for example the existence of one permanent facilitator team graduated from civil engineering to take care of the dissemination to the certain community**** As researcher D in Bengkulu's workshop stated: ......If they (all civil engineering study programs in Indonesia) are able to supply just 50 students (who accomplish their study), in one year thus there are about 8000 civil engineering alumnae....Is it possible if we propose one permanent facilitator team graduated from civil engineering to take care of (the dissemination) for a certain community? ...."	This additional idea of '*one permanent facilitator*' was added further to Statement Number 25.
4	Core area: Information Management and Communication Characteristic: Information and dissemination programmes and channels Indicator: Existence of documentation, databases, and an ***information system**** on seismic risk As researcher A in Yogyakarta's workshop urged: "...the short term program is to build an information system..."	This additional idea of an '*information system*' was added further to Statement Number 31.

*) The additional ideas improved or refined the final framework (written in bold and italic letter)

During the discussion, only two participants criticized the content of 'the final framework' from their point of view. The criticisms were as follows.

a. Criticism about the future implementation of the framework, as government staff A in Bengkulu's workshop stated so doubtfully: "...the big question is whether we can apply the framework, as it should be...".
b. Criticism about the other stakeholders involved in the framework and the breakdown of the stakeholders responsibilities. As researcher C in Yogyakarta's workshop said critically: "......when I read the introduction chapter, I see something missing......There are still many essential parties which need to be included in the context of stakeholders. There were no 'homeowners', there were no 'tukang' (mason and carpenter), for example...and also it needs to be broken down into 'who should do what', for example the teacher should do what,...."

The author, as workshop facilitator, did not respond directly to those criticisms during the workshop events, because the answer needed a comprehensive understanding in relation to the whole thesis. It is important to note that only the copy of the framework was given out for these events, not the whole thesis. The author gave feedback by talking to the participants directly soon after the end of the workshop. It is true that the full implementation and utilisation of the framework needs the comprehensive involvement of all government, non-government, and civil society organisations, as well as all individuals in Indonesia. It is not about achieving an overnight success. Therefore the answer to the above question: "Can we apply the framework successfully?" is 'Yes, we can'. As long as the involvement, commitment, and dedication from all parties exists for this long-term process. Still, integration of multidisciplinary stakeholders in seismic risk reduction is a complex process, and successful implementation may be achieved through incorporating the three factors: multidisciplinary stakeholder involvement, strengthening of local capacities, and poverty consideration.

The important stakeholders who were involved in the implementation of the framework are to be adopted into the framework as much as possible. Individuals, organisations, communities, agencies, and governments should be able to recognise their roles and responsibilities explicitly or implicitly somewhere in the framework. Each organisation or individual may adopt the content of the framework according to its own requirements, size, flexibility, and complexity. For example, the house owner roles and responsibilities can be seen implicitly in Statement Numbers 10, 25, 32, 45, 46, 57, 60, and 63. Also, the role of mason and carpenter can be identified implicitly in Statement Numbers 40, 45, 46, 57, 61, 62, and 63.

In this framework, the house owners were represented by community leaders, because the community leader, such as the head of neighbourhood administrative organisations, is the central figure in the Indonesian local community. Also, the mason and carpenter were represented by foremen, since the foremen were their superior in real construction. Explicitly, the role of community leader (also representing house owners) and the foremen (also representing masons and carpenters) appears in the Complement C (called a picture of agents of change) of the final framework (see the final framework in Appendix-5).

Indeed, some general assessments have proved that no single research project can encompass all the issues surrounding integrated and effective seismic risk management in that the content of the framework did not mention a breakdown of roles and responsibilities for each organisation or individual involved in the process of the seismic risk management of non-engineered buildings. This framework presents only the global and common conventions, issues, or areas, which need to be highlighted in accordance with guiding and monitoring seismic risk reduction of non-engineered buildings with reference to Indonesian cities. It is only a stepping stone for better and safer non-engineered buildings in Indonesia. Thus, it is suggested that future research work could identify in detail many of the stakeholders' roles and responsibilities for concrete action.

Figure 10.1 presents the distribution of participant's feedback with the assistance of NVivo software:

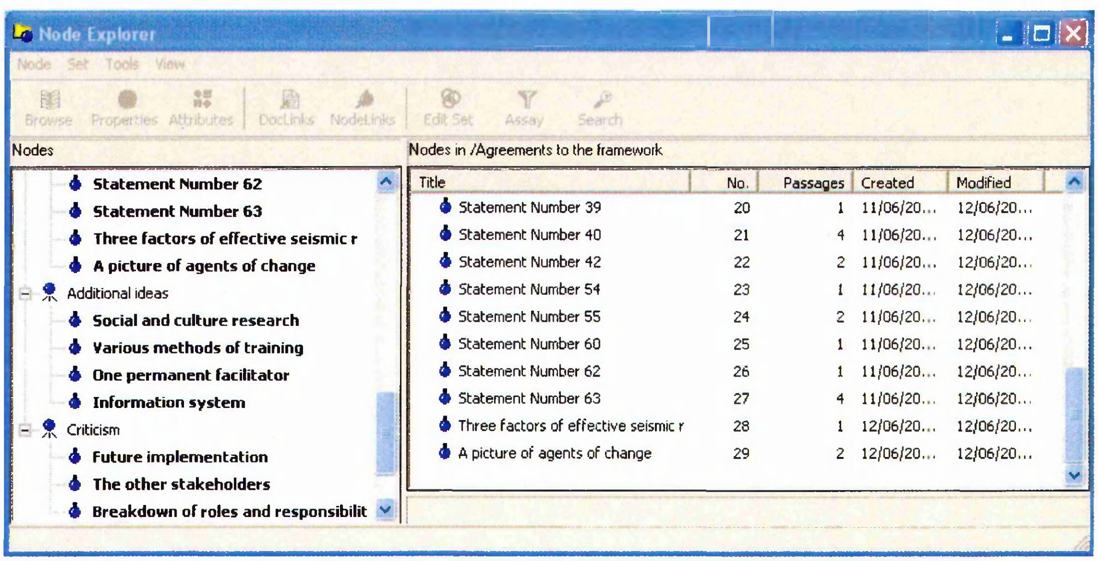

Figure 10.1 NVivo screen display of the nodes created from the two workshop events

10.3 Summation of the Framework Validation

Two brainstorming workshop events were successfully conducted in order to validate and obtain some improvements to 'the final framework'. Important people, representing key stakeholders from two Indonesian cities, Yogyakarta and Bengkulu, located in high seismic areas, participated in workshop events of around three hours each. Thirteen key people participated in Yogyakarta's workshop and twelve in Bengkulu's workshop. Although the issue of the systematic seismic risk management of non-engineered buildings was a relatively new initiative, through these huge efforts, positive and encouraging feedback has been collected from the participants, who are decision makers at a city wide level. Generally, all participants highly appreciated the content of 'the final framework'; however, there were four additional ideas, which were added to the refinement of the final framework, and two participants criticised the content of 'the framework'. The above evidence of the validation process and results has given a comprehensive picture that 'the final framework' is truly robust.

In essence, the validation of the findings of the research project was achieved from the series of primary data collections. Looking back at the sequence of the primary data collection, the findings of the postal questionnaire survey and selected interviews conformed and also validated the review of the literature and the existing frameworks. The previous workshop also agreed with and authenticated the findings of the questionnaire survey and interview. In this section, the two workshop events validated the final framework. Most of the findings to emerge so far conformed to and strengthened the previous findings. Therefore, every step in this research process validated the previous findings, and also the overall research process in this project was completely interwoven from the beginning to the end.

10.4 Summary

This chapter reported the validation for the framework for guiding and monitoring the seismic risk reduction of non-engineered buildings, which was developed in the previous chapter. The beginning of the chapter presented the rationale for the validation, and the justification of the chosen workshop event and the workshop structure were elaborated. Two workshop events in Yogyakarta City and Bengkulu City were carried out; many stakeholders in each city participated in these events, as they were actually included in the framework users.

Every workshop participant was asked to answer the question or give comment on: "How to reduce seismic risk comprehensively on non-engineered buildings particularly on residential houses, from the participant's point of view, with respect to their city-wide needs in relation to the content of 'the final framework' ".Workshop participants were only concerned with certain items which suited their interest. In relation to the 63 pairs of characteristic-indicators, their feedback was distributed mainly in four areas: dissemination, government political commitment, seismic codes, and 'building construction permit' regulation. Although there were four improvements or refinements and two criticisms, in general, all participants' comments were relevant or validated the content of 'the framework'. The summation section confirmed that the evidence of the validation process and the result has given a comprehensive picture that 'the final framework' is truly robust. In essence, looking at the series of research steps, every step in this research process validated the previous findings; this was also evidence that the overall research process in this project was highly interwoven from the beginning to the end. The next chapter concludes the thesis, presenting the conclusions of this research work.

Chapter XI
Conclusions

The critical evaluation of literature and the existing frameworks, the primary data collection as well as the validation process have been completely conducted. This chapter is the final section of the thesis. Primarily, it reports the conclusions drawn from this research work, which are closely tied to the introduction chapter. These conclusions include what has been achieved from the research aim and each research objective; they cover all the main research phases, including the review of literature and the existing frameworks, the postal questionnaire survey, selected interviews, and workshop events. These conclusions demonstrate the contribution to knowledge.

Based on the literature, the integrated seismic risk management of non-engineered buildings is a vast, comprehensive, and relatively new research area in Indonesia. Some evidence in this thesis has proved that no single research project can encompass all the issues surrounding integrated and effective seismic risk management, particularly in developing countries, for example Indonesia. Therefore, the limitations of this research work are explained. Continuing from the limitations, the chapter also identifies areas in the seismic risk management of non-engineered buildings where future research work is recommended.

11.1 Main Conclusions

The research project was aimed at developing a novel framework for guiding and monitoring seismic risk reduction of non-engineered buildings in Indonesian cities. This was achieved by employing five practical and theoretically sound main data sources. Firstly, a comprehensive literature review was conducted, as presented in Chapters II, III, and IV. Secondly, the review moved to examine the three existing frameworks as case studies in Chapter V. These two phases produced 'the first draft of the proposed framework'. Based on analysis of the literature review and the existing frameworks, and after developing a strong research methodology (in Chapter VI), field pilot studies were conducted to validate the previous findings, to authenticate the relevance and practicality of the research methods early in the research, and to identify any further issues, as given in Chapter VII. The pilot studies provided guidance for the following primary data collection. Thirdly, 875 questionnaires were sent out to obtain data from a large number of respondents, as representing various stakeholders involved in the decision making of seismic risk management of non-engineering buildings in Indonesia, and 305 healthy responses came back, or about 34.9%. Fourthly, the selected interviews were carried out to achieve a deeper understanding and factual story, according to the questions which emerged from questionnaire survey. As presented in Chapter VIII, the findings of the questionnaire survey and interview refined 'the first draft of the framework' into 'the second draft of the framework'. Fifthly, a workshop event was conducted by inviting various stakeholders to a forum as a complementary method; the stakeholders shared and argued their opinions and positions directly and openly, and also considered the ideas of others. This was aimed at developing 'the final framework' as described in Chapter IX. The validation process (in Chapter X), by conducting two workshop events in Yogyakarta City and Bengkulu City, constituted the final phase of the research project. Generally, all the research phases conformed to and strengthened the previous findings, and also confirmed that the overall research process in this project was highly interwoven from the beginning to the end.

In fact, the major finding and contribution of the research project is the novel framework itself (Appendix-5), i.e. a framework for guiding and monitoring the seismic risk reduction of non-engineered buildings in Indonesian cities via a risk management approach. The structure of the framework embraces 3 steps of seismic risk management, i.e. seismic hazard analysis, seismic risk assessment, and seismic risk response. Within those steps, there are 63 pairs of characteristic-indicators, complemented by (A) three important factors of effective seismic risk management of non-engineered buildings, (B) three guiding principles for sustainable and effective dissemination to the grass root communities, and (C) a map of agents of change. Furthermore, among the 63 pairs, there are 19 technical interventions and 44 non-technical interventions in relation to an action-oriented impact and likelihood of sustainability. The framework was carefully identified from the thorough analysis of all the data. In all, the novel framework as the principal research finding is fully significant in that it originally contributes to the wider knowledge in the domain of the seismic risk management of non-engineered buildings that bridge disciplines, scientific, and indigenous sources of knowledge. The framework may be seen as a living document to be modified as issues emerge, knowledge expands and capacities change. In addition to the framework and in relation to the research objectives, some of the research contributions as main conclusions leading to new understanding which was probably neglected or under-researched in the past are outlined as follows:

a. Earthquakes have long been feared as one of nature's most terrifying and devastating events. Although an earthquake cannot be prevented, modern science and engineering provides tools that can be used to reduce their effects based on the fact that much of the damage in earthquakes is predictable and preventable. The infamous earthquake and tsunami in the Indian Ocean in 2004 caused more than 150,000 Indonesian deaths and the Yogyakarta earthquake in 2006 claimed more than 5.700 deaths, which demonstrated that most of the Indonesian region is located in high or very high seismic areas.

b. The main concern of an earthquake is the number of deaths and injuries from the collapse of buildings which are poor in design and construction, in both developing and developed countries, namely non-engineered buildings. Conversely, the few buildings that were constructed according to the modern building code were able to survive the earthquakes.

c. A non-engineered building is an unsystematically designed, built, and supervised building. Non-engineered buildings are usually built by traditional builders and/or building owners, using common traditional approaches without intervention by qualified architects and engineers in their design and construction. In Indonesia, non-engineered buildings dominate most residential buildings constructed with heavy materials, such as masonry or multi-storey reinforced concrete, up to two stories and are still being built within medium-low-income populations to cope with the greater need for housing for a growing population. As a result, the number of non-engineered buildings built with non-seismic resistance has enormously expanded, and they will remain the single greatest source of existing seismic risk for the foreseeable future.

d. Seismic codes help to improve the behaviour of structures so that they may withstand earthquake effects at the appropriate levels of ground motion. Seismic codes exist in most countries with high seismic areas. In Indonesia, the seismic codes for practical implementation in residential houses have been developed since 1978. The newest formal seismic code for ordinary buildings (SNI-1726-2002) was launched in 2002. The seismic codes comprise many aspects of seismic features in both masonry and RC buildings, which describes elements such as: a simple structural configuration, the influence of openings, vertical reinforcement, the necessity of horizontal bands in masonry buildings, openings in walls, the roles of floor slabs and masonry walls, strength hierarchy in RC, beam and column design strategies, beam-column joints, vulnerability of open-ground storeys, and short columns. Although almost the entire seismic feature checklist mentioned in Table 3.3 is in line with Boen (1978) and SNI-1726-2002 (2002), the checklist provides a systematic way to have a look seismic features element by element, and this can be used as a complement for the existing seismic codes in Indonesia.

e. There is still wide gap between massive death tolls and the existence of seismic codes. On the one hand earthquakes continue to cause tragic events with high death tolls. On the other hand, seismic codes clearly exist in countries to save lives and human suffering. Many of the deaths could have been reduced, even avoided, if understanding and implementation of seismic codes had been employed properly. The application of the proposed framework could help to make implementation of seismic codes more functional and relevant and would ensure successful disaster reduction.

f. Since seismic risk is simply a real fact for many Indonesian people, it is not a wise solution to force them to leave their beloved but hostile areas; therefore the people should be able to live harmoniously with the seismic risk, as an inconvenient truth. One of the strategic solutions to live harmoniously with seismic risk and to bridge the above gap is to carry out mitigation actions aimed at reducing losses through the implementation of seismic codes on existing and new non-engineered buildings.

g. The implementation of seismic codes on non-engineered buildings is not only related to physical measures, but also to other issues, such as financial, educational, and administrative. This comprehensive perspective of seismic risk reduction and also disaster risk as a whole should be systematically integrated into development planning completely in order to meet the challenges ahead. Based on best practice in other countries, there are three suggested important factors for effective seismic risk management of non-engineered buildings in developing countries, i.e. involvement of multidisciplinary stakeholders to share risk and responsibility, strengthening of local capacities, and poverty consideration, as mutually supportive objectives. These findings are closely related with the elements in the overall disaster reduction mentioned by UNDP (2004) and UN-ISDR (2002).

h. The concept of the two senses, i.e. (1) a sense of place, where all community members become attached to their own home and should live harmoniously and side-by-side with the existing seismic risk and (2) a sense of responsibility, by which all community members should collectively bear responsibility to reduce seismic risk on a daily basis, appears to be a potentially useful mechanism to frame community sustainability projects.

i. Currently, disaster management programs in Indonesia are mostly oriented to provide response actions during disasters, hardly ever to conduct mitigation actions, and, furthermore, are not connected with the integral paradigm of sustainable development. The central challenge of the promising new agency, as approved by the House of Representatives on 29th March 2007, in disaster management organisation is to ensure that government decentralisation becomes a positive driving force: to promote disaster management as a key issue on the local agenda, to develop an integrated program for disaster activities, and to increase the local budget allocation for disaster reduction.

j. The existing frameworks provided evidence that all had a primary concern with reducing disaster risk with cross-cutting issues; however, they demonstrated their specific area of interest. There was still considerable variation in the density of the frameworks in terms of the number of specific features of indicators that were included for appraisal. Most of their principles comprised many aspects of both structural measures (for example: damage assessment, implementation of seismic codes, and retrofitting of important buildings) and non-structural measures (for example: public awareness, institution building, organizational structure).

k. Most of the content of the proposed framework in this research project, after it was validated and refined by thorough analysis during the questionnaire survey, interview, and workshop event, was in line with and relevant to the referred existing frameworks (ISDR, 2003; ADPC, 2000; and MHA, 2004) and ensured more systematic actions to address the seismic risk of non-engineered buildings in the context of development planning. The areas of important concern of SRRNEB to be carried out in Indonesia include: government political commitment, earthquake occurrence data dissemination, existence of information for pro-poor strategies, resource mobilization for expert staffing allocation, existence of deterministic and probabilistic earthquake scenario, existence of regulation of builders, existence of seismic codes with simple language, existence of seismic risk map using Geographic Information System, continuity of dissemination channels, good examples in real constructions, existence of inventory data: soil profiles and buildings, existence of seismic risk reduction as a policy priority, availability and accessibility of information in introducing seismic features of buildings. The findings concerning the high importance of government political commitment is similar to the UN-ISDR (2002).

l. For all people and organisations, a high awareness of seismic risk with a better understanding of earthquake data: their history, spatial distribution, characteristics, impacts, and the existing fault line, underlies every initiative to reduce seismic risk before introducing the importance of seismic codes.

m. A better combination of technical and non-technical measures is a substantial contribution towards the successful implementation of seismic codes through voluntary initiatives or through stringent regulation enforcement. Government political commitment should be first, followed by the involvement of many technical and non-technical actors, such as researchers, scientists, contractors, foremen, masons, carpenters, businessmen, educators, NGOs, community leaders, reporters, and others. This needs wider recognition that building a culture of disaster prevention should become everybody's duty of care on a daily basis to ensure sustainability.

n. It is imperative for decision-makers at local government levels, who are responsible for land use planning and construction planning and control, to consistently develop deeper dialogues with grass root communities about the changes they need to make. To achieve successful dialogues and dissemination, the disseminator, for example, government officials or scientists, should visit the community group and attend existing social meetings. Innovative initiatives, new synergies, and networks are easily absorbed over those already established. This will fit into the existing community structures without any friction and also value every person's unique contribution. This process breaks powerful psychological barriers, continues to build up trust amongst the community and also emphasises the importance of sustainability.

o. In relation to the message of dissemination, if people rationalise that the implementation of seismic features in their own house is the most effective strategy for reducing or avoiding losses, and at the same time they perceive it is practically possible and achievable and they can control it, this strategy will have a tremendous effect on how well they can cope with the process. If people have a sense of control and are clever enough to implement seismic features properly, then they can also achieve a sense of ownership, building upon a community's collective strength and skills. This sense of ownership enables people to generate a culture of prevention and also to make community members feel part of the effort. The implementation of the above principles can bridge the gap between scientific expertise and a concerned public, particularly lay people. This is far beyond the issue of technical capacity and these principles were probably neglected in the past.

p. Non-engineered construction practice is often driven by the local notion of social cohesion and spirit. Small-medium contractors, foremen, masons, and carpenters as the main actors in non-engineered construction practices usually use the vernacular method, local resources, and labour intensive methods, even unwritten rules without any formal contract or arrangement. In certain cases, the homeowner sometimes has full control over the overall house construction process, and the builders have no bargaining power to implement a new approach. They are often less educated, have had less training, less access to information, and less attention from modern science and technology. They learn construction practice naturally by doing and watching the neighbourhood practice. In fact, they are ultimately the major factor in governing whether the seismic features are implemented in the construction of non-engineered structures. Unfortunately, researchers tend to focus on research in engineered buildings and are less enthusiastic about studying the common practice of non-engineered building. Moreover, poor and vulnerable communities, who usually occupy non-engineered buildings, are often ignored by key decision-makers whose role is not to be on the side of the poor people; perhaps there may be no clear political and financial benefit for them to arrange this matter.

q. To achieve continuous change in a government body, there are three levels that should be revitalised. The first is revitalisation of the systems level, i.e. the regulatory framework and policies, the second is revitalisation of the institutional level, i.e. the structure of organizations, and the third is revitalisation of the individual level, i.e. individual skills, qualifications, and knowledge. This finding is synonomous with the improving capacity of government bodies in relation to the government decentralisation process, as mentioned by Turner et al (2003).

r. Meanwhile, to achieve change among non-engineered construction actors by introducing a new concept of seismic resistance, they should be equipped with a better fit between the steady flow of dissemination and communication of local seismic risk and the importance of seismic features and their continuous individual skill improvement. This finding tends to complement what CEEDEDS (2004) and Hausler (2006) have achieved in their seismic feature training for local builders as the main actors in the construction of non-engineered structures.

s. It is very hard, even impossible, to change common construction practice without an improvement of seismic risk awareness of government officials, construction actors, and community members. For grass root communities, understanding their beliefs and needs, social cohesion and spirit constitutes the foundation to achieve change continuously. Wide ranging reform in this construction practice should be a locally-adapted technique, culturally accepted and compatible, based on local resources, flexible, not burdensome, less bureaucratic, not too regimented, not too authoritative, moral and ethics based, and more innovative and improvised in intervention mechanisms. It is like engineering beyond the engineer. The purpose is to provide non-engineered construction actors and homeowners with a proper understanding of seismic risk and the simple implementation of seismic codes and then they are capable of implementing the codes by themselves.

t. Dynamic audio-visual media such as films, shows, movies, and clips, can be utilised to encourage people to implement seismic codes rather than using static media such as posters and brochures as an education tool for people in the domain of non-engineered construction practices, including those who self-build their homes.

u. The proposed framework is just a tool. The next important thing is to build popularity for mainstreaming seismic risk reduction by actively marketing the proposed framework as a clear, unambiguous tool for achieving incremental improvements.

v. Finally, the most challenging part in the successful seismic risk management of non-engineered buildings is not finding the tools, but realising and accepting that seismic events are simply a real fact for all people who are living in seismic prone areas. Since this event is unpredictable and unavoidable, it is better to grasp it rather than denying or ignoring it. As a result, conducting integrated seismic risk management of non-engineered buildings continues to be the biggest challenge for the global community today.

The above findings clearly demonstrate the successful achievement of the aims and objectives of the research. Moreover, the research represents a major contribution to knowledge of the subject area, and the novel framework developed provides the opportunity, through its utilisation, to radically improve current procedures and practice. In addition to the above contributions to wider knowledge, it needs to be highlighted that the ultimate goal of this framework is to save lives and human suffering against future strong earthquakes.

11.2 Limitations of the Research

Although the framework of the research was developed through rigorous data collection and analysis, some limitations still emerged throughout the research process, which hindered the researcher in achieving the high quality of the framework. Some limitations applicable to this research work are as follows:

a. This study was confined to the Indonesian environment, where existing social aspects and culture are enormously influential. In fact, the stakeholders who were approached and who participated in the research process did not cover all Indonesian regions. Due to the constraint of time and resources, the information or data from people who lived in the eastern and northern high seismic risk regions of Indonesia, such as Papua, Maluku, and Sulawesi, were not included in the data. For example, the workshop in Yogyakarta City and Bengkulu City only represented a small part of the central and western region of Indonesia. More could have been done to obtain a larger pool of data for the investigation.

b. The study was about seismic risk management activities, in which pro-active measures should be applied to the issues before the seismic event to prepare better and safer non-engineered buildings in the future. On the other hand, some evidence has shown that such seismic risk reduction, mitigation, and preparedness before the disaster was a relatively new concept to the common Indonesian people and government. Some respondent's comments concerned how to undertake disaster response rather than how to reduce seismic risk before the disaster comes. The difficulties emerged when the author had to explain in detail first 'what is the definition of seismic risk management' to the respondents before embarking on the interview and workshop data collection. Indeed, it was time consuming, particularly during the selected interview phase and the initial discussion activity prior to the workshop event. It is possible that the lack of the respondents' views about the exact meaning of seismic risk management might lead to relatively low quality in the framework achieved.

c. The research topic was closely related to disaster management. The non-existence of a permanent disaster management organisation in Indonesia meant that there was no permanent institution to take care of the gigantic problem of disaster risk management. The difficulty appeared because government departments or bodies needed to be approached one-by-one to find the correct key government officials to participate in the research. Again, it needed great patience and plenty of time, just to follow the complicated bureaucratic procedure and also for initial discussions with many government staff before deciding on the appropriate key staff who were able and had the capacity to get involved in the data collection. Due to time and resource constraints, some government officials and also other stakeholders who participated in this research, might have a low capacity or knowledge about the seismic risk management of non-engineered buildings. Thus, this situation might lead to the development of a relatively less perfect framework.

11.3 Suggestions for Further Research Work

As mentioned earlier in the thesis, the research topic about the seismic risk management of non-engineered buildings in Indonesia was very wide and a relatively new research field. The limited scope of this research project could not entirely embrace the integrated seismic risk management systems of non-engineered buildings from all facets within a single strand of research. Overall, further research should have the ultimate goal of reducing unnecessary high loss of life from earthquakes as the most important challenge facing the global community. Hence, further research in the following areas is suggested:

a. A wider study to develop an integrated framework of the seismic risk management of non-engineered buildings for common local initiatives in Indonesia with balanced data from all Indonesian regions, to produced a new form of solidarity respecting cultural differences. This research will work smoothly and be streamlined if the research initiative comes from central government, which has the power to ask each local government to accomplish it.

b. A collaborative study initiated by central and/or certain local governments to identify the most urgent activities of the seismic risk management of non-engineered buildings to be carried out immediately to fit into specific city wide needs. Because this proposed research would be instituted by the government, and therefore, through the existing government network, the bureaucracy barrier is not a big deal, and very senior positions of appropriate government key staff and other stakeholders can be decided to be included in the data collection. It is widely agreed that the result will be considerable because the participants are well known and prominent among the decision-makers.

c. Developing a framework that links between common local seismic risk management activities and a national program of seismic risk management to maintain the same language to reduce seismic risk.

d. A best practice local government political system of commitment, for the implementation of integrated seismic risk management, to promote collaboration and information sharing.

e. A best practice seismic resistant house model with cost effective considerations in many areas for the encouragement of others, in order to include more reward for the research of inadequately engineered construction, higher emphasis on unique local efforts, and a greater emphasis on advocacy. It is well believed that requiring seismic design and construction of new buildings may increase costs but far less than many people think. Furthermore, practice makes perfect builders, and there is a need to raise the profile of the successes of seismic resistant houses.

f. Development of dynamic audio-visual media of the implementation of seismic features as a wider dissemination tool in a movie format, built using local language and local resources. The purpose is to provide an interactive dissemination tool that everybody can use to learn to implement seismic features. This dissemination method has many advantages, such as: it uses less resources than conducting face-to-face training, the users can easily understand the local language employed in the film, the users will have a sense of control because the content of the film uses affordable local resources and conforms to their social cohesion, the users can easily adjust their schedules to see the film, and the film can be copied cheaply for wider circulation.

g. Earthquake loss estimation study (damage assessment) for the area that lies along what is well known in the scientific arena as 'the seismic gap', i.e. the area that is highly prone to earthquakes, but that has not had an earthquake recently. In fact, the existing framework from Nepal (ADPC, 2000) mentioned that this loss estimation study in Nepal constituted the first activity to encourage more initiatives.

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Appendix-1:

Critical value of ρ (rho) at various levels of probability (Spearman rank correlation coefficient) (Naoum, 1998)

For any N, the observed value of ρ is significant at a given level of significance if it is equal or larger than the critical values shown in the table.

N (number of subjects)	Level of significance for one-tailed test			
	.05	.025	.01	.005
	Level of significance for two-tailed test			
	.10	.05	.02	.01
5	.900	1.000	1.000	—
6	.829	.886	.943	1.000
7	.714	.786	.893	.929
8	.643	.738	.833	.881
9	.600	.683	.783	.833
10	.564	.648	.746	.794
12	.506	.591	.712	.777
14	.456	.544	.645	.715
16	.425	.506	.601	.665
18	.399	.475	.564	.625
20	.377	.450	.534	.591
22	.359	.428	.508	.562
24	.343	.409	.485	.537
26	.329	.392	.465	.515
28	.317	.377	.448	.496
30	.306	.364	.432	.478

Note: When there is no exact number of subjects use the next lowest number.

Appendix-2:
Survey questionnaire

From your experience, please express your opinion on how important to each statement to be carried out in Indonesian cities by ticking (√) the relevant box (and by writing additional statement in the space provided if necessary).

Please note: all information provided will be treated in the strictest confidence

A. Issues Related to Seismic Hazard Analysis

Characteristics	Indicators	Very important	Important	Neither	Not important	Absolutely not important	Don't know
1. Earthquake occurrence data: their historical, spatial distribution, characteristics, and impacts	Data recorded, mapped, and up-dated regularly						
2. Earthquake scenario data	1. Existence of earthquake data to conduct deterministic earthquake scenario						
	2. Existence of systematic analysis of return period of earthquake occurrence to conduct probabilistic earthquake scenario						
……………………………………………*)	…………………………………						

*) Please write additional statement if necessary

B. Issues Related to Seismic Risk Assessment

Characteristics	Indicators	Very important	Important	Neither	Not important	Absolutely not important	Don't know
1. Inventory data: geology/soil profiles and buildings	Geology/soil profiles and buildings inventory data recorded, mapped, and up-dated regularly as necessary, particularly in order to calculate the quantitative number of non-engineered buildings and their spatial distribution						
2. Building fragility curves	Building fragility curves up-dated regularly associated with the newest data						
3. Damage assessment	Existence of systematic damage assessment of the possible economic impact to buildings using seismic risk scenario both deterministic and probabilistic approach.						
……………………………………………*)	…………………………………						

*) Please write additional statement if necessary

C. Issues Related to Seismic Risk Response

Table C.1: Characteristics and indicators to '**policy and planning**'

Characteristics	Indicators	Very important	Important	Neither	Not important	Absolutely not important	Don't know
1. Seismic risk reduction of non-engineered buildings (SRRNEB) as a policy priority	Existence of SRRNEB commitment and strategy in city level (including collaboration with donor agencies) in relation to the context of decentralization						
2. Integration of reducing SRRNEB in development planning and sectoral policies (including poverty eradication)	Established or revised policies to facilitate action, regulation, enforcement, and/or incentives						
3. Responsibilities of reducing SRNEB	Map out institutions with responsibilities of SRRNEB						
……………………………………………*)	………………………………						

*) Please write additional statement if necessary

Table C.2: Characteristics and indicators to '**legal and regulatory framework**'

Characteristics	Indicators	Very important	Important	Neither	Not important	Absolutely not important	Don't know
1. Seismic codes	Seismic codes (socially acceptable, written in simple language, and economically feasible) are existed and updated						
2. Laws and regulations	Existence of administrative and institutional mechanism framework for implementation of seismic codes						
3. Compliance and enforcement	1. Existence of regulation of builders and real estate developers for creation of seismic resistant buildings						
	2. Existence of regulation of Financial Institution for ensuring seismic resistant features in new and extension of existing constructions while giving loans and insurance						
	3. Existence of systems to control compliance and enforcement in actual practices						
4. Certification system for engineers, architects, and foreman	Existence of compulsory certification system for engineers, architects, and foreman						
5. Responsibility and accountability	Existence of watchdog groups						
……………………………………………*)	………………………………						

*) Please write additional statement if necessary

Table C.3: Characteristics and indicators to '**organizational structures**'

Characteristics	Indicators	Very important	Important	Neither	Not important	Absolutely not important	Don't know
1. Implementing and co-coordinating bodies	Existence of an administrative structure responsible for disaster reduction						
2. Intra and inter-ministerial, multidisciplinary & multisectoral mechanisms	Existence of sectoral programmes in line ministries						
3. Civil society, NGOs, private sector and community participation	1. Existence of consultation, and role for civil society, NGOs, private sector and the communities to reduce seismic risk						
	2. Existence of group or individual that have incorporated earthquake risk reduction as a permanent or significant part of their operations and commitment						
……………………………………………*)	…………………………………						

*) Please write additional statement if necessary

Table C.4: Characteristics and indicators to '**resources**'

Characteristics	Indicators	Very important	Important	Neither	Not important	Absolutely not important	Don't know
Resource mobilization and allocation: financial (innovative and alternative funding, incentives), human, technical, material	1. Existence of disaster management office						
	2. Existence of permanence budgetary allocation						
	3. Expert staffing allocation						
	4. Existence of established link with donor organizations						
……………………………………………*)	…………………………………						

*) Please write additional statement if necessary

Table C.5: Characteristics and indicators to '**information management and communication**'

Characteristics	Indicators	Very important	Important	Neither	Not important	Absolutely not important	Don't know
1. Information and dissemination programmes and channels	1. Existence of dissemination media through web-site						
	2. Existence of documentation and databases on seismic risk						
	3. Continuity of dissemination channels and participation through down grass-root communities and use of traditional/indigenous knowledge and practice						
2. Networks for seismic risk management (scientific, technical, and applied information, traditional/indigenous knowledge)	1. Existence of multidiscipline stakeholders networks in seismic risk management						
	2. Existence of information centers and networks in seismic risk management						
	3. Existence inter-city exposure visits for city managers for mutual learning						
	4. Existence of pro-active sharing of best practices for earthquake risk management for wider circulation						
....*)	....						

Table C.6: Characteristics and indicators to '**education and training**'

Characteristics	Indicators	Very important	Important	Neither	Not important	Absolutely not important	Don't know
1. Inclusion of seismic risk reduction at all levels of education (curricula, educational material)	Existence of appropriate curricula in seismic risk reduction at all levels of education						
2. The role of teachers through school activities	Existence of the role of teacher to disseminate and apply seismic codes in the real practice through their student activities (including collaboration with other parties)						
3. Training of trainers (TOT) programmes	Existence of TOT for community leaders periodically						
4. Local, National, and International training program	1. Existence of training for development authorities, Community Organization, NGOs, group of foreman, private sectors: real-estate firms, builders, small-medium contractors in safe-building practices and retrofitting techniques						
	2. Existence of apprentice programmes in seismic risk management for government disaster management staff						
....*)	....						

*) Please write additional statement if necessary

Table C.7: Characteristics and indicators to '**public awareness**'

Characteristics	Indicators	Very important	Important	Neither	Not important	Absolutely not important	Don't know
1. Public awareness policy, programmes, and material	Existence of city specific awareness campaign strategies in seismic risk.						
2. Dissemination and use of traditional/indigenous knowledge through media involvement in communicating seismic risk	1. Availability and accessibility of information (handbook, poster, newspaper, exhibition, talks show, etc) in introducing seismic features of buildings with simple technical approaches and understandable to the laypersons, including the existing of model houses with seismic features, low-cost, and simple in neighboring areas						
	2. Existence of tradesman involvement in producing and circulating the seismic features information						
	3. Existence of mechanisms to monitor the increasing number of aware and informed community, students and teachers, key government functionaries, masons and engineering institutions, policy makers etc.						
	4. Existence of community-based informal meeting discussing good practices in seismic features of buildings						
3. Earthquake Safety Day	Visibility of Earthquake Safety Day through: school activities, audio-visual programmes, competitions, mock drills, etc						
4. Documentation	Existence of document of appropriate cost effective retrofitting techniques and sharing of best practices, conference proceedings and articles in popular magazines						
……………………………………………*)	…………………………………						

*) Please write additional statement if necessary

Table C.8: Characteristics and indicators to '**research**'

Characteristics	Indicators	Very important	Important	Neither	Not important	Absolutely not important	Don't know
1. Cost-effectiveness research in application of seismic features	Existence of cost-effectiveness research in application of seismic features both for new and existing buildings (retrofitting)						
2. Interdisciplinary research between science and policy	Existence of reducing seismic risk through Interdisciplinary research between science and policy (evidence-based policy) comprehensively						
3. Evaluations and feedback	Indicators, standards and methodologies established for seismic hazard analysis and assessment, unique to their local needs						
4. Local, National, and International co-operation in research, science and technology development	1. Providing technical support, training, and periodic assessments on earthquake vulnerability through the research/knowledge at all community levels.						
	2. Existence of local academic institutions as Key Resource Institutions for earthquake risk management.						
	3. Existence of Local, National, and International exchange						
....*)	....						

*) Please write additional statement if necessary

Table C.9: Characteristics and indicators to '**social and economic development practices**'

Characteristics	Indicators	Very important	Important	Neither	Not important	Absolutely not important	Don't know
1. Pro-poor and sustainable livelihood strategies	Existence of information that introducing seismic features in buildings are low-cost and simple (not burdensome) trough down to the grass root communities						
2. Financial instruments	1. Existence of incentive strategy for new buildings with seismic features						
	2. Existence of earthquake insurance initiatives						
....*)	....						

*) Please write additional statement if necessary

Table C.10: Characteristics and indicators to '**physical measures**'

Characteristics	Indicators	Very important	Important	Neither	Not important	Absolutely not important	Don't know
1. Land use applications	Existence of seismic risk map using Geographical Information System (GIS)						
2. Introducing seismic codes in new and existing buildings	Compliance of public and private buildings with seismic codes and standards						
3. Good examples in real constructions	1. Existence of retrofitting program for public buildings (health facilities, schools, lifelines, etc) at high seismic area						
	2. Existence of regular maintenance of seismic features in structures						
	3. Existence of the number of model houses with seismic features, low-cost, and simple as well as ready to replicate in other areas						
………………………………………………*)	………………………………						

*) Please write additional statement if necessary

Appendix-3:

Copy of some questionnaire circulation permits from organisations and/or agencies

PEMERINTAH PROPINSI DAERAH ISTIMEWA YOGYAKARTA

DINAS PERMUKIMAN DAN PRASARANA WILAYAH

(DISKIMPRASWIL)

JALAN BUMIJO NOMOR : 5 TELEPON. 565260, 514178, 589091

YOGYAKARTA

SURAT KETERANGAN

No: ...814.2/101/C.........

Menunjuk Surat dari Sdr. Setya Winarno tanggal 17 Nopember 2005 tentang permohonan ijin penelitian, bersama ini dapat diberikan ijin untuk melakukan penelitian kepada

Nama	: Setya Winarno
Pekerjaan	: Dosen Tetap Jur. Teknik Sipil FTSP UII Yogyakarta
Pendidikan	: Sedang studi lanjut Ph.D. (S-3) di Sheffield Hallam University, England

sebagai bagian dari penelitian Program Ph.D. di England, dengan judul: **Seismic Risk Management of Non-Engineered Buildings.**

Untuk itu kepada staf–staf teknik di lingkungan Bidang Cipta Karya, Diskimpraswil Propinsi DIY dan para kontraktor bangunan gedung (mitra kerja Bidang Cipta Karya, Diskimpraswil Propinsi DIY) untuk dapat ikut berpartisipasi dalam pengisian kuesioner dalam penelitian tersebut.

Demikian Surat Keterangan ini dibuat untuk dapat digunakan sebagaimana mestinya.

Yogyakarta, Desember 2005

An. Kepala

Kepala Bidang Cipta Karya

PEMERINTAH PROPINSI DAERAH ISTIMEWA YOGYAKARTA DISKIMPRASWIL

Ir. M. Nasir Basuki, MM

NIP. 110 020 171

Tembusan kepada Yth :

1. Bpk. Ka Dinas Kimpraswil Prop. DIY
   (sebagai laporan)
2. A r s i p .

PEMERINTAH PROPINSI DAERAH ISTIMEWA YOGYAKARTA

SATUAN KOORDINASI PELAKSANA PENANGGULANGAN BENCANA DAN PENANGANAN PENGUNGSI

(SATKORLAK PBP)

Komplek Kepatihan Danurejan Telepon (0274) 563231 , 562811 psw.230 Fax. (0274) 519441

Y O G Y A K A R T A - 55213

SURAT KETERANGAN

Nomor : 360.2/307 A/SATKORLAK PBP/XI/2005

Bersama surat ini kami, Sekretaris Pelaksana Harian SATKORLAK PBP Propinsi DIY **mendukung dan memberikan ijin** kepada :

Nama	:	Setyo Winarno
Pekerjaan	:	Dosen Tetap Jurusan Teknik Sipil FTSP UII Yogyakarta
Pendidikan	:	Sedang studi lanjut Ph.D. (S-3) di Sheffield Hallam University, England.

untuk melakukan **penelitian**, sebagai bagian dari penelitian Program Ph.D di England, dengan judul :

Seismic Risk Management of Non-Engineered Buildings.

(Kajian Faktor-faktor Kritis Dalam Penerapan Fitur-fitur Rumah/Gedung Tahan Gempa)

Untuk itu, perkenankanlah kami mohon kepada Bapak/Ibu/Sdr Kepala Dinas/Instansi terkait SATKORLAK PBP Propinsi DIY dan SATLAK PBP se Propinsi DIY **untuk dapat ikut berpartisipasi dalam pengisian kuesioner dalam penelitian tersebut**.

Demikian Surat Keterangan ini dibuat untuk dapat dipergunakan sebagaimana mestinya.

Yogyakarta, Nopember 2005

Kepala Dinas Ketentraman dan Ketertiban Umum Propinsi DIY
Selaku
Sekretaris Pelaksana Harian SATKORLAK PBP

SATUAN KOORDINASI PENANGGULANGAN BENCANA SATKORLAK PBP PROPINSI D.I. YOGYAKARTA

DRS. H. SO'IM, MM
NIP : 010105316

PEMERINTAH PROPINSI DAERAH ISTIMEWA YOGYAKARTA
BADAN INFORMASI DAERAH
(BID)
Jl. Brigjen Katamso, Komplek THR, Telp. (0274) 373444, 562811 pes 189, 520424
Fax. (0274)374022, e-mail: bid@pemda-diy.go.id; SMS: 081328444382
YOGYAKARTA
Kode Pos 55152

Nomor : 070./984.
Lamp. : 1 (satu) berkas
Hal : Penelitian

Yogyakarta, 28 Nopember 2005

Kepada
Yth. Sdr. Wartawan Unit Pemprop
Di Kepatihan Danurejan
Yogyakarta

Dengan hormat,

Bersama ini kami beritahukan bahwa berdasarkan permohonan dari:
Nama : Setya Winarno
Pekerjaan : Dosen Tetap Jurusan Teknik Sipil FTSP UII Yogyakarta
Mahasiswa : Program S-3 Sheffield Hallam University England
Judul Penelitian: Seismic Management of Non Engineered Buildings
tanggal 17 Nopember 2005, Badan Informasi Daerah mempersilakan kepada Sdr. tersebut di atas untuk melakukan penelitian dengan responden Wartawan Unit Pemerintah Propinsi Daerah Istimewa Yogyakarta, sesuai dengan izin yang dikeluarkan Pemerintah Propinsi Cq. Badan Perencanaan Daerah.

Sehubungan dengan hal tersebut, maka mohon bantuan kepada Rekan-rekan Wartawan untuk mengisi kuesener yang diberikan Sdr. Setya Winarno, serta memberikan jawaban / keterangan yang dibutuhkan.

Demikianlah pemberitahuan ini, atas kerja samanya diucapkan terima kasih.

A.n. Kepala,
Sekretaris

PEMERINTAH PROPINSI ★ DAERAH ISTIMEWA YOGYAKARTA
BID

Martan Kiswoto
NIP. 050049356

PEMERINTAH KOTA YOGYAKARTA
DINAS PENDIDIKAN DAN PENGAJARAN
Jalan Hayam Wuruk 11, Telepon (0274) 512956, 563078, Fax. (0274) 512956
E-mail : pendidikan@jogja.go.id
YOGYAKARTA
KODE POS 55212

Yogyakarta, 24 Nopember 2005

Nomor : 070 / 3886
Lamp. : -
H a l : Rekomendasi

Kepada
Yth. Kepala SD. SMP, SMA Negeri/Swasta
dilingkungan Dinas Pendidikan dan Pengajaran
Kota Yogyakarta.

Menunjuk surat dari Badan Perencanaan Daerah Propinsi DIY Nomor : 070/6042 tanggal 19 Nopember 2005 dan surat dari Sdr. Setyo Winarno tanggal 17 Nopember 2005 perihal permohonan surat persetujuan untuk penelitian sebagai berikut :

N a m a	: Setyo Winarno
N I M	: 14030496
Pekerjaan	: Dosen Tetap Jur. Teknik Sipil FTSP UII
Mahasiswa	: Program S-3 di Sheffield Hallam University, England
Alamat	: Jl. Kaliurang Km 14.5 Yogyakarta
Keperluan	: Mengadakan Penelitian dengan judul "Seismic Risk Management Of Non-Engineered Buidings" dan penyebaran Kuesioner ke SD, SMP, SMA Negeri Swasta Kota Yogyakarta.
Lokasi	: SD, SMP, SMA Negeri Swasta Kota Yogyakarta
Waktu	: Mulai tanggal 19 Nopember 2005 s.d. 19 Februari 2006

Berkaitan dengan hal tersebut diatas kami mohon kepada Saudara untuk menerima mahasiswa dimaksud mengadakan penelitian dan penyebaran kuesioner di sekolah binaan Saudara.

Demikian rekomendasi ini diberikan agar dipergunakan sebagaimana mestina, atas perhatian serta bantuan saudara kami ucapkan terima kasih.

PEMERINTAH KOTA YOGYAKARTA
DINAS PENDIDIKAN DAN PENGAJARAN

an. Kepala
Kabag. Tata Usaha

SRI MARWINING DJATI
NIP 4900247[illegible]

PEMERINTAH KOTA YOGYAKARTA
BADAN PERENCANAAN PEMBANGUNAN DAERAH

Komplek Balaikota Jalan Kenari No. 56 Telepon 515207, 515865/515866 Psw. 153, 154

SURAT KETERANGAN / IJIN

070/2033

Membaca Surat : Dari Rektor - UII Yogyakarta

Nomor : 1817/Rek/20/BPSDM/IX/20(Tanggal : 28/09/2005

Mengingat : 1. Keputusan Walikotamadya Kepala Daerah Tingkat II Yogyakarta Nomor 072/KD/1986 tanggal 6 Mei 1986 tentang Petunjuk Pelaksanaan Keputusan Kepala Daerah Istimewa Yogyakarta, Nomor : 33/KPT/1986 tentang : Tatalaksana Pemberian izin bagi setiap Instansi Pemerintah maupun non Pemerintah yang melakukkan Pendataan / Penelitian

2. Keputusan Gubernur Daerah Istimewa Yogyakarta Nomor : 38/I.2/2004 Tentang : Pemberian izin / Rekomendasi Penelitian/Pendataan/Survei/KKN /PKL di Daerah Istimewa Yogyakarta

Diijinkan Kepada
Nama : SETYA WINARNO NO MHS / NIM :
Pekerjaan : Dosen FTSP - UII Yogyakarta
Alamat : Jl. Kaliurang KM.14,5 Yogyakarta
Penanggungjawab : Prof.Dr. Alan Griffith
Keperluan : Melakukan penelitian dengan judul : KAJIAN ESTIMASI KERUSAKAN RUMAH DAN GEDUNG AKIBAT SKENARIO GEMPA DI KOTA YOGYAKARTA

Lokasi/Responden : Kota Yogyakarta
Waktu : 08/10/2005 Sampai 08/01/2006
Lampiran : Proposal dan Daftar Pertanyaan
Dengan Ketentuan : 1. Wajib Memberi Laporan hasil Penelitian kepada Walikota Yogyakarta (Cq. Badan Perencanaan Pembangunan Daerah Kota Yogyakarta)

2. Wajib Menjaga Tata tertib dan mentaatai ketentuan-ketentuan yang berlaku setempat
3. Ijin ini tidak dislahgunakan untuk tujuan tertentu yang dapat mengganggu kesetabilan Pemerintah dan hanya diperlukan untuk keperluan ilmiah
4. Surat ijin ini sewaktu-waktu dapat dibatalkan apabila tidak dipenuhinya ketentuan -ketentuan tersebut diatas

Kemudian diharap para Pejabat Pemerintah Setempat dapat memberi bantuan seperlunya

Dikeluarkan di : Yogyakrta
Pada Tanggal : 08/10/2005

A.n. Walikota Yogyakarta
Kepala Bappeda
Ub. Ka. Bid Data, Penelitian & KAD

Dra. Wodiarni PR.
NIP. 490027328

Tandatangan
Pemegang Izin

SETYA WINARNO

Tembusan Kepada Yth. :
1. Walikota Yogyakarta
2. Ka. BAPEDA Prop. DIY
3. Ka. Kantor Kesbang dan Linmas Kota Yogyakarta
4. Ka. DTKB Kota Yogyakarta
5. Camat se- Kota Yogyakarta (14)
6. Ka. BPS Kota Yogyakarta
7. Rektor - UII Yogyakarta
8. Arsip.

PEMERINTAH PROPINSI DAERAH ISTIMEWA YOGYAKARTA
DINAS SOSIAL
Jl. Janti, Banguntapan Telepon / Fax (0274) 514932, 563510
YOGYAKARTA

SURAT PENGANTAR
Nomor : 070/6081/II.2

Bersama surat ini kami, Dinas Sosial Propinsi Daerah Istimewa Yogyakarta mendukung dan memberikan ijin kepada :

N a m a	:	Setyo Winarno
Pekerjaan	:	Dosen tetap jur. Teknik Sipil UII Yogyakarta
Pendidikan	:	Sedang studi lanjut Ph.D (S.3) di Sheffeld Universitas, England

Untuk melakukan penelitian, sebagai bagian dari penelitian Program Ph.D. di England, dengan judul :

Seismic Risk Management of Non – Engineered Buildings.

Untuk itu, perkenankanlah kami mohon kepada pihak – pihak yang berkaitan dengan Lembaga Swadaya Masyarakat dan Kelompok – kelompok Masyarakat yang telah mendapat ijin operasional sebagai lembaga Organisasi Sosial yang menangani UKS di lingkungan Propinsi Daerah Istimewa Yogyakarta untuk dapat ikut berpartisipasi dalam pengisian kuesioner dalam penelitian tersebut.

Demikian surat keterangan ini dibuat untuk dapat digunakan sebagaimana mestinya.

Yogyakarta, 8 Desember 2005

Kepala

PEMERINTAH PROPINSI DINAS SOSIAL DAERAH ISTIMEWA YOGYAKARTA

Drs. A. Riswanto
NIP. 170 009 719

Ms. Word.Ijin PSAA

CEEDEDS
UNIVERSITAS ISLAM INDONESIA

UNIVERSITAS ISLAM INDONESIA
CEEDEDS
(Center for Earthquake Engineering, Dynamic Effect, and Disaster Studies)
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SURAT KETERANGAN
No: 02 / A / CEEDEDS / XII / 2005

Menunjuk surat permohonan dari Sdr Setya Winarno tertanggal 3 Desember 2005, bersama surat ini kami, Direktur CEEDEDS **mendukung dan memberikan ijin** kepada

Nama : Setya Winarno
Pekerjaan : Dosen Tetap Jur. Teknik Sipil FTSP UII Yogyakarta
Pendidikan : Sedang studi lanjut Ph.D. (S-3) di Sheffield Hallam University, England

untuk melakukan **penelitian**, sebagai bagian dari penelitian Program Ph.D. di England, dengan judul:

Seismic Risk Management of Non-Engineered Buildings.

Untuk itu, perkenankanlah kami mohon kepada Bapak/Sdr Mandor-Mandor Bangunan di lingkungan DIY dan sekitarnya (yang pernah berpartisipasi di kegiatan CEEDEDS) **untuk dapat ikut berpartisipasi dalam pengisian kuesioner** dalam penelitian tersebut.

Demikian Surat Keterangan ini dibuat untuk dapat digunakan sebagaimana mestinya.

Yogyakarta, 6 Desember 2005
Direktur CEEDEDS UII
Yogyakarta

CEEDEDS UII

(Ir. H. Sarwidi, MSCE. Ph.D., IPU)

PERSATUAN PERUSAHAAN **REAL ESTAT INDONESIA**
DPD PROPINSI DAERAH ISTIMEWA YOGYAKARTA

Nomor : 068/REI/DIY/XI/2005
Lamp. : ! (satu) Bendel
Perihal : Permohonan Partisipasi dalam Penelitian

Kepada Yth.
Segenap Anggota
DPD REI Prop. D.I.Yogyakarta
di Yogyakarta

Dengan hormat,

Memperhatikan surat dari UII Yogyakarta, 2028/Rek/20/BPSDM/XI/2005/, perihal permohonan ***permohonan partisipasi dalam penelitian*** dengan judul ***Seismic Risk Management of Non – Engineered Buildings*** penelitian ini bertujuan untuk membuat kerangka kerja yang berguna bagi pihak pemerintah,swasta, dan seluruh komponen masyarakat yang lain dalam rangka untuk mengurangi resiko gempa secara komprehensif akibat kerutuhan rumah/gedung non-teknis (non-engineered buildings) dengan pendekatan " risk management".

Maka Bersama ini DPD Persatuan Perusahaan Realestat Indonesia (REI) Propinsi Daerah Istimewa Yogyakarta mengharapkan kepada segenap anggota untuk dapat membantu memberikan informasi berkaitan dengan hal tersebut, kepada :

Nama	: Setya Winarno
Pekerjaan	: Dosen Tetap Jur.Tenik Sipil FTSP UII Yogyakarta
Pendidikan	: Sedang studi lanjut Ph.D (S-3) di Sheffield Hallam University, England

Salah satu metode pengumpulan data yang akan ditempuh adalah menggunakan metode kuesioner yang akan sisebarkan kepada anggota DPD REI DIY.

Demikian Surat Keterangan ini, untuk dapat digunakan sebagaimana perlunya, atas perhatian dan kerjasamanya kami ucapkan terima kasih.

Yogyakarta, 24 November 2005
DPD REI Prop. D.I.Yogyakarta

Ir. Henny Leksmana
Ketua

REALESTAT INDONESIA

Ir. Remigius Edy Waluyo
Sekretaris

JL. TIMOHO II NO. 28 MUJA-MUJU YOGYAKARTA 55165 TELP. (0274) 514181, 542867, 542868 FAX. (0274) 542868

PERSATUAN WARTAWAN INDONESIA
Pengurus Cabang Yogyakarta
Yogyakarta Branch Executive Board
INDONESIAN JOURNALISTS ASSOCIATION

ALAMAT : JALAN GAMBIRAN 45 YOGYAKARTA 55161 TELP. (0274) 380266

SURAT KETERANGAN

Nomor : 316/PWI-Yk/Sk/XI/2005

Pengurus PWI Cabang Yogyakarta menerangkan, bahwa :

Nama	**: SETYA WINARNO**
Pekerjaan	**: Dosen Tetap di Jurusan Teknik Sipil FTSP Universitas Islam Indonesia Di Yogyakarta**
Pendidikan	**: Sedang studi lanjut Ph.D (S3) di Sheffield Hallam University, England**

mengadakan penelitian sebagai bagian dari penelitian Program Ph.D di England, dengan judul :
'Seismic Risk Management of Non-Engineered Buildings'

Peneliti akan meminta masukan dan peran serta secara teknis dan non-teknis kepada berbagai pihak, termasuk wartawan.

PWI Cabang Yogyakarta memohon bantuan para wartawan di Yogyakarta dan sekitarnya, dapat ikut berpartisipasi dalam pengisian kuesioner dalam penelitian tersebut.

Surat Keterangan ini dibuat untuk bisa dipergunakan sebagaimana mestinya.

Yogyakarta, 25 November 2005

Pengurus PWI Cabang Yogyakarta

Drs Octo Lampito	**Rakiman Sh BA**
Ketua	**Sekretaris**

UNIVERSITAS ISLAM INDONESIA

Kampus Universitas Islam Indonesia, Gedung Rektorat, Jl. Kaliurang Km. 14,5, Yogyakarta 55584
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Nomor : 2028/Rek/20/BPSDM/XI/2005
Lamp. : 1 (satu) bendel
H a l : *Permohonan partisipasi dalam Penelitian*

Kepada Yth.
....
....
....

Assalamu'alaikum w.w.

Bersama surat ini, Rektor Universitas Islam Indonesia (UII) Yogyakarta menerangkan bahwa salah seorang Dosen Tetap Jurusan Teknik Sipil a.n. Setya Winarno sedang menempuh studi lanjut S-3 di Sheffield Hallam University. Saat ini yang bersangkutan sedang melaksanakan penelitian S-3 dengan judul: **Seismic Risk Management of Non-Engineered Buildings.**

Penelitian ini bertujuan untuk membuat sebuah kerangka kerja yang berguna bagi pihak pemerintah, swasta dan seluruh komponen masyarakat yang lain dalam rangka untuk mengurangi risiko gempa secara komprehensif akibat keruntuhan rumah/gedung non-teknis (*non-engineered buildings)*, dengan pendekatan "*risk management*". Pengumpulan data yang akan ditempuh adalah menggunakan metode kuesioner, wawancara terseleksi, dan workshop.

Untuk itu, perkenankanlah kami mohon kepada Bapak/Ibu untuk dapat berpartisipasi dalam pengumpulan data tersebut, baik melalui pengisian kuesioner, kesediaan untuk wawancara, dan/atau hadir di acara workshop.

Demikian atas kerjasamanya diucapkan terima kasih.

Wassalamu'alaikum w.w.

Yogyakarta, 12 November 2005
Rektor,

Dr. Ir. Luthfi Hasan, MS

Appendix-4:

Raw data of questionnaire survey

Table 1 Raw Data of Researchers/Scientists' Opinion to Seismic Risk Management Statements

Respondent Number	Statement Number 1	Statement Number 2	Statement Number 3	Statement Number 4	Statement Number 5	Statement Number 6	Statement Number 7	Statement Number 8	Statement Number 9	Statement Number 10	Statement Number 11	Statement Number 12	Statement Number 13	Statement Number 14	Statement Number 15	Statement Number 16	Statement Number 17	Statement Number 18	Statement Number 19	Statement Number 20
1	5	5	5	5	5	5	5	5	5	4	4	4	4	4	4	4	4	4	4	4
2	5	4	4	4	5	4	4	4	4	5	5	5	5	5	5	4	4	4	4	3
3	5	5	5	5	3	4	4	3	4	4	4	4	4	4	4	3	4	4	3	3
4	5	4	4	5	4	3	5	5	4	5	5	4	4	4	2	3	5	5	3	3
5	5	4	4	4	0	4	5	5	4	5	5	5	4	4	4	4	5	4	4	3
6	5	0	0	5	5	5	5	5	5	5	5	5	5	5	5	5	4	5	3	3
7	4	4	0	4	4	4	4	4	4	5	4	4	4	4	4	4	4	4	4	4
8	5	4	4	4	5	4	2	4	4	5	3	4	4	5	4	4	3	3	4	4
9	5	5	5	5	5	5	5	5	5	5	5	5	5	0	4	4	4	4	4	4
10	5	4	4	3	4	4	4	3	3	5	4	4	4	4	3	3	3	3	4	3
11	5	4	4	4	4	4	3	4	4	5	4	4	4	4	4	4	4	4	4	4
12	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	3
13	5	5	5	5	0	5	4	4	5	4	5	4	4	5	4	3	4	3	4	2
14	5	5	4	5	4	4	4	4	4	4	4	4	2	4	4	2	4	4	4	4
15	5	5	5	4	4	4	5	4	4	4	4	4	4	4	4	4	4	4	4	4
16	5	5	5	5	5	5	4	4	4	5	4	5	5	5	5	4	4	4	4	4
17	5	4	4	5	4	4	5	4	4	5	5	5	5	4	5	5	5	5	5	5
18	5	4	4	4	4	4	5	5	5	5	5	5	5	4	4	3	4	4	4	4
19	5	4	4	5	4	4	5	4	5	4	4	4	4	4	3	3	5	4	3	4
20	5	5	4	5	4	4	4	4	4	5	4	4	4	4	4	5	3	3	3	3
21	4	4	5	4	3	4	3	3	4	4	4	4	3	4	4	3	4	3	4	3
22	5	5	5	4	4	4	4	4	4	4	3	3	3	3	4	2	4	4	4	4
23	5	0	0	5	4	5	5	4	4	4	4	4	4	4	4	4	3	2	4	3
24	5	5	5	5	5	5	5	5	5	5	5	5	4	5	5	5	5	5	5	5
25	5	4	5	4	3	4	5	5	4	5	5	5	3	4	5	4	5	4	4	4
26	5	4	4	5	5	4	2	4	4	5	3	4	4	5	4	4	3	3	4	4
27	5	4	4	3	5	4	4	3	3	5	4	4	4	4	3	3	3	3	4	3
28	5	5	4	5	4	4	4	4	4	5	4	4	2	4	4	2	4	4	4	4
29	5	4	4	5	4	4	4	4	4	5	5	4	5	4	5	5	5	5	4	5
30	5	4	4	5	4	4	5	4	5	4	4	4	5	4	3	3	5	4	3	4
31	5	5	5	5	4	4	5	5	5	5	5	5	4	5	5	5	5	5	5	5
Average to each statement*	4.903	4.414	4.393	4.516	4.207	4.194	4.258	4.161	4.226	4.645	4.290	4.290	4.032	4.233	4.065	3.710	4.097	3.903	3.903	3.710
Ranks	1	7	8	3	22	26	17	31	20.5	2	14.5	14.5	41	19	38.5	53	36	47	47	53

Respondent Number	Statement Number 21	Statement Number 22	Statement Number 23	Statement Number 24	Statement Number 25	Statement Number 26	Statement Number 27	Statement Number 28	Statement Number 29	Statement Number 30	Statement Number 31	Statement Number 32	Statement Number 33	Statement Number 34	Statement Number 35	Statement Number 36	Statement Number 37	Statement Number 38	Statement Number 39	Statement Number 40
1	4	3	5	3	4	4	4	4	4	4	4	5	5	5	5	5	4	4	4	4
2	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
3	5	4	4	4	3	4	0	4	4	4	4	5	4	3	4	3	3	4	3	3
4	5	5	5	5	4	4	4	4	4	4	4	5	5	4	4	4	4	4	4	4
5	4	5	4	5	4	4	5	4	4	3	5	5	5	4	4	4	4	4	4	4
6	3	5	5	5	3	5	5	5	5	5	5	5	5	4	4	4	5	5	5	5
7	3	4	5	4	4	4	4	4	4	4	4	4	3	3	4	4	4	4	4	4
8	4	4	4	3	4	5	5	4	3	4	4	5	5	4	4	4	5	5	4	4
9	5	4	4	4	4	5	4	4	4	4	4	5	4	4	4	4	5	4	3	4
10	4	4	4	4	4	4	4	4	4	3	4	4	4	3	3	3	4	5	3	4
11	5	4	4	4	5	5	5	4	4	4	4	4	4	4	4	4	4	4	4	4
12	3	3	4	4	4	4	4	4	4	4	4	3	4	4	4	4	4	4	4	4
13	4	5	4	4	4	5	5	4	5	3	4	4	3	4	4	4	4	4	4	4
14	5	4	4	4	4	4	4	5	4	3	4	4	3	4	4	3	4	4	3	4
15	5	4	4	5	3	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
16	5	5	5	5	5	5	5	4	4	4	4	4	4	4	4	4	4	4	4	4
17	5	4	5	5	4	4	5	5	5	5	4	5	5	4	5	5	5	5	5	5
18	3	3	5	5	5	5	5	5	5	3	5	5	5	4	4	3	5	5	5	4
19	4	4	4	4	3	5	5	4	4	3	3	4	3	3	5	4	5	4	4	4
20	3	4	5	5	3	2	4	3	3	3	2	4	4	4	3	3	4	3	3	4
21	4	4	4	3	4	4	4	5	4	3	4	4	4	3	3	4	3	4	4	3
22	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	5	5	5
23	4	4	4	4	4	4	4	5	4	3	4	4	4	4	3	3	4	4	4	4
24	5	5	5	5	5	5	5	5	5	5	5	5	5	4	5	5	5	5	4	5
25	5	5	5	5	5	5	5	5	5	5	5	5	5	3	4	5	3	5	3	5
26	4	4	4	3	4	5	5	4	3	4	4	5	5	4	4	5	5	5	4	4
27	4	4	4	4	4	5	4	4	4	3	4	4	4	3	3	3	4	5	3	4
28	5	4	4	4	4	4	4	5	4	3	4	4	3	4	4	3	4	5	3	4
29	5	4	5	5	4	4	5	5	5	5	4	5	5	4	5	5	5	5	5	5
30	4	4	5	4	3	5	5	4	4	3	3	4	3	3	5	4	5	4	4	5
31	4	4	5	5	5	5	5	5	5	5	5	5	5	4	5	5	5	5	4	5
Average to each statement*	4.226	4.129	4.419	4.258	4.000	4.387	4.355	4.323	4.161	3.806	4.065	4.419	4.194	3.774	4.065	3.968	4.258	4.387	3.903	4.194
Ranks	20.5	34.5	5.5	17	42.5	9.5	11.5	13	31	49	38.5	5.5	26	50.5	38.5	44.5	17	9.5	47	26

Respondent Number	Statement Number 41	Statement Number 42	Statement Number 43	Statement Number 44	Statement Number 45	Statement Number 46	Statement Number 47	Statement Number 48	Statement Number 49	Statement Number 50	Statement Number 51	Statement Number 52	Statement Number 53	Statement Number 54	Statement Number 55	Statement Number 56	Statement Number 57
1	4	4	4	5	5	5	5	5	5	5	5	3	4	4	4	4	4
2	4	4	5	5	5	5	5	5	5	4	4	4	5	4	4	4	4
3	3	3	4	4	4	4	4	5	4	4	3	3	4	4	4	3	4
4	4	3	3	4	4	3	4	4	4	4	2	2	5	5	3	3	3
5	4	3	4	5	5	4	4	4	4	5	4	4	5	4	4	4	4
6	5	4	5	4	4	4	5	4	4	5	5	5	4	5	5	5	5
7	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
8	5	4	4	3	3	3	5	5	4	4	5	2	4	4	4	4	4
9	4	5	4	5	5	4	4	4	4	5	4	0	5	4	4	4	4
10	3	3	4	4	3	2	3	4	5	4	2	3	4	4	4	3	4
11	4	4	4	4	4	4	4	4	4	5	5	4	4	4	4	4	4
12	3	4	4	4	4	4	4	4	4	4	3	3	4	4	4	4	4
13	5	3	5	3	4	4	4	3	2	5	2	4	4	2	5	3	5
14	3	2	4	4	4	4	3	3	3	4	2	3	5	3	4	3	4
15	4	4	4	4	4	4	4	4	4	5	3	3	4	4	4	4	4
16	4	4	4	4	4	4	5	5	5	4	4	3	5	4	5	4	4
17	4	4	5	4	4	4	5	5	5	5	4	5	5	5	5	5	4
18	4	3	5	5	3	4	4	5	5	5	2	1	5	5	4	4	5
19	4	4	4	3	3	3	4	4	3	5	4	4	3	4	4	4	5
20	4	1	3	4	3	3	3	3	3	4	4	4	4	5	4	4	4
21	4	3	4	4	4	3	4	4	5	4	4	5	4	4	4	5	4
22	5	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
23	3	3	3	3	3	3	4	2	4	4	2	1	4	4	4	4	4
24	5	5	5	5	2	5	5	5	5	5	2	5	5	5	5	5	5
25	4	4	5	5	4	5	4	4	4	4	2	4	5	0	4	4	4
26	5	4	4	3	3	3	5	5	4	4	5	2	4	4	4	4	4
27	3	3	4	4	3	2	4	4	5	4	2	3	4	4	4	3	4
28	3	2	4	4	4	4	3	3	3	4	2	3	5	3	4	3	4
29	4	4	5	4	4	4	5	5	5	5	4	5	5	5	5	5	4
30	4	4	4	3	3	3	4	4	3	5	4	4	3	4	4	4	5
31	5	5	5	5	2	5	5	5	5	5	2	5	5	5	5	5	5
Average to each statement*	4.000	3.581	4.194	4.065	3.710	3.774	4.194	4.161	4.129	4.452	3.355	3.500	4.355	4.133	4.194	3.968	4.194
Ranks	42.5	55	26	38.5	53	50.5	26	31	34.5	4	57	56	11.5	33	26	44.5	26

Note: 1. The statement numbers correspond to the order of the questionnaire
2. Respondents were asked to rate 57seismic risk management statements they consider important to be carried out in Indonesian cities located in high seismic hazard(5=v.important;4=important;3=nor;2=not important;1=absolutely not important;0=don't know)
3. 0.62% of responses stated '0' (don't know)

*) The mean score of all statements is 4.132 (between important and very important)

Table 2 Raw Data of Small-Medium Contractors' Opinion to Seismic Risk Management Statements

Respondent Number	Statement Number 1	Statement Number 2	Statement Number 3	Statement Number 4	Statement Number 5	Statement Number 6	Statement Number 7	Statement Number 8	Statement Number 9	Statement Number 10	Statement Number 11	Statement Number 12	Statement Number 13	Statement Number 14	Statement Number 15	Statement Number 16	Statement Number 17	Statement Number 18	Statement Number 19	Statement Number 20	Statement Number 21	Statement Number 22	Statement Number 23	Statement Number 24	Statement Number 25	Statement Number 26	Statement Number 27	Statement Number 28	Statement Number 29
1	4	4	4	4	4	4	4	4	4	4	4	3	3	3	5	4	4	3	4	4	4	4	4	4	4	4	4	4	4
2	5	5	5	5	5	5	O	O	O	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
3	5	5	5	4	3	3	4	3	3	5	4	4	4	4	4	2	4	4	3	3	4	3	4	5	3	4	5	4	4
4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	4	4	4	4	5	4	5	5	5	5	4	4	4	5	4
5	5	5	5	5	5	5	5	5	5	5	5	4	5	5	4	4	4	4	5	4	5	5	5	5	4	4	4	5	5
6	5	4	4	4	4	5	4	5	4	4	5	5	4	4	4	4	4	4	3	4	3	4	O	4	4	4	4	3	4
7	5	4	4	4	4	4	4	4	4	5	5	5	5	5	5	2	4	4	3	3	4	4	5	4	4	4	4	4	4
8	4	4	4	5	4	5	4	4	4	5	4	5	5	5	5	2	4	4	3	4	5	5	5	4	3	4	5	4	4
9	4	3	3	3	3	3	4	4	3	4	4	4	3	4	2	2	2	2	3	4	5	5	4	4	4	4	3	3	4
10	5	4	4	4	3	3	4	4	4	4	4	4	4	4	4	4	3	3	4	3	4	3	4	3	4	3	3	3	4
11	4	4	4	4	4	4	4	3	3	5	4	5	4	5	4	4	2	3	3	2	4	3	4	3	3	4	4	3	4
12	3	4	4	5	4	3	3	4	3	4	5	5	3	4	3	4	4	3	5	3	3	3	5	4	4	4	5	4	3
13	4	4	5	4	4	3	5	4	5	5	3	5	4	2	2	3	2	3	4	2	3	3	4	4	5	5	4	4	4
14	5	5	4	5	5	5	4	5	4	5	4	5	5	5	4	5	4	4	4	4	5	5	4	4	5	5	5	4	5
15	5	O	4	3	3	5	3	3	3	4	3	4	4	4	3	3	4	4	3	3	3	3	3	3	5	4	3	4	4
16	5	4	4	5	5	4	5	5	5	5	4	5	5	5	5	4	5	5	4	4	5	5	5	5	5	5	4	4	5
17	5	5	5	5	5	5	4	5	4	5	5	5	4	5	4	4	4	5	5	4	5	5	5	5	5	5	5	5	5
18	3	3	3	3	3	2	4	4	3	4	3	5	4	5	4	4	2	2	2	2	3	3	3	3	2	3	3	4	3
19	5	5	5	5	3	5	4	3	3	5	5	5	3	5	5	3	5	5	5	5	4	4	4	4	4	4	4	4	4
20	5	5	5	5	3	4	4	5	5	3	2	5	4	4	4	5	4	5	4	2	5	5	5	2	3	5	4	5	5
21	5	5	5	5	5	5	5	5	5	5	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
22	5	5	5	5	5	5	5	5	5	5	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
23	5	5	5	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	2	2	5	5	5	5	5	5	5	5	5
24	4	3	3	3	3	3	4	4	3	4	4	4	4	4	4	3	4	3	3	3	3	3	3	3	3	4	3	3	3
25	5	4	4	4	4	3	5	4	3	5	4	4	4	5	4	3	4	4	3	4	3	3	4	4	4	4	5	4	4
26	5	5	5	5	4	4	5	5	5	5	4	3	4	4	5	3	5	4	5	4	4	3	5	5	5	5	5	5	5
27	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	5	5	4	4	4	5	4	5	4	5	5	5	5	5
28	5	5	5	5	5	5	4	4	3	5	4	5	5	5	5	4	5	4	3	3	4	4	4	4	5	5	5	5	5
29	5	5	5	4	4	4	4	4	3	5	4	5	4	4	5	3	5	5	4	3	4	5	5	4	4	5	5	5	4
30	4	4	4	4	4	4	5	5	4	3	3	3	3	4	4	4	4	3	3	3	3	3	3	3	4	4	4	3	3
31	5	4	4	4	4	5	4	4	4	5	4	4	4	4	5	4	4	5	4	2	4	4	4	4	5	5	4	4	4
32	5	4	4	4	5	4	4	4	4	5	4	5	2	4	5	4	4	4	3	3	2	4	4	4	5	5	4	4	4
33	5	4	5	4	4	4	4	5	4	4	4	5	4	4	5	4	4	4	4	4	5	4	5	4	5	4	5	5	4
34	5	4	5	4	4	4	4	5	4	4	4	5	4	4	5	4	4	4	4	4	5	4	5	4	5	4	5	5	4
35	5	5	5	5	4	5	5	4	4	5	5	4	4	4	4	3	4	4	4	3	4	4	5	4	4	4	4	5	5
36	5	5	5	5	5	5	4	4	4	5	5	5	4	4	4	4	4	3	4	4	5	4	5	4	4	5	4	4	5
37	5	5	5	4	4	4	4	4	4	4	4	4	4	4	4	4	3	3	4	4	3	4	4	4	4	4	4	4	4
38	5	4	4	4	4	4	4	4	4	4	4	4	4	4	5	4	4	4	4	4	3	4	4	3	4	4	4	4	4
39	5	5	4	4	4	3	4	4	4	5	4	4	4	4	3	4	4	3	4	4	4	4	4	4	4	4	4	4	4
40	5	5	5	4	4	4	4	4	4	4	4	4	4	4	4	4	3	3	4	4	3	4	4	4	4	4	4	4	4

Respondent Number	Statement Number 30	Statement Number 31	Statement Number 32	Statement Number 33	Statement Number 34	Statement Number 35	Statement Number 36	Statement Number 37	Statement Number 38	Statement Number 39	Statement Number 40	Statement Number 41	Statement Number 42	Statement Number 43	Statement Number 44	Statement Number 45	Statement Number 46	Statement Number 47	Statement Number 48	Statement Number 49	Statement Number 50	Statement Number 51	Statement Number 52	Statement Number 53	Statement Number 54	Statement Number 55	Statement Number 56	Statement Number 57
1	4	4	4	4	4	4	4	4	4	4	4	4	3	3	4	4	4	4	4	4	5	3	3	4	4	4	4	4
2	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
3	3	5	5	5	3	3	3	4	5	4	4	4	4	3	3	3	3	3	3	3	5	3	2	3	3	5	4	4
4	5	5	5	5	5	5	4	4	5	5	5	4	4	5	5	5	5	5	5	5	5	4	2	5	5	5	5	5
5	5	5	5	5	4	5	4	4	4	4	4	4	4	4	5	5	5	5	4	5	5	2	4	5	5	5	5	5
6	3	3	4	3	4	3	3	5	3	4	4	4	5	4	4	5	4	4	5	4	5	5	2	4	4	5	5	5
7	4	4	4	4	3	4	4	3	5	5	5	5	3	5	5	3	4	4	3	4	5	4	5	5	5	5	4	4
8	4	4	5	4	4	5	4	4	5	5	5	5	4	5	5	4	4	4	3	4	5	3	5	5	5	5	5	5
9	2	4	3	4	2	2	2	3	4	4	4	2	2	4	4	3	4	3	3	3	4	3	3	4	3	4	3	3
10	3	3	4	3	3	4	3	4	4	3	4	4	3	4	4	4	3	4	3	4	4	3	3	4	4	4	3	4
11	3	4	4	2	3	4	4	3	2	3	4	4	3	3	4	4	3	4	2	3	3	3	3	4	3	5	4	4
12	3	3	4	3	4	5	2	4	4	4	3	3	O	4	4	3	4	5	3	3	4	3	3	4	4	4	4	3
13	3	4	4	4	3	3	4	4	4	5	3	4	3	4	3	4	4	3	3	4	4	2	3	4	4	5	4	3
14	5	5	4	5	4	5	4	4	5	4	4	5	5	5	5	4	4	5	4	5	5	4	3	5	4	5	4	4
15	4	4	2	2	3	5	3	3	4	4	3	4	5	3	5	3	3	5	4	5	5	2	4	5	4	5	5	5
16	4	4	5	4	5	5	4	5	5	5	5	4	4	5	5	5	5	5	5	5	5	4	4	4	5	5	4	5
17	5	5	5	4	4	5	5	5	5	5	4	4	4	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5
18	2	3	4	4	3	4	3	2	5	4	4	4	3	3	4	3	3	3	3	3	4	4	4	5	4	5	5	4
19	4	4	4	4	4	4	4	4	4	4	4	4	4	5	4	4	4	4	4	4	4	4	4	4	4	4	4	4
20	5	4	1	5	5	5	4	3	4	5	5	3	4	5	3	5	5	5	3	4	3	4	5	5	4	5	5	5
21	5	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	4	5	4	5	5	5	5	5	5	5	5	5
22	5	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	4	5	4	5	5	5	5	5	5	5	5	5
23	5	5	5	5	4	4	4	5	5	5	5	5	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
24	3	3	3	3	2	2	2	3	4	3	3	3	3	3	4	3	3	3	3	4	4	3	3	3	3	3	3	4
25	3	3	4	3	3	4	4	4	4	4	3	4	3	5	3	4	4	4	3	4	4	3	4	4	4	5	4	5
26	4	5	3	4	4	5	4	4	4	5	4	3	3	5	5	5	4	4	4	5	5	5	4	4	4	4	4	4
27	5	5	4	3	4	4	4	4	4	5	4	3	3	5	5	5	4	4	5	5	5	5	4	5	5	5	4	4
28	5	5	3	3	3	4	3	5	5	5	5	4	4	5	4	4	3	3	3	4	5	4	4	4	4	5	4	4
29	3	4	2	3	3	4	4	3	5	4	4	4	3	4	5	5	4	O	O	5	5	4	5	5	5	5	4	4
30	3	3	3	4	4	3	3	4	4	4	4	4	3	4	4	3	4	4	3	3	4	4	4	4	3	4	O	4
31	4	4	5	4	4	5	5	4	4	4	4	4	5	5	4	4	4	5	5	5	4	4	5	4	4	4	5	5
32	4	4	4	4	4	5	4	4	5	4	4	3	5	5	4	4	4	4	5	5	4	4	4	4	2	4	4	4
33	5	4	4	4	4	4	4	4	4	5	4	4	5	4	4	4	5	4	4	4	3	3	4	4	4	5	4	4
34	5	4	4	4	4	4	4	4	4	5	4	4	5	4	4	4	5	4	4	4	3	3	4	4	4	5	4	4
35	4	4	4	4	4	4	4	4	4	3	4	4	3	4	5	5	5	5	4	5	4	3	3	5	3	3	3	4
36	4	4	4	4	4	4	4	4	5	4	4	4	4	4	5	5	5	5	5	5	4	2	3	4	4	3	3	4
37	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
38	4	3	4	3	4	4	4	4	4	4	4	4	3	3	4	3	3	3	3	3	4	4	4	4	4	4	4	4
39	4	5	4	3	4	5	4	4	5	3	4	3	3	5	5	4	4	5	5	5	5	5	5	5	5	5	4	4
40	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4

Table 2 Raw Data of Small-Medium Contractors' Opinion to Seismic Risk Management Statements
(Continued)

41	5	5	O	5	5	5	5	5	5	5	5	5	5	5	5	5	4	4	4	4	4	4	4	4	5	5	5	5	5
42	5	5	5	4	4	4	4	4	4	5	5	5	5	5	5	3	4	4	4	4	4	4	4	4	4	4	4	5	5
43	5	4	4	5	5	5	4	4	4	5	4	5	5	5	5	5	4	4	4	4	4	4	4	4	5	5	5	4	4
44	4	3	3	4	3	3	4	4	3	5	4	4	4	4	5	4	4	4	3	3	4	4	4	4	4	4	4	4	4
45	4	4	4	4	4	4	4	4	4	5	4	5	5	5	4	4	4	4	4	4	4	4	5	5	4	4	5	4	4
46	5	4	4	4	4	4	4	4	4	4	4	4	4	4	3	3	5	5	4	4	3	5	4	4	4	4	4	4	4
47	5	4	4	3	3	4	4	3	4	3	3	3	3	3	4	2	3	3	4	3	5	4	5	4	4	5	4	4	5
48	5	5	5	5	5	5	4	5	5	4	4	4	4	4	5	3	5	5	5	5	5	5	5	5	4	5	5	5	5
49	5	5	5	5	5	5	5	5	5	5	5	5	5	5	4	4	4	5	4	4	5	4	5	3	4	5	5	5	5
Average to each statement*	4.714	4.396	4.396	4.306	4.122	4.184	4.143	4.163	3.918	4.551	4.143	4.490	4.163	4.347	4.286	3.755	4.000	3.939	3.857	3.592	4.102	4.082	4.396	4.041	4.224	4.388	4.327	4.265	4.306
Ranks	1	7	7	14.5	33	25	31	28	46	2	31	3.5	28	11.5	16	55	41	43.5	50.5	57	34	36	7	39	22	9.5	13	18	14.5

41	4	4	4	5	4	4	4	4	4	4	4	4	4	5	4	4	4	4	4	4	5	5	5	5	5	5	5	5
42	4	4	4	4	3	4	4	4	5	4	4	4	3	4	4	4	4	4	4	4	5	5	5	4	4	4	4	4
43	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
44	4	4	3	3	3	4	4	4	4	3	3	3	3	4	3	3	3	4	4	4	4	3	2	4	4	4	4	4
45	4	4	4	4	5	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	3	5	4	4	4	4
46	4	4	3	3	4	3	3	4	3	4	4	3	3	3	4	4	4	3	3	4	5	4	4	4	4	4	4	4
47	3	3	3	3	4	3	3	4	5	4	4	3	3	4	3	2	2	3	3	4	5	4	5	4	4	5	4	4
48	3	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
49	4	5	4	3	3	5	4	4	5	5	3	4	2	3	4	3	3	4	4	3	5	4	3	5	4	3	3	4
Average to each statement*	3.939	4.082	3.918	3.857	3.837	4.163	3.816	4.000	4.347	4.224	4.082	3.918	3.750	4.245	4.265	4.061	4.000	4.167	3.875	4.224	4.449	3.816	3.898	4.388	4.143	4.490	4.188	4.265
Ranks	43.5	36	46	50.5	52	28	53.5	41	11.5	22	36	46	56	20	18	38	41	26	49	22	5	53.5	48	9.5	31	3.5	24	18

Note:
1. The statement numbers correspond to the order of the questionnaire
2. Respondents were asked to rate 57seismic risk management statements they consider important to be carried out in Indonesian cities located in high seismic hazard(5=v.important;4=important;3=nor;2=not important;1=absolutely not important;0=don't know)
3. 0.36% of responses stated '0' (don't know)

*) The mean score of all statements is 4.145 (between important and very important)

Table 3 Raw Data of Foremen's Opinion to Seismic Risk Management Statements

Respondent Number	Statement Number 1	Statement Number 2	Statement Number 3	Statement Number 4	Statement Number 5	Statement Number 6	Statement Number 7	Statement Number 8	Statement Number 9	Statement Number 10	Statement Number 11	Statement Number 12	Statement Number 13	Statement Number 14	Statement Number 15	Statement Number 16	Statement Number 17	Statement Number 18	Statement Number 19	Statement Number 20
1	5	4	4	5	5	5	5	5	5	5	5	5	5	5	5	4	4	4	4	4
2	5	4	4	4	3	4	4	4	5	5	4	5	5	5	4	4	5	4	4	4
3	4	4	3	4	4	4	4	4	4	5	4	5	4	4	5	3	5	4	4	3
4	5	5	5	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
5	4	4	4	5	4	5	5	5	4	4	3	4	4	4	4	3	4	3	3	4
6	4	4	4	4	4	4	5	5	5	5	5	5	5	5	5	5	5	3	4	4
7	4	4	4	3	4	4	3	3	3	4	4	4	4	4	3	4	3	3	4	4
8	4	5	5	4	4	4	4	5	4	5	4	5	4	0	5	4	5	4	5	4
9	4	0	4	3	4	4	3	3	2	5	4	5	4	4	4	3	4	3	4	2
10	3	4	0	5	4	4	4	4	4	5	4	5	5	5	4	4	5	4	5	4
11	5	5	5	5	5	4	4	4	4	3	3	3	3	3	2	4	4	4	4	3
12	5	4	5	4	4	4	4	4	5	4	4	4	3	4	4	4	5	5	4	4
13	5	4	4	4	4	3	4	5	4	5	4	4	4	5	3	4	4	5	4	3
14	0	5	5	4	5	5	5	5	5	4	5	5	5	5	5	5	4	5	5	4
15	5	4	4	5	4	3	4	4	3	4	4	5	5	5	4	5	5	4	4	4
16	5	5	5	4	4	4	4	4	3	5	4	4	3	4	3	3	5	4	4	3
17	5	5	4	5	4	5	4	4	5	5	5	5	4	4	4	5	5	5	4	4
18	5	4	5	5	5	5	4	5	5	5	5	5	4	5	5	5	5	5	5	4
19	4	5	5	5	5	5	5	5	5	4	4	5	4	5	4	2	5	5	4	5
20	5	4	4	5	4	4	4	5	4	4	4	5	4	5	4	5	4	3	4	5
21	5	4	4	4	5	4	4	5	4	4	0	5	5	4	5	4	5	4	5	5
22	4	4	4	4	2	0	4	4	5	4	4	4	4	4	4	2	4	4	2	2
23	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
24	4	4	4	4	2	3	4	4	3	3	2	5	2	3	5	4	2	2	4	3
25	5	5	5	4	5	5	5	5	5	4	4	4	5	4	4	4	5	4	4	4
26	4	4	3	3	4	4	4	4	4	0	4	4	4	4	3	3	4	4	4	4
27	4	4	4	4	3	4	4	2	3	5	4	5	5	5	4	2	4	3	3	3
28	4	4	4	4	4	4	5	4	4	5	4	4	4	4	4	3	4	4	4	3
29	4	5	5	5	4	4	5	4	4	5	4	5	4	5	5	4	5	4	4	4
30	4	5	5	5	4	5	5	4	4	5	4	5	4	5	5	4	5	4	4	0
31	4	4	4	2	4	4	5	5	4	4	4	4	4	4	5	4	5	4	4	3
32	4	5	4	5	4	5	5	5	5	3	4	5	5	5	4	4	5	4	4	4
33	5	4	4	5	4	4	4	4	4	5	4	4	4	5	5	3	4	4	3	3
34	2	2	4	2	4	4	5	4	2	5	2	2	4	4	4	5	5	2	3	4
Average to each statement*	4.333	4.273	4.273	4.176	4.029	4.182	4.294	4.265	4.059	4.424	3.970	4.471	4.147	4.394	4.176	3.824	4.441	3.882	3.971	3.697
Ranks	13	20	20	26	36.5	24	17.5	22	33	8	44	5	29	11	26	51	6.5	49	41.5	55

Respondent Number	Statement Number 21	Statement Number 22	Statement Number 23	Statement Number 24	Statement Number 25	Statement Number 26	Statement Number 27	Statement Number 28	Statement Number 29	Statement Number 30	Statement Number 31	Statement Number 32	Statement Number 33	Statement Number 34	Statement Number 35	Statement Number 36	Statement Number 37	Statement Number 38	Statement Number 39	Statement Number 40
1	4	4	5	5	4	4	5	4	4	4	4	5	5	4	5	5	4	4	5	4
2	5	5	5	4	3	4	4	4	4	3	4	3	3	3	4	5	5	4	4	3
3	4	4	5	4	5	4	5	4	4	4	4	5	5	4	5	4	4	4	5	4
4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
5	4	4	5	4	3	4	4	4	4	5	4	3	3	4	4	4	4	4	3	4
6	5	3	4	4	5	5	5	5	4	4	4	5	4	4	4	4	4	4	4	4
7	4	5	5	5	4	4	4	3	3	3	4	4	4	5	4	4	4	4	4	3
8	4	5	5	4	4	4	5	4	5	5	5	5	5	5	5	5	5	4	4	4
9	3	3	5	4	3	3	5	4	4	5	3	3	3	5	5	4	3	5	3	4
10	5	4	5	5	4	4	5	5	4	5	5	5	5	4	5	4	5	5	4	4
11	4	3	4	4	4	4	4	4	4	3	4	3	4	4	4	3	4	5	3	5
12	3	4	4	4	3	4	5	4	4	5	4	4	4	5	5	4	4	4	4	4
13	4	4	4	5	5	4	5	4	4	5	5	5	4	0	5	4	4	5	4	3
14	5	4	5	5	4	5	5	4	2	5	5	5	2	2	5	2	5	5	2	5
15	5	5	5	4	4	4	4	4	4	5	5	4	4	0	4	4	4	4	4	4
16	4	4	4	4	4	5	4	5	4	4	3	4	4	3	4	3	4	5	4	5
17	5	4	5	5	4	5	5	5	4	5	5	4	4	4	5	4	5	5	4	4
18	5	5	5	5	5	5	4	5	5	5	5	5	5	5	5	4	4	5	5	5
19	5	4	5	5	4	5	5	4	3	5	5	5	3	3	5	3	5	5	3	4
20	5	4	5	5	4	4	5	5	4	5	4	4	4	3	5	4	3	4	4	3
21	5	5	5	5	5	5	5	5	5	5	5	5	5	4	5	4	5	5	5	5
22	4	2	4	4	2	2	2	2	2	4	2	4	4	2	4	4	4	4	4	4
23	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
24	2	4	5	4	3	4	5	4	4	2	5	4	3	4	5	3	0	5	5	0
25	5	5	5	5	4	4	4	4	4	5	4	4	4	4	5	4	4	4	4	4
26	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	3	3	4
27	4	4	4	3	4	4	4	4	4	4	4	4	5	4	4	4	4	4	4	4
28	4	4	4	4	4	4	4	4	4	4	4	3	4	4	4	3	4	4	4	4
29	5	4	5	5	5	5	5	3	3	5	4	5	4	4	5	4	4	5	4	4
30	5	4	5	5	5	5	5	3	3	5	4	5	4	4	5	4	4	5	4	4
31	4	4	5	4	4	4	4	3	4	5	4	4	4	3	4	5	2	4	4	4
32	5	5	5	5	4	4	5	5	5	5	5	4	4	0	5	4	4	4	5	4
33	4	4	4	4	4	4	4	4	4	4	4	4	0	4	5	4	3	4	3	4
34	5	4	4	5	4	2	4	3	2	5	2	3	3	2	4	4	2	2	3	2
Average to each statement*	4.324	4.088	4.618	4.412	4.000	4.118	4.441	4.029	3.824	4.412	4.147	4.176	3.970	3.806	4.559	3.912	4.000	4.294	3.912	3.970
Ranks	14	32	1	9.5	39.5	31	6.5	36.5	52	9.5	29	26	44	53	2	47	39.5	17.5	46.5	44

Respondent Number	Statement Number 41	Statement Number 42	Statement Number 43	Statement Number 44	Statement Number 45	Statement Number 46	Statement Number 47	Statement Number 48	Statement Number 49	Statement Number 50	Statement Number 51	Statement Number 52	Statement Number 53	Statement Number 54	Statement Number 55	Statement Number 56	Statement Number 57
1	4	3	5	4	5	4	5	5	5	5	4	4	4	4	5	4	4
2	5	4	5	2	3	3	4	5	4	4	5	2	5	3	4	3	4
3	5	4	4	4	4	5	4	5	5	4	4	5	5	4	4	4	4
4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
5	4	3	4	3	4	4	3	4	4	5	4	4	4	4	5	5	4
6	4	4	4	4	4	4	4	4	4	5	2	3	4	4	4	4	5
7	3	3	4	4	4	4	5	4	4	5	5	4	4	4	3	3	5
8	5	4	5	5	4	4	5	4	5	5	5	3	5	4	4	4	4
9	3	2	3	2	0	0	4	2	4	5	4	3	4	4	3	2	4
10	5	4	4	5	4	3	4	4	5	5	4	4	4	5	4	4	5
11	4	4	4	5	2	2	4	5	5	5	3	3	5	4	4	3	5
12	4	4	5	4	3	4	5	3	4	5	4	3	4	4	5	4	4
13	4	4	5	4	4	4	3	4	5	5	3	4	4	4	5	4	5
14	5	2	4	5	2	1	5	4	5	3	5	4	5	5	5	5	5
15	4	4	4	4	4	4	5	4	5	4	4	4	4	4	4	4	4
16	4	4	4	3	4	4	5	5	4	4	5	3	4	4	5	3	5
17	4	5	5	5	4	4	4	4	4	5	5	5	4	5	5	5	5
18	5	5	5	4	5	4	5	5	5	5	5	5	5	5	5	5	4
19	5	5	5	5	1	1	5	3	5	5	5	2	5	4	5	5	5
20	4	4	4	3	4	2	4	3	5	4	1	4	4	5	4	4	4
21	5	4	4	4	5	4	5	5	5	5	5	5	3	3	0	5	5
22	4	2	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
23	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
24	4	2	4	4	3	4	4	2	5	5	2	4	4	3	4	3	3
25	4	3	5	4	4	4	5	4	5	5	4	4	5	4	4	4	5
26	4	3	3	3	3	3	3	3	4	4	4	3	3	4	4	3	3
27	5	4	4	5	5	4	4	4	4	4	4	4	4	5	3	4	4
28	4	3	4	4	4	3	4	4	4	4	4	4	4	4	4	4	4
29	4	4	5	4	4	4	5	4	5	5	4	5	5	4	5	4	4
30	4	4	5	4	4	4	5	4	4	4	5	5	4	4	5	4	5
31	4	4	4	5	4	4	4	4	5	5	4	4	5	4	5	4	5
32	4	3	5	5	4	3	5	2	5	0	0	0	4	4	5	5	5
33	4	3	4	4	4	4	4	4	4	5	4	5	5	4	4	4	4
34	2	0	2	4	2	0	4	2	4	4	4	5	0	2	4	4	5
Average to each statement*	4.147	3.606	4.235	4.029	3.727	3.455	4.324	3.853	4.500	4.545	4.030	3.909	4.273	4.029	4.303	3.971	4.382
Ranks	29	56	23	36.5	54	57	15	50	4	3	34	48	20	36.5	16	41.5	12

Note:
1. The statement numbers correspond to the order of the questionnaire
2. Respondents were asked to rate 57seismic risk management statements they consider important to be carried out in Indonesian cities located in high seismic hazard(5=v.important;4=important;3=nor;2=not important;1=absolutely not important;0=don't know)
3. 1.19% of responses stated '0' (don't know)

*) The mean score of all statements is 4.137 (between important and very important)

Table 4 Raw Data of Government Officials' Opinion to Seismic Risk Management Statements

Respondent Number	Statement Number 1	Statement Number 2	Statement Number 3	Statement Number 4	Statement Number 5	Statement Number 6	Statement Number 7	Statement Number 8	Statement Number 9	Statement Number 10	Statement Number 11	Statement Number 12	Statement Number 13	Statement Number 14	Statement Number 15	Statement Number 16	Statement Number 17	Statement Number 18	Statement Number 19	Statement Number 20	Statement Number 21	Statement Number 22	Statement Number 23	Statement Number 24	Statement Number 25	Statement Number 26	Statement Number 27	Statement Number 28
1	5	5	5	5	5	5	5	5	4	5	5	5	3	5	5	5	5	5	4	4	4	4	5	4	5	5	5	4
2	4	4	4	4	4	4	4	4	4	4	4	5	4	4	4	4	3	3	5	4	4	4	3	3	4	4	3	4
3	5	4	5	4	4	4	5	5	4	4	O	5	5	5	4	5	5	4	5	4	5	5	4	5	4	5	5	5
4	5	5	5	4	4	5	4	4	4	3	3	3	O	O	4	4	3	3	3	3	4	4	4	4	4	4	4	4
5	5	5	5	5	4	5	5	4	5	3	3	3	3	3	5	4	3	3	3	3	5	5	5	5	4	5	5	5
6	5	5	5	5	5	5	4	4	4	5	5	5	5	5	5	4	4	4	4	3	4	4	4	4	5	5	5	5
7	4	4	4	4	4	5	3	3	4	4	4	5	5	4	4	4	5	5	4	4	5	5	5	5	4	4	5	4
8	5	4	4	5	5	4	5	5	5	5	4	4	4	4	4	4	5	4	4	4	4	4	4	4	5	5	5	4
9	5	5	4	4	4	4	5	5	5	5	5	5	5	5	4	4	5	5	5	5	5	5	5	5	5	5	5	5
10	5	5	4	5	5	5	5	5	5	5	5	5	5	5	4	4	5	5	5	5	5	5	5	5	5	5	5	5
11	5	5	5	5	4	5	4	4	5	5	4	5	5	4	4	3	4	4	2	3	4	4	4	4	4	4	3	4
12	5	4	4	5	4	4	5	5	5	5	4	4	4	4	4	4	5	4	4	4	4	4	4	4	5	5	5	4
13	5	4	5	4	4	3	4	4	4	4	4	4	4	4	4	3	4	4	3	3	3	4	4	3	4	4	4	4
14	4	4	5	4	4	3	4	4	4	4	3	4	4	4	3	2	4	4	3	3	3	4	4	3	4	4	4	4
15	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	4	4	5	4	4	4	4	4
16	5	4	5	5	5	5	5	5	5	5	5	5	5	5	3	4	5	5	4	4	5	5	5	4	5	5	5	5
17	3	4	4	4	4	3	O	4	4	4	O	4	2	4	3	O	4	4	3	3	4	4	4	5	5	4	5	4
18	4	4	4	4	4	4	4	4	4	4	4	5	5	3	4	3	4	4	4	4	4	4	4	4	4	4	4	4
19	4	3	O	4	4	4	3	4	4	4	4	4	4	4	4	4	4	3	3	3	4	4	4	4	4	4	4	4
20	4	4	4	4	4	4	4	3	3	5	4	5	5	5	5	4	4	4	4	3	3	3	4	3	3	4	3	4
21	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
22	4	4	4	4	4	4	4	4	4	3	3	3	3	3	5	3	4	3	2	O	4	5	5	3	4	5	5	4
23	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	4
24	5	4	4	4	4	4	4	4	O	4	4	4	O	4	4	4	4	O	4	O	5	4	4	4	4	4	4	4
25	5	5	5	4	4	4	5	4	4	4	4	5	4	5	4	3	3	3	4	3	3	2	4	4	4	4	3	4
26	5	4	4	4	4	4	4	4	4	5	4	5	4	5	4	3	4	4	4	4	4	4	4	4	4	4	5	4
27	5	5	5	4	4	5	5	4	4	4	4	4	4	4	5	4	4	4	4	3	4	4	4	4	5	5	5	5
28	5	O	O	3	4	4	4	4	5	4	3	4	3	3	5	4	4	3	5	4	4	4	5	4	4	4	3	4
29	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	4	4	4	4	4	4	4	4	4	5	5	5	4
30	5	5	4	5	4	4	5	4	4	4	4	5	4	5	4	3	3	4	4	3	3	2	4	4	4	4	3	4
Average to each statement*	4.700	4.448	4.536	4.400	4.300	4.333	4.448	4.300	4.379	4.367	4.143	4.500	4.250	4.345	4.267	3.862	4.200	4.034	3.933	3.750	4.133	4.133	4.333	4.100	4.367	4.467	4.367	4.267
Ranks	1	6.5	2	8.5	19	16	6.5	19	10	12	27	3	24	14	22	54	25	43.5	46.5	57	30.5	30.5	16	37.5	12	4.5	12	22

Respondent Number	Statement Number 29	Statement Number 30	Statement Number 31	Statement Number 32	Statement Number 33	Statement Number 34	Statement Number 35	Statement Number 36	Statement Number 37	Statement Number 38	Statement Number 39	Statement Number 40	Statement Number 41	Statement Number 42	Statement Number 43	Statement Number 44	Statement Number 45	Statement Number 46	Statement Number 47	Statement Number 48	Statement Number 49	Statement Number 50	Statement Number 51	Statement Number 52	Statement Number 53	Statement Number 54	Statement Number 55	Statement Number 56	Statement Number 57
1	5	3	3	4	4	4	3	3	3	4	4	4	5	3	4	4	5	5	4	3	5	5	4	4	5	3	5	3	5
2	4	3	4	4	4	3	3	3	4	4	3	3	4	3	4	3	3	3	4	4	4	4	4	3	4	4	3	4	4
3	5	4	4	4	4	4	4	4	4	5	4	O	5	3	4	5	3	3	5	3	4	5	2	2	5	4	4	3	4
4	4	4	4	4	4	4	4	O	4	4	4	4	4	3	4	4	4	4	4	4	4	3	3	3	4	4	4	4	4
5	4	4	4	2	3	2	4	3	3	4	4	4	3	3	3	4	4	4	5	4	5	5	5	4	5	5	5	5	5
6	5	5	5	5	5	5	5	5	4	5	5	5	5	5	5	4	4	4	5	5	5	5	5	5	5	4	4	4	4
7	4	3	3	4	4	3	4	3	4	4	3	3	3	4	4	4	4	5	4	4	4	4	4	5	4	4	5	5	4
8	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
9	5	4	4	4	4	4	4	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
10	5	4	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
11	5	2	2	4	4	2	2	4	4	5	4	5	3	3	3	4	2	4	4	4	4	4	4	2	5	4	5	2	4
12	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
13	4	4	4	4	4	3	3	4	O	4	4	4	4	4	3	4	4	4	4	4	4	4	3	4	4	4	5	4	4
14	3	4	4	4	3	3	3	4	3	4	4	4	3	4	4	5	4	4	4	3	4	4	2	4	4	4	5	4	4
15	4	4	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
16	5	4	4	5	5	5	5	4	4	4	3	3	3	5	4	4	4	3	4	3	3	5	5	4	5	4	4	4	5
17	4	4	5	4	4	5	4	4	3	5	5	4	4	4	4	4	4	5	4	4	4	3	4	3	4	3	4	4	5
18	4	4	4	4	5	4	3	5	4	4	4	4	5	5	5	5	4	4	5	5	5	4	4	2	5	3	5	5	5
19	3	4	4	4	4	4	4	4	4	4	4	4	3	4	4	4	4	4	4	3	4	4	4	4	4	4	4	4	3
20	3	4	3	4	4	3	3	3	3	3	4	3	3	3	3	4	4	3	3	3	3	4	4	4	4	4	4	4	4
21	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
22	4	4	4	4	4	4	4	4	4	4	4	4	4	4	2	2	4	3	2	3	3	3	3	4	3	3	4	4	4	4	4
23	4	4	4	5	5	5	5	5	5	5	5	5	5	4	4	4	4	4	4	4	4	5	4	2	5	5	4	4	4
24	4	3	3	3	3	4	4	3	4	4	4	4	4	4	4	3	4	4	4	3	4	4	3	3	4	4	4	4	4
25	3	3	3	3	3	4	3	3	4	3	3	3	4	3	4	4	4	4	3	3	4	3	3	3	4	4	4	3	4
26	4	5	5	4	4	4	4	4	5	5	5	5	5	4	5	4	4	4	4	4	4	4	4	4	4	4	4	4	5
27	5	4	4	3	4	3	5	4	4	4	4	4	4	4	4	4	4	4	4	4	4	5	2	4	4	4	5	5	5
28	3	4	4	4	4	3	4	4	3	4	4	4	4	3	4	3	2	3	4	4	4	5	5	5	4	4	4	4	3
29	4	4	4	5	5	5	5	5	5	5	5	5	5	5	5	4	4	5	4	4	4	5	5	5	5	5	5	5	5
30	3	3	3	5	3	4	3	3	4	3	3	3	4	3	4	4	4	4	3	3	4	3	3	3	5	4	4	3	4
Average to each statement*	4.100	3.833	3.867	4.100	4.100	3.900	3.933	3.966	4.034	4.267	4.133	4.103	4.067	3.867	4.133	4.100	3.900	4.067	4.133	3.867	4.167	4.300	3.900	3.767	4.467	4.133	4.400	4.100	4.333
Ranks	37.5	55	52	37.5	37.5	49	46.5	45	43.5	22	30.5	34	41.5	52	30.5	37.5	49	41.5	30.5	52	26	19	49	56	4.5	30.5	8.5	37.5	16

Note: 1. The statement numbers correspond to the order of the questionnaire

2. Respondents were asked to rate 57seismic risk management statements they consider important to be carried out in Indonesian cities located in high seismic hazard5=v.important;4=important;3=nor;2=not important;1=absolutely not important;0=don't know)

3. 0.99% of responses stated '0' (don't know)

*) The mean score of all statements is 4.170 (between important and very important)

Table 5 Raw Data of Bussinesmen's Opinion to Seismic Risk Management Statements

Respondent Number	Statement Number 1	Statement Number 2	Statement Number 3	Statement Number 4	Statement Number 5	Statement Number 6	Statement Number 7	Statement Number 8	Statement Number 9	Statement Number 10	Statement Number 11	Statement Number 12	Statement Number 13	Statement Number 14	Statement Number 15	Statement Number 16	Statement Number 17	Statement Number 18	Statement Number 19
1	4	4	4	3	3	3	3	4	4	4	3	3	3	3	3	3	4	3	3
2	4	4	4	4	4	4	4	5	4	5	4	4	4	4	4	4	4	4	5
3	4	4	4	4	4	4	4	5	4	5	4	4	4	4	4	4	4	4	5
4	5	4	4	4	5	4	2	2	3	5	4	5	5	5	3	2	3	3	2
5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
6	5	O	O	5	5	4	O	O	4	4	4	4	4	4	3	3	4	4	4
7	5	O	O	5	5	4	O	O	4	4	4	4	4	4	3	3	4	4	4
8	5	5	5	4	4	4	5	5	5	5	5	5	5	5	5	5	4	3	5
9	5	5	5	4	4	4	5	5	5	5	5	4	5	4	5	4	4	3	4
10	5	4	4	5	4	4	4	2	4	5	5	5	5	5	5	5	5	5	5
11	5	5	5	5	4	4	4	4	4	5	4	5	4	4	4	4	5	4	4
12	5	5	5	4	4	4	2	2	2	4	4	4	4	4	4	4	4	4	4
13	5	5	5	4	4	4	2	2	2	4	4	4	4	4	4	4	4	4	4
14	5	5	5	5	5	5	3	3	4	5	5	5	4	4	5	5	4	3	5
15	5	4	4	5	5	4	3	3	3	4	4	4	4	4	4	4	4	4	3
16	5	4	5	5	5	5	4	3	4	5	5	5	4	4	5	5	4	3	5
17	5	5	5	4	4	5	5	5	5	4	4	4	4	4	5	4	5	4	5
18	5	5	5	4	4	5	5	5	5	4	4	4	4	4	5	4	5	4	5
19	5	5	5	4	4	5	5	4	5	5	4	4	5	4	5	4	5	4	5
20	5	5	5	4	4	5	5	5	5	4	4	4	4	4	5	4	5	4	5
21	5	5	5	4	4	5	5	5	5	4	4	4	4	4	5	4	5	4	5
22	4	4	4	4	4	4	4	4	4	5	5	4	4	4	3	3	4	4	3
23	5	4	4	4	4	4	4	5	4	4	4	4	3	4	4	3	4	4	4
24	4	4	4	4	4	3	4	3	5	5	4	3	4	4	4	2	3	4	4
25	5	5	5	5	4	4	2	2	5	3	3	3	5	3	5	3	5	3	3
26	5	5	5	4	4	4	4	4	4	3	3	3	3	4	4	3	4	3	3
27	5	5	5	5	5	5	5	4	4	5	5	5	5	5	4	4	4	O	4
28	4	4	4	4	4	4	3	3	3	3	3	3	3	3	3	3	3	3	3
29	5	5	5	5	5	5	5	5	5	5	5	5	5	5	4	4	5	5	3
30	5	5	4	3	3	3	4	3	3	5	4	5	5	4	2	5	4	3	4
31	5	4	4	5	4	4	5	4	5	5	4	4	4	4	5	4	4	4	4
32	5	4	4	3	3	3	4	4	4	5	4	4	4	4	4	2	4	4	3
Average to each statement*	4.813	4.567	4.567	4.281	4.188	4.188	3.967	3.833	4.125	4.469	4.156	4.156	4.188	4.094	4.156	3.750	4.219	3.774	4.063
Ranks	1	2.5	2.5	14.5	19	19	40	51	25.5	5	22	22	19	28.5	22	55.5	16.5	53.5	31.5

Respondent Number	Statement Number 20	Statement Number 21	Statement Number 22	Statement Number 23	Statement Number 24	Statement Number 25	Statement Number 26	Statement Number 27	Statement Number 28	Statement Number 29	Statement Number 30	Statement Number 31	Statement Number 32	Statement Number 33	Statement Number 34	Statement Number 35	Statement Number 36	Statement Number 37	Statement Number 38
1	3	4	4	4	4	4	4	3	4	4	3	3	2	2	3	3	3	3	3
2	2	5	4	5	4	4	5	5	4	4	1	4	4	4	4	5	3	4	5
3	2	5	4	5	4	4	5	5	4	4	1	4	4	4	4	5	3	4	5
4	O	5	5	5	3	5	5	5	4	4	3	4	4	4	4	3	3	4	4
5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
6	4	4	4	4	4	4	4	4	4	4	4	4	5	5	5	5	5	5	4
7	4	4	4	4	4	4	4	4	4	4	4	4	5	5	5	5	5	5	4
8	4	4	4	5	5	5	5	5	5	5	4	5	5	5	5	5	5	4	5
9	4	4	4	5	4	5	5	5	5	5	4	5	4	4	4	5	5	3	4
10	5	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	4	5	5
11	4	5	4	5	5	5	5	4	5	4	4	4	4	4	4	4	4	4	5
12	4	5	5	5	5	4	4	4	4	4	4	4	4	4	4	4	4	4	4
13	4	5	5	5	5	4	4	4	4	4	4	4	4	4	4	4	4	4	4
14	5	3	2	3	5	5	4	3	3	4	3	4	5	5	3	4	4	4	4
15	3	3	3	3	3	4	4	4	4	4	3	3	3	3	3	3	3	3	3
16	5	3	2	3	5	5	4	5	3	5	4	5	5	4	3	4	3	3	4
17	5	4	4	4	5	3	4	5	5	5	5	4	3	3	4	3	4	3	3
18	5	4	4	4	5	3	4	5	5	5	5	4	3	3	4	3	4	3	3
19	4	4	5	5	5	4	4	5	5	5	4	4	4	4	4	4	5	4	5
20	5	4	4	4	5	3	4	5	5	5	5	4	3	3	4	3	4	3	3
21	5	4	4	4	5	3	4	5	5	5	5	4	3	3	4	3	4	3	3
22	3	3	4	5	5	4	4	4	4	5	3	3	3	3	3	5	4	5	4
23	3	4	5	5	5	3	4	4	5	4	4	4	4	4	4	3	3	4	4
24	3	3	3	4	4	4	3	3	4	4	5	4	4	4	4	4	4	4	4
25	3	2	2	4	3	4	5	5	3	3	5	5	5	4	5	5	5	3	3
26	3	3	4	4	4	5	5	5	4	4	5	4	4	4	4	4	3	4	4
27	4	5	5	5	5	4	4	5	4	4	4	4	4	4	4	5	4	5	5
28	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
29	3	5	5	5	5	5	5	5	5	5	5	5	4	4	4	5	5	4	5
30	2	5	3	5	4	5	5	4	5	5	2	3	3	3	2	4	3	4	3
31	4	5	5	5	4	5	5	4	3	4	4	4	3	3	4	4	4	3	3
32	3	3	4	4	4	4	4	4	4	4	3	4	4	4	4	4	4	4	4
Average to each statement*	3.774	4.063	4.031	4.438	4.438	4.219	4.375	4.438	4.281	4.375	3.875	4.094	3.938	3.875	3.969	4.125	3.969	3.875	4.000
Ranks	53.5	31.5	34.5	7	7	16.5	10.5	7	14.5	10.5	46	28.5	42	46	38.5	25.5	38.5	46	36.5

Respondent Number	Statement Number 39	Statement Number 40	Statement Number 41	Statement Number 42	Statement Number 43	Statement Number 44	Statement Number 45	Statement Number 46	Statement Number 47	Statement Number 48	Statement Number 49	Statement Number 50	Statement Number 51	Statement Number 52	Statement Number 53	Statement Number 54	Statement Number 55	Statement Number 56	Statement Number 57
1	3	3	3	3	3	3	3	3	3	3	3	4	4	4	4	4	4	4	4
2	4	4	4	5	5	5	4	4	4	3	5	5	4	4	4	4	5	4	5
3	4	4	4	5	5	5	4	4	4	3	5	5	4	4	4	4	5	4	5
4	4	3	3	4	4	4	3	3	3	3	3	3	3	3	4	3	3	3	3
5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
6	4	4	4	4	4	3	3	3	3	3	3	4	4	4	4	4	4	4	4
7	4	4	4	4	4	3	3	3	3	3	3	4	4	4	4	4	4	4	4
8	5	4	5	3	4	4	4	4	5	5	5	5	5	5	4	4	5	5	5
9	4	4	4	4	3	4	5	4	4	5	5	5	5	5	5	4	5	5	5
10	5	5	5	5	5	5	5	3	2	5	5	5	5	5	5	5	5	5	5
11	4	4	4	4	4	4	4	4	5	3	4	5	4	3	5	4	5	4	4
12	4	4	4	4	4	4	4	2	4	4	4	4	4	4	4	4	4	4	4
13	4	4	4	4	4	4	4	2	4	4	4	4	4	4	4	4	4	4	4
14	4	3	5	5	5	4	4	4	5	5	5	5	4	4	5	4	4	4	4
15	3	3	3	3	3	3	3	3	3	3	3	3	2	2	4	4	4	4	4
16	4	4	3	5	5	4	4	4	5	5	5	5	4	5	5	4	5	4	4
17	3	4	4	4	3	4	5	4	4	4	4	5	3	5	4	4	4	4	4
18	3	4	4	4	3	4	5	4	4	4	4	5	3	5	4	4	4	4	4
19	5	4	5	4	5	5	5	5	4	4	5	5	5	4	4	4	5	5	5
20	3	4	4	4	3	4	4	4	4	4	4	5	3	5	4	4	4	4	4
21	3	4	4	4	3	4	5	4	4	4	4	5	3	5	4	4	4	4	4
22	3	3	3	5	4	3	4	4	4	4	4	5	2	3	3	4	4	3	3
23	3	4	4	4	3	3	4	3	4	4	5	5	3	3	5	4	5	4	4
24	4	3	3	3	3	4	3	4	4	3	4	5	4	4	4	4	4	4	5
25	3	4	3	3	5	5	3	3	4	3	5	5	5	5	4	4	5	4	5
26	3	3	3	4	4	3	3	3	4	3	3	4	5	5	4	3	4	3	5
27	5	4	5	4	4	5	4	4	4	4	4	5	4	5	5	4	5	5	5
28	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
29	5	5	4	3	4	5	5	5	5	5	5	5	3	4	5	5	5	5	5
30	4	4	4	2	4	5	3	4	4	4	4	3	2	1	5	4	4	4	5
31	3	3	4	4	4	4	4	4	4	3	3	4	3	3	5	5	4	4	4
32	4	4	4	3	2	4	2	3	3	4	3	4	4	2	4	4	5	4	3
Average to each statement*	3.844	3.844	3.938	3.938	3.906	4.063	3.719	3.750	4.031	3.844	4.125	4.531	3.781	4.000	4.313	4.063	4.406	4.125	4.313
Ranks	49	49	42	42	44	31.5	57	55.5	34.5	49	25.5	4	52	36.5	12.5	31.5	9	25.5	12.5

Note: 1. The statement numbers correspond to the order of the questionnaire

2. Respondents were asked to rate 57seismic risk management statements they consider important to be carried out in Indonesian cities located in high seismic hazard 5=v.important;4=important;3=nor;2=not important;1=absolutely not important;0=don't know)

3. 0.55% of responses stated '0' (don't know)

*) The mean score of all statements is 4.109 (between important and very important)

Table 6 Raw Data of Educators' Opinion to Seismic Risk Management Statements

Respondent Number	Statement Number 1	Statement Number 2	Statement Number 3	Statement Number 4	Statement Number 5	Statement Number 6	Statement Number 7	Statement Number 8	Statement Number 9	Statement Number 10	Statement Number 11	Statement Number 12	Statement Number 13	Statement Number 14	Statement Number 15	Statement Number 16	Statement Number 17	Statement Number 18	Statement Number 19	Statement Number 20	Statement Number 21	Statement Number 22	Statement Number 23	Statement Number 24	Statement Number 25	Statement Number 26	Statement Number 27	Statement Number 28	Statement Number 29	Statement Number 30	Statement Number 31	Statement Number 32	Statement Number 33	Statement Number 34	Statement Number 35	Statement Number 36	Statement Number 37	Statement Number 38	Statement Number 39	Statement Number 40	Statement Number 41	Statement Number 42	Statement Number 43	Statement Number 44	Statement Number 45	Statement Number 46	Statement Number 47	Statement Number 48	Statement Number 49	Statement Number 50	Statement Number 51	Statement Number 52	Statement Number 53	Statement Number 54	Statement Number 55	Statement Number 56	Statement Number 57
1	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
2	4	4	4	3	4	3	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	O	3	3	3	3	3	4	4	4	4	4	4	4	4	4	4	4	4	4	4	3	3	3	4	3	3	4	4	4	3	3	3	3	3
3	4	5	4	O	3	4	4	3	4	4	5	5	4	3	5	3	5	4	4	3	4	5	5	4	3	3	4	5	4	5	4	3	3	4	5	O	4	5	5	4	3	3	4	4	4	4	5	4	O	3	4	5	3	4	3	4	5
4	5	4	4	5	5	4	4	4	4	3	3	4	4	4	3	3	4	5	5	5	4	4	5	5	4	4	3	3	3	3	4	3	4	4	4	3	3	4	3	3	4	3	3	3	4	3	3	3	3	5	5	4	5	4	4	4	5
5	4	4	4	5	4	4	5	4	4	4	4	5	4	4	4	3	5	4	3	4	5	5	5	4	5	4	4	4	4	5	4	3	4	2	4	4	4	4	4	4	3	3	4	5	4	4	4	4	4	5	5	4	4	4	5	5	4
6	4	5	4	4	4	4	5	4	5	5	4	5	5	5	5	4	5	5	4	3	4	4	4	4	4	4	5	4	5	4	4	5	4	4	5	4	4	5	4	4	5	4	5	4	4	5	4	4	5	5	4	5	4	4	5	4	5
7	4	4	4	4	4	4	4	4	4	3	O	5	4	4	5	4	4	4	5	3	5	5	5	5	5	5	5	5	5	5	5	1	2	4	3	4	4	4	4	4	5	4	4	4	2	3	2	3	4	5	5	4	5	3	5	5	5
8	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	4	4	4	4	5	5	5	5	5	5	5	5	5	5	5	5	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
9	4	4	4	4	4	4	4	5	4	5	5	5	5	5	4	O	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	5	4	5	4	4	4	4	4
10	5	4	4	2	2	5	5	5	5	5	5	5	5	4	5	5	4	5	5	5	5	5	5	5	5	4	4	4	4	4	5	5	2	5	5	4	4	4	4	4	2	5	4	4	4	4	4	5	5	4	5	5	4	3	4	4	4
11	4	4	4	4	4	4	4	4	4	5	4	4	4	4	5	5	4	4	4	4	4	4	4	4	5	5	4	4	4	4	4	4	5	4	4	4	5	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
12	5	4	4	5	4	5	5	5	5	5	5	5	5	5	4	5	4	4	5	4	5	5	5	5	5	5	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	4	5	4	5	4	5	O	O	4	5	4	5	5	5
13	5	5	5	5	5	5	4	4	4	4	4	5	5	4	4	5	5	5	5	5	4	4	4	4	5	5	4	5	5	5	5	4	4	4	3	5	5	5	5	4	4	4	5	5	5	5	5	4	4	5	4	4	5	5	4	4	5
14	4	4	4	4	4	4	O	O	4	4	4	5	5	5	5	5	5	5	5	4	5	5	5	4	5	5	5	5	5	4	4	5	4	3	5	4	5	4	5	4	3	4	5	5	5	4	4	4	5	5	2	4	5	4	5	4	5
15	5	5	O	5	5	4	4	4	4	4	4	4	4	4	3	3	4	4	4	4	4	4	5	4	3	3	3	4	4	3	3	4	4	5	4	O	4	4	4	4	O	5	4	3	3	3	4	3	3	4	4	4	4	4	4	4	4
16	5	5	5	5	5	5	5	4	4	4	4	4	5	4	5	4	5	4	4	4	4	4	5	4	4	4	4	4	4	4	4	4	4	4	4	4	4	5	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
17	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
18	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	5	5	5	5	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	5	5	5	4	4	4	4	4	4	4	4	4	4	4
19	5	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	5	5	5	5	5	4	4	4	4	4	4	3	4	4	4	3	3	4	4	4	4	4	4	3	4	4	3	4	5	4	4	4	4
20	5	O	5	4	4	3	3	4	3	4	4	3	2	3	4	4	3	2	4	2	3	4	4	4	4	4	4	4	4	4	4	3	3	4	3	3	4	4	3	4	3	3	4	4	4	4	4	3	4	4	2	4	4	4	5	5	4
21	5	4	5	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	3	4	4	5	4	4	4	4	4	4	4	4	4	3	4	4	3	4	4	3	3	4	4	4	4	4	4	4	4	4	5	4	4	4	5	4	4	4
22	4	4	4	4	4	4	4	4	4	4	4	4	4	5	5	5	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	3	4	4	4	4	4	4	4	4	4	4	4	3	4	4	4	4	4	4	4	4	4	4	4	4	4
23	5	5	O	5	5	5	4	5	5	5	5	5	5	5	5	5	5	4	O	5	4	5	5	5	5	5	4	4	4	5	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	5	4	5	5	5	5	5	5	4	4	4
24	4	4	4	4	4	4	4	4	5	4	4	4	5	5	5	5	4	5	4	4	4	4	4	5	4	4	4	4	4	4	4	3	4	4	4	4	4	4	4	4	4	4	4	3	4	4	4	4	4	4	4	4	4	4	4	4	4
25	4	4	4	4	4	4	4	4	O	4	4	4	5	5	5	5	4	5	4	4	4	4	4	5	4	4	4	4	4	4	4	3	4	4	4	4	4	4	4	4	4	4	4	3	4	4	4	4	4	4	4	4	4	4	4	4	4
26	5	4	4	3	3	3	4	3	3	3	4	4	3	4	4	4	3	4	4	3	4	4	4	4	4	4	4	4	O	3	3	4	3	3	4	4	4	3	3	3	3	3	4	3	3	3	4	3	4	4	3	3	4	4	4	4	4
27	5	4	5	2	2	3	4	2	2	2	3	3	3	3	4	4	2	4	4	3	4	4	4	4	3	4	4	4	O	O	O	4	3	3	3	3	3	O	2	2	2	3	4	3	3	3	3	3	2	2	2	2	4	3	3	3	4
28	5	4	5	5	4	4	4	4	5	4	4	5	5	5	5	4	4	4	4	4	4	4	4	5	5	5	4	4	4	4	5	4	4	3	3	3	4	4	5	4	4	5	4	4	4	4	4	3	4	5	2	3	5	4	4	4	4
29	5	5	5	5	5	5	5	4	4	4	4	O	4	4	5	4	3	3	4	3	3	3	4	4	4	4	4	4	5	3	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	5	5	5	4	4	5	5	5
30	4	5	4	4	4	5	4	4	4	4	3	5	4	4	4	4	5	4	4	4	5	4	5	5	4	4	5	4	5	5	5	4	3	4	4	4	4	4	4	3	3	3	4	4	4	4	4	5	5	4	4	4	4	4	4	4	4

Table 6 Raw Data of Educators' Opinion to Seismic Risk Management Statements (Continued)

31	5	0	5	4	2	4	2	4	2	2	4	2	2	4	5	2	5	3	1	5	5	5	5	5	5	4	4	4
32	5	4	4	3	4	5	4	4	5	4	5	4	4	2	5	4	5	5	4	4	5	4	5	4	5	4	5	4
33	5	5	5	4	4	4	3	3	3	5	5	4	4	4	4	4	4	4	4	4	5	5	5	4	4	4	4	4
34	4	4	4	4	4	4	0	4	0	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
35	5	5	5	5	5	4	5	5	5	5	5	5	5	5	5	5	5	5	4	5	5	5	5	5	5	5	5	5
36	4	4	4	4	4	5	4	5	4	4	4	5	5	4	3	3	4	5	4	3	4	4	4	5	3	3	4	5
Average to each statement*	4.556	4.353	4.353	4.143	4.028	4.194	4.147	4.086	4.088	4.083	4.200	4.343	4.250	4.194	4.417	4.143	4.222	4.222	4.114	3.944	4.278	4.306	4.500	4.400	4.278	4.194	4.167	4.222
Ranks	1	6.5	6.5	29.5	42	23.5	28	36	35	38	20.5	8	15.5	23.5	3	29.5	18	18	32.5	49	12.5	10.5	2	4	12.5	23.5	27	18

31	4	2	3	2	1	4	4	4	3	4	3	4	4	1	4	3	3	5	4	5	4	5	5	1	4	2	4	4	5
32	4	2	4	2	5	4	4	2	5	4	4	4	4	0	4	5	2	2	4	2	4	4	1	4	5	4	5	4	4
33	4	4	4	4	4	4	4	4	4	4	4	4	0	5	5	4	4	4	4	4	4	4	4	4	4	4	4	4	4
34	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
35	5	5	5	5	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
36	4	4	4	3	4	5	4	4	4	4	4	3	3	4	3	4	5	5	4	4	4	4	3	3	5	4	5	5	5
Average to each statement*	4.265	4.057	4.171	3.778	3.806	4.000	4.083	3.912	4.111	4.200	4.028	3.917	3.824	3.943	4.139	3.972	3.972	4.000	4.083	3.833	4.114	4.371	3.886	4.028	4.306	4.000	4.250	4.194	4.333
Ranks	14	40	26	57	56	45	38	52	34	20.5	42	51	55	50	31	47.5	47.5	45	38	54	32.5	5	53	42	10.5	45	15.5	23.5	9

Note:
1. The statement numbers correspond to the order of the questionnaire
2. Respondents were asked to rate 57seismic risk management statements they consider important to be carried out in Indonesian cities located in high seismic hazard(5=v.important;4=important;3=nor;2=not important;1=absolutely not important;0=don't know)
3. 1.36% of responses stated '0' (don't know)

*) The mean score of all statements is 4.140 (between important and very important)

Table 7 Raw Data of Non-Government Organizations' Opinion to Seismic Risk Management Statements

Respondent Number	Statement Number 1	Statement Number 2	Statement Number 3	Statement Number 4	Statement Number 5	Statement Number 6	Statement Number 7	Statement Number 8	Statement Number 9	Statement Number 10	Statement Number 11	Statement Number 12	Statement Number 13	Statement Number 14	Statement Number 15	Statement Number 16	Statement Number 17	Statement Number 18	Statement Number 19	Statement Number 20	Statement Number 21	Statement Number 22	Statement Number 23	Statement Number 24	Statement Number 25	Statement Number 26	Statement Number 27	Statement Number 28	Statement Number 29
1	4	O	O	5	5	5	5	5	5	4	3	4	4	4	4	4	5	4	4	4	4	4	5	4	3	4	5	4	4
2	4	4	5	4	4	5	5	5	4	4	4	4	4	4	5	4	4	4	4	4	3	3	4	5	4	4	4	4	4
3	5	4	4	4	4	4	5	4	4	5	4	5	4	4	4	2	4	4	4	4	4	4	5	4	4	5	5	4	4
4	5	5	5	5	5	5	2	4	4	4	4	4	4	O	5	5	4	4	4	3	3	5	5	4	4	4	4	4	4
5	5	4	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
6	5	5	5	4	4	4	4	4	4	4	4	4	4	4	4	4	4	3	3	3	5	4	3	5	4	4	5	4	4
7	5	4	4	5	5	5	5	4	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
8	5	5	5	5	4	4	4	4	5	3	3	4	4	4	4	3	3	3	4	4	3	3	4	3	3	4	3	3	4
9	5	4	4	4	3	5	5	5	4	5	5	5	5	5	5	5	4	3	4	1	5	5	5	5	5	5	5	5	5
10	5	5	O	5	5	5	4	4	4	5	5	O	5	O	4	5	4	4	4	4	4	4	5	4	4	4	4	4	4
11	5	5	5	5	5	5	5	5	5	5	O	5	5	5	4	4	4	4	4	4	4	4	5	5	3	4	4	4	4
12	5	5	5	5	4	4	5	5	5	4	4	4	4	4	5	5	5	5	4	4	4	5	5	4	4	4	4	4	4
13	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
14	5	4	5	4	5	4	5	5	4	4	3	5	4	4	5	5	5	2	O	2	5	5	4	3	3	4	4	5	3
15	5	5	5	5	5	5	5	4	5	5	5	5	5	5	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5
16	5	5	5	5	5	5	5	5	5	5	5	5	5	5	4	4	4	4	4	4	5	5	4	4	5	5	4	5	5
17	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
18	4	5	5	5	4	4	3	5	5	4	4	4	4	4	5	4	5	4	4	4	5	4	5	3	4	4	4	5	4
19	4	5	4	4	4	4	5	5	4	4	4	5	4	4	5	4	4	4	4	4	5	5	4	4	4	5	4	4	4
20	5	4	4	5	5	5	5	4	5	5	5	5	5	5	3	4	5	5	5	5	5	5	5	5	5	4	4	4	5
21	4	4	5	4	4	5	5	5	4	4	5	3	4	4	5	4	4	4	4	4	3	3	4	5	4	4	4	4	5
22	5	4	4	5	5	5	5	4	4	5	5	5	5	5	5	5	5	5	5	4	4	4	5	5	5	5	5	5	5
23	5	4	4	5	3	5	5	5	4	5	5	5	5	4	4	5	4	3	4	1	5	5	5	5	5	5	5	5	5
24	5	5	5	4	4	4	4	4	4	4	4	4	4	4	4	4	4	3	3	3	5	4	3	5	4	4	5	4	4
25	5	4	4	5	4	4	5	5	5	4	4	4	4	4	5	5	5	5	4	4	4	5	5	4	4	4	4	4	4
26	5	4	4	5	4	4	5	4	4	5	4	5	4	4	4	2	4	4	5	5	4	4	5	4	4	5	5	4	4
27	5	4	4	5	5	5	5	5	4	4	5	5	5	5	5	5	5	5	5	4	4	5	5	5	5	5	5	4	5
28	5	4	4	5	4	4	5	5	5	5	5	5	4	3	5	5	5	5	3	3	4	5	5	5	5	5	5	5	5

Respondent Number	Statement Number 30	Statement Number 31	Statement Number 32	Statement Number 33	Statement Number 34	Statement Number 35	Statement Number 36	Statement Number 37	Statement Number 38	Statement Number 39	Statement Number 40	Statement Number 41	Statement Number 42	Statement Number 43	Statement Number 44	Statement Number 45	Statement Number 46	Statement Number 47	Statement Number 48	Statement Number 49	Statement Number 50	Statement Number 51	Statement Number 52	Statement Number 53	Statement Number 54	Statement Number 55	Statement Number 56	Statement Number 57
1	5	4	4	4	3	3	3	4	4	4	4	3	4	4	4	4	5	4	4	4	4	4	5	4	3	3	3	4
2	4	4	4	4	4	5	4	4	4	4	4	4	3	4	4	4	4	4	4	4	5	4	4	4	4	5	4	5
3	5	4	4	4	O	5	4	4	5	4	4	4	4	5	4	5	4	4	4	5	5	4	4	5	5	4	4	5
4	3	3	5	4	3	3	O	3	4	3	4	4	4	4	4	4	4	3	3	3	4	2	3	4	4	5	4	4
5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
6	5	4	5	4	4	5	4	4	4	4	3	3	4	3	3	4	3	4	3	4	5	5	4	4	4	3	3	4
7	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
8	4	3	4	4	3	3	3	3	3	4	3	3	3	3	3	3	3	3	4	4	4	4	4	4	4	4	4	3
9	4	5	5	5	5	5	5	4	5	3	5	5	5	4	5	4	4	4	5	5	5	5	5	4	5	4	5	5
10	5	4	4	4	4	3	4	4	4	3	4	3	3	4	4	3	3	4	4	5	4	4	4	O	4	5	4	4
11	4	4	5	4	5	5	3	4	5	4	4	4	5	5	4	5	4	4	4	4	4	4	4	5	4	4	4	4
12	4	4	3	3	4	4	4	4	4	4	4	3	3	4	4	4	4	4	4	4	4	3	2	5	3	4	4	4
13	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
14	5	1	4	2	3	4	3	4	3	1	O	3	3	4	4	4	3	4	4	4	5	4	5	5	4	3	4	4
15	5	5	4	4	5	5	5	4	5	4	4	5	5	5	5	4	4	5	4	5	5	5	5	5	5	5	5	5
16	5	5	5	5	4	4	2	5	5	4	4	4	4	4	4	4	4	4	5	4	3	4	4	4	3	3	4	4
17	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
18	4	4	3	3	3	4	4	3	4	3	4	3	3	4	4	4	4	4	4	5	5	5	3	5	5	5	5	5
19	5	4	5	4	5	5	4	4	4	4	4	4	4	5	4	4	4	4	4	4	5	4	4	5	5	5	4	5
20	5	5	5	5	5	5	5	3	5	5	5	5	3	4	5	5	5	5	5	5	4	4	5	5	3	5	5	5
21	4	4	4	4	4	5	4	4	4	4	4	4	3	3	4	4	4	4	4	4	5	4	4	4	4	5	4	5
22	5	5	5	5	5	4	4	5	5	5	5	5	4	4	5	5	5	5	4	5	5	5	4	4	5	5	5	5
23	4	5	5	5	5	5	5	4	5	3	5	5	5	4	5	4	4	4	5	5	5	5	4	4	5	4	5	5
24	5	4	5	4	4	5	4	4	4	4	3	3	4	3	3	4	3	4	3	4	5	5	4	4	4	3	3	4
25	4	4	3	3	4	4	5	4	4	4	4	3	3	4	4	4	4	4	4	4	4	3	2	4	3	4	4	4
26	5	4	4	4	O	5	4	4	5	4	4	5	4	5	4	5	4	4	4	5	5	4	4	5	5	4	5	5
27	4	5	5	4	5	5	5	5	5	5	5	5	4	5	5	4	4	5	5	5	5	5	5	5	5	4	4	5
28	4	4	4	5	5	5	5	5	4	4	4	5	5	5	5	5	5	5	5	5	5	4	4	5	5	5	4	5

Table 8 Raw Data of Community Leaders' Opinion to Seismic Risk Management Statements

Respondent Number	Statement Number 1	Statement Number 2	Statement Number 3	Statement Number 4	Statement Number 5	Statement Number 6	Statement Number 7	Statement Number 8	Statement Number 9	Statement Number 10	Statement Number 11	Statement Number 12	Statement Number 13	Statement Number 14	Statement Number 15	Statement Number 16	Statement Number 17	Statement Number 18	Statement Number 19
1	5	5	5	5	4	4	5	5	5	4	4	4	4	5	5	5	4	5	5
2	5	5	5	4	4	5	4	3	3	2	2	3	3	3	4	4	2	2	3
3	5	O	5	5	5	5	5	5	5	5	5	5	5	5	5	5	4	4	5
4	5	4	3	4	3	3	4	5	4	4	3	5	5	4	5	4	5	4	5
5	5	5	5	5	4	4	5	5	5	5	4	4	5	5	3	5	5	5	4
6	5	5	5	5	5	5	5	4	4	5	5	5	5	5	5	5	5	4	5
7	5	4	4	4	4	4	5	4	3	4	3	5	3	3	4	3	4	3	2
8	5	5	O	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
10	4	4	4	4	3	3	3	2	2	4	4	5	5	5	3	2	4	2	4
11	4	4	4	4	4	4	3	4	5	4	4	4	4	4	5	4	4	4	4
12	5	4	3	4	4	4	5	4	3	3	3	5	2	5	4	3	4	4	4
13	4	4	4	2	3	2	4	4	4	3	3	4	4	4	4	2	4	4	4
14	4	4	5	5	4	O	5	4	4	4	4	4	O	5	5	2	5	4	5
15	5	5	5	4	4	4	5	5	3	5	4	5	4	4	4	4	4	4	4
16	5	4	5	5	4	4	5	4	4	4	4	O	5	5	4	5	5	4	4
17	5	O	4	5	5	5	4	5	5	5	4	5	4	5	5	4	5	4	5
18	5	5	5	5	5	5	5	5	5	5	5	5	4	4	4	4	5	5	4
19	5	4	4	4	5	4	2	3	4	5	5	4	4	4	5	4	4	4	4
20	5	4	5	4	5	4	4	4	5	4	4	5	5	5	5	5	4	4	5
21	5	5	5	5	4	5	4	4	4	5	5	5	5	5	5	5	4	4	4
22	5	4	4	5	4	5	4	3	3	2	2	3	3	3	4	4	2	3	3
23	5	4	4	5	4	4	5	5	5	5	4	4	5	5	3	5	5	4	4
24	5	4	4	5	4	4	5	4	3	5	3	5	3	3	4	3	4	3	2
25	4	4	3	4	3	3	4	5	4	4	3	5	5	4	5	4	5	4	5
26	5	5	5	5	5	5	5	5	4	4	5	5	4	5	4	4	5	5	4
27	4	4	4	5	3	2	4	4	4	3	3	4	4	4	4	2	4	4	4
28	5	4	5	5	4	4	5	4	5	4	4	O	5	5	4	5	5	4	4
29	5	5	4	5	5	5	5	5	5	5	5	5	4	5	4	4	5	5	4
30	5	O	O	4	4	4	5	5	4	4	4	4	4	4	4	3	4	4	3
Average to each statement*	4.633	4.222	4.214	4.367	4.000	3.966	4.300	4.133	3.967	4.033	3.767	4.357	4.069	4.267	4.167	3.800	4.167	3.833	3.933
Ranks	1	13	14	3.5	33.5	39	9	23.5	37	30	51	5	26	11	20	46.5	20	44	41

Respondent Number	Statement Number 20	Statement Number 21	Statement Number 22	Statement Number 23	Statement Number 24	Statement Number 25	Statement Number 26	Statement Number 27	Statement Number 28	Statement Number 29	Statement Number 30	Statement Number 31	Statement Number 32	Statement Number 33	Statement Number 34	Statement Number 35	Statement Number 36	Statement Number 37	Statement Number 38
1	4	5	5	4	5	5	5	5	4	4	5	4	4	5	5	5	5	5	5
2	2	2	2	4	4	2	3	4	4	4	2	3	2	3	3	4	2	5	5
3	4	4	5	5	5	5	4	4	4	4	4	4	4	4	4	4	4	4	4
4	3	3	4	5	3	2	2	5	2	3	1	1	5	5	4	4	4	4	5
5	4	5	4	4	3	3	5	5	5	4	3	4	3	5	5	4	3	5	5
6	4	4	5	5	4	4	4	4	5	5	5	5	5	5	5	5	5	5	5
7	2	4	3	3	4	4	4	3	4	4	4	3	3	3	3	3	2	3	4
8	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
10	3	5	4	4	4	5	5	5	5	5	5	5	5	5	2	3	3	3	5
11	3	4	4	4	4	4	4	4	4	4	4	4	3	3	3	3	3	4	4
12	5	4	5	4	3	4	4	4	4	3	5	5	4	4	O	5	4	4	5
13	2	4	5	4	4	4	4	2	4	4	4	4	5	2	2	4	2	1	4
14	3	5	4	5	5	4	5	4	4	5	5	5	3	4	4	4	3	4	4
15	4	5	4	5	5	4	5	5	4	4	4	4	4	5	5	5	4	4	4
16	5	5	5	5	5	4	4	4	5	5	5	4	4	4	3	5	5	4	4
17	4	5	5	5	4	3	4	5	5	5	4	4	3	4	4	3	4	5	5
18	4	5	5	5	5	4	5	5	4	5	4	4	5	5	4	4	4	5	5
19	4	5	5	O	4	5	4	4	5	5	5	5	5	4	4	5	4	5	4
20	5	4	5	5	5	5	4	5	4	4	5	2	4	4	4	4	4	4	4
21	4	4	4	5	5	5	5	5	4	4	4	4	5	5	5	4	4	5	5
22	2	2	2	4	4	2	3	4	4	4	2	3	2	3	3	4	2	5	5
23	4	5	4	4	4	3	5	5	5	4	3	4	3	5	5	4	3	5	4
24	2	5	3	3	4	4	4	3	4	4	4	5	4	3	3	3	2	3	4
25	3	3	4	5	3	2	2	4	2	3	1	1	4	5	4	4	4	4	5
26	4	5	5	5	5	4	5	5	4	5	4	4	4	5	4	4	4	5	4
27	2	4	5	4	4	5	4	2	4	4	4	4	5	2	2	4	2	1	4
28	5	5	5	4	5	4	4	4	5	5	5	4	4	4	3	5	5	4	4
29	4	5	5	5	5	4	5	5	4	5	4	4	5	5	4	4	4	5	5
30	3	5	4	O	4	4	4	4	5	5	5	5	3	3	4	5	5	4	5
Average to each statement*	3.433	4.200	4.167	4.286	4.133	3.767	4.033	4.100	4.067	4.167	3.833	3.767	3.833	3.967	3.655	4.000	3.500	4.000	4.367
Ranks	57	15.5	20	10	23.5	51	30	25	27.5	20	44	51	44	37	55	33.5	56	33.5	3.5

Respondent Number	Statement Number 39	Statement Number 40	Statement Number 41	Statement Number 42	Statement Number 43	Statement Number 44	Statement Number 45	Statement Number 46	Statement Number 47	Statement Number 48	Statement Number 49	Statement Number 50	Statement Number 51	Statement Number 52	Statement Number 53	Statement Number 54	Statement Number 55	Statement Number 56	Statement Number 57
1	4	5	3	5	4	5	4	4	4	5	4	5	5	5	4	4	5	5	5
2	4	4	5	3	4	3	3	4	3	2	5	5	1	3	3	3	3	2	5
3	4	4	4	4	4	5	4	5	4	4	4	4	5	5	5	5	5	4	4
4	3	O	5	4	3	4	5	4	4	5	5	5	3	5	4	5	4	5	5
5	5	5	4	5	4	4	5	4	5	5	4	5	5	5	3	5	5	5	3
6	5	5	4	5	5	5	5	5	5	5	4	5	5	5	5	5	5	5	5
7	3	3	4	3	4	3	4	3	4	3	4	5	2	3	5	3	4	4	5
8	5	5	5	5	5	5	5	5	5	5	5	5	O	5	5	5	5	5	5
10	4	4	4	4	4	4	3	3	3	4	3	5	4	4	5	4	5	5	5
11	4	3	4	4	3	3	3	3	3	3	3	4	3	3	4	3	4	4	4
12	5	4	4	3	4	5	4	4	4	3	5	5	5	5	5	4	5	4	5
13	4	4	3	2	2	4	2	4	4	4	4	4	4	4	4	2	4	4	4
14	3	5	4	3	4	4	2	2	4	4	5	3	4	2	5	3	5	3	4
15	4	4	4	3	3	5	4	4	4	4	4	5	4	5	5	5	5	4	5
16	5	5	4	4	4	4	2	4	4	5	5	4	4	5	5	O	O	4	4
17	5	4	4	4	4	3	4	3	4	4	4	5	5	5	5	4	4	5	4
18	4	5	5	5	5	4	5	4	4	4	4	5	5	5	5	5	5	5	5
19	4	4	4	4	4	4	4	4	4	4	5	4	5	4	5	4	4	4	5
20	4	4	5	4	5	5	4	4	5	5	5	4	4	5	5	5	5	5	4
21	5	4	4	5	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5
22	4	4	5	3	4	4	3	4	3	2	5	5	1	3	4	4	4	2	5
23	5	5	4	5	4	4	5	4	5	5	4	5	5	5	3	5	5	4	3
24	4	3	4	3	4	3	4	3	4	3	4	5	2	3	5	3	4	5	5
25	3	O	5	4	3	4	5	4	4	5	5	5	3	5	4	5	4	5	4
26	4	5	5	5	5	4	5	4	4	4	4	4	5	5	5	5	5	5	4
27	4	4	3	2	2	4	2	3	4	4	4	4	4	3	4	2	4	4	4
28	5	5	4	4	4	4	2	4	4	5	5	4	4	5	5	O	4	4	5
29	4	5	4	5	5	4	5	4	4	4	4	5	4	4	5	5	5	5	5
30	5	5	4	O	4	4	4	4	4	3	5	4	4	5	3	4	4	4	4
Average to each statement*	4.067	4.179	4.033	3.793	3.800	3.967	3.733	3.733	3.933	3.933	4.233	4.433	3.793	4.200	4.333	4.000	4.345	4.167	4.333
Ranks	27.5	17	30	48.5	46.5	37	53.5	53.5	41	41	12	2	48.5	15.5	7.5	33.5	6	20	7.5

Note:
1. The statement numbers correspond to the order of the questionnaire
2. Respondents were asked to rate 57seismic risk management statements they consider important to be carried out in Indonesian cities located in high seismic hazard5=v.important;4=important;3=nor;2=not important;1=absolutely not important;0=don't know)
3. 1.11% of responses stated '0' (don't know)

*) The mean score of all statements is 4.184 (between important and very important)

Table 9 Raw Data of Reporters' Opinion to Seismic Risk Management Statements

Respondent Number	Statement Number 1	Statement Number 2	Statement Number 3	Statement Number 4	Statement Number 5	Statement Number 6	Statement Number 7	Statement Number 8	Statement Number 9	Statement Number 10	Statement Number 11	Statement Number 12	Statement Number 13	Statement Number 14	Statement Number 15	Statement Number 16	Statement Number 17	Statement Number 18	Statement Number 19	Statement Number 20	Statement Number 21	Statement Number 22	Statement Number 23	Statement Number 24	Statement Number 25	Statement Number 26	Statement Number 27	Statement Number 28
1	4	2	2	4	3	4	3	4	4	4	5	4	4	4	5	2	4	2	2	2	5	4	4	4	4	3	4	5
2	5	0	5	4	5	5	5	5	5	5	5	4	0	0	4	4	5	4	5	5	4	4	5	4	5	5	5	5
3	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
4	4	0	5	5	4	5	5	5	5	5	5	5	5	5	4	4	4	4	0	5	5	5	5	5	4	5	4	5
5	5	5	0	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
6	5	5	5	5	4	4	5	4	4	4	4	3	3	4	5	4	4	3	5	5	5	5	5	4	5	5	4	5
7	5	4	5	5	4	4	5	5	5	5	5	5	5	5	4	5	4	3	4	4	5	5	5	4	5	5	5	4
8	4	4	4	4	4	4	5	4	4	5	4	4	4	4	5	2	5	4	4	4	5	3	0	2	3	4	4	4
9	5	4	4	4	4	4	4	4	4	4	4	4	4	4	4	0	4	4	4	4	4	4	4	4	4	4	4	4
10	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
11	5	5	5	5	5	5	5	5	5	4	4	5	5	5	5	5	3	4	4	4	4	5	5	4	5	5	5	5
12	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	5	5	5	5	4	4	4	4	5	5	5	4
13	0	0	0	0	1	5	5	4	4	5	4	5	4	3	5	4	4	5	3	3	4	5	0	3	5	4	4	5
14	4	4	5	4	5	5	5	5	5	5	5	5	0	0	5	5	5	4	5	4	0	5	5	0	5	4	5	4
15	5	5	5	4	4	4	5	5	5	5	5	5	5	5	5	5	4	5	5	5	4	5	4	5	5	5	5	5
16	5	5	5	5	5	4	5	5	5	4	5	4	4	4	5	5	5	4	5	4	5	4	5	5	5	5	5	4
17	5	5	5	4	5	4	4	4	5	5	4	5	5	4	5	5	5	4	3	3	5	5	5	4	4	5	5	4
18	5	5	5	4	3	4	5	4	5	5	2	4	4	5	5	4	5	3	3	3	4	5	5	2	5	5	3	4
19	5	5	5	4	4	5	5	5	5	4	0	4	0	3	4	4	5	4	5	4	5	5	5	4	5	5	5	4
20	5	4	4	4	4	4	4	4	4	4	4	5	5	5	5	5	4	4	5	5	4	5	5	5	5	5	5	4
21	5	5	5	5	4	4	5	5	5	5	5	5	5	5	5	5	5	4	5	5	3	4	5	4	5	5	5	5
22	5	5	5	5	5	5	5	5	5	0	0	0	0	0	5	0	5	5	5	5	5	5	5	3	5	5	5	5
23	5	4	4	4	4	4	4	4	4	4	4	3	4	3	3	3	4	4	4	4	4	3	4	4	3	4	3	3
24	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
25	4	0	5	3	4	4	5	5	3	3	3	4	2	4	5	5	5	5	5	4	3	4	5	4	5	2	5	5
26	5	5	5	4	5	0	4	4	5	4	4	5	4	4	4	5	4	5	4	4	5	5	5	4	4	4	4	5
27	5	5	5	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	5	5	5	5
28	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
29	4	3	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	5	5	5	5	5	5	5	4
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31	4	4	5	4	4	4	4	4	4	5	4	5	5	5	4	5	4	4	3	4	4	4	4	4	4	4	5	5
32	5	5	5	5	5	5	5	5	5	5	5	5	0	0	4	4	5	4	4	0	3	3	4	4	4	5	4	5
33	5	4	4	4	4	4	4	3	3	4	3	4	4	4	4	3	4	3	3	3	3	3	3	3	3	4	4	4
Average to each statement*	4.545	4.031	4.469	4.212	4.182	4.344	4.576	4.424	4.455	4.333	4.030	4.273	3.636	3.758	4.485	4.000	4.485	4.121	4.121	4.061	4.212	4.424	4.333	3.939	4.545	4.545	4.545	4.515
Ranks	4	44	12	28	31.5	19	1	15.5	13	21	45	23.5	55.5	53	10	46.5	10	38	38	42.5	28	15.5	21	49	4	4	4	7.5

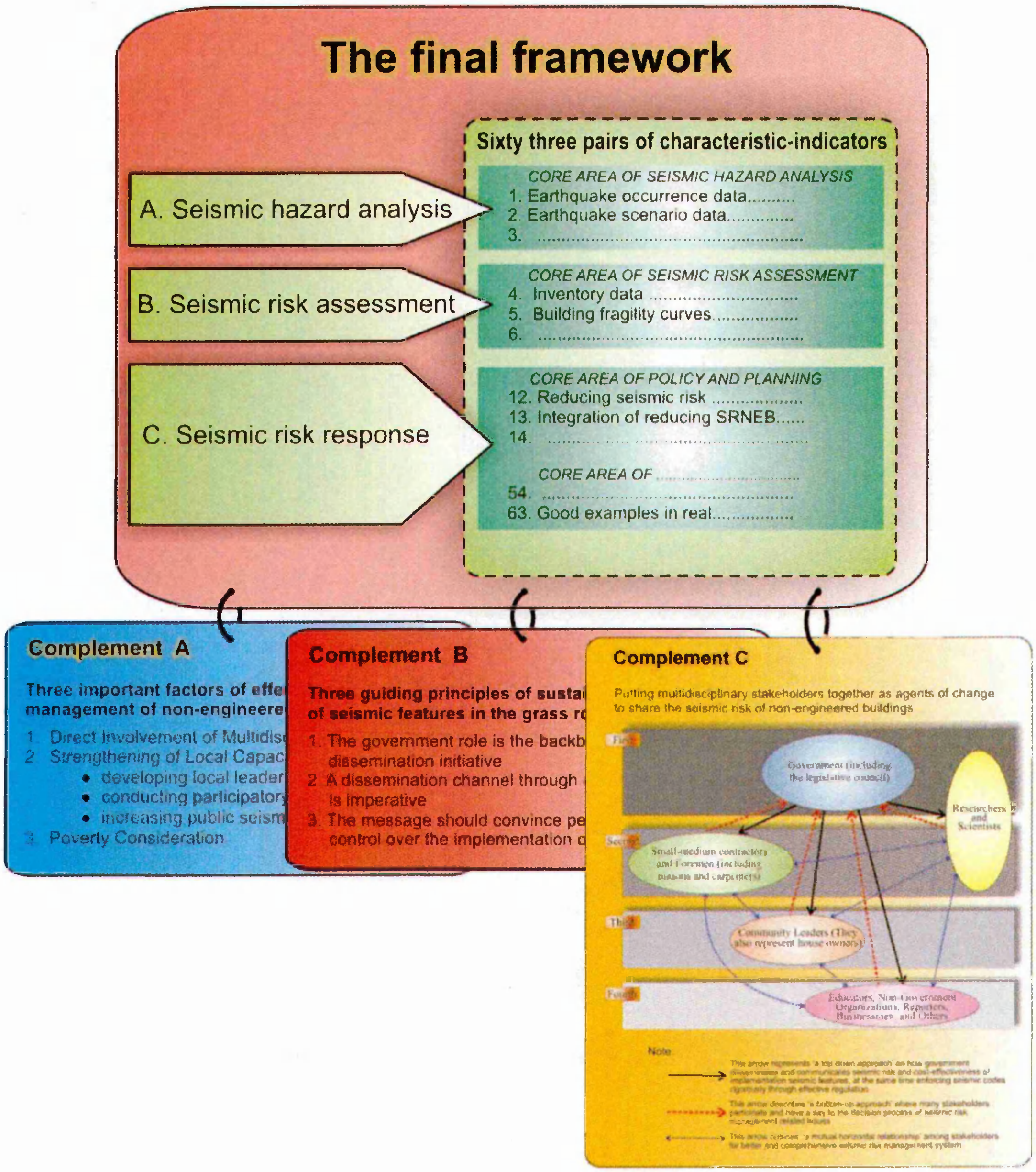
Respondent Number	Statement Number 29	Statement Number 30	Statement Number 31	Statement Number 32	Statement Number 33	Statement Number 34	Statement Number 35	Statement Number 36	Statement Number 37	Statement Number 38	Statement Number 39	Statement Number 40	Statement Number 41	Statement Number 42	Statement Number 43	Statement Number 44	Statement Number 45	Statement Number 46	Statement Number 47	Statement Number 48	Statement Number 49	Statement Number 50	Statement Number 51	Statement Number 52	Statement Number 53	Statement Number 54	Statement Number 55	Statement Number 56	Statement Number 57
1	4	3	4	2	3	3	3	0	4	4	4	4	4	3	3	4	4	4	4	4	4	5	1	4	4	4	4	4	4
2	5	5	5	4	4	4	4	4	5	5	4	4	4	4	5	4	4	4	4	4	4	4	4	4	5	4	4	4	4
3	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
4	5	5	0	5	5	5	5	4	4	5	5	5	5	4	4	4	4	4	5	5	5	4	4	5	4	4	5	5	5
5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
6	5	4	5	4	4	4	5	5	4	5	4	5	5	3	4	5	4	5	4	5	5	5	5	3	5	4	5	4	4
7	5	2	4	3	4	3	4	3	5	5	5	5	4	3	5	4	4	0	4	4	4	5	2	3	5	4	5	5	5
8	4	5	3	3	3	3	4	0	5	4	4	4	4	0	5	3	4	4	4	4	4	4	4	4	4	4	4	5	4
9	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	0	4	4	4	4
10	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
11	5	4	5	5	5	5	5	4	5	5	5	5	5	5	5	4	4	4	5	5	5	5	4	5	4	4	4	4	4
12	5	4	4	5	4	4	4	4	5	4	4	4	4	5	4	5	4	4	4	5	4	4	4	5	3	0	4	4	5
13	4	4	4	4	4	3	4	0	4	3	3	3	4	4	5	4	4	3	3	4	3	5	3	4	4	3	4	0	2
14	5	4	5	5	4	5	5	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	4	5	4	5
15	5	5	5	4	5	4	5	5	5	5	4	4	4	5	5	4	5	4	5	4	5	5	5	4	5	4	5	4	5
16	5	5	5	4	4	5	4	4	5	4	4	5	5	5	4	5	3	4	4	4	4	5	3	3	5	4	5	4	5
17	4	5	4	4	4	4	5	5	5	5	4	4	4	4	5	4	5	3	5	4	4	0	3	4	5	4	5	5	4
18	4	3	3	5	5	4	3	2	4	4	5	4	4	5	2	3	3	3	5	5	3	5	4	5	5	5	5	4	5
19	5	3	4	3	3	3	4	3	4	5	2	4	2	3	3	3	2	3	3	2	2	3	2	1	5	3	5	3	5
20	4	4	4	5	5	5	5	5	4	5	5	5	4	5	4	4	4	4	4	4	4	5	4	4	4	5	5	4	5
21	5	3	4	3	4	4	4	3	4	4	4	4	5	5	4	4	4	4	4	4	4	5	5	5	5	4	5	5	5
22	5	5	5	5	5	5	5	5	5	5	5	5	3	3	4	3	5	0	5	5	5	5	0	0	5	3	0	0	5
23	3	3	4	4	4	4	3	4	4	4	4	0	4	4	4	4	4	4	4	3	4	5	2	4	4	4	4	5	4
24	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
25	4	3	4	5	5	4	4	2	5	3	3	4	5	5	4	2	1	3	4	3	2	5	3	1	3	2	4	2	5
26	5	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	5	5	5	5	5
27	5	5	5	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	5	5	5	4	4	4	4	4
28	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	2	5	5	5	5	5
29	4	4	4	4	4	4	4	4	4	4	4	4	4	4	5	4	4	4	4	3	5	5	4	5	4	4	4	4	4
30	4	3	3	4	4	4	4	3	5	4	3	4	3	3	4	4	4	4	4	4	4	5	4	4	4	4	5	4	5
31	4	4	4	5	4	4	5	4	3	3	3	4	4	0	3	4	0	0	3	3	4	5	2	3	4	4	5	4	4
32	5	5	5	2	2	2	4	4	4	4	4	4	4	4	4	5	4	4	4	4	4	5	2	4	4	4	4	4	4
33	3	3	3	3	4	3	3	3	3	4	4	4	4	3	3	4	4	3	4	4	4	4	4	4	5	4	4	4	4
Average to each statement*	4.515	4.091	4.152	4.121	4.182	4.061	4.273	3.636	4.424	4.364	4.152	4.212	4.212	3.939	4.212	4.091	3.909	3.636	4.242	4.152	4.152	4.545	3.636	3.848	4.333	3.939	4.424	4.000	4.485
Ranks	7.5	40.5	34.5	38	31.5	42.5	23.5	55.5	15.5	18	34.5	28	28	49	28	40.5	51	55.5	25	34.5	34.5	4	55.5	52	21	49	15.5	46.5	10

Note:
1. The statement numbers correspond to the order of the questionnaire
2. Respondents were asked to rate 57seismic risk management statements they consider important to be carried out in Indonesian cities with high seismic hazard(5=v.important;4=important;3=nor;2=not important;1=absolutely not important;0=don't know)
3. 2.55% of responses stated '0' (don't know)

*) The mean score of all statements is 4.308 (between important and very important)

Appendix-5:

The final framework for guiding and monitoring seismic risk reduction of non-engineered buildings in Indonesia



The following explanation describes the above framework -----------------------------------→

'The final proposed framework', consisting of sixty three pairs of characteristic-indicator

Seismic Hazard Analysis

	Characteristics	Indicators
	Core area: Seismic Hazard Analysis	
	1. Earthquake occurrence data: their history, spatial distribution, characteristics, impacts, and the existing fault line *	Data recorded, mapped, up-dated, disseminated and communicated regularly
	2. Earthquake scenario data *	Existence of earthquake data to conduct deterministic earthquake scenario
	3. Earthquake scenario data *	Existence of systematic analysis of return period of earthquake occurrence to conduct probabilistic earthquake scenario

Seismic Risk Assessment

	Characteristics	Indicators
	Core area: Seismic Risk Assessment	
	4. Inventory data: geology/soil profiles and buildings *	Geology/soil profiles and buildings inventory data are recorded, mapped, and up-dated regularly as necessary, particularly in order to calculate the quantitative number of non-engineered buildings and their spatial distribution
	5. Building fragility curves *	Existence of building fragility curves: up-dated regularly and associated with the newest data
	6. Damage assessment *	Existence of systematic damage assessment of the possible economic impact to buildings using a seismic risk scenario both the deterministic and probabilistic approaches
	7. Land use applications *	Existence of seismic risk map using Geographic Information System (GIS)
	8. Land use application *	Existence of followed-up program of damage assessment in relation to the city spatial planning under 'the city spatial planning board'
	9. Land use application *	Existence of balanced information between a 'geographic seismic risk map' and a 'geographic city economic development map' for a better understanding for public and investors
	10. Land use application *	Community members and many stakeholders become involved in seismic risk map dissemination and communication
	11. Building interior layout *	Existence of information about a seismic resistant interior layout: disseminated and communicated to the public

Seismic Risk Response

Core area: Policy and Planning	
12. Seismic risk reduction of non-engineered buildings (SRRNEB) as a policy priority	Existence of SRRNEB commitment and strategy on a city level (including collaboration with donor agencies, in relation to the context of decentralization)
13. Integration of SRRNEB in development planning and sectoral policies (including poverty eradication)	Established or revised policies to facilitate action, regulation, enforcement, and/or incentives
14. Responsibilities of SRRNEB	Map out institutions with responsibilities of SRRNEB
Core area: Legal and Regulatory Framework	
15. Seismic codes *	Seismic codes (socially acceptable, written in simple language, easy to implement, and economically feasible) are in existence and updated
16. Laws and regulations	Existence of an administrative and institutional mechanism framework for the implementation of seismic codes
17. Compliance and enforcement	Existence of regulation of builders and real estate developers for the creation of seismic resistant buildings
18. Compliance and enforcement	Existence of rigorous regulation of the issuance of a 'building construction permit' for builders and the issuance of the formal 'fit for sale certificate' for every house as a product of real estate firms for widespread creation of seismic resistant buildings
19. Compliance and enforcement	Existence of systems to control compliance and enforcement in actual practices under the 'city construction control committee'
20. Certification system for engineers, architects, and foreman	Existence of compulsory certification system for engineers, architects, and foremen
21. Responsibility and accountability	Existence of watchdog groups
Core area: Organizational Structure	
22. Implementing and co-coordinating bodies	Existence of a city-wide administrative structure responsible for disaster reduction
23. Intra and inter-ministerial, multidisciplinary & multisectoral mechanisms	Existence of sectoral programmes in line ministries
24. Civil society, NGOs, private sector and community participation	Existence of consultation, and role for civil society, NGOs, private sector and the communities to reduce seismic risk
25. Civil society, NGOs, private sector and community participation	Existence of a group or an individual that have incorporated earthquake risk reduction as a permanent or significant part of their operations and commitment, for example the existence of one permanent facilitator team graduated from civil engineering to take care of the dissemination to the certain community

	Core area: Resources	
	26. Resource mobilization and allocation: financial (innovative and alternative funding), incentives, human, technical, material	Existence of disaster management office
	27. Resource mobilization and allocation: financial (innovative and alternative funding, incentives), human, technical, material	Evidence of permanent budgetary allocation
	28. Resource mobilization and allocation: financial (innovative and alternative funding, incentives), human, technical, material	Expert staffing allocation
	29. Resource mobilization and allocation: financial (innovative and alternative funding, incentives), human, technical, material	Existence of established link with donor organizations
	Core area: Information Management and Communication	
	30. Information and dissemination programmes and channels	Existence of dissemination media through web-sites
	31. Information and dissemination programmes and channels	Existence of documentation, databases, and information system on seismic risk
	32. Information and dissemination programmes and channels	Continuity of dissemination channels and participation down through grass-root communities and use of traditional/indigenous knowledge and practice
	33. Networks for seismic risk management (scientific, technical, and applied information, traditional/indigenous knowledge),	Existence of multidisciplinary stakeholder networks in seismic risk management
	34. Networks for seismic risk management (scientific, technical, and applied information, traditional/indigenous knowledge),	Existence of information centers and networks in seismic risk management
	35. Networks for seismic risk management (scientific, technical, and applied information, traditional/indigenous knowledge),	Existence of inter-city exposure visits for city managers for mutual learning
	36. Networks for seismic risk management (scientific, technical, and applied information, traditional/indigenous knowledge),	Existence of pro-active sharing of best practices for earthquake risk management for wider circulation
	Core area: Education and Training	
	37. Inclusion of seismic risk reduction at all levels of education (curricula, educational material)	Existence of appropriate curricula in seismic risk reduction at all levels of education
	38. The role of teachers through school activities	Existence of the role of teacher to disseminate and apply seismic codes in real practice through their student activities (including collaboration with other parties)
	39. Training of trainer (TOT) programmes	Existence of TOT for community leaders periodically

	40. Local, National, and International training programmes	Existence of training for development authorities, Community Organization, NGOs, group of foreman, private sectors: real-estate firms, builders, small-medium contractors in safe-building practices and retrofitting techniques, through various methods such as: elucidation, workshop, and learning by doing in real construction.
	41. Local, National, and International training programmes	Existence of apprentice programmes in seismic risk management for government disaster management staff
	Core area: Public Awareness	
	42. Public awareness policy, programmes, and material	Existence of city-wide specific awareness campaigns and strategies in seismic risk.
	43. Dissemination and use of traditional/indigenous knowledge through media involvement in communicating seismic risk	Availability and accessibility of information (handbook, poster, newspaper, exhibition, talks show, short TV program, audiovisual program, etc) in introducing seismic features of buildings with simple technical approaches understandable to the laypersons, including the existence of model houses with seismic features, low-cost, and simple in neighbouring areas
	44. Dissemination and use of traditional/indigenous knowledge through media involvement in communicating seismic risk	Existence of tradesman involvement in producing and circulating the seismic features information
	45. Dissemination and use of traditional/indigenous knowledge through media involvement in communicating seismic risk	Existence of a mechanism to monitor the increasing number of aware and informed community members such as students and teachers, key government functionaries, construction actors and engineering institutions, policy makers etc.
	46. Dissemination and use of traditional/indigenous knowledge through media involvement in communicating seismic risk	Existence of community-based informal meetings discussing good practices in seismic features of buildings
	47. Dissemination and use of traditional/indigenous knowledge through media involvement in communicating seismic risk	Existence of artist involvement in communicating seismic features
	48. Earthquake Safety Day	Visibility of Earthquake Safety Day through: school activities, audio-visual programmes, competitions, mock drills, etc
	49. Documentation	Existence of documents of the appropriate cost of effective retrofitting techniques and sharing of best practices, conference proceedings and articles in popular magazines
	50. Monument of tragic earthquake event	Existence of monument to commemorate the tragic event of an earthquake
	Core area: Research	
	51. Cost-effectiveness research on the application of seismic features *	Existence of cost-effectiveness research in the application of seismic features both for new and existing buildings (retrofitting)
	52. Interdisciplinary research between science and policy *	Existence of reducing seismic risk through interdisciplinary research between science and policy (evidence-based policy) comprehensively

	53. Evaluation and feedback *	Existence of indicators, standards and methodologies for seismic hazard analysis and assessment, unique to their local needs
	54. Local, National, and International co-operation in research: science and technology development, social and culture	Providing technical support, training, and periodic assessments on earthquake vulnerability through research/knowledge at all community levels.
	55. Local, National, and International co-operation in research: science and technology development	Existence of local academic institutions as Key Resource Institutions for earthquake risk management
	56. Local, National, and International co-operation in research: science and technology development	Existence of Local, National, and International exchange
	Core area: Social and Economic Development Practices	
	57. Pro-poor and sustainable livelihood strategies	Earthquake occurrence data: their historical, spatial distribution, characteristics, impacts, and the existing fault line.
	58. Financial instruments	Existence of an incentive strategy for new buildings with seismic features
	59. Financial instruments	Existence of earthquake insurance initiative
	Core area: Physical Measures	
	60. Introducing seismic codes in new and existing buildings *	Compliance of public and private buildings with seismic codes and standards
	61. Good examples of real constructions*	Existence of a retrofitting program for public buildings (health facilities, schools, lifelines, etc) at high seismic risk
	62. Good examples of real constructions*	Existence of regular maintenance of seismic features in structures
	63. Good examples of real constructions*	Existence of a number of model houses with seismic features, low-cost, and simple as well as ready to be replicated in other areas. For example: a number of houses made of different materials, extendable houses, and a post patrol ('gardu ronda') in the neighbourhood area

*) The pairs are close to the technical intervention

Complement A

Three important factors of effective seismic risk management of non-engineered buildings:

1. Direct Involvement of Multidisciplinary Stakeholders
2. Strengthening of Local Capacities
    - developing local leadership
    - conducting participatory approaches
    - increasing public seismic awareness
3. Poverty Consideration

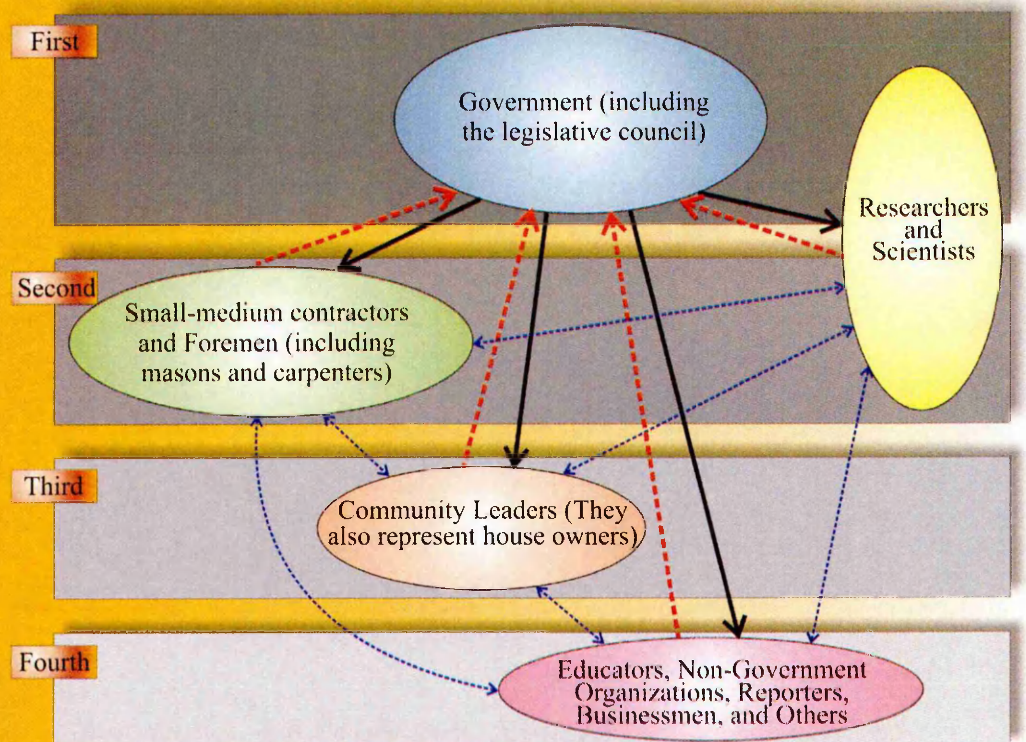
Complement B

Three guiding principles of sustainable dissemination of seismic features to grass root community:

1. Government role is the backbone of dissemination initiative
2. Dissemination channel through the existing social bond is imperative
3. The message should convince people that they can control over the implementation of seismic codes.

Complement C

Putting multidisciplinary stakeholders together as agents of change to share the seismic risk of non-engineered buildings



Note:

This arrow represents 'a top-down approach' on how government disseminates and communicates seismic risk and cost-effectiveness of implementation seismic features, at the same time enforcing seismic codes rigorously through effective regulation

This arrow describes 'a bottom-up approach' where many stakeholders participate and have a say to the decision process of seismic risk management related issues

This arrow outlines 'a mutual horizontal relationship' among stakeholders for better and comprehensive seismic risk management system

Appendix-6:

Copy of Indonesian newspaper article

Indonesian newspaper article

The title: Seismic Risk Management: Yogyakarta please be ready to earthquake!
(Manajemen Risiko Gempa:Yogyakarta Bersiaplah)
Name of newspaper: Kedaulatan Rakyat
The purpose: Encouraging Yogyakarta people to be ready to earthquake following tragic seismic event in Aceh 26 December 2004
Date: 10 January 2005
Authors: Setya Winarno and Prof. Dr. Sarwidi

Manajemen Risiko Gempa: Yogyakarta Bersiaplah

OLEH
Setya Winarno & Sarwidi

BENCANA gempa di bumi Indonesia sudah tidak asing lagi muncul ke permukaan karena secara geologi wilayah Indonesia merupakan tempat bertemunya beberapa lempeng tektonik penyebab gempa. Gempa dengan kekuatan 9 skala Richer di pantai selatan Aceh tanggal 26 Desember 2004 menduduki rangking ke 5 gempa terbesar di dunia (sejak 1900) setelah 1960 Chile skala 9,2; 1964 Prince William Alaska skala 9,1; 1957 Andrean of Island Alaska skala 9,1; 1952 Kamchatka skala 9. Jumlah korban meninggal yang mencapai 126.000 orang, tersebar di 12 negara (korban terbanyak di Indonesia yang mencapai 80.000 orang) merupakan rangking ke 4 di dunia setelah Xining China 1927 dengan 200.000 meninggal; 1920 Gansu China dengan 200.000 meninggal; 1923 Kanto Jepang dengan 143.000 meninggal (*sumber: www.earthquake.usgs.gov).*

Gempa yang berpusat di lepas pantai selatan Aceh dengan yang diakibatkannya mengingatkan kembali kepada masyarakat di dunia terhadap pentingnya perencanaan dan persiapan pra-gempa untuk mitigasi/pencegahan terhadap efek yang ditimbulkan. Ini jelas bahwa peringatan dini dari institusi yang berwenang dan tingkat kewaspadaan/kesiapan penduduk dirasakan sangat kurang, sehingga kejadian tragis itu terjadi.

Kejadian-kejadian tragis di awal abad 21 telah menunjukkan betapa besarnya korban dan kerugian yang ditimbulkan di negara2 yang sedang berkembang. Kejadian gempa itu meliputi 2001 di India 20.000 meninggal, 2002 di Afghanistan 1.000 meninggal, 2003 di Algeria 2.266 meninggal, 2003 (26 Des) di Iran 26.200 meninggal, dan 1 th kemudian di tanggal yang sama 26 Des 2004 di selatan pantai Aceh 125.000 meninggal.

Komunitas Tahan Uji

Tantangan yang dihadapi penduduk dunia adalah mengimplementasikan ilmu kegempaan secara teknis operasional serta efek yang ditimbulkan pada semua aspek komunitas: masyarakat, pemerintah, akademisi, dunia bisnis, dan instansi yang lain baik dari sisi tingkat kewaspadaan, ketahanan bangunan, dan lingkungan hidup yang menjamin adanya keselamatan. Pada akhirnya sisi sosial, politik, dan ekonomi harus bekerja secara bersama-sama untuk mewujudkan komunitas baik di perkotaan maupun di pedesaan tahan uji terhadap bencana gempa serta efek yang ditimbulkan.

Sebagai contoh komunitas yang tahan uji terhadap bahaya gempa adalah di California Amerika Serikat. Cerita tentang California tidak lepas dari catatan sejarah gempa yang signifikan yang berulang kali menerpa wilayah ini. Sejak gempa San Francisco di tahun 1906, hampir 100 tahun yang lalu, berbagai upaya mitigasi/pencegahan, riset, dan pengembangan telah dilakukan guna mewujudkan komunitas yang tahan uji gempa. Sekarang, keselamatan terhadap gempa sudah diimplementasikan di semua aspek perencanaan, pembangunan, bisnis dan lingkungan hidup yang berkesinambungan di California. Sehingga masyarakat dunia saat ini jarang sekali mendengar adanya korban gempa di daerah California meskipun di daerah itu gempa sampai level menengah datang secara bertubi-tubi. Semua penduduk telah menyadari sepenuhnya bahwa gempa itu tidak membunuh orang, tapi yang membunuh adalah bangunan yang dibangun secara sembarangan dan infrastruktur (termasuk untuk peringatan dini) yang tidak memadai.

Mestinya gempa Aceh tidak sedahsyat ini, apabila sejak awal sudah ada upaya mitigasi termasuk peringatan dini. Dr Laura SL Kong, Direktur International Tsunami Information Center di Hawai, telah menginformasikan adanya gerakan gelombang yang luar biasa segera setelah kejadian gempa di pantai Sumatra kepada 26 negara di kawasan sekitar Pasifik, termasuk Indonesia. Namun yang terjadi, informasi tidak dapat sampai ke daerah bencana karena ketidaksiapan aparat pemerintah setempat. *Nah......* terjadilah malapetaka yang sungguh tragis di Aceh.

Manajemen Risiko Gempa

Hal pokok yang harus digaris bawahi adalah bahwa komponen utama dalam upaya manajemen risiko gempa adalah tanggung jawab dan usaha bersama dalam rangka mengurangi efek gempa di masa yang akan datang, antara lain sebagai berikut:

(a). Penyebarluasan informasi tentang kesigapan dan kesadaran hidup di daerah gempa. Hal ini dapat dicapai melalui anak didik sekolah, yang melatih kesigapan siswa apabila terjadi gempa, yang pada akhirnya dapat disampaikan kepada orang tuanya masing-masing apa yang telah mereka pelajari tentang gempa di sekolah. Selain itu, adanya brosur-brosur tentang bahaya gempa yang dicetak dan disebarkan di daerah tersebut: Apa yang harus dilakukan pada diri, keluarga, rumah, dan perabotan sebelum, selama dan sesudah terjadi gempa. (b). Penegakan peraturan terhadap rumah tahan gempa dan infrastuktur yang ada dengan desain dan pembangunan secara tepat, yang meliputi standar keamanan, material, tenaga kerja, metode kerja, dll.

(c). Beberapa fasilitas yang esensial yang tetap harus menjalankan fungsinya apabila terjadi gempa harus didesain dan dibangun dengan standar ketahanan gempa yang lebih tinggi. Misalnya: rumah sakit, pemadam kebakaran, kantor polisi dan sekolah. (d). Pemerintah secara tegas harus mengatur tataguna lahan pada daerah-daerah yang rawan efek lain dari bencana gempa, misal longsor, likuifaksi bahkan Tsunami. (e). Pemerintah harus menyediakan informasi dan bantuan untuk strategi-strategi mitigasi pra-gempa dan juga respons yang harus diambil setelah gempa terjadi. (f). Pengadaan tanggungjawab korporasi untuk menciptakan lingkungan kerja yang aman bagi semua pekerja melalui pembelajaran manajemen risiko pada bisnis. (g). Pengadaan asuransi gempa untuk rumah tinggal dan bisnis komersial

Meskipun bencana gempa yang cukup besar memiliki probabilitas yang kecil tetapi efek gempa mempunyai konsekuensi kerugian yang sangat tinggi. Tapi gempa yang signifikan tidak terjadi tiap tahun, bahaya gempa tidak boleh diartikan tidak mendatangkan malapetaka bagi masyarakat, dunia bisnis dan pemerintah. Tanpa adanya mitigasi (termasuk peringatan dini), risiko bencana gempa menjadi sangat besar seperti di Aceh saat ini. Hal ini berimbas dengan proses rekonstruksi terhadap bangunan, infrastruktur, psikologi masyarakat, dan tata pemerintahan memakan waktu sampai bertahun-tahun. Terlebih lagi bagi Bangsa Indonesia yang sedang membangun dimana kondisi ekonomi belum membaik, bencana gempa di Aceh menyebabkan kondisi masyarakat dan lingkungan kembali ke beberapa tahun silam.

Kontribusi dari negara-negara maju untuk upaya manajemen risiko gempa barangkali hanya sebatas menyalurkan ilmu pengetahuan dan peralatan gempa dengan segala aspeknya, tidak akan bisa memandu secara detail proses manajemen gempa sepenuhnya kerena berkaitan dengan kompleksitas masalah sosial, politik, ekonomi dan sebagainya. Pada kenyataannya yang terjadi adalah adanya jurang pemisah antara pengetahuan yang ada dengan implementasinya, yang benar-benar terjadi di negara berkembang seperti di Indonesia. Melihat peta geologi Indonesia, bencana gempa sebesar di Aceh betul-betul sedang menunggu untuk terjadi lagi. Mestinya setiap komunitas berusaha menutup jurang pemisah tersebut dengan mengidentifikasi alur yang paling lemah sebagai tahap awal menuju komunitas yang tahan uji bahaya gempa dengan manajemen risiko gempa. Pengambil keputusan juga harus mengambil langkah ke depan dengan upaya mitigasi apabila gempa sebesar Aceh terjadi lagi, dan tidak hanya meresponsnya setelah adanya malapetaka, baik nyawa dan harta benda.

Risiko Gempa di Yogyakarta

Wilayah Pulau Jawa bagian selatan, termasuk Yogyakarta, dalam *'Peta Wilayah Rawan Bencana Gempa Indonesia'* yang disusun oleh Pusat Penelitian dan Pengembangan Geologi, Bandung (2001) termasuk wilayah yang berisiko tinggi terhadap goncangan tanah akibat gempa. Wilayah ini berpeluang terjadi goncangan tanah sampai dengan intensitas VI-VII skala MMI. Wilayah yang berpeluang terjadi intensitas lebih dari skala VI MMI ditandai dengan warna merah. Ibukota-ibukota propinsi di Indonesia yang ditandai dengan warna merah adalah Yogyakarta, Mataram, Banda Aceh, Manado, Gorontalo, Bengkulu, Kupang, Padang, Ternate, Palu, Ambon dan Jayapura.

Risiko gempa yang berupa goncangan tanah (tanpa mengikutsertakan Tsunami) di suatu tempat dipengaruhi oleh (a) besarnya goncangan permukaan tanah, (b) jumlah penduduk, (c) nilai aset, dan (d) kerentanan aset terhadap goncangan tanah. Risiko malapetaka gempa menjadi sangat besar dikala mengguncang kota berpenduduk padat, aset yang berupa bangunan dan infrastruktur nilainya cukup besar dan aset tersebut tidak tahan gempa.

Yogyakarta yang ditandai dengan warna merah di peta mempunyai penduduk terpadat (sekitar 12069 orang/km2; BPS 2003) dibandingkan dengan 11 ibukota propinsi di atas. Selain terpadat penduduknya, aset yang dimiliki Kota Yogya nilainya cukup signifikan (hotel, gedung perkantoran, pertokoan, sekolah, bangunan kuno, beserta segenap infrastrukturnya) dan sampai saat ini belum ada ukuran yang pasti berapa level kerentanan aset tersebut terhadap goncangan gempa. Di sisi lain, Yogyakarta adalah salah satu ibukota propinsi di Jawa yang terletak di sisi selatan Pulau Jawa berdekatan dengan sumber gempa di Samudera Indonesia yang berpeluang terjadi gempa 8,2 skala Richter *(Firmansyah, Irsyam, Kertapati, 1999).*

Sungguh, Yogyakarta yang berpenduduk yang padat, beraset yang signifikan, dekat dengan pusat gempa merupakan daerah sangat tinggi risikonya terhadap bahaya gempa. Berkaca dari besarnya malapetaka gempa yang terjadi Indonesia dan berbagai belahan dunia terutama di negara-negara yang sedang berkembang. komunitas di Yogyakarta harusnya sudah membekali dirinya untuk tahan uji terhadap bahaya gempa. Sudah saatnya semua elemen masyarakat di Yogyakarta dibekali mitigasi bahaya gempa dengan manajemen risiko gempa. Alangkah bangganya, apabila komunitas di wilayah Yogyakarta dan sekitarnya: masyarakat, pemerintah, akademisi, dunia bisnis, dan instansi yang lain, menyandang predikat kota pendidikan dan kota tahan gempa (seperti di California). Gempa sebesar 8,2 atau lebih di pantai selatan Jawa (sebenarnya) sedang menunggu untuk menghentak Wilayah Yogyakarta dan sekitarnya. Yogyakarta bersiaplah dengan manajemen risiko gempabumi yang bersiklus! Wallahu alam. □ - c

*) *Setya Winarno MT, PhD Student in Sheffield Hallam University, UK) & Ir Sarwidi, PhD, Direktur CEEDEDS dan Dosen Teknik Sipil UII)*

Appendix-7:
Copy of poster publication

Poster Publication

1. Date: 9 May 2007
   Name of event: Poster Competition and Networking Event
   Host institution: Leeds Metropolitan University
2. Date: 20 June 2007
   Name of event: 'Heritage and the Environment Conference 2007'
   Host institution: Glasgow Caledonian University and Sabhal Mōr Ostaig

Appendix-8:
Miscellaneous

Sheffield Hallam University

11 July 2005

To Whom It May Concern:

Name:	**Setya WINARNO**
Student ID:	**14030496**
Programme:	**PhD Research Programme (Full-time)**
Title of Research:	**Seismic Risk Management of Non-Engineered Buildings**
Commencement:	**1 October 2004**
Nationality:	**Indonesia**

PROGRESS REPORT

I can confirm that Mr Winarno, registered PhD candidate with Sheffield Hallam University, has made 'excellent' progress in the first phase of his research programme. Phase 1 research has involved the development of research aims and objectives, outline research methodology and the draft of a comprehensive literature review. All of these aspects have been completed to a very high standard.

Phase 2 of the research is to carry out a pilot study to develop the research methodological approach in detail and to gather quantitative and qualitative data using a questionnaire survey, interviews and workshops. This will take place over the next six to eight months.

At this time, we are well satisfied with progress made and the planning for the next phase of the research programme.

Yours sincerely

Professor Dr. Alan Griffith
Research Director of Studies.

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This Centre is part-financed by the European Regional Development Fund

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To whom it may concern

Mr Setya WINARNO
PhD Research Student Programme

PROGRESS REPORT

I am writing to confirm the current progress of PhD research being conducted by Mr Setya Winarno.

Mr Winarno has completed the critical evaluation of literature in connection with his studies. He has also completed the pilot study associated with his primary data collection. Both of these stages have been carried out to a very high standard of investigation and written presentation.

The next stage of the research is to collect primary data which is being undertaken during mid 2006 in Indonesia. The underpinning research methodology for this stage is clearly in place and it is expected that the data gathered will be of a high standard to facilitate the final stages of the research.

We would take this opportunity to confirm that the overall progress of Mr Winarno's PhD studies has been excellent and that all stages have been conducted most effectively and to a very high standard.

Should you require any further information then please do not hesitate to contact me.

Yours sincerely

Professor Dr. Alan Griffith
Research Director of Studies

Sheffield Hallam University

11 July 2005

To Whom It May Concern:

Name:	**Setya WINARNO**
Student ID:	**14030496**
Programme:	**PhD Research Programme (Full-time)**
Title of Research:	**Seismic Risk Management of Non-Engineered Buildings**
Commencement:	**1 October 2004**
Nationality:	**Indonesia**

DATA COLLECTION

I can confirm that Mr Winarno, registered PhD candidate with Sheffield Hallam University, is currently conducting the data collection phase of his research programme.

Mr Winarno will be collecting information using a questionnaire survey, selected interviews and a number of workshop events.

Your assistance in connection with the research programme is kindly requested.

Yours sincerely

Professor Dr. Alan Griffith
Research Director of Studies.

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To whom it may concern

Mr Setya WINARNO
PhD Research Student Programme

Mr Winarno's programme of PhD research is examining *Seismic Risk Management of Non-Engineered Buildings.* He is currently at the stage of gathering data for his studies which will take place during mid-2006 in Indonesia.

Sheffield Hallam University would welcome your involvement in assisting Mr Winarno with this important stage of his PhD research. It is a programme of research which we believe will have considerable impact and usefulness to the future of building work in Indonesia.

We thank you for your kind interest and help in this research programme.

Yours sincerely

Professor Dr. Alan Griffith
Research Director of Studies

heritage futures

GLASGOW CALEDONIAN UNIVERSITY

Ms Setya Winarno
Owen Building Room 946
Sheffield Hallam University
Howard Street
Sheffield S1 1WB

5 March 2007

Dear Setya

Thank you for your interest in the 'Heritage and the Environment' conference to be held at Sabhal Mor Ostaig in the Isle of Skye, 19-23 June 2007. I am happy to confirm that your poster presentation has been accepted for the conference.

I look forward to meeting you in Skye.

Kind regards

Fiona McLean

Professor Fiona McLean

Summary of activities in relation to the research project

1. **Indonesian newspaper article**
   The title: Seismic Risk Management: Yogyakarta please be ready to earthquake!
   (Manajemen Risiko Gempa:Yogyakarta Bersiaplah)
   Name of newspaper: Kedaulatan Rakyat
   The purpose: Encouraging Yogyakarta people to be ready to earthquake following tragic seismic event in Aceh 26 December 2004
   Date: 10 January 2005
   Authors: Setya Winarno and Professor Dr Sarwidi

2. **Research work**
   The title: Study on 27 May 2006 Earthquake Economic Loss on Residential Houses in Yogyakarta City, a Comparison between the Estimation and the Actual Loss
   (Kajian Perbandingan Kerugian Bencana Gempa 27 Mei 2006 pada Sektor Rumah Tinggal Di Kota Yogyakarta Antara Kerugian Hasil Estimasi dan Kerugian Aktual)
   Institution: Research Institute, Islamic University of Indonesia
   Authors: Professor Dr Sarwidi and Setya Winarno

3. **Poster publication**
   a. The title: Framework for Guiding and Monitoring Seismic Risk Reduction of Non Engineered Buildings
      Name of event: Poster Competition and Networking Event
      Host institution: Leeds Metropolitan University
      Date: 9 May 2007

   b. The title: Framework for Guiding and Monitoring Seismic Risk Reduction of Non Engineered Buildings
      Name of event: Conference of 'Heritage and Environment'
      Host institution: Glasgow Caledonian University
      Date: 20 June 2007

4. **There were two papers for journals**