Challenges in delivering the UK-SPEC learning outcomes in engineering - a non-Russell Group sector experience

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Challenges in delivering the UK-SPEC learning outcomes in Engineering Analysis:

a non-Russel Group sector experience

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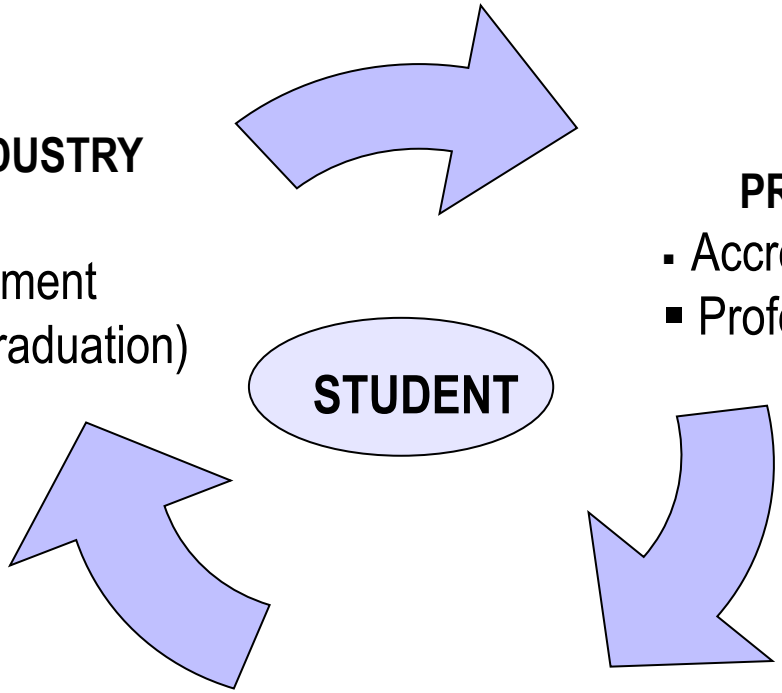
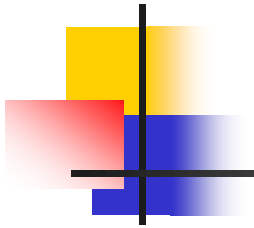
Why have we selected this topic?

We thought it is timely to draw attention to what really contributes to the **identity of an engineering degree programme** and some of the complexities associated with its delivery to satisfy stake holder aspirations.

Context



Key stakeholders



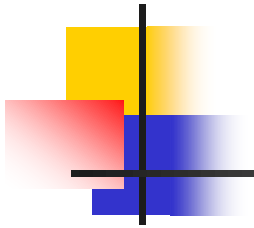
Who sets out threshold academic standards that all providers of UK higher education (in engineering) should ensure?

Academic Standards

The Quality Assurance Agency (QAA)

Subject Benchmark Statement for Engineering

sets out threshold academic standards that all providers of UK engineering higher education reviewed by the QAA should ensure.



Who regulates the Engineering Profession ?

The Engineering Council (EC)

The UK regulatory body for the engineering profession

The Engineering Council sets and maintains the internationally recognised standards of professional competence and ethics that govern the award and retention of the titles, Chartered Engineers (CEng), Incorporated Engineers (IEng), Engineering Technicians (EngTech) etc.

Engineering Council

Engineering Institutions and the Engineering Council

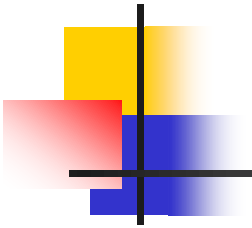
How does the Engineering Council ensure uniformity of professional standards across the Engineering Institutions ?

The UK-SPEC

The UK-SPEC sets out the required competence levels for registration as a Chartered Engineer (CEng), Incorporated Engineer (IEng), or an Engineering Technician (EngTech). It describes the requirements that have to be met in order to gain these professional qualifications, and gives examples of ways of doing this.

The United Kingdom **S**tandard for **P**rofessional **E**ngineering **C**ompetence

Competence:
The ability to carry out a task to an effective standard.
Its achievement requires the right level of **knowledge**, **understanding** and **skill** .



- **Knowledge** - Information that can be recalled.
- **Understanding -** Capacity to use the knowledge creatively (in problem solving, design, diagnosis etc.)
- **Skills -** Acquired and learned attributes that can be applied almost automatically.
- **Know-how -** Ability to apply learned knowledge and skills to perform operations intuitively, efficiently and correctly.
- **Transferable skills**?

  A mix of certain subject specific skills as well as the general abilities a student develops during a programme of study that will be of value in a wide range of situations.

Engineering Degree Accreditation

The Engineering Council sets the overall requirements for the Accreditation of Higher Education Programmes **(AHEP)** in engineering, in line with the UK Standard for Professional Engineering Competence (UK-SPEC).

AHEP was first published by the Engineering Council in 2004, and adopts the same outcomes-focused approach as UK-SPEC. It was reviewed in 2013 with its latest edition published in April 2014.

Since 2006, the Quality Assurance Agency (QAA) has adopted the Engineering Council's learning outcomes as the subject benchmark statement for engineering.

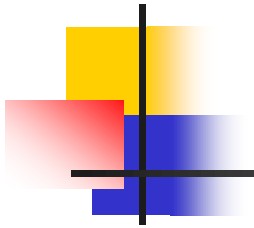
Subject Benchmark Statement for Engineering (QAA - February 2015)

QAA
Subject Benchmark Statement
Engineering
February 2015

Relevant Quotes .....

QAA has worked closely with the Engineering Council to ensure that this Statement takes account of the review and revision of the *Accreditation of Higher Education Programmes: UK Standard for Professional Engineering Competence*, which was completed in May 2014. The Statement reaffirms the link between the Benchmark Statement and the *Accreditation of Higher Education Programmes: UK Standard for Professional Engineering Competence*,

Since 2006, the engineering community has agreed that the academic standards expected of engineering graduates are the same as the learning outcomes for graduates of Engineering Council accredited degrees, as set out in the *Accreditation of Higher Education Programmes: UK Standard for Professional Engineering Competence*. For this reason a separate list of standards is not provided in this benchmark statement. Instead readers are referred to the *Accreditation of Higher Education Programmes: UK Standard for Professional Engineering Competence*.



This approach enables engineering higher education providers to work from a single point of reference to meet academic and professional standards, thereby minimising the danger of conflicting interpretations, either by higher education providers or accrediting agencies.

The six key areas of learning..... (AHEP - EC)

- Science and mathematics
- Engineering analysis
- Design
- Economic, legal, social, ethical and environmental context
- Engineering practice
- Additional general skills

Note : What were previously (prior to AHEP 3rd edition - May 2014) referred to as 'General Learning Outcomes' have mostly been integrated within the five engineering-specific areas of learning, except for some that are listed as 'additional general skills', which are primarily transferable skills additional to those incorporated within the other learning outcomes.

THE SUMMARY OF UK-SPEC SPECIFIC LEARNING OUTCOMES (US and E categories)

Undergraduate programmes:

Underpinning Science and Mathematics and associated engineering disciplines (US)

US1m	A comprehensive understanding of the scientific principles of mechanical and related engineering disciplines.
US2m	A comprehensive knowledge and understanding of mathematical models relevant to the mechanical and related engineering disciplines, and an appreciation of their limitations.
US3m	An understanding of concepts from a range of areas including some outside engineering, and the ability to apply them effectively in engineering projects.
US4m	A comprehensive knowledge and understanding of the role and limitations of ICT, and an awareness of developing technologies in ICT.

Engineering Analysis (E)

E1m	Ability to use fundamental knowledge to investigate new and emerging technologies.
E2m	Ability to extract data pertinent to an unfamiliar problem, and apply its solution using computer based engineering tools when appropriate
E3m	An understanding of the capabilities of computer based models for solving problems in engineering, and the ability to assess the limitations of particular cases.
E4	Understanding of and ability to apply a systems approach to engineering problems.

Our approach……..

Level 4 - Strong focus on reinforcing **fundamental knowledge**.

Engineering **principles and concepts**.

Analytical approaches to **problem solving**

A sound platform to build upon for subsequent years

Level 5 - Subject specific engineering skills development

Development of **critical thinking** and **analytical ability**.

Use of state-of-the-art **analytical software tools**.

Project based learning

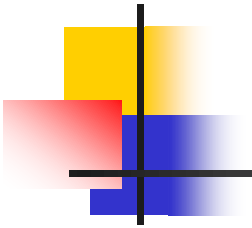
Our approach……..

Placement year - Broadening Horizons

Level 6 - **Intellectual challenge** and further development of higher level engineering skills including state-of-the art software skills.
Innovation in Engineering.
The Project.
Build up motivation to progress up to MEng. level.

Level 7 - **Leadership** and interdisciplinary study/group project focus.

A strong MEng. is essential for long-term sustainability of our programmes.



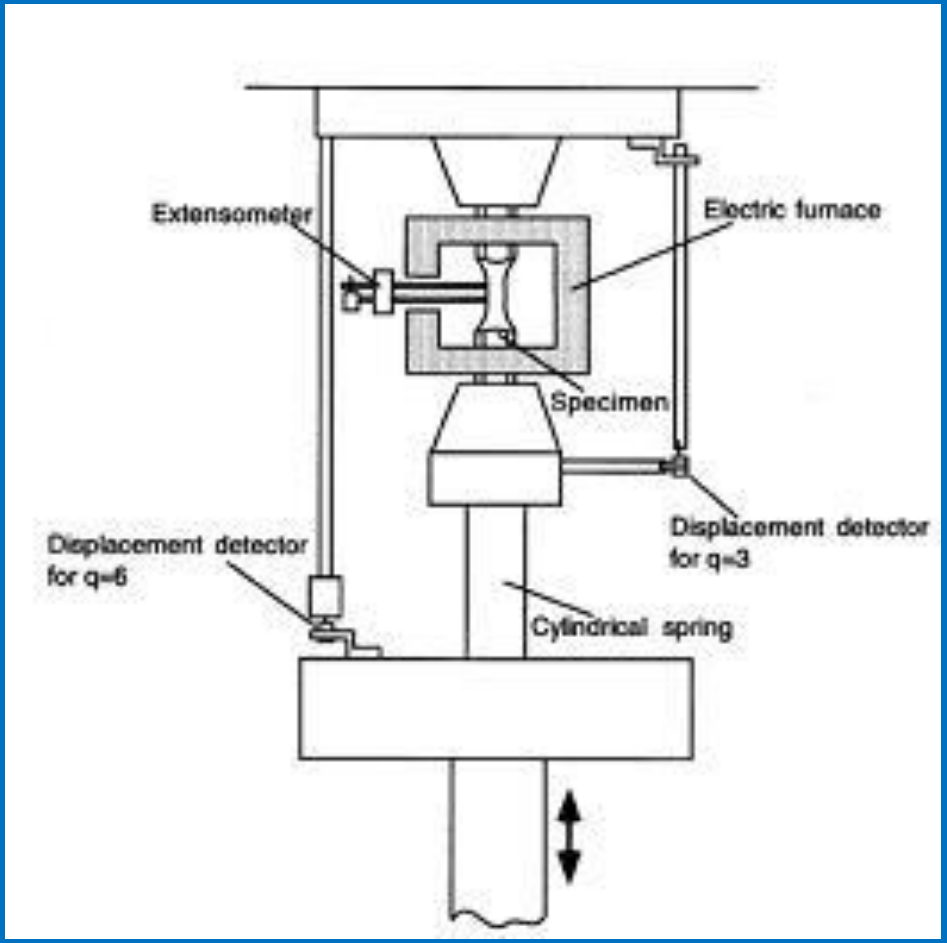
Example in Structural Analysis

Solid Mechanics

Concept

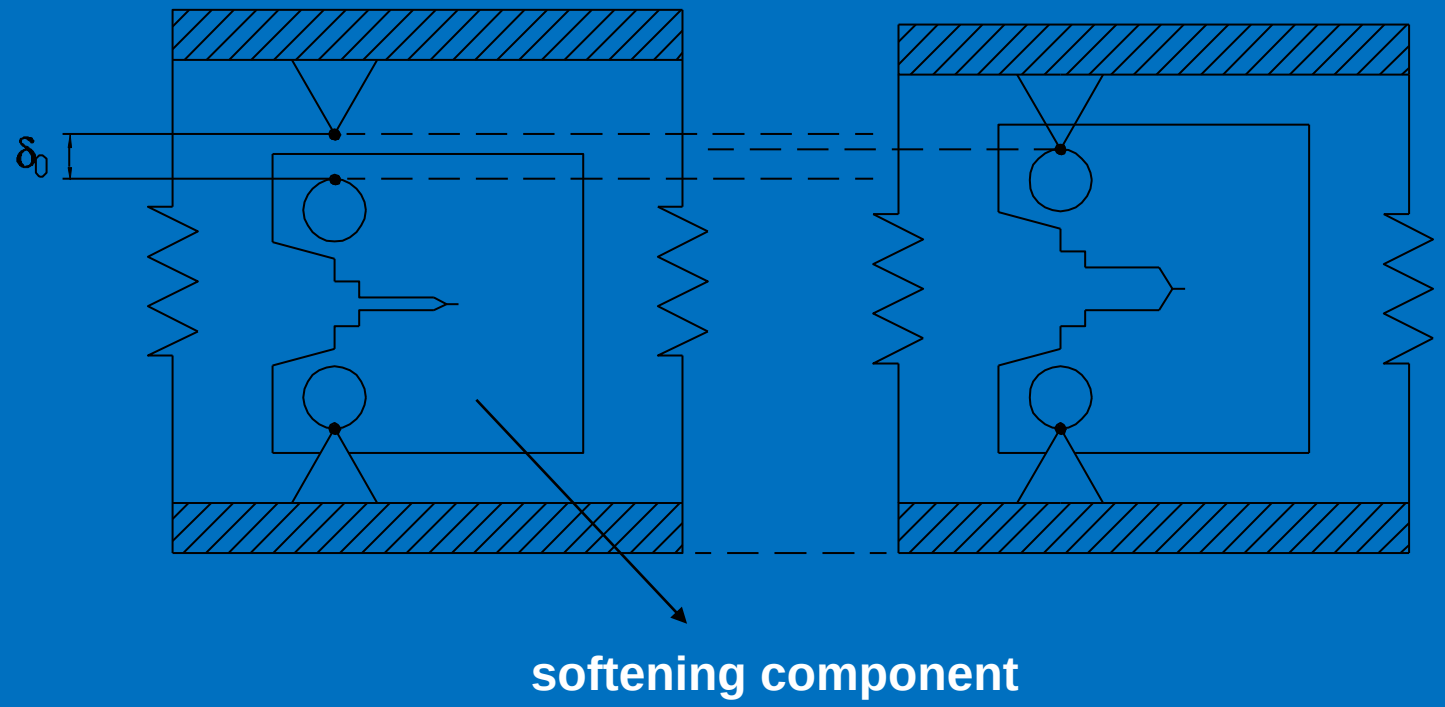
Applied displacement is the test piece deflection only if the fixtures and the test rig are rigid

The stiffness of the surroundings affects the response of structure to the applied loading

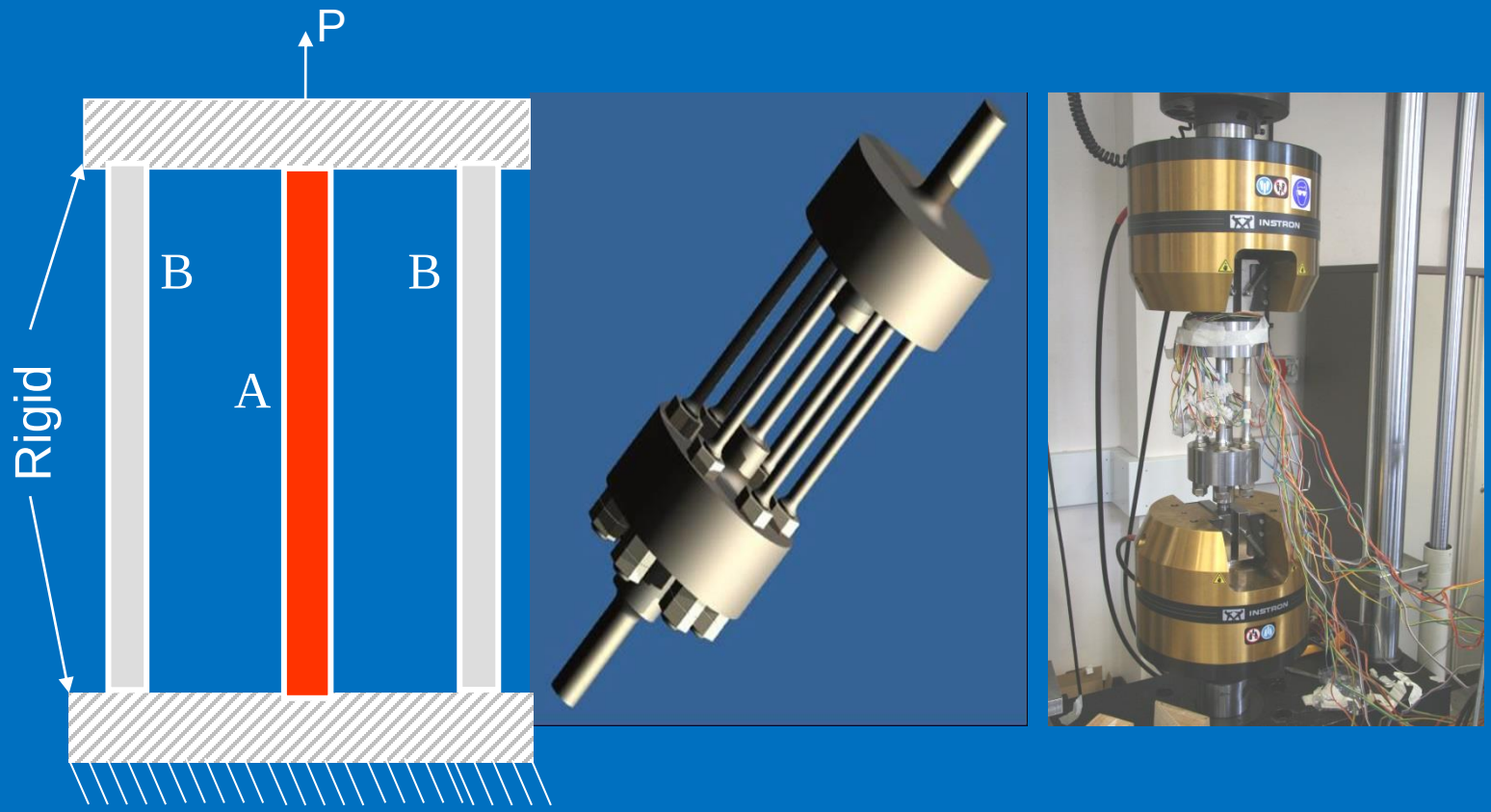


Alternative experimental design

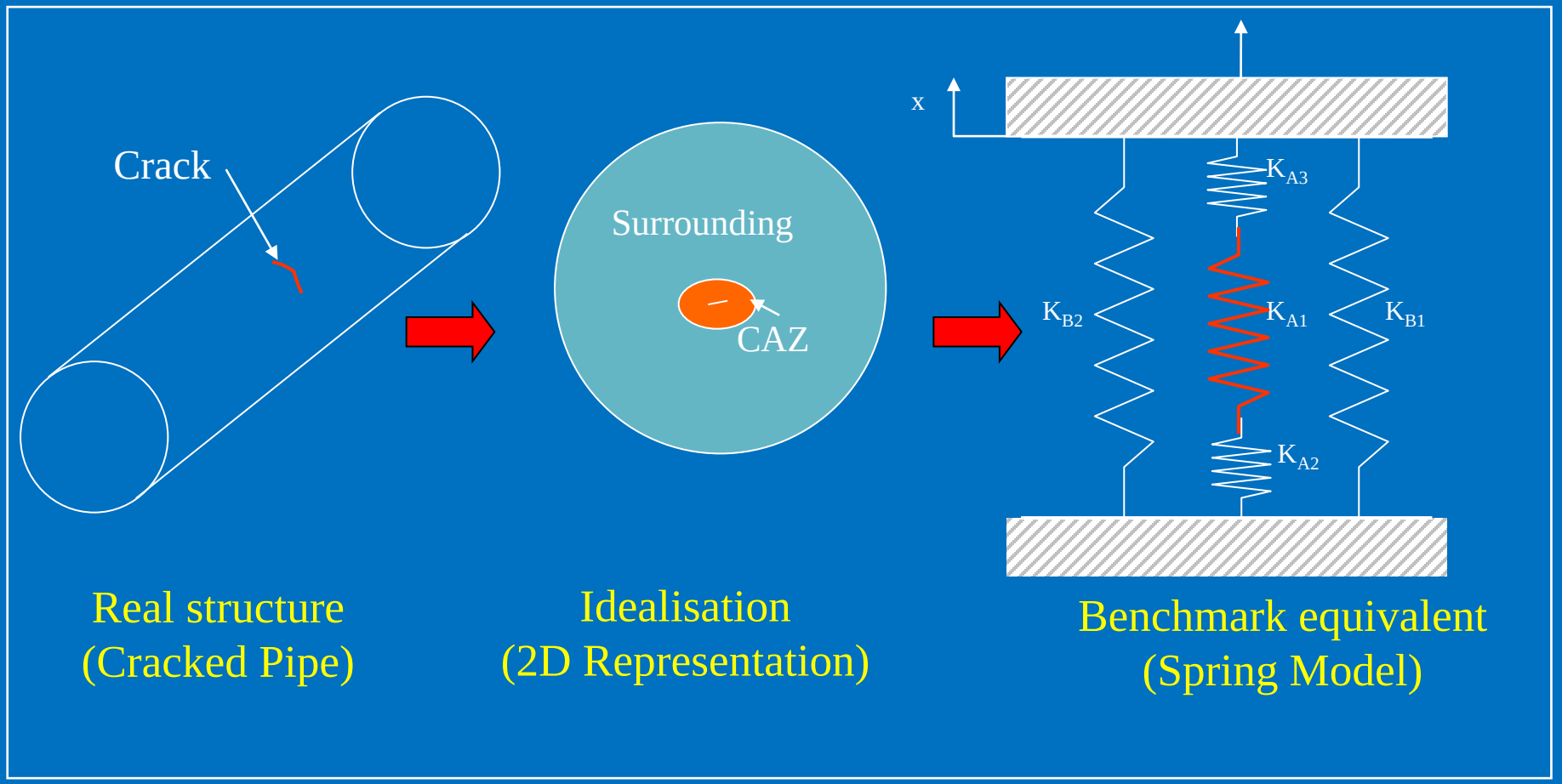
preloaded cracked component in flexible structure



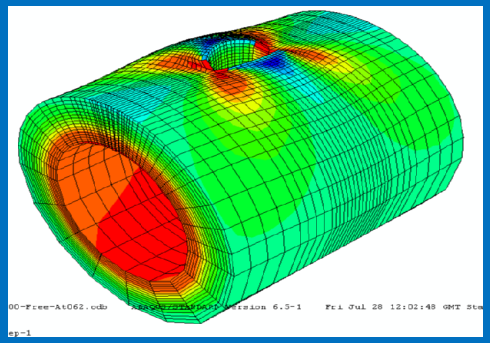
Experimental evaluation



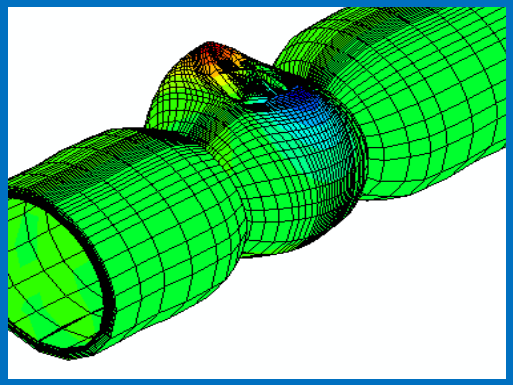
Real Structure Idealised

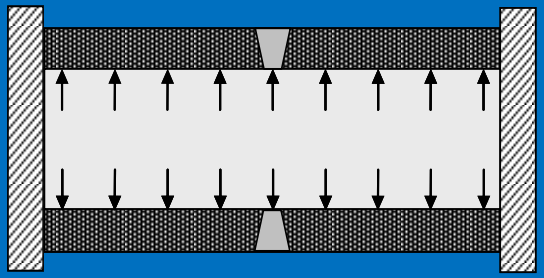


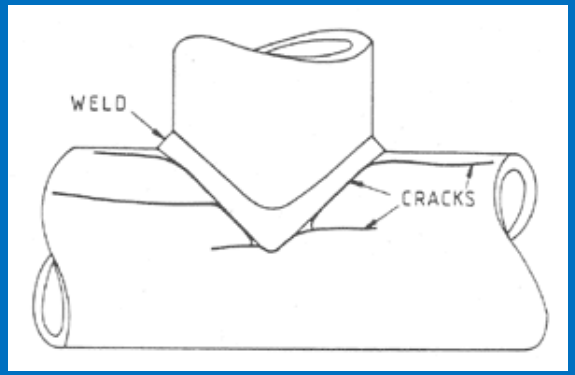
The big picture: Typical structure!



- Pressure vessel
- Service loads
- Residual stresses
- Cracks
- Boundary conditions





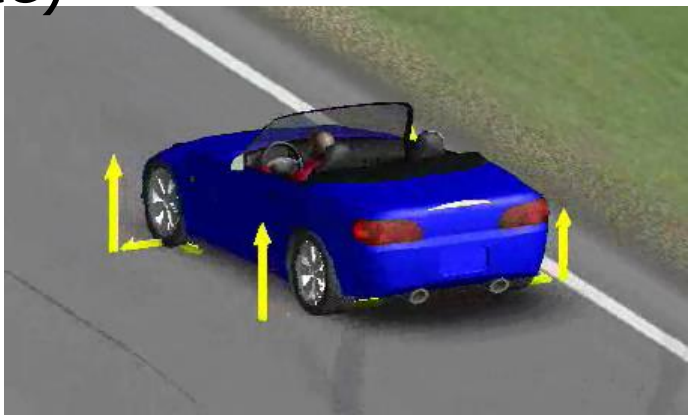


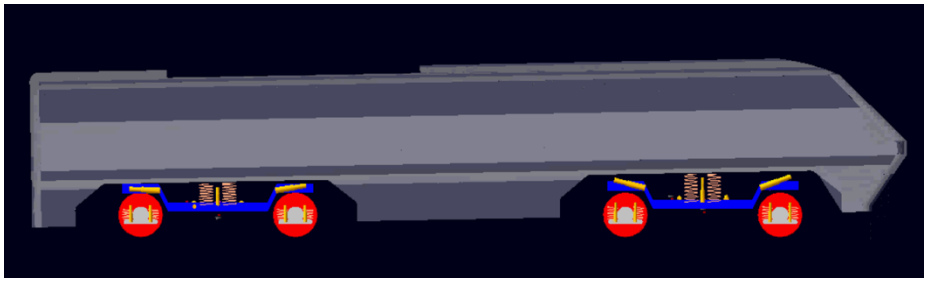
Example in Structural Analysis

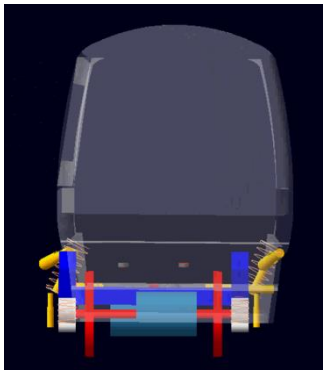
Dynamics

An Example for L4 & L5 Teaching

Using state-of-art analytical software (Matlab/Simulink, Solidworks, Vampire, Adams/rail, etc)







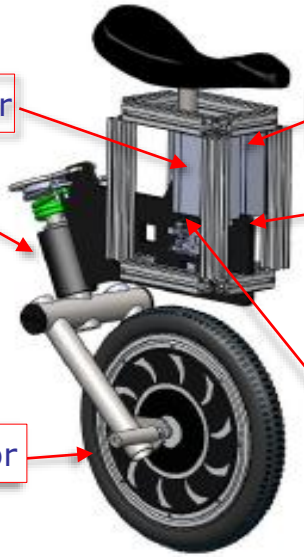
A L6&L7 Project: Single-Wheeled Scooter

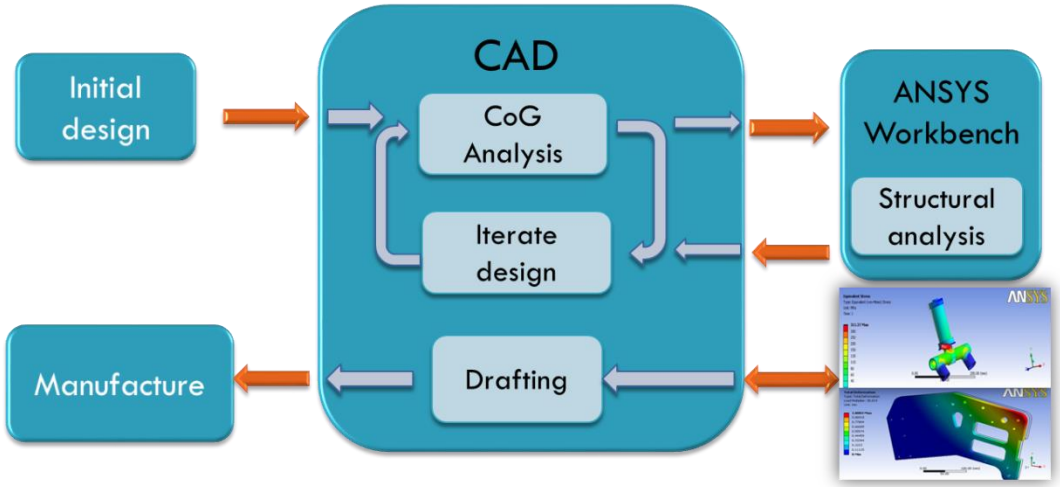
(Design, model and prototype an one-wheeled segway scooter)

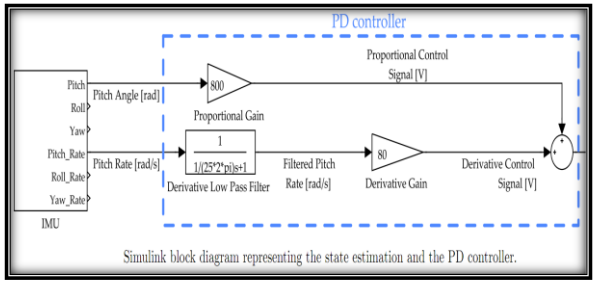
Mechanical System

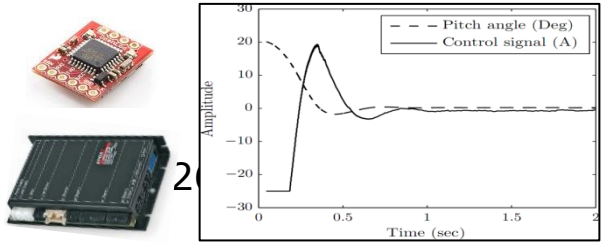
Electrical System

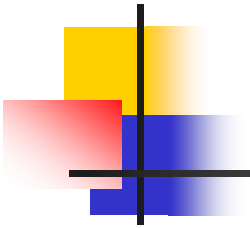
Control











DISCUSSION!