



University of
Nottingham
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Mechanics of Solids

MMME2053

Finite Element Analysis

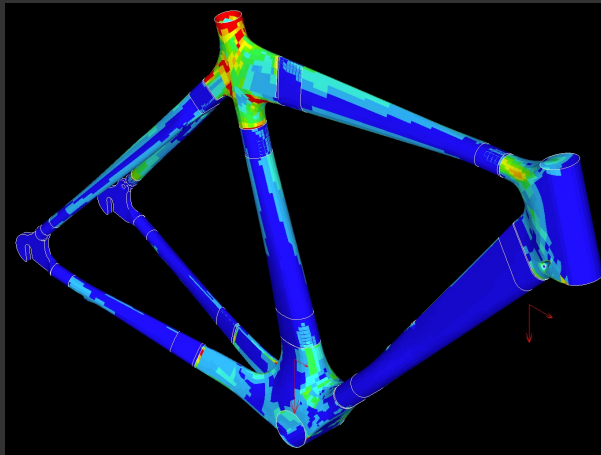
Lecture 1

Learning Objectives

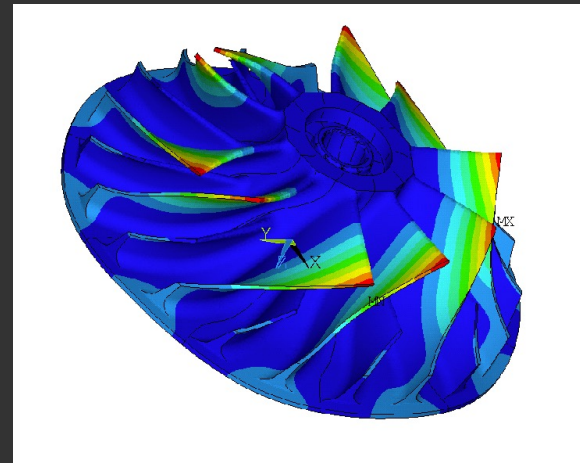
1. Recognise that FEA is a useful technique to aid the solution of many Structural Mechanics problems
2. Understand how 1D elements and the matrix method can be used to analyse uniaxial bars
3. Apply theory for 1D elements and the matrix method to an assembly of bars
4. Understand the derivation of the global stiffness matrix of a truss element

Introduction

- **What is the Finite Element Method (FEM)?**
- FEM is a numerical technique for finding approximate solutions to partial differential equations
- These are often structural mechanics problems (and this is the focus here) but the method is also commonly applied to thermal, fluid, dynamic, electrical, magnetic and acoustic problems among others (and even combinations of these)



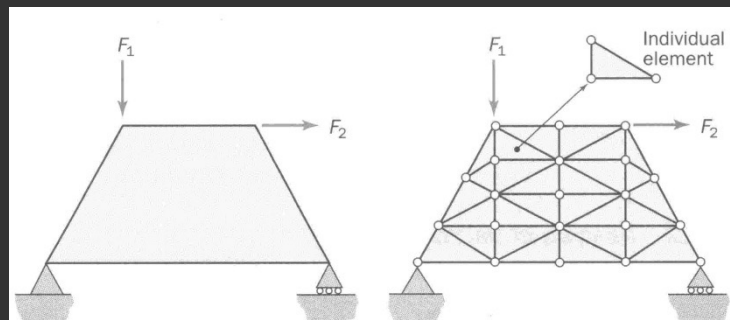
<http://www.williamsbikes.com/>



<http://simmsmachineryinternational.com/>

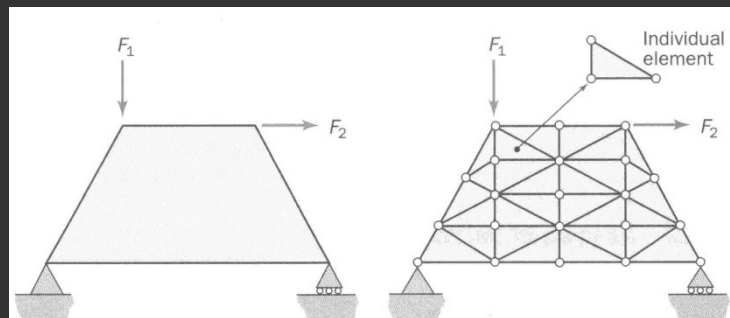
Introduction

- **How does FEM work?**
- The basic concept of FEM is to discretise a domain into a number of smaller 'finite elements'
- These finite elements are appropriately connected on their boundaries at 'nodes'



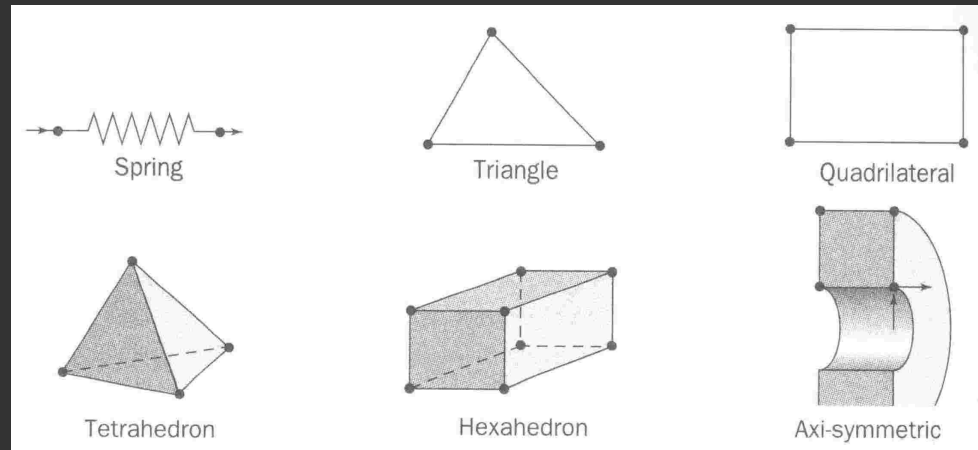
Introduction

- **How does FEM work?**
- The exact solution of the global function is approximated locally in each element using simplified functions while maintaining equilibrium, deformation compatibility and stress-strain relationships.



Introduction

- **How does FEM work?**
- There are many different types of element that can be used dependent on the requirements of the solution, or the type of problem being analysed

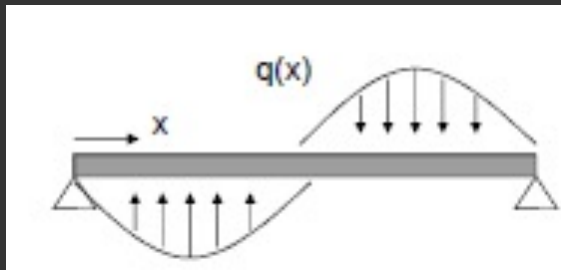


Introduction

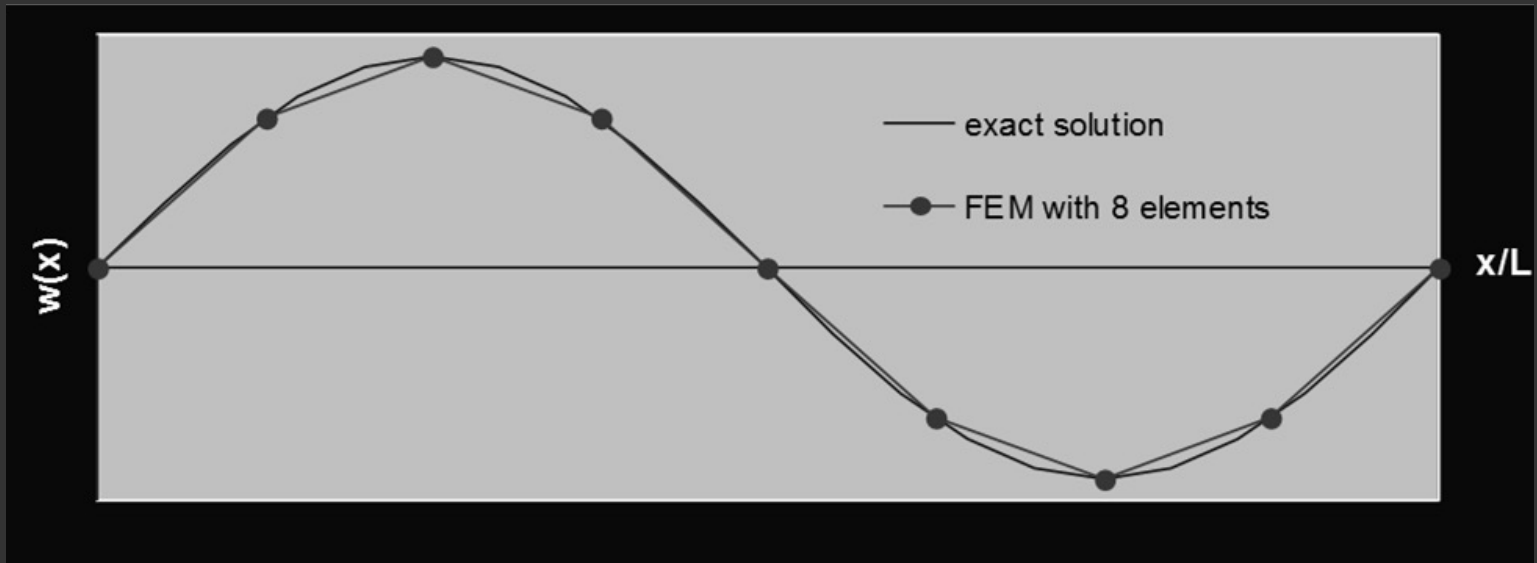
- **How does FEM work?**
- The accuracy of the FE solution depends on the number of elements and while the analysis of each element is relatively simple, the complete analysis for a large number of elements is extremely tedious, hence the need for computers.

Introduction

- How does FEM work?



Beam with sinusoidal load $q(x)$, deflection $w(x)$ is also sinusoidal



Learning Objectives

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