

AE 420 / ME 471 / CSE 451
Introduction to the Finite Element Method

1. Introduction

- 1.1 Introduction - Historical perspective
- 1.2 Review of basic relations of beam theory and elasticity

2. Rayleigh-Ritz method

3. Basic concepts of the FEM: solution of 1-D bar problem

- 3.1 Basic concepts : mesh, nodes, elements, interpolation, ...
- 3.2 FEA of axially loaded bar
- 3.3 Notes : direct method, higher-order elements, ...
- 3.4 Principle of Virtual Work (PVW) approach
- 3.5 Galerkin Weighted Residual (GWR) method
- 3.6 Implementation issues

4. FEA of 2-D truss problem

5. FEA of 2-D Poisson problem

- 5.1 Equation and applications
- 5.2 Variational approach
- 5.3 Weighted residual method
- 5.4 2-D global elements
- 5.5 Convergence
- 5.6 Higher-order C^0 elements
- 5.7 Isoparametric elements
- 5.8 Numerical integration
- 5.9 Gradient computation

6. FEA of structural problems

- 6.1 3-D elastic continuum element
- 6.2 Plane stress/plane strain element
- 6.3 Axi-symmetric element
- 6.4 Euler/Bernouilli beam element
- 6.5 Frame element
- 6.6 Mindlin beam element
- 6.7 Plate and shell elements

7. Important issues in FEA

- 7.1 Mesh design and error control
- 7.2 Condensation and substructuring
- 7.3 Special integration schemes
- 7.4 Special elements

8. Advanced topics in FEA

- 8.1 FEA of transient problems
 - 8.1.1 Transient thermal problems
 - 8.1.2 Transient structural problems
- 8.2 FEA of nonlinear problems