

AE-675A Introduction to Finite Element Method
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One Dimensional Code for Beam Bending Problem

Write a one dimensional finite element code using Hermite cubic shape functions with the following details for the beam bending problem.

- 1) Uniform cross section: 1 cm X 1 cm
- 2) Length of the beam: 10 cm
- 3) $E = 200 \text{ GPa}$
- 4) The code should be capable of handling the transverse loads of the type
 - a. Concentrated/point load
 - b. Uniformly distributed load
 - c. Point moments *at the centre of the beam length only*
- 5) Further, it should be capable of applying the appropriate combination of boundary conditions at either of the ends as:
 - a. Specified transverse displacement
 - b. Specified slope of the transverse displacement
 - c. Shear force
 - d. Bending moment

Now, take appropriate values of loads as mentioned in Point # 4 above and perform the following finite element analysis using your code for 1, 4, 10, 50 and 100 elements.

- 1) Give continuous variation of transverse displacement and its slope
- 2) Give continuous variation of shear force and bending moment
- 3) Bending stress on the top most line of beam along its entire length.

Discuss your results and verify those using Euler Bernoulli beam theory closed form solutions.