

Finite Element Method

STAAD PRO Assignment

Q. What is FEM?

⇒ FEM is numerical technique for solving problems which are described by partial differential equations or can be formulated as functional minimization. A domain of interest is represented as an assembly of finite elements. Approximating functions in finite elements are determined in terms of nodal values of physical field which is sought.

A continuous physical problem is transferred into a discretized finite element problem with unknown nodal values. For a linear problem a system of linear algebraic equations should be solved. Values inside finite elements can be recovered using nodal values.

Two features of FEM

1) Piecewise Approximation

2) Locality of approximation.

Q. How FEM works in STAAD pro?

⇒ 1) Discretise the continuum! - The first step is to divide solution region into finite elements. Preprocessor programme generates the finite element mesh. The description of mesh consists of several arrays main of which are nodal co-ordinates and element connectivities.

2) Select interpolation function! - Polynomial of different order are chosen and interpolated field variables are adopted. Degree of polynomial depends on no. of nodes assigned to element.

3) To find element properties:- Matrix equation for finite element should be established which relates the nodal values of the unknown function to other parameters. For this task different approaches can be used.

4) Assembly:- Global equation or matrices are formed by assembly process. Element connectivities are used for assembly process.

5) Solve global eq's:- Reduced matrices are solved.

6) Compute addnal results:- Stress, strains in mechanical systems or velocities and accelerations in fluid system are found out.

Q. Material Data & Loading Data:-

$$(\sigma_{ut})_{\text{steel}} = 545 \text{ MPa.}$$

$$(\text{High yield strength})_{\text{steel}} = 500 \text{ MPa.}$$

$$\mu = 0.3$$

$$E = 2.05 \times 10^8 \text{ kN/m}^2.$$

$$\rho = 7850 \text{ kg/m}^3$$

1) Dead load \rightarrow self weight

2) Live load $\rightarrow 10 \text{ kN/m}^2$ (on plates (deck)).

3) Nodal force \rightarrow Berthing load $\rightarrow 250 \text{ kN}$ (at corner pt).

4) serviceability \rightarrow for above loads with 1.0 factor.

5) collapsibility \rightarrow for above loads. with 1.5 factors.