Course Name:
Nonlinear analysis of structures

Course Number:
20013

Credit:
3

Course Content (outline):

1. Stress- strain relations
   Strain deformations, steel and concrete, inelastic deformation of rod.
2. Moment- curvature relations
   Calculation of moment- curvature relation for various sections and materials (concrete and steel), shape factor, curvature ductility, effect of axial and shear forces on bending strength and curvature ductility capacity, relation of curvature ductility capacity with strain capacity, the effect of thermal and residual stresses.
3. Moment- torsion relation for beam- column
   Inelastic zone of beam (concrete and steel), plastic hinge, equivalent length of plastic hinge, plastic rotation capacity, effect of axial and shear forces in moment- torsion relation, relation of rotation capacity and curvature ductility capacity, effect of thermal and residual stresses.
4. Plastic analysis of beam and frame
   Collapse load, theorem of lower bound, upper bound and uniqueness, equilibrium method, mechanism method, limitless of plastic analysis, effect of axial load, shear effect, calculation of hinge rotation, deformations calculation, P-Δ and P-δ effects
5. Beam- column inelastic element
   Large inelastic deformation, geometric non-linear effects, tangent stiffness matrix, various simplified elements
6. Inelastic analysis of frame
   Frame with rigid plastic hinge, inelastic hinge, compound hinge, frame with inelastic members, numerical method for inelastic and geometric nonlinear problems, dynamic analysis

References:

- Horne, M.R., and Morris, L.J., "Plastic Design of Low-Rise Frames", Collins, London, 1981.
- Chen, W.F., and Lui, E.M., "Stability Design of Steel Frames", CRC Press, London, 1991.
- Jirasek, M., and Bazant, Z.P., "Inelastic Analysis of Structures", J. Wiley, London, 2002.