53:134 Structural Design II (Steel Structures)
Spring 2006 (Lecture Summary)
Week 8 (3/06 – 3/10/06)

3/6/06

- ♦ **Direct Stiffness Method Applied to Frames**
- ♦ Meaning of the stiffness coefficients, K_{ij}.
- ♦ Beam element vs beam-column element.
- ♦ Procedure for analysis is the same as for trusses:
  - ○ write equilibrium equation for each element in the local coordinate system
  - ○ transformation to the global coordinate system
  - ○ combine elemental equations.
- ♦ Discuss the beam element. 6 dof.
  - ○ Element stiffness matrix – derivation using the slope-deflection equations for bending part of the element stiffness matrix.
  - ○ Inclusion of axial deformation to obtain 6 x 6 matrix.
  - ○ Transformation from local to global coordinate system.
- ♦ **Read**: Section 6.2.3, pages 362 - 366.

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- ♦ Review of direct stiffness method for frames.
- ♦ Element stiffness matrix.
- ♦ Transformation from local to global coordinate system.
- ♦ Element loads – equivalent joint loads - negative of the fixed end reactions.

- o Difference between the fixed-end reactions and the equivalent joint forces.
♦ Assembly of the global equilibrium equations.
♦ Recovery of elemental forces; reaction forces.
♦ **Read**: Section 6.2.3.

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♦ Review of frame analysis using stiffness method: assembly of global equations, application of boundary conditions, solution of the reduced equilibrium equations, element force recovery. Summary of all the equations.
♦ Discuss Examples 6.2.5 -6.2.7 on page 369; use of the Excel worksheet.
♦ Discuss Example 6.2.8 on page 373.
♦ **HW#15**: Verify solution of Example 6.2.8 using the Excel spreadsheet.