

53:134 Structural Design II (Steel Structures)
Spring 2006 (Lecture Summary)
Week 10 (3/20 - 3/24/06)

3/20/06

- ◆ Review: Chapter 3 of Rajan's book - Structural Design Fundamentals.
 - What is design?
 - Material behavior
 - Material properties
 - Stress-strain relationship, principle stress and strain.
 - Stress and strain computation - direct stress, bending stress, shear stress, combined axial and bending stress.
 - Theories of failure.
 - Steel grades and mechanical properties - stress strain diagram.
 - Modeling of structure. Loads - dead load, live load, snow load, wind load, earthquake load.
 - Steel structures and their members.
- ◆ Introduction to the AISC Manual and Specifications.
- ◆ Load and Resistance Factor Design (LRFD): Specifications for Structural Steel Buildings. These have four parts: Specifications, Appendices for Specifications, Commentary, Appendices for Commentary.
- ◆ **Read:** Chapter 3.

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- ◆ Load and Resistance Factor Design (LRFD): review.
- ◆ Design philosophy.
- ◆ Structural safety requirement.
- ◆ Load combinations.
- ◆ Concepts of load factors and resistance factors.
- ◆ Basic design requirement is that the factored load effects be less than or equal to the design strength of the member (i.e., factored nominal strength).
- ◆ Glossary of terms.
- ◆ Example of load combinations.
- ◆ **Read:** Glossary and Chapter A of the AISC LRFD Specifications.

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- ◆ Design of truss and framed structures will be discussed in this course.
- ◆ Design of determinate trusses: internal force distribution does not depend on member sizes; member force calculation does not require initial selection of members. Analyze the truss and then design members to carry the calculated member compressive or tensile loads.
- ◆ Design of indeterminate trusses: tension and compression members. Need to select members before analysis can be performed; how to select initial member sizes?

- ◆ Design of indeterminate trusses - steps of the design process; re-design cycles.
 1. Determine factored loads.
 2. Select an initial design - select sections.
 3. Analyze the truss structure.
 4. For each member of the truss, check all the failure conditions; i.e. all the specifications.
 5. If all the conditions are satisfied, we have a feasible design. Does the design need to be improved? If YES, update the design and go to Step #3. Otherwise, quit.
 6. If some of the failure conditions are violated, update the design and go to Step #3.
- ◆ AISC Manual: contains useful tables for cross-sectional; properties and tables and charts as design aids.
- ◆ Design of tension members:
 - Tension limit states - yielding of the section.
 - Fracture of the net section.
 - Slenderness ratio.
 - Effective area for fracture limit state - shear lag factor, reduction factor.
 - Refer to Part 3 of the Manual.
 - Chapter D and Commentary D - Part 16, the Specifications.
 - For Block Shear, refer to Section J4 of the Specs, page 16.1-67.
- ◆ **Read:** Chapter D of the AISC LRFD Specifications and Part 3 of the Manual, Design of Tension Members.