**CIV E 372 SYLLABUS**

COURSE NAME: Structural Analysis I – CIV E 372
DETAILS: 3 hour lectures, 2/1 hour Seminar
TERM: Fall

COURSE DESCRIPTION

\*4 (fi 8) (either term, 3-2S-0) Introduction to structural loads; deformations of statically determinate beams,

trusses and frames; influence lines; analysis of statically indeterminate structures by consistent

deformations, slope deflection and moment distribution; direct stiffness analysis.

This course aims to cover the principles of classical structural analysis. Its goal is to help students

understand the fundamental concepts and methods in structural analysis to calculate the structural internal

forces and deformations, and to learn how to use a relevant structural analysis software (e.g., S-Frame).

These are required skills in the structural design process. Emphasis will be placed on the analysis of

idealized structural systems and presented in a logical order, including truss structures, beam/frame

structures, cable and arch structures subject to static loads.

The course tends to cover:

(1) Brief introduction to concepts and calculations of structural loads according to NBCC (National Building

Code of Canada).

(2) Classical structural analysis methods for structural forces and deformations by hand-calculations, to

develop an understanding of the fundamental concepts and basic principles of structural analysis, as well as

engineering intuitions

(3) Basic use of structural analysis software (e.g., S-Frame).

(4) Introduction to direct stiffness method for structural analysis

REQUIRED MATERIAL

(Mandatory)- Aslam Kassimali, Structural Analysis, SI Edition, PWS-Kent Publishing Company, Boston, 1993

(Recommended)- Hibbeler, R.C., Structural Analysis, Prentice Hall, 6th edition (in SI units), 2006.

LECTURE CONTENT

1. Introduction to Structural Analysis . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . \_ 1 hour

* Engineering structures in general
* Role of structural analysis in design process
* Structural analysis in general
* Course objectives

2. Fundamental Concepts for Structural Analysis . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . \_ 5 hours

* Structural systems
* Structural idealization for structural analysis
* Equilibrium of structures and equilibrium equations
* Static determinacy, indeterminacy, and geometric stability

3. Loads on Structures (REMOVED) . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . \_ 0 hours

* National Building Code of Canada
* Concepts of tributary areas for loads
* Dead loads and live loads
* Snow loads
* Wind loads
* Other loads and actions\*

4. Truss Structures (statically determinant) . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . \_ 3 hours

* Assumptions (idealization) in truss members
* Method of joints for internal forces in plane trusses
* Method of members for internal forces in plane trusses
* Axial force diagram
* Zero-force member identification
* Compression/Tension member identification
* Principle of superposition
* Space trusses\*

5. Beam and Frame Structures (statically determinant) . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . \_ 8 hours

* Internal force calculation (axial, shear, and moment)
* Internal force diagrams and their relationships
* Beam deformation: direction integration method
* Beam deformation: Moment area method
* Beam/Frame deformation: Energy method
* Analysis of symmetric structures

6. Cables and Arches (statically determinant) . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . \_ 1 hours

* Internal forces
* Deformations

7. Statically Indeterminate Structures: Method of Consistent Deformations . . . . . . . . . . . . . . . . . \_ 4 hours

* Indeterminate trusses
* Indeterminate beams
* Indeterminate frames

8. Statically Indeterminate Structures: Slope-Deflection Method . . . . . . . . . . . . . . . . . . . . . . \_ 6 hours

* Slope-deflection equations
* Analysis of continuous beams
* Analysis of frames without sidesway
* Analysis of frames with sidesway
* Moment distribution method\* (not covered)

9. Basics of Direct Stiffness Method\* . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . \_ 4 hours

* Truss element stiffness matrix
* Global truss structural stiffness matrix
* Beam element stiffness matrix formulation, assembly, and applications\*

10. Influence Lines . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . \_ 3 hours

* Equilibrium method
* Muller-Breslau principle
* Applications of influence lines for moving loads

SEMINAR CONTENT

1. Static determinacy and indeterminacy . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . \_ 2 hours

2. Loads and structural systems . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .. \_ 2 hours

3. Structural analysis for trusses . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .. \_ 2 hours

4. Structural analysis software: trusses . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . \_ 2 hours

5. Structural analysis for beams . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . \_ 2 hours

6. Structural analysis for frames . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . \_ 2 hours

7. Structural analysis software: beams/frames . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .. \_ 2 hours

8. Method of consistent deformations & slope-deflection method . . . . . . . . . . . . . . . . . . \_ 2 hours

9. Influence lines . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . \_ 2 hours

10. Engineering intuitions from structural analysis . . . . . . . . . . . . . . . . . . . . . . . . . . . . .. \_ 2 hours

11. Computer-aided structural analysis . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . \_ 2 hours