LONDON SOUTH BANK UNIVERSITY

unit guide

Structural Analysis

BCE-3-221

Faculty of Engineering, Science and the Built Environment

2008-09

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1 UNIT DETAILS

Unit Title:	Structural Analysis
Unit Level:	3
Unit Reference Number:	BCE-3-221
Credit Value:	1.0
Student Study Hours:	90
Contact Hours:	60
Pre-requisite Learning (If applicable):	BCE-1-221, Mechanics, or equivalent BCE-2-211, Strength of Materials, or equivalent
Course(s):	BSc (Hons) Civil Engineering BSc (Hons) Architectural Engineering
Year and Semester	Year 3; Semester 1
Unit Coordinator:	M H Datoo
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Subject Area:	Civil Engineering
Summary of Assessment Method:	2 Courseworks, 1 Examination

2 SHORT DESCRIPTION

Structural Analysis of determinate and indeterminate beams and frames is developed in this Unit at Level 3. It builds on the principles developed in the Mechanics Unit at Level 1 and the Strength of Material Unit at Level 2. The moment distribution and unit load methods of analyses are introduced and developed. The plastic theory of analysis for beams is covered here. Calculations for column instability are presented. Theories of elastic failure for a complex stress system will be investigated. Finally, the student is introduced to the usage of computer aided analysis using commercial software.

3 AIMS OF THE UNIT

To acquaint the students with various analytical methods for structural analysis of determinate and indeterminate beams and frames. Also to introduce them to the plastic analysis of simple indeterminate beams and to cover the topics of elastic instability and failure criteria. To expose the students to the usage of a commercial software package for structural analysis of planar structures.

4 LEARNING OUTCOMES

4.1 KNOWLEDGE AND UNDERSTANDING

- analyse indeterminate beams using the moment distribution method
- understand the basic principles of plastic theory and be able to apply these to the analysis of beams
- determine the Euler buckling load for struts having different basic end conditions and of compound sections
- calculate the deflections of determinate beams subjected to various loading conditions using the differential equations method
- calculate the deflections of determinate frames subjected to various loading conditions using the unit load method
- determine failure of a complex stress system using an elastic failure criterion

4.2 INTELLECTUAL SKILLS

- the analysis of indeterminate beams
- application of various techniques to solutions of structural analysis
- designing of beams to the plastic limit
- determination of beam deflections
- designing for structural instability of beams
- ascertaining failure due to combined stress system

4.3 PRACTICAL SKILLS

- use computer PC based Windows package for simple structural analysis
- perform, analyse and interpret results from structural tests

4.4 TRANSFERABLE SKILLS

- appreciate the complexities and pitfalls of using a commercial engineering software for design and analysis
- apply the concept of structural modelling to indeterminate beams
- interpret results in a meaningful way from the computer analysis output
- usage of IT packages for the production of reports and drawings

5 INTRODUCTION TO STUDYING THE UNIT

5.1 OVERVIEW OF THE MAIN CONTENT

Moment distribution
Degree of indeterminacy; Fixed end moments; Distribution Factors; Carry over factors; Bending moment and shear force diagrams of indeterminate beams.

Unit Load Method
Energy method; Volume integrals; Translations and rotations of determinate frames. Non-uniform section.

Deflection
Macauleys method for determination of vertical defections in determinate beams

Computer Aided Analysis
Degrees of freedoms; Axes systems; Nodes; Supports; Section properties; Elastic properties; Load applications; Supports; Output interpretation for moments, forces, deflections and stresses.

Plastic theory
Plastic section properties; Hinge formation and application to beams; upper and lower bound theorems.

Column Instability
Introduction to column instability; Euler buckling; Support end conditions; Calculations of buckling load, including for compound sections.

Failure Criteria
Rankine, Tresca and von Mises; failure due to combined axial, bending, shear and torsional loads

5.2 OVERVIEW OF TYPES OF CLASSES

Lectures and tutorials will be supplemented by printed handouts, worked solutions to tutorials and past examination questions. The lectures are complemented by laboratory exercises and supervised computing sessions.

One member of staff will deliver lectures. The teaching block will normally be a lecture – break – lecture - followed by a tutorial/class test/laboratory.

5.3 IMPORTANCE OF STUDENT SELF-MANAGED LEARNING TIME

The successful passing of this unit is very much dependent on the student spending a lot more private study time. For this unit, this involves the student attempting all the tutorial sheets, and past examination questions (certainly the last five years). A unit like this cannot be studied at the last minute; the effort has to be continuous and steady throughout the semester.

6 THE PROGRAMME OF TEACHING, LEARNING AND ASSESSMENT

Week Beginning	Teaching Week No	Lecture	
22 September 2008	1	Moment distribution	Moment distribution
29 September	2	Moment distribution	Moment distribution
6 October	3	Computer aided analysis	Beam deflections
13 October	4	Beam deflections	Lab/Computing
20 October	5	Beam deflections	Lab/Computing
27 October	6	Unit load – deflections	Unit load – frame deflections
3 November	7	Unit load – frame deflections	Plastic section properties
10 November	8	Plastic section properties	Plastic section properties
17 November	9	Beam plastic analysis	Beam plastic analysis
24 November	10	Column instability	Column instability
1 December	11	Failure criteria	Failure criteria
8 December	12	Lab	Lab
15 December		Christmas vacation	
22 December		Christmas vacation	
29 December		Christmas vacation	
5 January 2009	13	Examinations	
12 January	14	Examinations	
21 January	15		

Coursework 1 (Continuous Beam) Hand-in Date
Thursday, 20 November 2008

Demonstration Lab
Thursday, 11 December 2008 Laboratory testing of a beam to plastic failure.

7 ASSESMENT OF THE UNIT

70% 3 hour end of unit written examination. Five out of seven questions to be attempted, including a compulsory question on beam moment distribution.

10% Coursework 1 will involve laboratory testing of a continuous beam, coupled with the usage of a computer aided analysis package.

20% Coursework 3 is based on a series of open book in-class tests.
Students missing a test will get a zero mark, unless a doctor's medical note is produced – confirming illness on the day of the test, in which case the average will be adjusted accordingly. For any other exemption, the average will be adjusted only upon a supported Extenuating Circumstances procedure.

8 LEARNING RESOURCES

8.1 CORE MATERIALS

Neal, B.G., The Plastic Methods of Structural Analysis, Chapman & Hall, 1977

Horne, M.R., Plastic Theory of Structures, Pergamon, 2nd ed., 1979

Todd, J.D., Structural Theory and Analysis, Macmillan, 1981

Young, B W, Energy Methods of Structural Analysis, Macmillan, 1981

Thompson, F & Hayward, Structural Analysis using Virtual Work, Chapman & Hall, 1986

Chen & Lui, Structural Stability - Theory and Implementation, Elsevier, 1987

Spencer, W J, Fundamental Structural Analysis, Macmillan, 1988

Croxton & Martin, Solving Problems in Structures, Volume 2, 1990

Marshall & Nelson, Structures, Longman, 1990

Coates, Coutie & Kong, Structural Analysis, Nelson, 3rd ed., 1992

Moy, S S J, Plastic Methods for Steel & Concrete Structures, Macmillan, 2nd ed., 1996

Ghali, A & Neville, A M, Structural Analysis, Spon, 1997

Bhatt, P, Structures, Longman, 1999

Jennings, A, Structures – From Theory to Practice, Spon, 2004

Hibbeler, Mechanics of Materials, Pearson, 2005.

Megson; Structural and Stress Analysis, Elsevier, 2005.

Hibbeler, Structural Analysis, Pearson, 2006.

McKenzie, Examples in Structural Analysis, Taylor & Francis, 2006.

Ye; Structural and Stress Analysis, Taylor & Francis, 2008.