LONDON SOUTH BANK UNIVERSITY

unit guide

Theory of Structures 1

BCE-2-119

Faculty of Engineering, Science and
the Built Environment

2008-09

become what you want to be

Table of Contents

1 UNIT DETAILS

Unit Title:	Theory of Structures 1
Unit Level:	2
Unit Reference Number:	BCE-2-119
Credit Value:	1.0
Student Study Hours:	90
Contact Hours:	60
Pre-requisite Learning (If applicable):	BCE-1- 118, Statics, or equivalent BCE-1-119, Strength of Materials & Design, or equivalent
Course(s):	BEng (Hons) Civil Engineering
Year and Semester	Year 2; Semester 1
Unit Coordinator:	M H Datoo
UC Contact Details (Tel, Email, Room)	020 7815 7388, m.datoo@lsbu.ac.uk BR-T-601
Teaching Team & Contac Details (If applicable):	M H Datoo
Subject Area:	Civil Engineering
Summary of Assessment Method:	2 Courseworks, 1 Examination

2 SHORT DESCRIPTION

This unit offers the first Structural Analysis course at Level 2 of the Course. It builds on the principles developed in the Statics and Strength of Materials & Design Units at Level 1. Determination of stresses and deflections in determinate and indeterminate beams are developed here. Various methods of analysis are introduced and developed: energy methods, numerical approximations (moment distribution) and force method. The plastic theory of analysis for beams is covered. Modes and calculations for column instability are presented. Failure criteria due to combined loadings are also covered. Finally, the student is introduced to the usage of computer aided analysis using commercial software

3 AIMS OF THE UNIT

To introduce the concept of indeterminate structures and to acquaint the students with the calculation of deflections for statically determinate and singly indeterminate structures. Also to introduce them to the plastic analysis of simple indeterminate structures and to cover the topics of elastic instability and failure criteria.

4 LEARNING OUTCOMES

4.1 KNOWLEDGE AND UNDERSTANDING

- Understand the concept of indeterminate structures and ascertain its degree of indeterminacy
- determine deflections of statically determinate, uniform and non-uniform section, beams and frames using the unit load method structures
- analyse indeterminate beams for moments and reactions using the moment distribution method
- understand and analyse the principles of plastic theory and be able to apply these to the analysis of indeterminate beams
- determine the Euler buckling load for simple struts, including compound sections, having different support end conditions
- understand and calculate the redundant force in singly indeterminate beams and frames using the force method
- perform stress analysis using failure criteria to ascertain failure under combination of loadings

4.2 INTELLECTUAL SKILLS

- the analysis of indeterminate beams and frames
- application of various techniques to solutions of structural analysis
- designing of beams to the plastic limit
- determination of deflections on determinate structures
- ascertain material failure under combined loadings using failure criteria

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 using a beam element method
- 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 beams and frames. Non-uniform section.

Force Method
Compatibility conditions; Influence coefficients; Beams and frames of singe redundancy.

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

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.

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.

The timetabled day is Tuesdays:
am session – lecture and tutorial
pm session – lecture and test/tutorial/lab.

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	Lab/Computing
13 October	4	Unit load method	Lab/Computing
20 October	5	Unit load method	Unit load method
27 October	6	Flexibility method	Flexibility method
3 November	7	Flexibility method	Flexibility method
10 November	8	Plastic section properties	Plastic section properties
17 November	9	Lab	Lab
24 November	10	Beam plastic analysis	Beam plastic analysis
1 December	11	Column instability	Column instability
8 December	12	Failure criteria	Failure criteria
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
Tuesday, 11 November 2008

Demonstration Lab
Tuesday, 9 December 2008 Laboratory testing of a beam to plastic failure.

7 ASSESMENT OF THE UNIT

70% 3 hour end of unit written examination. Four out of six questions to be attempted.

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

20% Coursework 2 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.