FACULTY OF ENGINEERING SCIENCE AND THE BUILT ENVIRONMENT

Unit title:	Soil-Structure Engineering	
Unit number:	BCE/M/420	
Unit level:	M	
Unit value:	1.0	
Unit co-ordinator:	M. Gunn	
Contact time:	Lectures	30 hours
	Tutorials	8 hours
	Laboratories	8 hours
Private study time:	110 hours	
Total study time:	150 hours	
Unit pre-requisites:	None	

AIMS

To acquaint the student with classical and modern methods for the analysis and design of structures which are embedded in the ground (specifically embedded retaining walls, piled foundations and tunnels).

LEARNING OUTCOMES

The student should be able to:

- Demonstrate an understanding of the theory by solving simple problems based on the theoretical concepts
- Carry out simple design calculations by hand
- Carry out SSI analysis, making use of computer software where appropriate
- Appreciate the limitations of the various approaches

TEACHING AND LEARNING PATTERN

Lectures and tutorials.

INDICATIVE CONTENT

<u>Basic Soil Mechanics</u>

Principle of effective stress.
Drained and undrained soil strengths.
Limit analysis.
Bearing capacity factors.
Elastic stress distributions.
Consolidation theory (overview).

<u>Classical analysis based on the Winkler spring approach</u>

Theories/ equations for classical analysis.
Why the Winkler spring constant (subgrade modulus) is not a fundamental soil property.
Terzaghi's advice on the selection of subgrade modulus for soils.
Analytical solution for the infinitely long beam on a Winkler foundation
Obtaining a solution using the finite difference approach.
Effect of finite difference grid spacing on solution grid spacing.
Finite differences versus finite elements.

<u>Geotechnical finite element analysis</u>
Elements for modelling soils and structures. Soil models. Insitu stresses and their importance in excavation analysis. Non linear or linear analysis?

Retaining Walls
Design using earth pressure theory.
SSI analysis using Winkler spring and continuum (finite element) analysis.

Piled Foundations

Design using α and β factors
Randolph's elastic solution for axially loaded pile
Winkler spring and continuum analysis

Tunnels

Ring compression theory.
The Muir Wood/Curtis analysis.
Winkler Spring and finite element analysis.

ASSESSMENT METHOD

The unit is assessed by a combination of examination and coursework with the proportion of marks allocated to each component given below:

Examination : 70%

Coursework: 30%

INDICATIVE SOURCES

Bakker, K.J. (2000), Soil Retaining Structures: Development of Models for Structural Analysis, Balkema.

Bowles, J.E., (1996), Foundation Analysis and Design, Mc-Graw-Hill.

Britto, A.M. & Gunn, M.J., (1987), Critical State Soil Mechanics via Finite Elements, Ellis Horwood.

Clayton, C.R.I., Milititsky, J. & Woods, R. I., (1993) Earth Pressure and Earth Retaining Structures, Blackie.

Cook, R.D., (1995), Finite Element Modeling for Stress Analysis, Wiley.

Davis, R.O. & Selvadurai, A.P.S., (1996) Elasticity and Geomechanics, Cambridge University Press.

Fleming, W.G.K., Weltman, A.J., Randolph, M.F. & Elson, W.K., (1991), Piling Engineering, Blackie.

Griffiths, D.V. & Smith, I.M. (1991), Numerical Methods for Engineers, Blackwell.

Macleod, I.A., (1990), Analytical Modelling of Structural Systems, Ellis Horwood.

Muir Wood, A. (2000), Tunnelling: Management by Design, E&FN Spon.

Naylor, D.J. & Pande, G.N., (1984), Finite Elements in Geotechnical Engineering, Pineridge Press.

Scott, R.F., (1981), Foundation Analysis, Prentice Hall.

Terzaghi, K., (1955) Evaluation of Coefficients of Subgrade Reaction, Geotechnique, vol. 5, no. 4, 297-326.

Tomlinson MJ, (1995) Foundation Design and Construction, 6th ed, Longman.