University of Macau

Undergraduate Civil Engineering Programme

Coordinating Unit:	Department of Civil and Environmental Engineering, Faculty of Science and Technology		
Supporting Unit(s):	Nil		
Course Code:	CEEB453	Year of Study:	4
Course Title:	Advanced Reinforced Concrete Design		
Compulsory/Elective:	Elective		
Course Prerequisites:	CEEB321 Reinforced Concrete Design		
Prerequisite Knowledge:	Analysis of reinforced concrete structural systems under gravity and lateral loads; a general understanding of the behavior and design of reinforced concrete members (including beams, slabs, and columns).		
Duration:	One semester	Credit Units:	3
Class/Laboratory Schedule:	Three hours of lecture and one hour of tutorial per week.		
Laboratory/Software Usage:	The software SAP2000 is adopted.		
Course Description:	This course covers the following topics: Introduction to Macao codes for loadings (including vertical loads, wind loads, and seismic loads) on structures and the reinforced concrete structural design; behavior and design of flat slabs and stair slabs; behavior and design of structural walls, foundations and earth retaining structures; prestressed concrete.		
Course Objectives:	1. To introduce to students the local Macao codes of practices in loading and design of reinforced concrete structures. 2. To extend students' knowledge and proficiency in reinforced concrete structural design and analysis. 3. To develop students with the teamwork experience and prepare them for the effective use of the latest industry standard formulas, tables, design aids and computer software in the design of reinforced concrete building structures.		
Learning Outcomes (LO):	Upon completion of this course, students should be able to: 1. apply the basic requirements of Macao codes for loadings on structures and the reinforced concrete structural design [POs: a,c,e]; 2. analyze and design reinforced concrete walls, flat slabs, stair slabs, foundations and earth retaining structures [POs: a,c,e]; 3. apply the basic theory of prestressed concrete to structural design [POs: a,c,e]; 4. use techniques and computer software in the analysis of reinforced concrete structural systems [POs: a, l]; 5. apply the principles, procedures and current code requirements (i.e. Macao codes, and Eurocodes) to the analysis and design of reinforced concrete structures through a design project [POs: a,c,e]; 6. work in groups in the solution of design problems, and adequately present technical information in written form through project reports [POs: d,g].		
Texts & References: *(* recommended textbook(s))*	1. Mosley, W.H., Bungey, J.H., and Hulse, R. (2007)*, *Reinforced Concrete Design to Eurocode 2*, 6th ed., Palgrave Macmillan, U.K. 2. LECM (2008)*, *Regulamento de Segurança e Acções em Estruturas de Edifícios e Pontes (RSAEEP) – Wind and Seismic Action Revision (Consultation Document)*, LECM, Macau. 3. LECM (1998), *Regulamento de Segurança e Acções em Estruturas de Edifícios e Pontes (RSAEEP)*, Imprensa Oficial de Macau, Macau. 4. LECM (1998), *Regulamento de Estruturas de Betão Armado e Pré-esforçado (REBAP)/ Norma de Cimentos (NC)/ Norma de Aços para Armaduras Ordinárias*		

	(NAAO), Imprensa Oficial de Macau, Macau. 5. BSI (2004), *BS EN1992-1-1:2004, Eurocode 2: Design of Concrete Structures – Part 1-1 General rules and rules for buildings*, British Standard Institution, U.K. 6. Jacobs, J.P. (2008a), *Eurocode 2 – Commentary*, European Concrete Platform ASBL, Belgium. 7. Jacobs, J.P. (2008b), *Eurocode 2 – Worked Examples*, European Concrete Platform ASBL, Belgium. 8. Narayanan, R.S., and Beeby A. (2005), *Designers' Guide to EN1992-1-1 and EN1992-1-2 Eurocode 2: Design of Concrete Structures. General Rules and Rules for Buildings and Structural Fire Design*, Thomas Telford Ltd, London. 9. Betonvereniging, The Concrete Society and Deutscher Beton-Verein (2005), *Design Aids for EC2 – Design of Concrete Structures*, 2005 edition, E & FN Spon, London.
Student Assessment:	• One test/mid-term examination: 30%; • One project (teamwork): 35%; • One final examination: 35%
Learning Outcome Assessment:	• Tests, project and final examination. • Course evaluation
Pedagogical Methods:	☑ Lecture ☐ Service learning ☐ Guest speakers ☐ Internship ☐ Case study ☐ Field study ☐ Role playing ☐ Company visits ☑ Student presentation ☐ e-learning ☑ Project ☑ Independent study ☐ Simulation game ☐ Others:_____ ☑ Exercises and problems

Major Assessment Methods: For each Major Assessment Method below, please indicate the specific pedagogical methods involved (by putting a ✓ in the relevant box(es) on the right-hand side).	Case Study	Role Playing	Student Presentation	Individual project/paper	Group project/paper	Simulation Game	Exercises & problems	Service learning	Internship	Field Study	Company visits	Written examination	Oral examination	Others (please specify)
Class Participation/ Discussion														
Assignment(s)														
Test(s)												✓		
Examination												✓		
Others *(please specify)* Team Project_			✓		✓									
Course Web: (if any)	Course materials are available in UMMoodle (http://webcourse.umac.mo/).													

Course Content: (topic outline)

Week no.	Topics	LO no.
1,2	**Introduction to Macao codes** Limit states; load combinations; specification of wind loading in Macao; specification of seismic loading in Macao; specification of materials; concrete stress block.	1,5,6
3	**Design of Shear Walls** Analysis of shear walled structures; end-zone resisting moment; Truss models.	2,4~6
4	**Design of Stair Slabs** Sizing; stair slabs spanning in the transverse direction; stair slabs spanning longitudinally	2,5,6
5 ~ 7	**Design of Foundations** Punching shear; Isolated pad footings; combined footings; strip footings; pile cap design	2,5,6
8,9	**Design of Earth Retaining Structures** Types of earth retaining structures; stability of retaining walls; cantilever retaining walls.	2
10,11	**Design of Flat Slabs** Punching shear; Equivalent frame methods; simplified method using moment and shear coefficients; column strips; middle strips.	2,4
12~ 14	**Prestressed Concrete** Principle of prestressing; prestressing methods; section analysis under working stresses; design for serviceability limit state; analysis at ultimate limit state	3

Percentage Content of:

Mathematics and Basic Sciences	Engineering Subjects	Complementary Studies	Total
10	90	0	100

Timetabled work in hours per week:

Lecture	Tutorial	Laboratory	Other	Total
3	1	---	---	4

Contribution to Programme Outcomes:

Programme Outcomes	Contribution to POs#	
	Primary	Secondary
(a) an ability to apply knowledge of mathematics, science, and engineering appropriate to the degree discipline	✓	
(b) an ability to design and conduct experiments, as well as to analyse and interpret data		
(c) an ability to design a system, component or process to meet desired needs within realistic constraints, such as economic, environmental, social, political, ethical, health and safety, manufacturability and sustainability	✓	
(d) an ability to function on multi-disciplinary teams	✓	
(e) an ability to identify, formulate and solve engineering problems	✓	
(f) an ability to understand professional and ethical responsibility		
(g) an ability to communicate effectively		✓
(h) an ability to understand the impact of engineering solutions in a global and societal context, especially the importance of health, safety and environmental considerations to both workers and the general public		
(i) an ability to stay abreast of contemporary issues		
(j) an ability to recognise the need for, and to engage in life-long learning		
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice appropriate to the degree discipline		
(l) an ability to use the computer/IT tools relevant to the discipline along with an understanding of their processes and limitations		✓

Course Instructor(s):

Prof. Wai-Meng QUACH

(Please refer to the following link for the consultation hours of the course instructor: http://www.fst.umac.mo/cee/contacthour.html)