UNIVERSITY OF ALBERTA

Department of Civil and Environmental Engineering

CIV E 676 – Behaviour and Design of Masonry Structures (Fall Term, 2016)

Instructor: Dr. Carlos Cruz-Noguez
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Teaching Assistants: None
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Class location and time: GSB-811
M 10:00 – 13:00

Course Objectives and Outline

Recognize, understand, and apply basic principles of mechanics and strength of materials to the analysis and design of masonry structures. This course discusses the behaviour and performance of masonry elements under flexural, shear and axial stresses with the help of research results and test data. Two special modules, one covering the fundamentals of earthquake engineering and the other discussing seismic analysis of reinforced masonry structures, are included. At the end of the course, the student will (1) have a working knowledge of analysis and design procedures for reinforced and unreinforced masonry members under the framework of the Canadian concrete standards, (2) understand the mechanics and structural principles behind the code provisions, (3) apply the theory to tackle unusual or critical structures not covered in the code, and (4) be able to conduct seismic analysis and design of masonry structures.

Suggested textbooks:

- Drysdale R.G. and Hamid, A. A. (2005) "Masonry Structures – Behaviour and Design" Canadian Edition. This book is bundled with the 2004 version of the code, S304.1, and is one of the most comprehensive masonry books in all of North America. This book is usually donated by the Canada Masonry Design Center (CMDC) to the students of this course.
- Hatzinikolas, Korany, and Brzev. (2015) "Masonry Design for Engineers and Architects", 4th Ed. Although not as comprehensive as the reference above, it has the advantage of being written in compliance to the latest National Building Code of Canada (2015) and the latest masonry code, S304 (2104). This book has been donated by Dr. Hatzinikolas in previous editions of this co

Code:

CSA S304-14, "Design of Masonry Structures", available for purchase online (optional).

Course contents

(Topics and emphasis may vary at the instructor's discretion, based on the class progress and time available).

1. **INTRODUCTION, MASONRY MATERIALS AND ASSEMBLAGE TESTING**
2. **DESIGN OF BEAMS: FLEXURE, SERVICEABILITY, AND MOMENT-CURVATURE RESPONSE**
3. **DESIGN OF BEAMS: SHEAR**
4. **LOADBEARING WALLS (OUT OF PLANE)**
5. **COLUMNS***
6. **SHEAR WALL BEHAVIOUR**
7. **FUNDAMENTALS OF EARTHQUAKE ENGINEERING AND SEISMIC ANALYSIS**
8. **SHEAR WALL DESIGN**

* Time permitting.

Month	Day	Topic	Assignment #	
			Due	Left
September	5	Introduction to masonry		
	7	Assemblage testing and behaviour		
	12	Flexure: basic theory		
	14	Flexure: analysis		1
	19	Flexure: design		
	21	Shear: basic theory		
	26	Shear: analysis	1	
	28	Shear: design		2
October	3	Behaviour of Out-of-Plane (OOP) Walls		
	5	Interaction diagram: unreinforced masonry	2	
	10	Interaction diagram: reinforced masonry		
	12	Slenderness effects		3
	17	Analysis and design of slender walls		
	19	Lateral loads: wind and earthquake		
	24	Fundamentals of earthquake Engineering	3	
	26	Determination of seismic forces in a building		
	27	**Midterm examination**		
	31	Distribution of lateral forces to shear walls		
November	2	Lateral forces due to torsion		4
	7	Design of unreinforced masonry (URM) shear walls		
	9	Design of reinforced masonry (RM) shear walls		
	21	Example: design of RM shear walls	4	
	23	Seismic design of (RM) shear walls		5
	28	Example: seismic design of RM shear wall		
	30	Review	5	
December	5	**Final Examination**		
	7	Masonry symposium		
	15	Research paper		