**SYLLABUS -- ARCH 6252 Building Structures II**

**Learning Objectives**

This course is a requirement for the professional degree in architecture and as such focuses on the core knowledge of building structures as contained in the Architectural Registration Exam (ARE). The prerequisite course, ARCH 6251 provides an introduction to structural analysis, structural material science and building structures constructed of wood members. This course covers the design of building structures in structural steel and reinforced concrete, and the design of all building structures to resist lateral loads. The National Architectural Accrediting Board (NAAB) in the *2014 Conditions of Accreditation[[1]](#footnote-1)*sets forth the following provisions for the technical competency expected of architects as related to building structures and materials as follows:

*A.5 Ordering Systems:* **Ability** to apply the fundamentals of both natural and

formal ordering systems and the capacity of each to inform two- and three dimensional

design.

*Realm B: Building Practices, Technical Skills, and Knowledge.* Graduates from NAAB accredited programs must be able to comprehend the technical aspects of design, systems, and materials and be able to apply that comprehension to architectural solutions. In addition, the impact of such decisions on the environment must be well considered.

*B.5 Structural Systems:* **Ability** to demonstrate the basic principles of structural systems and their ability to withstand gravitational, seismic, and lateral forces, as well as the selection and application of the appropriate structural system.

B.8 Building Materials and Assemblies: **Understanding** of the basic principles used in the appropriate selection of interior and exterior construction materials, finishes, products, components, and assemblies based on their inherent performance, including environmental impact and reuse.

The specific objectives of Building Structures II are as follows:

* To introduce structural design in steel using allowable stress design for tension members, compression members, and flexural members.
* To introduce the physical concepts of lateral load events (wind, earthquake, blast), to understand the physical principles of how these events are quantified in terms of loadings, and to introduce design concepts for lateral force resisting systems in buildings;
* To introduce cementitious materials: Portland cement, mortar, sand concrete, and normal concrete through descriptions of how Portland cement is manufactured, how it hydrates, and how it is combined with fine and coarse aggregates to make concrete;
* To describe the mechanical, thermal, and weathering properties of plain concrete and reinforced concrete in terms of both “engineering” units and in non-quantitative terms;
* To review the practical aspects of concrete construction: concrete mix design, formwork, shoring, rebar placement, concrete placement, finishing, and curing;
* To present the design of common reinforced concrete floor systems: concrete joist systems, one-way slabs, waffle-slabs, flat plates and flat slabs – and methods for integrating these systems into architectural design proposals;
* To review design of typical structural members of reinforced concrete: beams, columns, slabs, spread foundations and introduce the design and behavior of other concrete structural systems: pre-cast concrete, pre-stressed and post-tensioned concrete and load-bearing concrete masonry;

In addition to its technical role, the course content complements architectural studio by focusing on the form-giving and construction-technology aspects of building structures.

**Textbook and References**

*required text:*

Statics and Strength of Materials for Architecture and Building Construction, 4th Edition (2011),   
by Onouye and Kane

*reference texts:*

Building Structures*,* 2nd Edition (1993) by James Ambrose

Fundamentals of Building Construction 6th Edition, 2013 by Edward Allen

Building Construction Illustrated, 5th Edition (2011) by Francis Ching

Structures, by Daniel Schodek and Martin Bechthold, Prentice Hall , 7th Ed., 2013

Origins of Form, Christopher William, 1995

National Design Specification for Wood Construction (w/ Design Supplement), American Forest and Paper Association.

Minimum Design Loads for Buildings and Other Structures, ASCE 7-10, American Society of Civil Engineers, 2005.

Steel Roof and Floor Deck, Vulcraft.

Steel Joists and Joist Girders, Vulcraft.

Design and Control of Concrete Mixtures, Portland Cement Association

ACI 318, Building Code Requirements for Reinforced Concrete, American Concrete Institute

**Homework**

Approximately 7 homework assignments will be given during the semester. Each homework will be assigned a due date. Homework must be turned in on time to receive a grade -- *late homework will not be not be accepted.* The lowest homework grade will be dropped. Homework must be neat and well laid out. Your logic should be easy to follow. Use a straight edge, underline intermediate answers, and box your final answers. All calculations must be shown. Homework grades will be based on neatness, presentation and completeness of work, and inclusion of required sketches.

**Laboratory**

The purpose of the laboratory is to allow us to hold more in-depth discussions than are possible in the lectures. In general, the laboratory period will not be used for the presentation of new material (unless we are making up for time missed in a regularly-scheduled class). Specifically, the laboratory period will be used for:

* presentation and discussion of case studies and worked problems,
* demonstration of structures computer software,
* materials demonstrations and labs,
* completion of team and individual lab projects
* field trips, and
* exam preview and review.

The course is scheduled to have two hours of supervised lab per week and one credit hour of unsupervised lab per week. When we have “lab”, class will start at 8 a.m. On lecture days, we will typically start at 8.30 a.m.

**Laboratory Projects**

There will be two major laboratory projects during the term: a lateral load model project and a concrete block project. The concrete block project is part of the NCMA (National Concrete Masonry Association) unit masonry competition – see <http://www.ncma.org/events/unitdesigncompetition/Pages/default.aspx>.

Construction of laboratory projects for this class may be completed in the college shop if you have completed the safety training course offered by the college shop. Students who abuse their shop privileges by ignoring safety procedures, by neglecting to clean up after themselves, or by leaving material in the shop without permission will be asked to complete their course projects elsewhere.

**Grading**

The hourly quizzes will be announced at least a week in advance. They are preliminarily scheduled in the course outline below. If you must miss an exam, you must inform me and complete a makeup exam *before* the scheduled date or receive explicit permission to take it later. I reserve the right to give the same exam or a different exam as a makeup, at my discretion. Grades will not be curved. I reserve the right to shift exam grades if I deem that the test was too difficult or too long to complete in the allotted time. Course credit is distributed as follows:

|  |  |
| --- | --- |
| Homework | 15% |
| Attendance and Participation | 5% |
| Lab Projects | 15% |
| Hourly Quizzes | 40% |
| Final Exam | 25% |
|  | 100% |

**Attendance et cetera**

If you are to do well in this class, you must attend. Much of the information needed to complete the course will come from the lectures and handouts. Absence from class is not considered a valid excuse for not turning in your homework. If you have a problem that prohibits your participation, you must let me know beforehand. Students who are chronically absent or are repeatedly late to class will lose 3% of their final grade.

All students are expected to adhere to the Georgia Tech Academic Honor Code. Collaboration on homework is acceptable, but it is improper to copy the work of other students. Remember that is unlikely that you will learn the material if you work in teams to complete the homework. Obviously it is appropriate to collaborate on the assigned group projects; however, you are expected to do your part and I ask to be informed if members of your group are not participating as required by the assignment.

Students with special needs that are administered by the Dean of Students or by the ADAPTS office should contact the appropriate office and inform me at the start of the term so that I can ensure that we accommodate you to the fullest degree possible.

**Preliminary Schedule**

We will attempt to follow the preliminary schedule presented below. The readings for the course are assigned in the schedule below. Additional readings may be assigned during the term.

Text abbreviations are as follows:

ACI=American Concrete Institute, ACI 318

ASCE7 = Minimum Design Loads on Buildings and Other Structures (ASCE-7)

BS = Building Structures, Ambrose

BCI = Building Construction Illustrated, Ching

FBC = Fundamentals of Building Construction, Allen

Schodek = Structures, Schodek

SSM = Static and Strength of Building Materials, Onouye

DCCM=Design and Control of Concrete Mixtures, Portland Cement Association

| **Week** | | **Lecture** | **Assignments** |
| --- | --- | --- | --- |
| 1 |  | Lateral Forces: Wind and Earthquake  *BS,* Chapters 44, 45, 46  *Schodek,* Chapter 14  *ASCE7,* Chapters 6, 9 (Skim) | *Lab Assignment #1: Lateral Force Resisting Systems* |
| 2 |  | Lateral Force Resisting Systems:  Wood Stud Walls and Structures  *BS,* Chapter 47, 48 | *Homework #1 Lateral Forces* |
| 3 |  | Lateral Force Resisting Systems  *BS,* Chapters 54, 56  **Monday – GT Holiday MLK** | **Lab Assignment #1: Testing** |
| 4 |  | Structural Steel Materials and Hot-Rolled Sections |  |
| 5 |  | Structural Steel Beams  Steel Deck and Open Web Joists  Structural steel Framing Plans | Homework #2 Steel Beam Design + Framing Plans of Steel Buildings |
| 6 |  | Steel Columns and Tension Members | Homework #3 Steel Columns |
| 7 |  | Structural Steel Trusses | Homework#4 Steel Truss Design |
| 8 |  | Reinforced/Prestressed Concrete Materials  *DCCM,* Chapters 7 and 9  *BCI,* 4.30, 4.31, 6.26 | **EXAM #1** |
| 9 |  | Introduction to Load-Bearing Masonry  Reinforced Concrete Buildings and Systems  *BS,* Chapters 27 & 30  *FBC,* Chapter 11  *ACI,* Chapters 7-10 (skim)  *BCI,* 2.14, 2.15, 2.24, 4.32, 4.33, 5.44, 5.45 | *HW #5: Concrete Framing Systems*  *Lab Assignment 2: Concrete Block Design Competition* |
| 10 |  | Behavior of Moment Resisting Frames  Structural Planning of Steel and R/C Buildings |  |
| 11 |  | Factored Load Design Concept  Flexural Behavior and Design of R/C Beams  *Schodek,* Section 6.4 | HW #6: Flexural Capacity of R/C Beams  **Lab Project 2: Presentations + NCMA Unit Design Competition** |
| 12 |  | Flexural Design of R/C Beams  *BS,* Chapter 34 | *HW #5: Design of R/C Beams for Flexure*  ***EXAM #2*** |
| 13 |  | **SPRING BREAK** |  |
| 14 |  | Flexural Design of R/C Frames  Pre-Stressed Concrete  Shear Design of R/C Frames  BS, Chapter 34  *BS,* Chapter 31  *ACI,* Chapter 10 | *HW #7: Behavior of Pre-Stressed Concrete* |
| 15 |  | Design of Concrete Columns  Design of Concrete Columns  *BS,* 30, 54, 58, 59 | *HW #8: Concrete Column Design* |
| 16 |  | Final Jury Week |  |
| 17 |  | Final Exams | Final Exam Review (Sunday afternoon/evening) |

1. http://www.naab.org/accreditation/2014\_Conditions [↑](#footnote-ref-1)