ARCH 2240 Structures 2: Tectonics
Spring 2011 ∙ Course Syllabus

"Construction is the art of making a meaningful whole out of many parts. Buildings are witnesses to the human ability to construct concrete things. I believe that the real core of all architectural work lies in the act of construction. At the point in time when concrete materials are assembled and erected, the architecture we have been looking for becomes part of the real world."


Faculty
Erkin Ozay, AIA, lecturer
e-mail: e.ozay@neu.edu
Office hours: Tue & Fri, 9:00 am, by appointment

Time and Location
Section 2 (30321): Tue & Fri 9:50 am – 11:30 am Behrakis 010

Prerequisites
Satisfactory completion of undergraduate level PHYS 1151 Physics 1, undergraduate level MATH 1341 Calculus 1 and ARCH 2230 Structures 1: Statics with a minimum grade of D- for each course is required. If it is discovered that you have not completed these prerequisites, you may be removed from the course at any time during the semester as per university policy and deadlines.

Course Content and Goals
This course will focus on the art of building, or “tectonics.” It is rooted in both a fundamental knowledge of building techniques and a study of the “significance” of materials, structure, and construction to larger architectural ideas. This course will be an extension of your previous Structures I: Statics course in that this course will focus on the application of the structural concepts in built form.

We will study the four primary construction types: wood, masonry, steel, and concrete. We will investigate the wide range of structural and constructional variations within these four groups, and we will also explore the qualitative issues generated by a particular “tectonic” system. We will also look at hybrid systems that mix construction types. We will produce a series of detailed models and drawings that demonstrate your understanding of the construction types.

Interwoven throughout the course will be a series of topics to fuse your understanding of design, history, theory, and building technology. This course shall explore how architecture unites material, form, and performance in construction to embody meaning in the design of selected buildings. We will analyze case studies of existing buildings by renowned architects here in Boston as well as from all points on the globe to exemplify the art of building in practice.

There will also be a prevalent subtext that will pervade this course: the ethical responsibility of an architect in relationship to the environment, economics, and the law as s/he is making construction choices.
**NAAB Student Performance Criteria**

This course meets the following NAAB Student Performance Criteria to the extent designated in 2009 Conditions for Accreditation document:

A.4 Technical Documentation: *Ability* to make technically clear drawings, write outline specifications, and prepare models illustrating and identifying the assembly of materials, systems and components appropriate for a building design.

B.9 Structural Systems: *Understanding* of the basic principles of structural behavior in withstanding gravity and lateral forces and the evolution, range, and appropriate application of contemporary structural systems.

B.10 Building Envelope Systems: *Understanding* of the basic principles involved in the appropriate application of building envelope systems and associated assemblies relative to the fundamental performance, aesthetics, moisture transfer, durability, and energy material resources.

B.12 Building Materials and Assemblies: *Understanding* of the basic principles utilized in the appropriate selection of construction materials, products, components, and assemblies, based on their inherent characteristics and performance, including their environmental impact and reuse.

**Completion Requirements**

Your final grade will be calculated as a composite of the following criteria:

- Class participation: 10%
- Quizzes: 30%
- Projects: 60%
- Extra credit: May be available at instructor’s discretion

Readings: All reading shall be completed before the class it is assigned. See schedule and bibliography below. There may be additional required reading material assigned for certain topics.

Quizzes: There will be 8 quizzes based on both the required reading for that class and all lecture material delivered in class up to the time of the quiz. The quizzes will be open-book so you may bring your textbook and notebook for reference. No laptops are allowed during quizzes. You are responsible for all the material covered by the book, not only what we are able to discuss during class time. If you are absent without an acceptable excuse (as per school policy) you will fail the quiz for that meeting time. If you are absent due to an acceptable reason, the quiz will not count toward your average. In either case, there are no make-up quizzes.

Projects: Projects are due at the beginning of class on the due date. Late projects will be reduced one full letter grade each day it is late. There will be three major projects for the term. Project 1 will model the composite and layered nature of wood frame construction and its expressive potential. Project 2 will be a detailed wall section drawing of masonry cavity wall. Project 3 will be a three-dimensional exploded axonometric of your own studio project. Any written work must be typed and printed on the computer or it will not be accepted. All drawings for presentation shall abide by a regularized format, 24” horizontal x 31” vertical.

Class participation: All students are required to participate in class discussions; active dialogue is encouraged and required. Slide shows and teaching notes will not be distributed. You are also required to attend all the evening lectures offered during this term. The lectures meet on some Monday evenings.

**Bibliography**

Required textbook:

Suggested reading material that you will need to reference for your own projects. Most of these books are on reserve at the library:
Neatness
Clarity and proper formatting is a professional requirement for architectural and engineering professions. Hence, neatness, legibility and cleanliness are required for and will be part of the grading for all work submitted by you including quizzes and projects.

Attendance Policy
Three unexcused absences will drop your grade by one letter grade, e.g. from an A to a B. Late attendance will be tracked and for every three sessions you are late to class, your participation points will be decreased by 2 points. If you miss a class for any reason, it is your responsibility to get a copy of the notes from your classmates and do the catch up work. Excusable absences are as follows per university policy: Participation in athletics, participation in student activities, illness or personal crisis, religious observances, jury duty and military service. All of these conditions except the religious observances require documentation. Please contact College Student Services Office for details on what forms of documentation are acceptable and how it should be submitted. For religious observances please notify me as early as you can.

Grade Dispute Policy
Your final grade is not negotiable. I will make every effort to make sure grading is fair to everyone. If you believe that there is a legitimate problem with your grade on a specific project or a quiz, please e-mail me a scanned copy of your returned work and I will make a decision on whether it needs to be reviewed again. You are not allowed to bring up personal grade issues during class.

Advice
- Attend all sessions and ask questions.
- Do the readings. Follow a reading schedule and take notes as you read. You may consider using tabs to locate topics easier within the book.
- Construction is a vast subject matter. You are expected to do all required research for your own projects, including topics that may not get covered in the class.

Students with Disabilities
The University is committed to compliance with the Americans with Disabilities Act. If you anticipate issues related to the format or requirements of this course, please notify me. If you determine that formal, disability-related accommodations are necessary, it is important that you be registered with the Disability Resource Center (617-373-2675; www.drc.neu.edu) and notify me of your eligibility for reasonable accommodations.

Academic Integrity and Honesty
You are expected to be fully aware and compliant of the University’s Academic Integrity Policy:
http://www.northeastern.edu/osccr/academichonesty.html

If you have any questions regarding proper attribution of the work of others, contact your professor prior to submitting work for evaluation.
**School of Architecture Grading Guidelines for Lecture Classes**

**A** exemplary quality work. The student:
- demonstrates one of the best performances on exams/quizzes/papers/projects the instructor has seen at Northeastern or any other accredited school of architecture
- demonstrates a superior understanding of course readings and lectures
- participates in class discussions cogently and willingly

**A-** high quality work. The student:
- demonstrates one of the best performances on exams/quizzes/papers/projects within the class
- demonstrates a high level of understanding of course readings and lectures
- participates in class discussions intelligently and willingly

**B+** good quality work. The student:
- demonstrates strong performance on exams/quizzes/papers/projects
- demonstrates a good understanding of course readings and lectures
- participates in class discussions intelligently

**B** above average work. The student:
- demonstrates above average performance on exams/quizzes/papers/projects
- demonstrates an above average understanding of course readings and lectures
- participates in class discussions when asked to respond

**B-** average work. The student:
- demonstrates average performance on exams/quizzes/papers/projects
- demonstrates an average understanding of course readings and lectures
- meets attendance requirements

**C+** below average work. The student:
- demonstrates below average performance on exams/quizzes/papers/projects
- demonstrates a below average understanding of course readings and lectures
- meets attendance requirements

**C** well below average work. The student:
- demonstrates well below average performance on exams/quizzes/papers/projects
- demonstrates a well below average understanding of course readings and lectures
- engages in excuse-making, tardiness, and absence

**C-** minimal work. The student:
- demonstrates minimal performance on exams/quizzes/papers/projects
- demonstrates a minimal understanding of course readings and lectures
- engages in chronic excuse-making, tardiness, and absence

**D+, D, D-** marginally acceptable work. The student:
- demonstrates unacceptable performance on exams/quizzes/papers/projects
- demonstrates an unacceptable understanding of course readings and lectures
- engages in chronic excuse-making, tardiness, and absence
<table>
<thead>
<tr>
<th>Week</th>
<th>Class</th>
<th>Date</th>
<th>Topic</th>
<th>Reading (read before class)</th>
<th>Quiz</th>
<th>Assignment</th>
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<tbody>
<tr>
<td>1</td>
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<td>Introduction: Tectonics</td>
<td></td>
<td></td>
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</tr>
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<td>1</td>
<td>1/14</td>
<td>Site and Foundations</td>
<td>Chapters 1, 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>1/18</td>
<td>Wood 1: Material properties</td>
<td>Chapter 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>21</td>
<td>1/21</td>
<td>Wood 2: Heavy Timber Frame</td>
<td>Chapter 4</td>
<td>Quiz 1</td>
<td></td>
</tr>
<tr>
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<td>25</td>
<td>1/25</td>
<td>Wood 3: Light Frame</td>
<td>Chapter 5</td>
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<td>Project 1 assigned</td>
</tr>
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<td>28</td>
<td>1/28</td>
<td>Wood 4: Light Frame - Exterior Finishes</td>
<td>Chapter 6</td>
<td>Quiz 2</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>2/1</td>
<td>Wood 5: Light Frame - Interior Finishes</td>
<td>Chapter 7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>4</td>
<td>2/4</td>
<td>Preliminary review crits</td>
<td></td>
<td>Quiz 3</td>
<td>Project 1 - Preliminary review</td>
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<td>5</td>
<td>9</td>
<td>2/8</td>
<td>Masonry 1: Brick</td>
<td>Chapter 8</td>
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</tr>
<tr>
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<td>11</td>
<td>2/11</td>
<td>Masonry 2: Stone and Concrete</td>
<td>Chapter 9</td>
<td>Quiz 4</td>
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<tr>
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<td>2/15</td>
<td>Masonry 3: Cavity Walls</td>
<td>Chapter 10</td>
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<tr>
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<td>18</td>
<td>2/18</td>
<td>Steel 1: Material properties</td>
<td>Chapter 11</td>
<td></td>
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<td>22</td>
<td>2/22</td>
<td>Lecture: Assembly</td>
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<td>25</td>
<td>2/25</td>
<td>Steel 2: Details and construction</td>
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<td>3</td>
<td>3/1</td>
<td>Spring Break</td>
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<td>Spring Break</td>
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<tr>
<td>15</td>
<td>8</td>
<td>3/8</td>
<td>Steel 3: Light metal framing</td>
<td>Chapter 12</td>
<td>Quiz 5</td>
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<td>11</td>
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<td>Preliminary review crits</td>
<td></td>
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<td>3/15</td>
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<tr>
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<td>3/22</td>
<td>Concrete 3: Precast systems</td>
<td>Chapter 15</td>
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<tr>
<td>20</td>
<td>23</td>
<td>3/25</td>
<td>Lecture: Expression</td>
<td></td>
<td></td>
<td>Project 2 due - Project 3 assigned</td>
</tr>
<tr>
<td>12</td>
<td>26</td>
<td>3/29</td>
<td>Roofing</td>
<td>Chapter 16</td>
<td>Quiz 7</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>25</td>
<td>4/1</td>
<td>Field Trip</td>
<td></td>
<td></td>
<td>Trip Report</td>
</tr>
<tr>
<td>13</td>
<td>28</td>
<td>4/5</td>
<td>Lecture: Integrated Design</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>12</td>
<td>4/8</td>
<td>Guest lecturer</td>
<td></td>
<td>Quiz 8</td>
<td>Project 3 - Preliminary review</td>
</tr>
<tr>
<td>14</td>
<td>15</td>
<td>4/12</td>
<td>Preliminary review crits</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>26</td>
<td>18</td>
<td>4/15</td>
<td>Lecture: Sustainability</td>
<td></td>
<td></td>
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<tr>
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<td>27</td>
<td>4/19</td>
<td>Student presentations</td>
<td></td>
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<td>Project 3 due</td>
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Please note: Syllabus subject to change
ARCH 2240 Structures 2: Tectonics
Spring 2011 – Project 1: Watchtower

Assigned: Tuesday, January 25
Preliminary review: Tuesday, February 4
Final submission: Friday, February 18

PROJECT

Project 1 will investigate wood light frame construction and its expressive potential. This will be a mini design project for a ‘watchtower’ on two levels. The location will be non-specific and flat. The structure itself shall reveal, exploit, and dramatize the nature of wood frame construction including its lightweight standardized elements, modular planning, simple assembly, and plethora of formal possibilities. The requirements for configuration [explained below] will also demonstrate “load path,” the path that loads necessarily follow to ultimately reach the ground. You may not use any heavy timber material: all wood members must be ‘2x’ members. No 2x member can be longer than 16’.

PROGRAM

1. Foundation: Use a crawl space 4’ deep: represent a 10” thick poured-in-place concrete foundation wall with a 2’ wide by 1’ deep continuous footing. Do not include a slab at the bottom of the crawl space.

2. Lower level: This level will contain a stair: no more, no less. It will include an entry door, landings at the lower and the upper level of a minimum 3’-6” x 3’-6”, and an enclosed 3’-6” wide stairway that leads to the upper level: no other rooms will be on the lower level. Your treads can be between 10” and 12”. Your risers can be between 7” and 8”. You may use a straight run, switchback, or winder stair, but you may not use a spiral stair. You will need three stringers for each stair run. You must have a minimum of 20sf of rough opening for a window[s] in the stairway.

3. Upper level: This level will be a minimum 9 feet above grade, it will be approximately 100sf [upper level floor area plus the area open for the stairway], and it will have a minimum 80sf of rough opening for windows so one can see out of the upper level in all directions. All areas of the upper level need to be accessible with a 3’ clear walk way. The upper level must be supported by the stairway walls. Your upper level must cantilever some interior space beyond the footprint of your lower level at least 4 feet. The upper level plan must have one non-orthogonal load bearing wall. No other structure other than the stairway walls may come down to the ground.

4. Roof[s]: Your roof must cantilever beyond the footprint of your upper level at least 4 feet in one location, and you must ensure proper support of your roof and all your roof overhangs. You must make a roof form that incorporates a folded roof surface or surfaces that will demonstrate clearly the proper drainage of water, and must collect and drain the rainwater at a maximum of two places. No continuous drip edges are allowed for your roofs. Roof corners as low points will not control the water to exit roof at one point.

Note: To construct your framing, you may consider making a drawing of the framing on a surface that will not stick to Elmer’s Glue [like mylar], and then assemble the basswood pieces on top of the drawing. This will help keep you framing accurate and square.
PRELIMINARY CRITIQUE
Drawings: all drawings [manual or digital] shall be on separate 8.5" x 11" or 11" x 17" sheets of paper with a computer-generated name, date [Spring 2011], course name and number [ARCH 2240 Tectonics], scale of drawing [1/4" = 1'-0" scale], and drawing title [i.e., Floor Plan] in the lower right-hand corner of each page. These will be schematic design drawings, so they do not need to show any structure. These drawings will be collected at the preliminary crit so please make copies or have digital version for yourself.

1. First Floor Plan: show stairs, all doors and windows. Indicate location of second floor plan and openings in floor above with dashed lines above.
2. Second Floor Plan: show stairs, all doors and windows. Indicate location of first floor plan below with dashed lines below and roof overhangs with dashed lines above.
3. Section: cut the section through the stair and the upper level
4. Elevations: draw all the elevations of your watchtower showing location of windows, door, roofs, etc.

FINAL PROJECT
Model: produce a 1/2" = 1'-0" scale basswood model of your watchtower including all the wood framing pieces. Your framing sizes must be reasonably accurate, for example, 1/16" x 3/16" basswood is a good approximation for representing a 2 x 6. Use only basswood, not balsawood. Buy your material at size of your framing members: do not cut your framing out of larger sheets, and you may not use the laser cutter to cut any part of your model. Use only “Elmer’s” white glue for connecting your basswood pieces. Do not use a hot glue gun: these produce messy models where the joints are neither strong nor durable.

1. Foundation: represent the foundation walls and footings, but do not show a crawlspace slab. Do not add a model base other than the foundation itself. This will be fabricated with chipboard: nothing else may be used.
2. Framing: build all the floor framing, wall framing, and roof framing members with particular attention to framing details, such as nailing surfaces, door headers, jack and king studs, proper cantilevers, etc. All framing shall be 16" o.c. Bridging is required for studs, joist, and rafter spans larger than 10’. All floor and roof framing will use 2 x 10’s [1/16" x 3/8” basswood is good]. You only need to show the stair stringers: you do not need to add the treads or risers.
3. Label: computer generate a label to be glued to the side of your foundation that includes your name, date, course name and number, and scale of model on your model.

Projects are due at the beginning of class on the due date. Late projects will be reduced one full letter grade each day it is late. There will be a preliminary critique to review and collect your design drawings [10%]. Projects will be evaluated on their accuracy of detail [70%], quality of craftsmanship [10%], creative ability to exploit the expressive qualities of wood light framing [10%], and timeliness.
ARCH 2240 Structures 2: Tectonics
Spring 2011 – Project 2: Cavity Wall

Assigned:   Friday, February 16
Preliminary review:  Friday, March 11
Final submission:  Friday, March 25

PROJECT

Project 2 will investigate and document masonry cavity wall construction in a 3/4" = 1'-0" scale wall section. “Working Drawings” or “Construction Documents” are the instrument architects use to precisely describe their constructional intentions to the contractor. Clarity, legibility, and ease of locating information are critical characteristics of any architect’s technical drawing. Ultimately, “Construction Documents” constitute legal documents.

This wall section will be of a two-story brick-veneer with a CMU back-up cavity wall located in the northeast of the USA. It will have a full basement and a “flat roof” with a “green roof” system. The first floor and second floor will have different floor structures and different finished surfaces. Your section shall cut through a window at each level. Each window will employ a “light shelf” detail.

Your wall section shall be continuous from foundation footing to the parapet. The exterior shall be to the left, and the interior to the right of your drawing. It will show a lateral depth of 6’ from the exterior face of the wall. All elements shall be clearly and logically labeled: the organization and logic of the labeling must be designed to communicate most clearly your constructional intensions to the contractor. Align and left or right justify your labels.

Similarly, dimension strings must also be designed to communicate most clearly your dimensional intensions to the contractor. You must draw two critical continuous dimension strings that dimension the following: 1. the floor construction thicknesses to the rough framing such as slab, subfloor, joists and beams (not to finished surfaces like face of sheetrock), 2. the critical details of the CMU wall (top of bond beams, rough openings for windows). Both dimension strings will be continuous from bottom to top of drawing.

Line weight is particularly important for legibility of such a complex drawing. Develop a system for dark lines for section cuts, medium lines for internal wall information, and light lines for objects beyond in elevation, dimension lines, and pointer lines for notes. Any hatching of materials must be done with discretion and lightness so it does not dominate the drawing. Many important components of masonry cavity wall construction are too thin to represent to scale: often you must exaggerate a material thickness to be able to read it clearly (e.g., for flashing or membranes).

When you are producing your drawings on the computer, you must realize how lines will print so they don’t bleed together: practice prints will be necessary. Not all required construction elements are listed below; however, you will still be responsible for them in your drawing. Do not add borders to your drawings, and don’t even dare using the typeface that looks like hand lettering.

ELEMENTS

1. Foundation/basement [unfinished] minimum 8'-0" floor to ceiling:
   a. Represent a 1’ deep x 2’ wide continuous poured-in-place concrete footing
   b. Represent a poured-in-place concrete foundation wall
   c. Represent a 6" basement floor slab with wire mesh, on top of 4" compacted gravel and requisite vapor barrier
   d. Represent proper waterproofing, footing drain, and requisite drainage system
   e. Represent proper insulation for the basement
2. First floor structure:
   a. Represent 2x10 floor joists with metal tie straps bearing on the wall that is cut in section
   b. Represent 3/4" subfloor and 3/4" finished floor

3. First floor walls and ceiling, minimum 8'-0" finished floor to finished ceiling:
   a. Represent modular brick veneer, 1" air-space cavity, 2" rigid insulation, and standard CMU back-up wall
   b. Represent all required flashing and weep holes
   c. Represent masonry ties every third course
   d. Represent necessary waterproofing
   e. Represent exposed CMU walls in the interior
   f. Represent exposed floor structure above at ceiling

4. Second floor structure:
   a. Represent 14" deep heavy timber beams bearing on the wall that is cut in section
   b. Represent 3" solid wood decking

5. Second floor walls and ceiling, minimum 8'-0" finished floor to finished ceiling:
   a. Represent modular brick veneer, 1" air-space cavity, 2" rigid insulation, and standard CMU back-up wall
   b. Represent all required flashing and weep holes
   c. Represent masonry ties every third course
   d. Represent necessary waterproofing
   e. Represent 5/8" gypsum wall board with proper furring on wall surfaces and strapping for the ceiling

6. Windows minimum 3'-0" tall at each floor (rough openings should be of a logical dimension relating to CMU construction):
   a. Represent proper lintels over your window openings
   b. Represent proper flashing and weep holes at your window openings
   c. Represent windows as prefabricated windows: minimal detail required
   d. Add a light shelf detail to each window: this must bypass the brick veneer and attach to the CMU block back up (this may require a separate detail to be made integral to your page composition)

7. Roof structure; see chapter 16 roofing
   a. Represent 2x10 roof rafters with metal tie straps bearing on the wall that is cut in section
   b. Represent 3/4" sheathing
   c. Represent a minimum 2'-0" tall parapet wall measured from the top of your roof membrane
   d. Represent a single-ply roof membrane and its necessary connection to the parapet wall
   e. Represent a shallow "extensive" sedum green roof system
   f. Represent a roof drain in section (drain pipe is dotted in beyond 3'-0" o.c. from outer face of wall, drain tube goes away from exterior wall)
   g. Represent a minimum 4" rigid insulation on decking with a 1/4" per 1'-0" slope toward the roof drain
   h. Represent proper flashing at all critical points at roof and parapet

REQUIREMENTS FOR PRELIMINARY CRIT
Draft of the drawing on 24" x 36" vertical format with computer-generated name, professor’s name, date (Spring 2011), course name and number, scale of drawing (3/4" = 1'-0" scale), and drawing title (Masonry Cavity Wall Section) in the lower right hand corner.

REQUIREMENTS FOR FINAL PROJECT
Final drawing on 24" x 36" vertical format with computer-generated name, professor’s name, date, course name and number, scale of drawing (3/4" = 1'-0" scale), and drawing title (Masonry Cavity Wall Section) in the lower right hand corner.

Projects are due at the beginning of class on the due date. Late projects will be reduced one full letter grade each day it is late. Projects will be evaluated on their completeness and accuracy of detail [90%], quality of craftsmanship and quality of page composition (10%).

Please note that digital files are easily shared. You are welcome and encouraged to consult with your classmates, but sharing digital drawing files is plagiarism.
ARCH 2240 Structures 2: Tectonics  
Spring 2011 – Project 3: School Project – Tectonic Analysis

Assigned:       Friday, March 25  
Preliminary review:  Friday, April 8  
Final submission:  Wednesday, April 20

PROJECT

The focus of Project 3 is your own studio project. The submitted work will be part of your final studio presentation.

Once the diagrammatic design parti and the general configuration of the project are established, i.e. “what to build”; the architect is confronted with the question: “how to build it?” In some cases, development of “what” and “how” could be an integrated process: Work of visionary architects such as Louis Kahn, Jean Prouvé, Peter Zumthor and Renzo Piano, are built over the premise of a highly controlled tectonic relationship between the parts and the whole.

Architectural design is a complex decision making process, the ultimate objective of which is the creation of a material body. The ability of an architect to establish early tectonic decisions and rules may help provide a conceptual integrity to the whole project.

Focusing on one key area of a project during the schematic design stage is a way to study, analyze and structure a set of tectonic guidelines for the subsequent design development: slab construction, floor to floor dimensions, ceiling cavities, exterior wall construction, openings and general ideas about finishes, etc. could be considered in a more detailed manner early on. This could initiate a back and forth design process at different scales. Surfaces, proportions, general architectural and material expression could be tested with drawings, renderings, models and mock-ups to make better design decisions as the process evolves and gets more complex.

You are asked to build a conceptual tectonic model of a typical bay of your school project within the following guidelines:

- Scale: 1/2”=1’-0”
- Depict the “typical fabric” of your design: At a minimum you are expected to build one floor with half a story above and below at 24’ depth and width, which is about a 12”x12”x12” model. The model should clearly capture a structural bay whether it is supported by bearing walls, a frame or a hybrid system.
- You may also choose to focus on singular/multistory spaces other than the auditorium. In any case, your model should show at least one structurally supported/suspended floor. Just a slab on grade is not acceptable. As a rule of thumb, for every inch of height added to your model, you can reduce the depth of your model by an inch.
- Clearly differentiate the structural (columns, shear walls, frames, beams, slabs etc.) and nonstructural elements (light framed walls, partitions, dropped ceilings, cladding elements etc.) These elements should be shaped, sized and oriented in a structurally accurate manner. Your model should evoke a proper sense of thickness and weight for each component.
- Please do not build a “diorama”. The model should be a conceptual representation of the architectonic idea. Try to give a sense of finishes (smooth, textured, reflective, matte etc.) using as few materials as possible. Avoid applied colors, line work or prints.
- Using acrylic sheet (Plexiglas) for glass is optional. However, you are required to build any window frames, mullions, transoms etc. as neatly and to scale as possible. There may be instances where use of acrylic sheets may be necessary, such as a model focusing on a heavily glazed area.
- Show major exterior wall layers and cavities without minor details such as flashing. However, basic joint lines and how different materials come together (flush, proud, with a joint cover/third material, with a gap, etc.) should be indicated on the façade.
- Do not peel away any surfaces to reveal other sub-surfaces. Wall and slab layers should be visible at the cut
lines of the model. You may also find other creative and expressive ways to build your model to explain the
tectonic concept better. A good example: partially covered structural frames.

- Remember: deciding which portion and what extent to build is a crucial step. Your model should stand up on its
own without the help of extra elements. Decide which portions to cover and which portions to leave exposed in
order to maximize the clarity and usefulness of the model as a design tool.

- Please be sensitive to how different components of your design come together. Construction sequence,
structural and visual hierarchy, nature of connections (flush, stacked, concealed, articulated, etc.) should be
clearly formulated and represented in your model.

- Include a discreet computer generated name and affix it to a proper corner of your model.

- All basswood models will receive up to 10 bonus points. Models that use a reasonable amount of basswood will
receive up to 5 bonus points. Extent of bonus points will depend on the scope and the craft level.

**REQUIREMENTS FOR PRELIMINARY CRIT**

Draft façade, façade plan and wall section drawing at 1/2" = 1'-0" scale arranged on a single 24"x36" sheet (no
exceptions.) Locate the elevation drawing on the top left corner of your sheet. Wall section should be on the right hand
side and the plan directly below the elevation. Align the plan and section with the elevation. On the lower right hand corner
include a small scale diagrammatic elevation and a diagrammatic plan with a north arrow. Highlight the study area in both
drawings with a thick rectangle in both key drawings.

Include a computer-generated name, professor’s name, date (Spring 2011), course name and number, scale of drawing
(1/2" = 1'-0" scale), and a drawing title (School Project-Tectonic Analysis) in the lower right hand corner.

We suggest you gradually improve this drawing to provide a reference to build your final model. You may choose to use
this drawing in your final presentation as well.

**CRITERIA AND SUBMISSIONS**

Projects are due at the beginning of class on the due date. Late projects will be reduced one full letter grade each day it is
late. Projects will be evaluated on their scope (10%), quality of preliminary submission (10%), completeness and accuracy
of detail (70%) and quality of craftsmanship (10%).
You have exactly 20 minutes to complete this quiz.

1. Describe the primary differences between caissons and piles. (20 points)

______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________

2. During the construction of a single family residence, it is determined that the backfill material is not clearly specified in the construction documents. The contractor proposes to use highly clayey soils that are readily available on site as backfill. As an architect your direction would be: (20 points)

______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________

3. What is a needle beam? (12 points)

______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________

4. Why do we use frost walls? (12 points)

______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________

5. The boards of a recently built outdoor wooden deck are subject to water accumulation after rains. What kind of distortion or defect may be the possible source of problem? Select one. (12 points)

   a. Crook
   b. Decay
   c. Cup
   d. Wane
   e. Twist
6. In the foundation wall/footing detail below, what is the element shown? (12 points)
   a. Waterproof membrane
   b. Key
   c. Separator
   d. Bentonite waterstop

7. During the schematic design phase for a low rise structure, three structural systems are being compared: wood light frame, light gauge steel studs and concrete. Which system is more likely to have the lowest total embodied energy? Why? (12 points)

______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
1. What are the two advantages of glue laminated beams lumber over solid lumber beams? (12 points)
   a. ____________________________________________
   b. ____________________________________________

2. Indicate what the following abbreviations stand for and list two characteristic uses of these wood products. (18 points)

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Long name</th>
<th>Two uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSL</td>
<td>___________________________</td>
<td>___________________________</td>
</tr>
<tr>
<td>MDF</td>
<td>___________________________</td>
<td>___________________________</td>
</tr>
<tr>
<td>LSL</td>
<td>___________________________</td>
<td>___________________________</td>
</tr>
</tbody>
</table>

3. Fill in the blanks. (6 points ea.)

   The strongest way to nail two wood members is ____________________________.
   ________ nailing method is the weakest and only used to keep two members in alignment.

4. Indicate True or False regarding heavy timber framing. (6 points ea.)

   Structural wood decking could be used as the finish floor surface in a Type IV building.  T  F
   Iron dogs are used to tie beams and girders to columns.    T  F
   Firecut beam ends are used to accommodate shrinkage of beams lengthwise.  T  F
   Anchor straps are steel elements that counteract wind uplift forces by tying the roof girders and trusses down to masonry exterior walls.  T  F

5. What are the actual dimensions of the following nominally dimensioned kiln dried solid lumber pieces? (10 points)

   1x6 ____________________________
   4x12 ____________________________
6. While redlining a schematic design drawing set for a heavy timber frame building, you notice the following column and double beam connection detail. The detail shows two solid lumber beams bolted to the sides of a heavy timber column. Briefly explain why this connection detail may be structurally deficient and neatly and clearly sketch a solution next to the original detail. Note the key components of your sketch. (24 points)
1. What is the role of a double header joists in wood light frame floor construction? (12 points)
   a. to attach floor joists to the rim joist
   b. to support partition walls that land between joists
   c. to support joists at a floor opening
   d. to allow floor joists to share a concentrated load

2. Anchor bolts are used in wood light frame construction to connect (12 points)
   a. steel beams to interior steel pipe columns
   b. rafters to top plates
   c. foundation walls to foundation footings
   d. stair stringers to stair treads
   e. sills to foundation walls

3. When specifying the insulation material for an unventilated roof system, what are the two important issues that need to be addressed by the architect? (14 points)
   a. ___________________________________________________________
   b. ___________________________________________________________

4. Briefly explain what ice dams are in wood light frame construction. (12 points)
   ___________________________________________________________
5. In the space provided below neatly and legibly draw an exterior wall and eave section detail constructed out of light wood framing members that is configured to prevent ice damming. Clearly designate and note each item shown in your section. Show all framing and finish members required for this detail. Do not show roof underlayment, moisture barrier, roofing material, exterior and interior wall finishes. Draw each element roughly to scale. (50 points)
   - Wall framing: 2x6 studs
   - Roof framing 2x10 rafters
   - Roof framing attached to wall framing with a "birdsmouth" cut
   - Roof pitch: 6:12
   - Show wall sheathing
   - Show roof sheathing
   - Show metal drip edge
   - Show 5 1/2" wood fascia with a metal gutter
   - Show plywood soffit with related framing to hold it in place
   - Show wall and roof insulation
   - Show all required components to prevent ice damming

Scale: one square equals 5 1/2"x5 1/2"
ARCH 2240 Structures 2: Tectonics
Spring 2011 – Quiz 4

You have exactly 20 minutes to complete this quiz.

1. Indicate True or False regarding light wood framed structures. (6 points ea.)
   
   Vapor retarder is generally installed on the warm side of the building envelope.  T  F
   
   Board and batten siding can be used horizontally.  T  F
   
   Plumbers generally install waste pipes before the supply pipes.  T  F
   
   Most building codes require a 7'-0" minimum clear headroom at stairs.  T  F

2. Casings are most closely associated with: (12 points)
   
   a. finish stairs
   b. doors and windows
   c. brick arches
   d. siding
   e. eaves

3. Neatly and clearly sketch in plan, detail drawing of an exterior corner post using 2 x 6’s for wood light frame construction, which provides a nailing surface for both interior finish materials and exterior sheathing (12 points)

4. What is the benefit of a rainscreen wood siding application compared to a wood siding finish that is directly fastened to wall sheathing? (12 points)
5. Neatly and legibly freehand draw the complete elevation of a stud assembly from end to end for a wall with a rough opening for a window. Draw a complete wall at 12'-0" wide [corner to corner] by 8'-0" tall [from sole plate to top plate] with a rough opening for a window that is 3'-0" wide by 4'-0" tall with the window sill at 2'-0" off the floor. Show all vertical studs needed at proper spacing. Your drawing must be reasonably to scale relative to itself. Dimension your drawing and draw lines from the list at left to the correct framing element: [40 points]

- top plates
- header
- king studs
- jack studs
- sole plate
- the cripple studs
- rough sill
1. Indicate True or False masonry construction systems and materials. (6 points ea.)

In severe climates, struck mortar joints should not be used in exterior walls.  

In general, granite has a higher water absorption rate than limestone.  

A post tensioned CMU wall is likely to be double wythe.  

A single stretch of a linear, blank masonry wall should not exceed 125’ without a movement joint.  

2. Most brick buildings today are built with running bonds. Why? (12 points)

   a. due to lack of skilled masons  
   b. major expansion and contraction problems may occur when other types of bonds are used  
   c. running bond is the most moisture proof bonding method  
   d. most brick buildings today feature brick veneer facades that do not require structural bonds  

3. How tall, in feet and inches (example: 3'-6'’), is a brick masonry wall that is comprised of 63 courses of modular brick? (12 points)  

4. What is EIFS? What are the two basic problems associated with this system? [12 points]
5. Neatly and legibly sketch a window head section detail built within a brick veneer cavity wall with CMU back up. You do not have to draw the window in detail but it should be located correctly within the wall depth. Include at least a 24" portion of the wall above the window opening. Use lines to connect the labels below to the elements in your sketch. [40 points]

Concrete masonry unit (CMU)

Modular brick veneer facing
(Show correct number of bricks in relation to CMU)

Steel lintel for brick veneer facing over opening

Reinforced block lintel over opening made up of bond beam units

Masonry tie

2" cavity (no thermal Insulation needed)

Flashing and weep holes where required
1. Indicate True or False steel and light gauge steel frame construction. (8 points ea.)

   Cold forming process makes light metal framing members stronger.    T    F
   A 12 gauge steel sheet is thinner than a 20 gauge sheet.             T    F
   Light metal framing members are installed using predrilled holes.   T    F
   The lower the carbon content in a steel alloy, the more ductile it is. T    F

2. Name the three basic methods of providing a building frame with lateral stability? (12 points)

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

3. What is the total weight of a W12x120 that is 5’ in length? (12 points)

________________________________________________________________________

4. What kind of steel alloy is used to prevent corrosion in the exposed steel components of Eero Saarinen’s John Deere Headquarters Building in Moline, Illinois? Describe the basic chemical process. (12 points)

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
5. You are the project architect for a medium size, low rise building project located in the Northeast USA. During the conceptual design phase you assumed a light wood framed exterior wall system. However, the client now wants you to consider a light gauge metal exterior wall system. How would you explain to the client that the exterior wall construction will likely to be more expensive using light metal framed walls? [20 points]

________________________________________________________________________
________________________________________________________________________
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________________________________________________________________________
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6. A ceiling cavity contains a horizontal structure that consists of W12x14 girders and HSS 6x4x1/4 beams stacked directly on top. What is the depth of the cavity if the floor decking and ceiling finish are directly above and below this system? [12 points]

________________________________________________________________________
You have exactly 20 minutes to complete this quiz.

1. Indicate True or False for cast in place concrete construction. (6 points ea.)

   Air entraining cement reduces the workability of concrete.         T  F
   #4 rebar is 1/4” in diameter.                                      T  F
   Vertical shear studs and stirrups function somewhat similarly.    T  F
   Concrete cures by drying.                                         T  F

2. In very cold climates, it may be difficult or costly to use cast in place concrete, Why? (16 points)

   ____________________________________________________________________
   ____________________________________________________________________
   ____________________________________________________________________
   ____________________________________________________________________

3. For the concept design of a 12-story residential building project with a tight budget, you are asked to specify a concrete floor framing system. What would be the system of your choice and how would you explain to the project team the reasons for its cost effectiveness? (12 points)

   ____________________________________________________________________
   ____________________________________________________________________
   ____________________________________________________________________
   ____________________________________________________________________

4. The higher the water to cement ratio, the __________ the concrete is. (select 2 that apply to fill in the blank) (12 points)
   a. stronger
   b. weaker
   c. easier to work with
   d. harder to work with

5. Explain why and when you perform a slump test for sitecast concrete construction? (16 points)
   When:___________________________________________________________________
   Why:____________________________________________________________________
   _____________________________________________________________________
   _____________________________________________________________________

6. Neatly and legibly sketch in section a basic wall formwork assembly. Show and label the following elements: (20 points)

   Formwork panels        Studs        Walers        Bracing        Form ties
Name: ___________________________________

Northeastern University
School of Architecture
Erkin Ozay, AIA

ARCH 2240 Structures 2: Tectonics
Spring 2011 – Quiz 8

MFA courtyard walk through – Due April 6th – beginning of class

1. What is the approximate typical structural bay and span of the structure? (10 points)

2. How is the wide span achieved? What is the approximate size of a column? (10 points)

3. Where are the forced air ducts? (10 points)

4. What is the approximate size of the mullions (vertical glazing elements)? What is the spacing? What are they made of? (Make sure to knock on them) Can you spot another structural element in the glazing system that allows for such thin cross sections? (15 points)

5. What are the major alignments and spatial continuities that give the space its definition? How are such continuities achieved? How do you think the material choices accentuate such spatial continuities? Include a sketch on the back to explain. (25 points)

6. Select a detail you find interesting and sketch it as a plan or section detail on the back. Briefly explain what the sketch shows. (20 points)

7. Please e-mail me a question that you would like to pose to Chad Reilly by Sunday April 3rd with the subject line “MFA question”. Please make your question specific to the building. (10 points+10 bonus points for good questions)