Strip Mall

Introduction:

The simplest structure is a single span supported by bearing walls or columns. The 3 critical variables in designing a structure are:

1. **Span**-*the distance between supports*
2. **Load**-*the weight the structure must carry*
    a. **Live Loads**-*the weight of occupants, furnishings and precipitants, snow, ice and rain*.
    b. **Dead Loads**-*the weight of the materials of construction.*
3. **Material**-*what the structure is made of*

The span is determined by the designer. It may be defined by the function of the spaces, the size of the site or the nature of the structural materials. Steel is manufactured in 60' lengths so spans that are factors of 60 are especially efficient.

Load is determined by the construction materials, the spacing of members and code requirements. Most horizontal structures, floors and roofs, use regularly spaced, repetitive members. The spacing of the members is often determined by the decking material being used, plywood is supported at 16" or 24" intervals, and the strength of the member. When the members are further apart they have to carry a larger load, the area that is supported by each member is the **tributary area**.

The three major structural materials are wood, steel and reinforced concrete. Each material has characteristics that may make it the best choice in a given situation. All three materials exist in a wide range of forms that allow them to be effectively used for many different conditions.

- **Wood**-*an organic and renewable material. Much stronger parallel to grain than perpendicular to grain. Dimension lumber, 2x12's, can be cut to length on the job site. Uses simple connections, nails, screws, bolts*

- **Steel**-*available in a large variety of shapes and configurations for a wide range of applications. Equally strong in tension and compression. Non-flammable but will fail structurally when subjected to the high temperatures of a building fire. Uses welded or bolted connections. High strength connections are possible.*

- **Reinforced Concrete**-*can be precast or cast-in-place. Concrete structural elements are always custom elements. Combines compressive strength of concrete with tensile strength of steel. It is inherently fireproof. May use weld plates or cast connections.*

Objectives:

- To be able to research structural systems for a specific application by looking at building examples.
- To be able to evaluate structural systems in wood, steel and concrete for their appropriateness in a given situation.
- To be able to perform a basic code analysis as it impacts the choice of structural system.
- To be able to evaluate the relative costs of various structural systems.
- To be able to read span tables in various formats.
- To be able to design a schematic roof framing plan.
- To be able to design a schematic wall section
- To be able to determine tributary area
- To be able to calculate loads
- To be able to draft a schematic roof framing plan.
- To be able to draft a schematic wall section

Problem:

Design and draft a structural system for a 1 story strip mall. Each store bay is 30' x 100'. The building consists of 10 units. The building is on a corner lot with parking on both of the internal sides. The parking areas are 66' wide**.**

Process:

1. Using the library, internet and your environment review similar buildings.
2. Prepare a simple code review; this will be done in class.
3. Determine possible structural elements for each material.
4. Develop a preliminary wall section for each system.
5. Review systems for code, cost and appropriateness.
6. Choose a structural system.
7. Calculate necessary loads to construct system in Multiframe.
8. Create Multiframe model.

Requirements:

Report

- Precedent Study - *Review similar buildings through observation and research. Report on their structural systems to the extent that it can be determined and other relevant issues.*
- Code Review – *Perform code review done in class.*
  - Identify occupancy group(s)
  - Specify actual area and height
  - Determine construction type
    - Identify possible construction types
    - List allowable area and height
    - Calculate allowable area and height using base area and allowable increases
    - Select best construction type
- Define Construction System for Steel
  - Select component (ie K series steel bar joists) and determine approximate size and spacing of the following structural components based on span ranges and depth ratios.
  - Identify the following components and determine rough size range based on probable spans and loads
    - Roof deck
    - Roof Structure
    - Beams
    - Bearing Walls
    - Floors
  - Draw wall section
- Define Construction System for Wood
  - Select component (ie lumber joists) and determine approximate size and spacing of the following structural components based on span ranges and depth ratios.
  - Identify the following components and determine rough size range based on probable spans and loads
    - Roof deck
    - Roof Structure
    - Beams
    - Bearing Walls
    - Floors
  - Draw wall section
- Define Construction System for Concrete
  - Select component (ie Double Tees) and determine approximate size and spacing of the following structural components based on span ranges and depth ratios.
  - Identify the following components and determine rough size range based on probable spans and loads
    - Roof deck
    - Roof Structure
    - Beams
    - Bearing Walls
    - Floors
  - Draw wall section
- Evaluate options and choose system based on evaluation criteria. Summarize decision.

Drawings

- Develop wall section
- Calculate actual loads, roof and floor.
    - Live Load – *from code*
    - Dead Load – *based on your wall section, include weights of structural elements where appropriate*
- Size structural elements based on span tables
- Draft framing plans
- Finalize and draft wall section
- Drawings should follow all standard drafting conventions, be fully dimensioned and noted. They will be evaluated for accuracy, completeness and correct graphic conventions.

A version of this grading matrix will be used for assignments B and C. Use it to evaluate the work you have done on this assignment. This assignment will only be graded based on having the assigned homework at the start of each class.

	EXCELLENT	VERY GOOD	GOOD	AVERAGE	FAIR	POOR	INCOMPLETE
Precedent Study - reference materials & actual observation	**20**	**18**	**16**	**14**	**12**	**10**	**5**
System Analysis and Comparison - wood	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Wall Section – design, completeness & graphic quality - wood	**6**	**5**	**4**	**3**	**2**	**1**	**0**
System Analysis and Comparison - steel	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Wall Section – design, completeness & graphic quality - steel	**6**	**5**	**4**	**3**	**2**	**1**	**0**
System Analysis and Comparison – reinforced concrete	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Wall Section – design, completeness & graphic quality - concrete	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Evaluation	**4**		**3**	**2**		**1**	**0**
Multiframe Analysis	**40**	**36**	**32**	**28**	**24**	**20**	**10**
TOTAL							