Andrew Solomon
Structural Design Option
Advisor: M Kevin Parfitt
Spring Run Assisted Living
12/12/2005

Thesis Proposal

Executive Summary

The purpose of this proposal is to introduce possible alternative designs. It is the result of work generated throughout fall semester 2005 for the purpose of a structural redesign of Spring Run Assisted Living. Upon approval, this proposal will serve as objectives and a schedule for spring semester 2006.

The structural redesign for Spring Run Assisted Living is to convert this load bearing masonry shear wall building utilizing hollow core precast planks and limited amounts of steel, to a steel skeleton building using none load bearing steel studs with masonry limited to subgrade retaining walls. The redesign will also use composite metal decking and concrete slab as the floor system. The lateral system will use a combination of moment connections and cross bracing.

The breathe topics to be evaluated in spring semester are based on the structural redesign and what sort of impact it will have on the building. First, two schedules will be created. One schedule will be of the current design followed by a schedule of the redesign and finally a comparison of the two will be completed. Secondly, a cost analysis and comparison of the two systems will be performed and an analysis of the comparison will be performed.

The following breathe topic is of the mechanical nature. It will be an analysis of the effects which changing the external wall composition will have on the building.

"All modifications and changes related to the original building design and construction methodology will be solely for the purpose of academic development. Changes and discrepancies will in no way imply that the original design contained errors or was flawed. Different assumptions, code references, requirements, and methodologies will be incorporated into the redesign; therefore, investigation results will vary from the original design" (The Pennsylvania State University, Architectural Engineer Department, Thesis E-Studio Disclaimer).

Background

Just south of the heart of Lancaster, in Willow Street, PA, lies Willow Valley Retirement Community. The newest addition to the community, Spring Valley Assisted Living, is a 4 story, 118,400 square foot building utilizing load bearing and shear masonry walls sitting on concrete wall footings, as well as 8" thick hollow core precast planks. Steel columns, resting upon concrete column footings, and steel lintels are used in very isolated cases where masonry was not feasible for load transfer and the exterior façade is a brick veneer.

Spring Run Assisted Living has a partial basement which is divided evenly between storage, staff lounge and locker rooms, mechanical and electrical rooms, and undefined space which can be allocated at a later date. The first floor begins at the entry with a porte-cochere leading occupants and visitors into a "grand hotel" lobby. The corridor leading off of the grand entry is meant to give the feeling of a "main street". This is acquired through the presence of such things as a gift shop, dinning area, café, administration, library, mail room, lounge areas and rest rooms. There are also a total of 18 dwelling units located on the first floor.

Floors 2 through 4 each consist of 36 dwelling units as well as various other rooms. These rooms vary between floors and include such things as exercise rooms, personal laundry area, a spa, arts and crafts areas, lounges, wellness areas, and every floor has a country kitchen..

Brief Overview of Building:

- Load bearing masonry shear walls
- Steel columns and beams are used strategically used to support plank flooring from gravity loads.
- Foundation: Wall footings under load-bearing masonry walls and spread footings under columns
- Floor/Roof System: 8" hollow core pre-cast planks (2" topping on floors and no-topping used on roof)

Detailed Breakdown of Walls:

- All walls are of 8" CMU with 1500 psi f'm.
- All shear walls are required to have 2 #5 bars placed in the last 2 cells of the shear wall.
- First floor: #5 bars are used at 16" o.c. with full grouting.
- Second floor: #5 bars used at 24" o.c. with full grouting.
- Third and Fourth floors: #5 bars used at 48" o.c. with grouting at 24" o.c.

Foundation System:

- Spread footings vary from 3' x 3' through 9' x 9' dependant on their placement throughout the building.
- Wall footings range from 3' wide through 4' wide dependant on the location of the walls, i.e. exterior and interior walls.
- The Slab-on-Grade system is a 4" concrete slab with 6x6 – w2.9 x w2.9 WWF reinforcing.

Floor System:

- 8" Pre-cast hollow core planks
- Spans are typically 19' or 27' dependant upon location.
- Spans are typically perpendicular to longitudinal wall of section.
- Plank flooring and steel members do not contribute to the lateral force resistance system.

Design Codes and Standards

Design Codes:

International Building Code 2003 (IBC 2003)

Design Standards and Specifications:

ASCE 7-02 "Minimum Design Loads for Buildings and Other Structures"
1999 Masonry Standards Joint Committee Code, Specifications and Commentaries (MSJC 1999)
ACI 318-02 "Building Code Requirements for Reinforced Concrete"

Design Live Loads

*Loads acquired from ASCE 7-02 Table 4.1

Roof live load	30	PSF
Corridors – First floor	100	PSF
Others	40	PSF
Lobbies	100	PSF
Mechanical Rooms	150	PSF
Storage (Light)	125	PSF
Dwelling Units	40	PSF

Proposal for Structural Redesign

When a building is being designed, there is not one perfect structural system for that building. Different structural systems have different advantages and disadvantages such as; cost, availability of materials, better performance, erection time, ease of construction, and available trades in the local area.

The use of load bearing masonry shear walls is a slow process. For instance, placement of the 2nd floor walls must wait until the 2nd floors precast hollow core planks are set in place, grouted to the first floor walls, and the topping is placed. During the initial design of Spring Run Assisted Living, the original engineer found it necessary to reinforce every cell of several of the shear walls. This means that the masons needed reinforcement at every 8" which slows construction time and drastically increases the cost of labor.

My proposed structural redesign is to reduce the use of masonry to subgrade retaining walls. I propose to make Spring Valley Assisted living a steel skeleton utilizing steel columns, girders, beams and joists. All previous masonry walls along with current partitions will be changed and composed of steel studs. The floor system will be a composite metal deck and concrete slab.

The lateral system for the redesign will consist of a combination of moment frames and cross bracing.

Breathe Topic 1

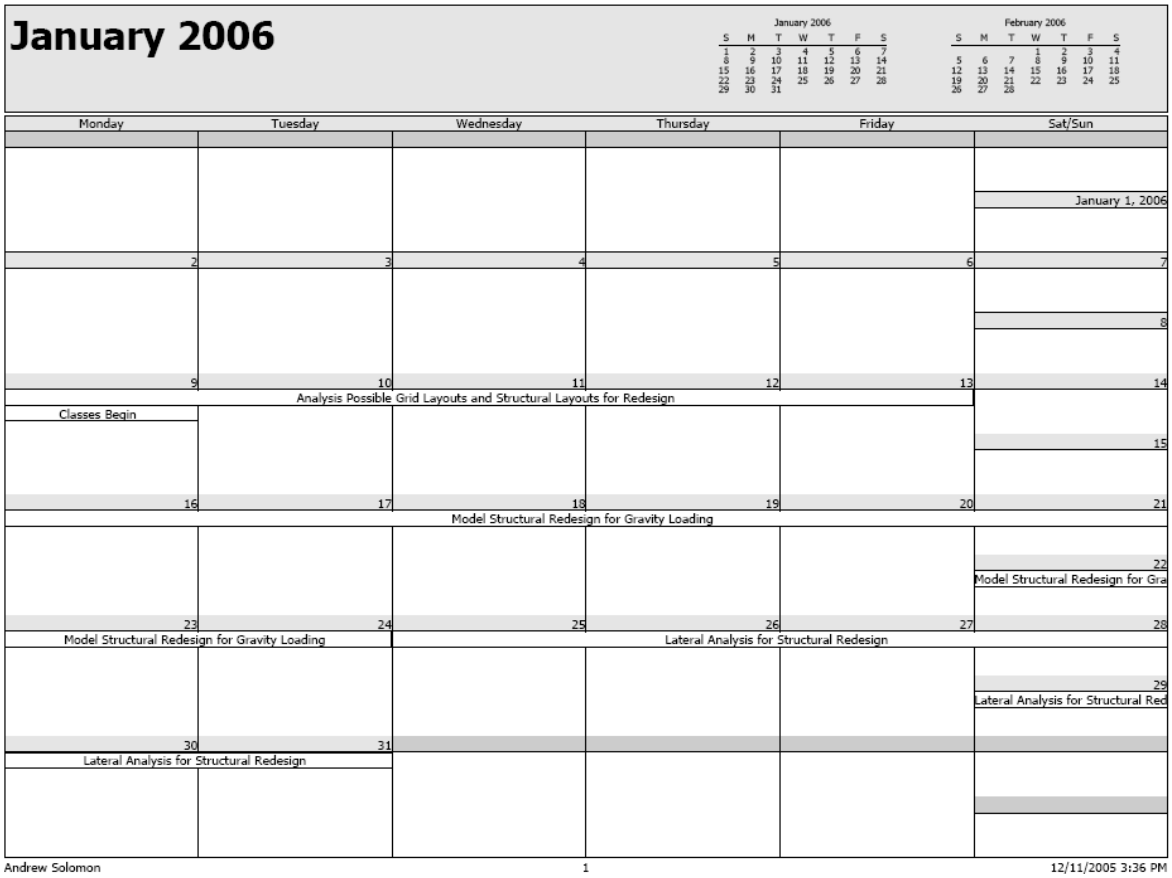
Two large factors which are included when deciding on a structural system are the impact the system will have on the cost and duration of a project. Therefore, a construction schedule is going to be completed for current building design along with the redesign. The construction schedule will be created with the assistance of the current contractor to ensure accuracy and feasibility. Since cost is usually the ultimate factor in decision making, a cost analysis will be performed. This analysis will not be limited to only the structural members but will include all walls which have been changed. The cost analysis will be performed using any or all of the following; RS Means, Primavera, and MC^2.

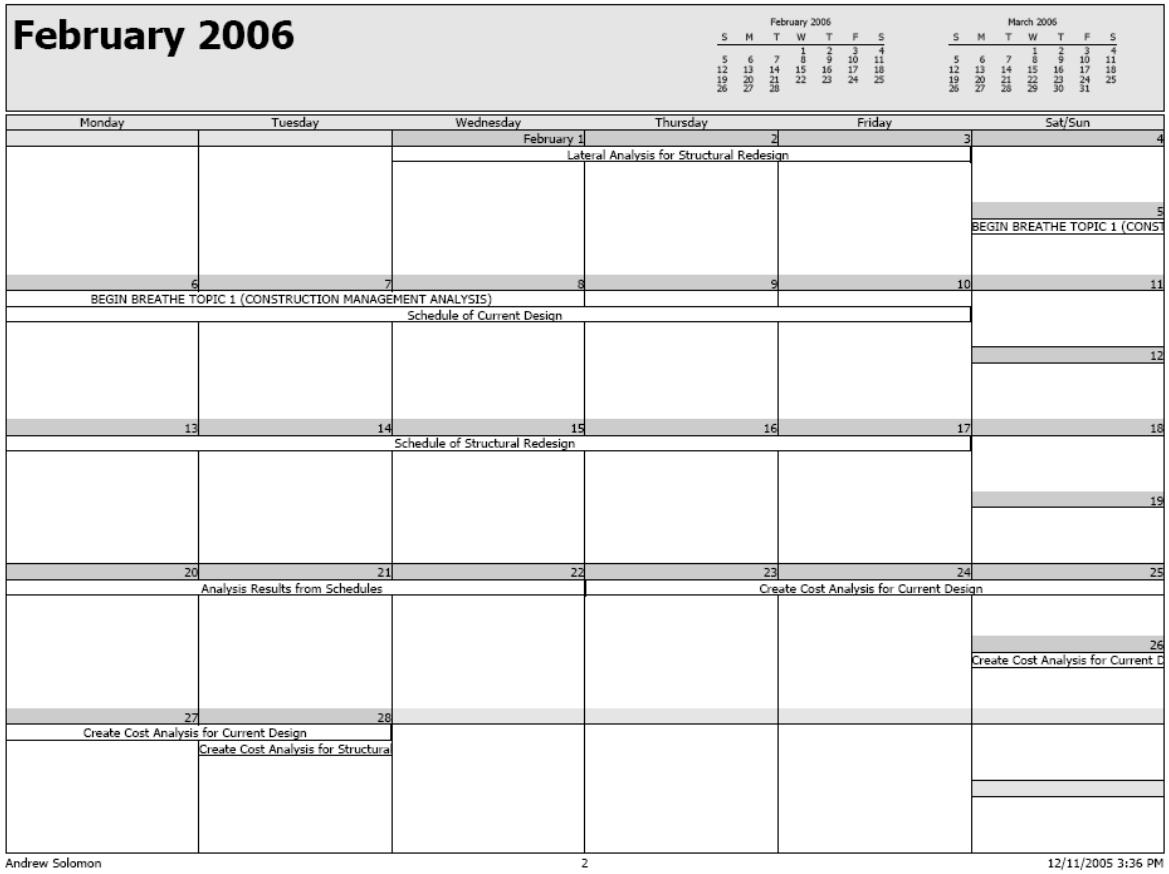
Breathe Topic 2

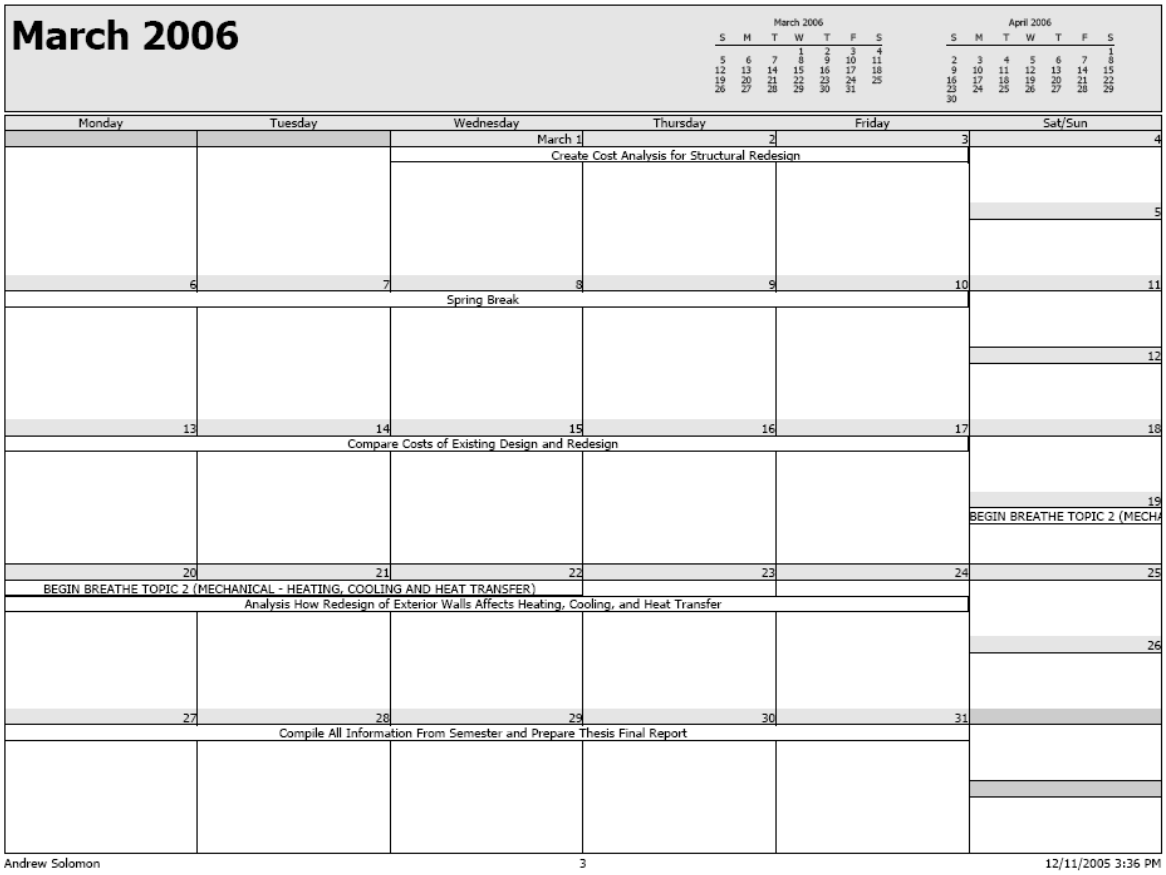
The proposed change to the structural system will result in a new exterior wall construction. The American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) provides a guideline for the minimum allowed resistance value, or R-value for wall construction. These minimum values are dependant upon the type of building construction, building usage, and location. The new exterior wall construction's overall R-value will be determined and compared to the minimum value set forth by ASHRAE.

After the exact construction is determined and compliance to ASHRAE is achieved, a check of the wall's resistance to condensation will be determined. A wall section will be drawn and will include the thermal gradient of the construction. This illustration will ensure that portions of the wall from the interior surface to the insulation are above the dew point temperature, therefore avoiding potential mold problems.

Proposed Schedule



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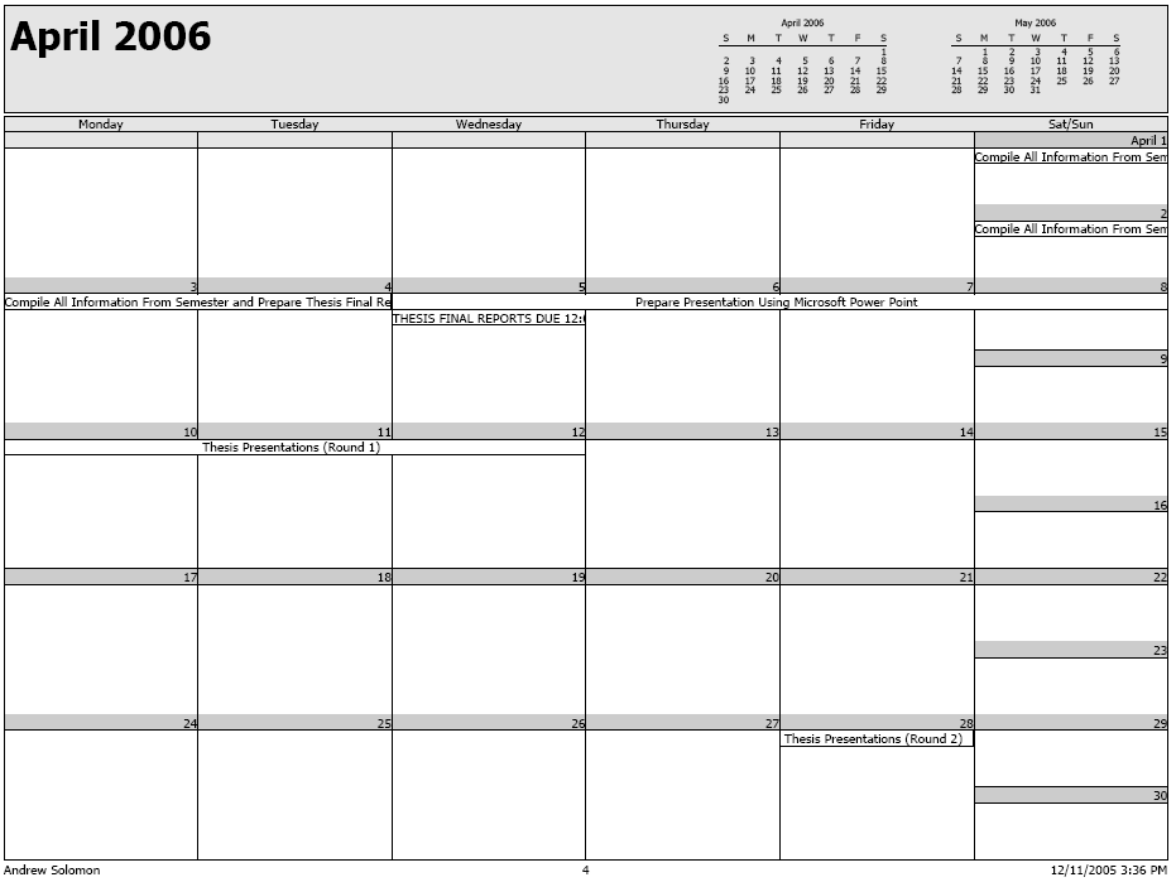
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