HOWARD COUNTY GENERAL HOSPITAL

PATIENT TOWER ADDITION

COLUMBIA, MD

Thesis Proposal

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Structural Option
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December 17, 2007

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THESIS PROPOSAL

Exective Summary:

The Howard County Hospital Patient Tower was originally designed as a steel beam and composite slab system with moment frames as the lateral resisting elements. Throughout a series of analyses performed in the first three technical assignments, this system was evaluated and compared to other possible framing systems. It was determined that this system meets the strength requirements and is a suitable system for the calculated loads, but fails to meet the desirable drift limit of H/400. Another system could likely achieve the same strength and durability as the composite system but address the drift issue. It has been determined that the most viable solution would be a concrete floor system.

This proposal outlines the steps that will be taken in order to determine and design the best alternative floor system. The two systems being considered are a concrete flat slab with drops and a concrete flat plate with stud rails. The latter system was not previously analyzed, so some initial analysis will be necessary, which is the first task. Loads will be determined based on ASCE 7-05 and the building plans, then trial sizes will be selected. Using a variety of computer programs including RAM, PCA Slab, and PCA Column, the various aspects of the structural system will be designed. This includes typical slab strips, typical column sizes, and any foundation redesign. A new lateral analysis will be performed based on the new concrete structure, since the weight of the building will effect seismic loads and some of the wind variables will change. It can then be determined if and where shear walls are necessary in addition to the inherent concrete moment frames to resist these loads. Finally, impacts on the building's lateral system due to increased weight will be considered and redesign will be performed where necessary. The two concrete systems can then be compared to determine which system is more suitable for the required loads and building grid.

In addition to the depth topic, two breadth topics will be investigated. The change from steel to concrete will affect all other systems of the building, but construction management and architecture will be further explored. For the construction management breadth, the schedule and detailed cost estimate of the concrete system will be compared to the existing composite system. For the architecture breadth, impacts to the column grid due to the switch from steel to concrete will be investigated so that necessary changes to the layout can be made. The impact on the façade will also be considered so that new elevations and sketches can be produced. At last, it will be determined if the outcome of these two breadth topics verifies the selected concrete system. A calendar is included at the end to be used as a tentative scheduling tool throughout next semester.

Breadth #1: Construction Management

As mentioned above, changes to the structural system will affect all of the other building systems. One of the most important issues will be construction management, since switching to concrete will result in a completely different cost estimate and schedule than the existing composite steel system.

First, any available information on the actual building cost for the existing composite system will be obtained from the Construction Manager. This data will be used in conjunction with RS Means 2006 to estimate the overall building cost, including materials and labor, for the existing composite system. Some of the major costs for the composite system will include, steel framing, shear studs, lightweight concrete, and moment connections. Also, any scheduling information available for the existing composite system will be requested. This will allow a mock schedule to be produced based on the provided schedule and/or knowledge of steel fabrication, lead time, etc.

Next, RS Means will be used to evaluate the cost of the new concrete system chosen – either the flat plate with stud rails or flat slab with drops. Concrete, formwork, and reinforcing will be some of the major expenses for this system. A mock schedule for the new concrete system will be produced, considering issues such as concrete curing time. It will be helpful to have contacts in the construction industry for additional scheduling insight.

The total cost and schedule of the two structural systems will be compared to determine if one of the systems has advantages in terms of construction. This decision will mainly be based on cost and schedule. Some research will be performed to determine if the costs and scheduling for each of the two systems seem reasonable.

Breadth #2: Architecture

It is almost certain that there will be some changes to the column grid and column locations when switching from the steel to concrete system. Also, the typical W12 and W14 girders will become larger concrete columns, which could impede on the existing room layout. These changes will be evaluated so that a typical floor plan can be redesigned where necessary.

It is important that any changes to the floor plans maintain the current spatial relationships. Once it is identified where the alterations will occur, it may be necessary to use bubble diagrams and/or other space/relation exercises to reconfigure the floor plans. After the floor plan is rearranged, a new typical floor will be drawn in AutoCAD to be included in the final report.

The floor plan is not the only architectural aspect affected by the structural changes. Currently, the façade consists of precast and metal panels with lots of glass. The new, larger concrete columns are likely to require changes to the façade. Also, the overall floor thickness will decrease, further changing the "striping" of the façade. Sketches of possible new façade options will be produced, taking the new concrete framing into consideration.

Tasks and Tools: Construction Management

Task 1: Determine the Cost and Schedule of the Existing Composite System:

a. Inquire to the CM about any actual cost data or scheduling information that may be available.
b. Using RS Means and Cost Works, estimate any costs that were not available including material and labor expenses.
c. Based on any scheduling information provided by the CM and knowledge as to steel fabrication, lead time, erection time, etc., create a mock schedule of construction.

Task 2: Determine the Cost and Schedule of the New Concrete System:

a. Based on the selection of a new concrete framing system, use RS Means and Cost Works to estimate material and labor expenses.
b. If possible, obtain cost information for a building of similar size and function to verify the estimate made in part a.
c. Based on knowledge of concrete availability, curing requirements, etc., create a mock schedule of construction.

Task 3: Comparison of Steel vs. Concrete Systems

a. Compare detailed cost estimates obtained in tasks 1 and 2. Determine any significant savings provided by one system or the other.
b. Compare schedules and total time of construction obtained in tasks 1 and 2. Determine any significant scheduling advantages or disadvantages for one system or the other.
c. Make a decision as to whether one system is significantly advantageous in terms of construction management.

Tasks and Tools: Architecture

Task 1: Identify Necessary Floor Plan Adjustments:

a. Identify changes in column grid or column locations required by new concrete floor system.

b. Using trace paper, overlay new column locations as identified in part a to existing floor plans. Make note of rooms that will require relocation or new layouts.
c. Redraw columns as square/rectangular concrete columns rather than steel w-shapes. Note where the new column sizes pose a layout issue. Realize that the steel columns were hidden and concrete columns may be exposed.

Task 2: Make Changes to Floor Plan:

a. Based on the issues identified in task 1, perform bubble diagram and space planning exercises to rearrange the necessary spaces.
b. While maintaining general spatial relationships and room sizes, reconfigure a typical floor plan.
c. Draw the new floor plan in AutoCAD.

Task 3: Consider Façade Alterations

a. Identify the location of exterior concrete columns.
b. Using the elevations provided by the architect, determine where the increased column sizes require changes to the façade.
c. Considering the decreased structural floor thickness in the new concrete system, determine if any positive changes to the façade could be made.
d. Sketch ideas for new façade based on parts a-c. Realize that the same overall look of precast, glass, and aluminum striping is to be maintained, as it mimics the façade of the existing hospital.