Overlook Towers

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Thesis Proposal

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Executive Summary

Overlook Towers is located south of Washington Dulles International Airport in Herndon, VA. The complex will have two nine story office buildings and two five story parking decks. This report will focus on one office building. Long interior spans are used to reduce the number of columns and make the office space more versatile for the tenants. The exterior walls are made of architectural precast concrete panels. Structural steel and a lightweight composite concrete deck make up the structural system.

First, I propose for the structural system change from a steel building to a precast concrete building. Several construction management issues will be addressed and an alternate system will be chosen. The floor-to-floor heights will remain the same; however total floor depth may change. The column grid will also remain the same unless a better arrangement is found for each system.

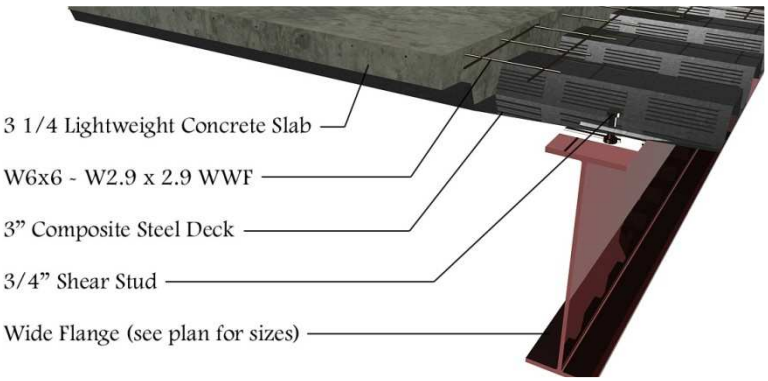
The system to be considered will involve using pre-cast members. Hollow-core planks were not found to be a viable system, so only pre-stressed double-T planks can be used more efficiently. This system will have an advantage over the cast-in-place on site cureing time will be much less.

A breadth analysis will be conducted for each system. Construction management issues will be addressed and the best system for the given conditions will be chosen. Approximate cost and construction schedule will be investigated in detail. Material cost, labor cost and erection time are to be included. Other issues relating to the mechanical, plumbing and electrical systems will be considered, but not in detail.

Introduction & Existing Conditions

Overlook Towers is a new nine story office building currently under construction in Herndon, VA. The complex has two office buildings and two five story parking garages. One of the office buildings will be used for this analysis. When completed, each office building will have a total height of 148'. The ninth floor reaches a height of 127' and the mechanical penthouse makes up for the rest of the height of the building. The total building area will be 262,000 s.f., approximately 25,000 per floor. A mechanical penthouse sits on the roof creating a total building height of 148'. The building is designed in accordance with the 2000 International Building Code.

The illustration to the right shows the basic structural system of Overlook Towers. The existing floor system is a 6 ¼" lightweight composite deck. Reinforcement is provided through W6x6 W.W.F and ¾" shear studs. A 3" 18 gauge steel deck is used. All have a design strength of 4000 psi. The typical beam size is W24x55 spaced at 12'-6" o.c. The largest span is 46' running from the interior core to the exterior wall. A typical floor framing plan is illustrated below. Since each office space has an open plan, long unobstructed spans are desired.



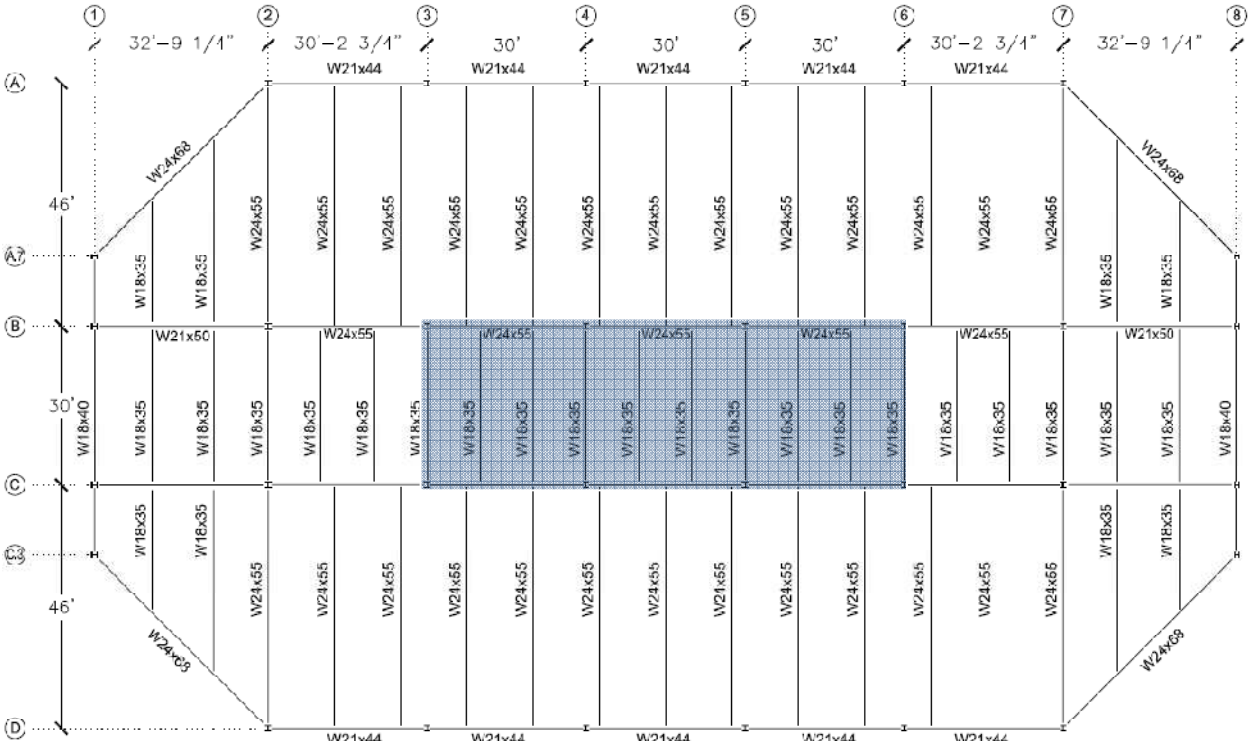
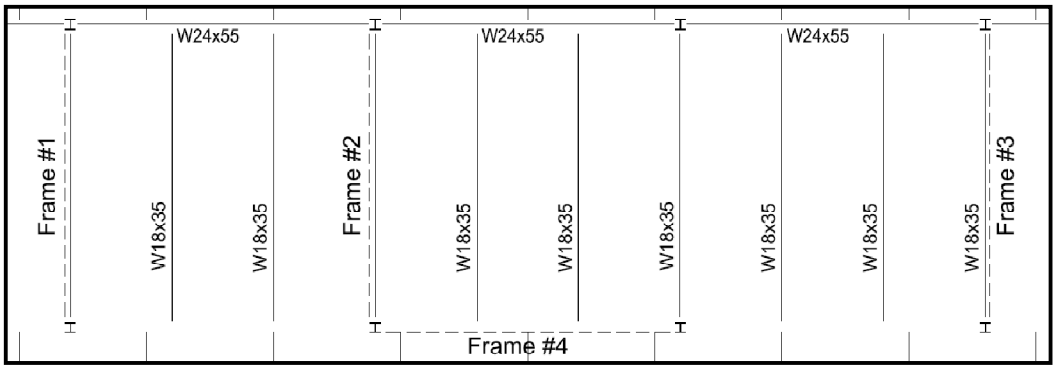
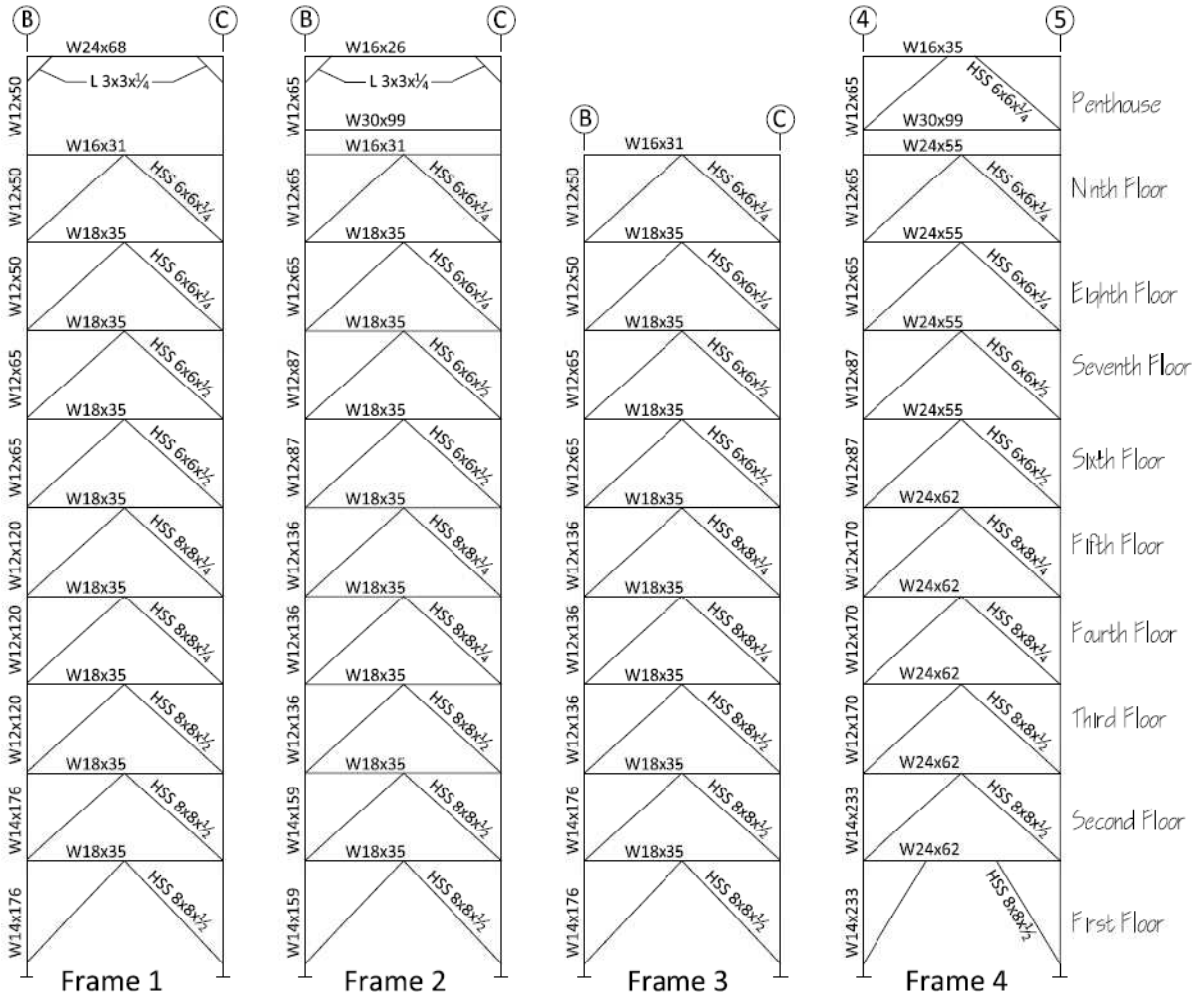


Figure 1 - Framing Planqsave

Steel braced frames are used for lateral reinforcing system. Four frames are located in and around part of the central core. The columns typically span two stories for a height of approximately 32'. Lateral forces are distributed through the frame via 5/8" gusset plates and the steel tubing. Forces are then transferred to the ground through concrete spread footings. The foundation has a 3'-6" grade beam running along the perimeter of the building. Footing sizes range from 5'-6" square to 13'-6" square at a depth of two through six feet. Typical floor spacing is 13'6" and a height of 15'-8" from the slab-on-grade to the second floor. Frame location and member sizes are illustrated below.





Problem Statement

The design of Overlook Towers is a functional open plan office building. Having long spans and unobstructed office space allows for flexibility of the office spaces being rented. The existing structural system has proven to be a very good choice for the given conditions. Previously, alternate flooring systems were compared to the existing system. Pre-stressed Double-T's and post-tensioning were found to be a viable alternative. Instead of using a steel structural system, I will investigate the use of a concrete structural system. Possible savings in material, labor and construction time will be presented. All floor heights will be the same; however slight changes will be made to the sandwich depth of the flooring system. Impacts on cost and schedule will be included in the design.

Proposed Alternate System

A precast concrete structure will be designed for Overlook Towers, replacing the current system. This change will affect all aspects of the building design, two of which will be investigated through the breadth analysis. The first and most obvious change will be the redesign of the beams, columns and girders. Floor to floor heights will remain the same at 13'-6" for a typical floor. As found in technical assignment 2, if double-T planks are used, the total floor depth will decrease. Steel columns and braced frames will remain the main gravity and lateral supporting system, although it will have to be redesigned due to the difference in dead and wind loads. Cost, erection time and impacts on other systems will be compared to see if a more suitable system has been chosen.

The flooring system will be precast double T planks. Each system has an advantage over the steel because there is no need for fireproofing. Pre-cast will allow for a quicker erection where cast-in-place will be more rigid with an integral beam and column. The study of the breadth topics will be conducted to conclude the best structural system for Overlook Towers.

Breadth Studies

Changing the structural system of a building involves many changes and not just to the structural system. The study of two breadth topics will also be included in the report. These topics will help to determine which system is best for Overlook Towers.

First, a cost estimate will be performed for each of the systems. Building cost has a big influence on type and design of the building. Performing and approximate cost for each system and considering other construction management issues will be one determining factor for the use of a system.

Secondly, a construction schedule will be made. Cutting down the construction time could noticeably drop the cost of the building. Constructability and effects on the other trades will be considered in the chosen system.

Problem Solution

An alternate system has been chosen and an analysis on the precast concrete system will be conducted to weight out advantages and disadvantages. As in previous assignments, loads will be designed in accordance with IBC, ASCE7-05, ACI and other applicable codes. Next, will be the design of the main structural system. The slab and joists are incorporated into the design of the double-T plank. A structural topping may have to be applied to strengthen the system and lengthen the span. Inverted T beams will then be designed to transfer the load from the floor to the columns. Each precast component will be designed by using the PCI Handbook. The lateral system will be the same type as in the existing, although will need to be redesigned to accommodate different loads. A RAM model will be created to design beam sizes and to simplify calculations for story drift.

After the system is in place, construction management issues will be addressed. A construction schedule will be constructed through Primavera. Each of the schedules will be compared to the approximate construction date to find any advantages. Along with a construction schedule, a cost estimate will be conducted using the RS Means values for material cost and labor cost. A timetable for completing these tasks is in the following page.

Tasks & Schedule

Task 1 Investigate systems to be analyzed

Task 2 Re-Calculate dead, live, wind and seismic loads

Task 3 Design of System

Task 4 Construction Schedule

Task 5 Cost Estimate