Best Buy Corporate Building D (4)
Richfield, MN

Thesis Proposal

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Structural Option
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Executive Summary:

The Best Buy Corporate Building D is a 6 story building with a total area of 304,610 square feet. The floor system is a structural steel system with composite beam floor framing and a precast concrete and glass facade. The main lateral resisting system for this building is a braced frame system. This frame extends to all 6 floors of the buildings and braces the building in both the N-S and the E-W conditions.

The proposal objective for the Best Buy Corporate Building D is to redesign the building using concrete. The floor system will be redesigned as a post-tensioned slab on beams. During technical assignment 2, it was found that a post-tensioned slab would reduce the number of column rows in the short direction. The slab was found to be 15.5" thick with 68 strands tensioned at 35 kips, with a minimum eccentricity of 6.75". The existing steel columns will be replaced by concrete columns. The existing foundation will also have to be verified or redesigned to support the new concrete columns. The change to concrete is an effort to reduce the number of columns in the short direction of the building to increase usable floor area. ASCE 7-05 will be used to determine loading.

Breadth Summary:

The breadth projects chosen will supplement the changes made in my thesis proposal. The first breadth topic will deal with construction management issues, specifically dealing with costs and schedule changes. The second breadth topic will address some architectural changes in the building, specifically examining the change in usable floor area and aesthetic impact.

Topic 1: Construction Management

The first breadth proposal will focus on specific cost comparison of the current building system against the new proposed system. The change in material from steel to concrete will introduce other costs such as formwork and the labor involved in setting that formwork. The use of concrete will also have an effect on the schedule; therefore a comparison of the schedules will also be researched.

Topic 2: Architecture

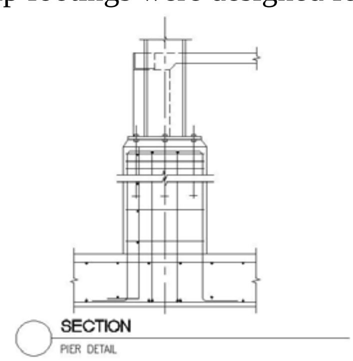
The second breadth proposal will look at the amount of additional floor space that will be gained by removing a row of columns. This change will have an impact on rentable space that should increase the inflow of money to balance the change in costs of building. A brief research into the effect of a concrete work environment versus a steel work environment will also be conducted.

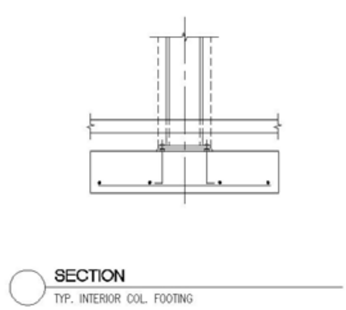
General Background Information:

The Best Buy corporate campus consists of four buildings connected by a central hub. This report focuses on building number four, which is a six story composite steel system with architectural precast panels surrounding it. The 304,610 square foot building consists of slab on grade construction with wide flange steel columns supported on concrete piers. Lateral loads are supported by a braced frame system. The exterior of the building consists of an architectural precast curtain wall with integrated ribbon windows. The occupancy of the building, as expected, is primarily for office use.

Foundation:

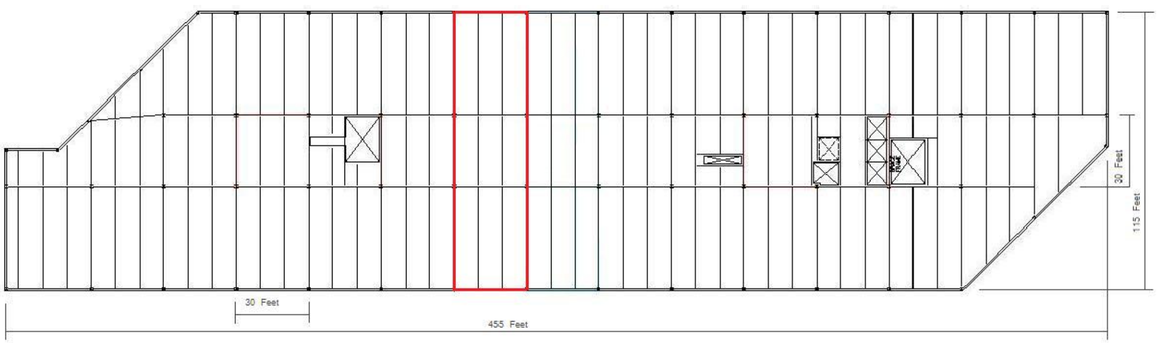
The foundation for this structure uses a combination of spread footings and piers for the interior and strip footings on the exterior. The concrete slab on grade is unreinforced with a 4" minimum depth with the basement slab on grade having a 6" minimum. Footings are placed under the columns and braced from system. Step footings were used where needed for extra support. All exterior footings must extend 4' below the finished grade to protect from frost with open air foundations having a minimum of 5'. Spread and strip footings were designed for a net soil bearing pressure of 10,000 psf.

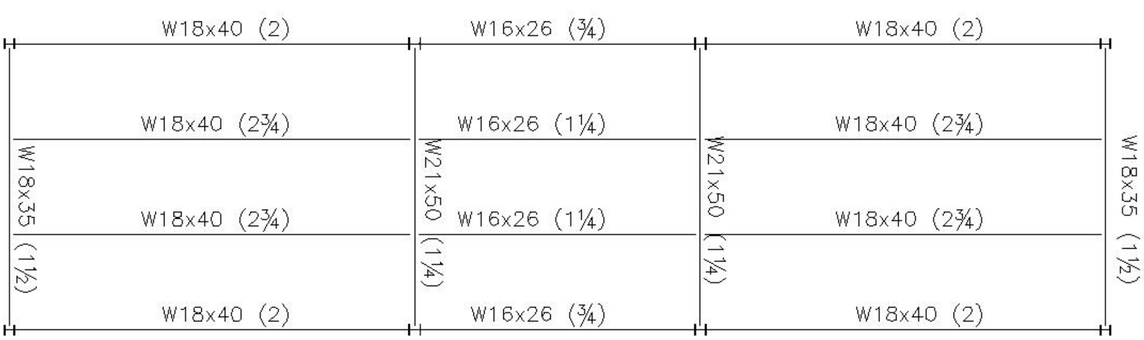




Floor System:

The floor system Building D utilizes a composite beam floor framing system. The overall slab is 6¼" using 3" 20 gauge composite deck and 3¼" lightweight concrete covering. The first floor uses #4 rebar at 18" on center for concrete reinforcing while the remaining floors use 6x6-W2.1xW2.1 welded wire frame. Each internal bay has a typical size of 30'x30' and external bays are typically 30'x42'8". The internal beams are typically W16x26 while the typical external beam is W18x40. Finally, the typical internal girder size is W21x50 and external is W18x35. Material strength is given as 3500 psi for the concrete and A992 50 ksi steel for the beams and girders. Spray on fireproofing was used to meet the fire rating required for the building. The floor framing system along with a typical interior bay is shown below.

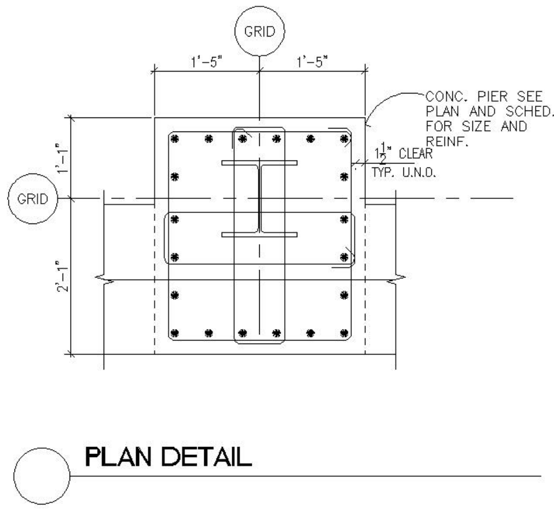




(Rotated 90 degrees)

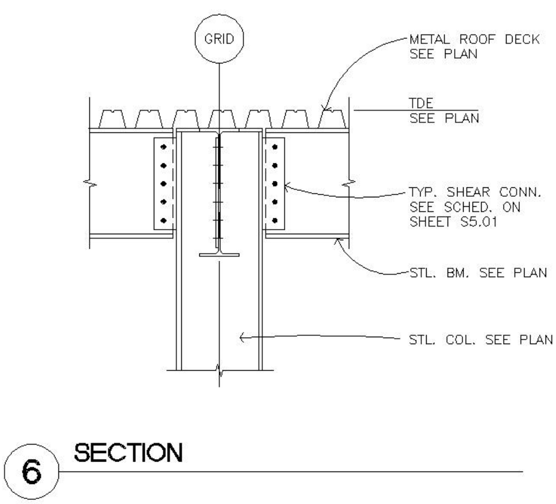
Columns and Piers:

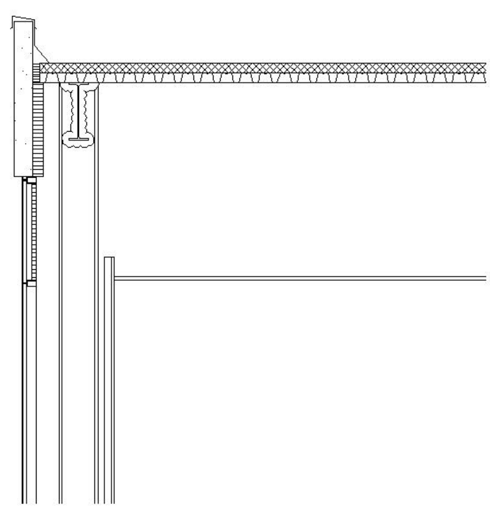
While columns for the building vary in size and weight, the typical depth is 14”. The columns are spaced according to the bay size mentioned previously. Support fo the columns is provided by concrete piers. Below is a typical pier cross section showing overall size and reinforcement.



Roof:

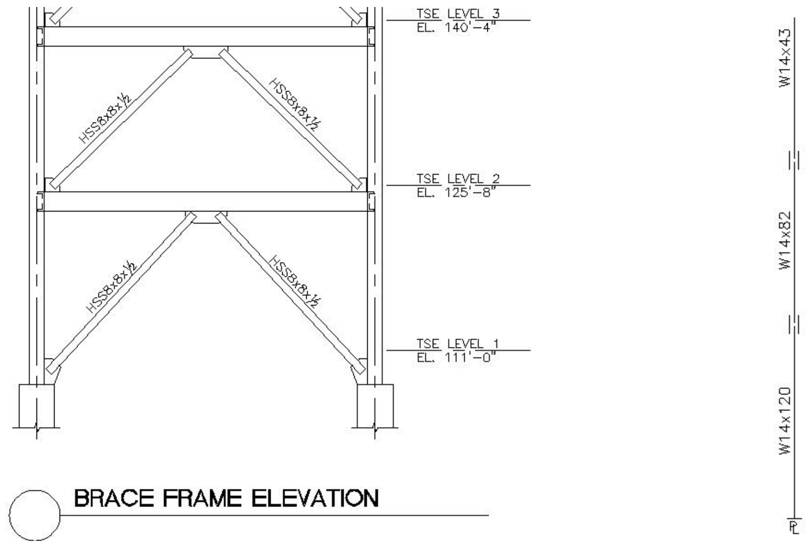
As with the floor system, the roof consists of a composite deck using 3” 20 gauge roof decking with 3 ½” lightweight concrete. This system is covered by a rigid insulation and B.U.R. system. Girder size did not need to increase for the interior; however the exterior girders were increased to W24x55. There is a penthouse located on the roof that houses all the major mechanical components for the entire building.





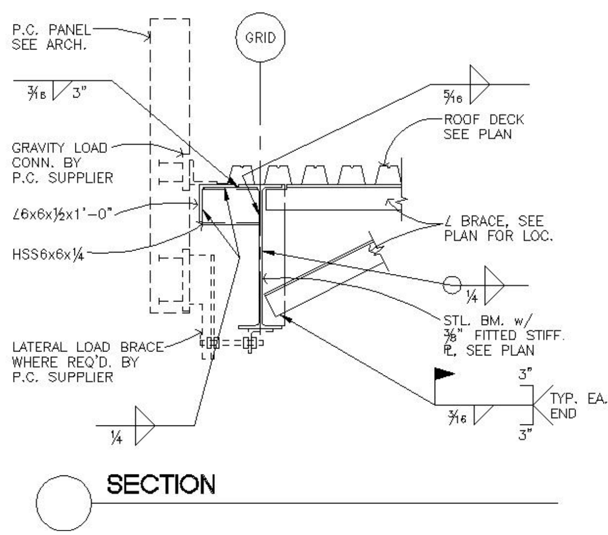
Lateral Systems:

For the lateral system, this building utilizes a composite floor system and braced framing. The vertical members of the braced frame consist of 3 W14 columns spliced together at the 3rd and 5th floors. The beams between these columns are heavier, W16x57. As shown below, there are 2 diagonal HSS members to provide further support.



Envelope:

The building has an angled wall on the end furthest from the central hub. The façade is 6" architectural precast concrete separated by ribbon windows on each level. The precast components were cast with gravity load connections and lateral load bracing where required by the precast supplier. A detail of the precast connection to the building frame is shown below. This is at the roof level, however it is typical throughout.



Problem Statement:

After extensive studies of the building systems found in Best Buy Corporate Building D, the current system has been determined to be effective. All of the building loads and forces are sufficiently resisted by the building in accordance with ASCE 7-05. The problem that will be addressed for next semester is to redesign the building using concrete instead of steel. The floor system will consist of a post-tensioned slab with beams. All of the steel columns will also be replaced by concrete columns. These changes will have a large architectural affect on the building along with scheduling and cost changes. The aim of these changes is to reduce the number of column rows in the long direction of the building. The post-tensioned slab should also allow for shallower floor depths and elimination of fireproofing.

Proposed Solution:

The proposal is to redesign Best Buy Corporate Building D as a full concrete system. The floor system will be redesigned using a 15.5” post-tensioned slab with beams and the columns will also be redesigned into concrete. This change to post-tension allows for a larger bay size in the short direction of the building. Also as a result of the move away from steel, the lateral bracing system will have to be redesigned to utilize shear walls instead of the current braced frame. All of the building loads will be computed using ASCE 7-05. Research from the spring semester regarding gravity and lateral loading will be used to aid in the redesign of the structure. Special attention will also be given to the change in schedule and overall costs of the project. The impact of the change in architecture on the tenant and rentable area, such as removing a column row, will be investigated as well.

Solution Method:

The design of the post-tensioned system will be based on ACI 318-05 Building Code Requirements for Structural Concrete, chapter 18. After completing the redesign of the building, RAM Concept will be used to verify the design can withstand the gravity and lateral loads calculated. Based on preliminary findings in technical report 2, the design will start with a slab thickness of 15.5”, using 68 strands tensioned at 35 kips, and an eccentricity of at least 6.75”. A cost analysis of the structure will be determined using the most recent version of RSMeans Building Construction Cost Data available in the engineering library and a schedule analysis will be constructed using Primavera 5 scheduling software. Basic floor area calculations will be performed to compare the change in usable floor area and online research will be used to determine the aesthetic impact on tenants as a result of using concrete instead of steel.

Tasks & Tools:

Task 1: Redesign the building using concrete

i. Design post-tensioned floor system
ii. Design beams and girders
iii. Design columns
iv. Design and place shear walls
v. Double check design of system in RAM Concept

Task 2: Breadth analysis: Construction management

i. Obtain cost information on current system
ii. Obtain cost information on proposed new system
iii. Comparative cost analysis
iv. Obtain schedule information for current system
v. Obtain schedule information on proposed new system
vi. Comparative schedule analysis

Task 3: Breadth analysis: Architecture

i. Check existing usable floor area
ii. Calculate proposed new usable floor area
iii. Compare usable areas
iv. Research possible aesthetic impact of concrete versus steel on tenants

Task 4: Overall comparison of existing system to proposed new system

i. Summary of findings
ii. Cost comparison
iii. Schedule comparison
iv. Advantages of proposed new system
v. Disadvantages of proposed new system
vi. Presentation of results

Schedule:

9-Jan	Proposal corrections and basic research
16-Jan	Design post-tensioned slab
23-Jan	Design concrete beams and girders
30-Jan	Design columns
6-Feb	Design and place shear walls
13-Feb	Check new system in RAM Concept
20-Feb	Research cost and schedule comparisons
27-Feb	Complete construction management breadth
6-Mar	Complete architecture breadth
13-Mar	SPRING BREAK
20-Mar	Completed overall comparisons
27-Mar	Final presentation preparation
3-Apr	Final presentation cleanup
8-Apr	Final summary report handed in