American Eagle Outfitters
Quantum II Corporate Headquarters

Thesis Proposal:

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Structural Option

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Advisor: Dr. Memari

Executive summary

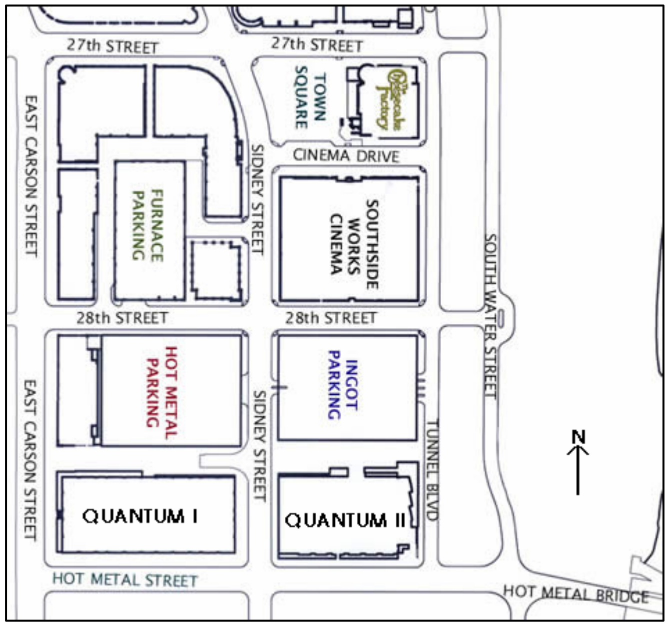
The American Eagle Outfitters Quantum II Corporate Headquarters is a 6 story 186,000 square foot office building located just outside the city of Pittsburgh Pennsylvania in the new multi million dollar Southside Works commercial development. The building is currently in the tenant fit-out phase of construction.

The structure is comprised of conventional steel framing. Each floor slab is made of composite metal deck and concrete slab. The building is supported by a foundation of auger piles and grade beams. Lateral forces are resisted by an extensive system of moment connections. The decision to use a moment frame system stemmed from the building's design prior to having a tenant and a final floor plan.

The focus of this thesis is to redesign the structure's lateral force resisting system. The proposed new system will utilize lateral cross bracing to resist load. Computer analysis programs such as RAM Steel will be utilized to design the new system. Once a design has been finalized a thorough cost analysis comparing it to the existing system will be performed. A scheduling plan for the chosen design will also be created. Finally, encouraged by the results of Technical Assignment #2 an alternative floor system of hollow core concrete planks will be considered.

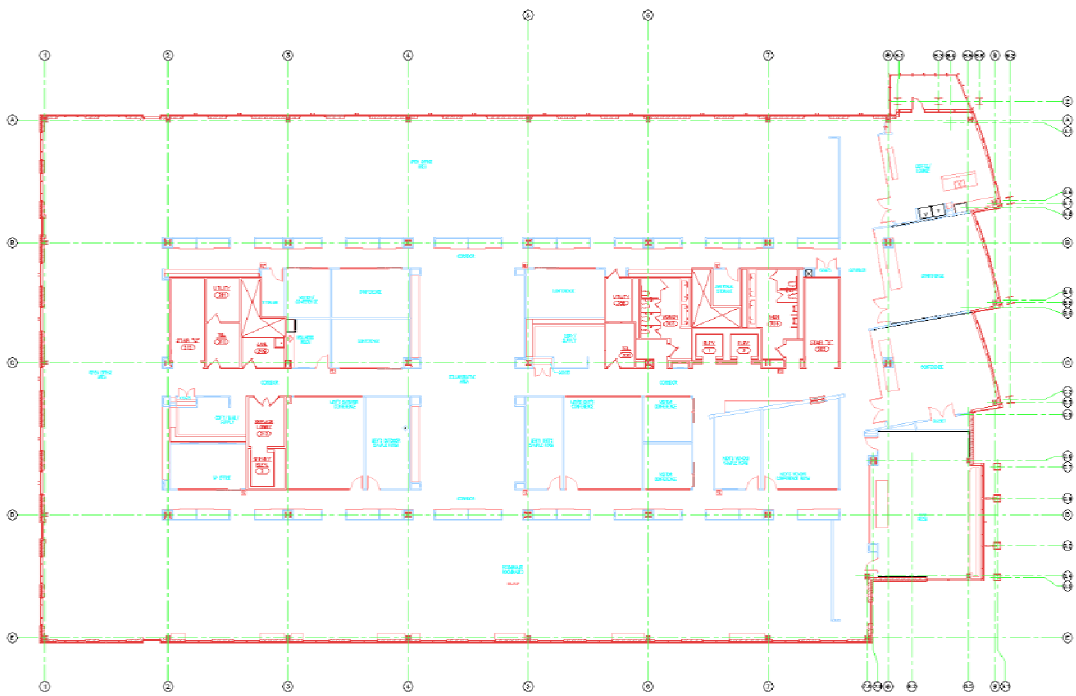
Background

The Quantum II office is located along the Monongahela River at the east end of Pittsburgh's Southside Works commercial development. Currently it is the first building seen when traveling to Pittsburgh's Southside via the Hot Metal Bridge. The 6 story 186,000 square foot office suite was purchased, and is currently being fitted-out by the American Eagle Outfitters Corporation. Being that the structure was built without a contracted tenant the designers took steps to make it versatile and attractive to business. The building is conveniently located just outside the confusion of the city where there is more space and parking. The structure has a contemporary shape and look utilizing a brick and glass curtain wall. A series of balconies runs up the North West corner of the building. The building fits in well with its other modern neighbors in the new district. The engineers strived to keep as many options for fit-out as open as possible. To achieve this they utilized composite slab floor decks, large bays, and moment frame connections.



Each of the 6 levels is approximately 31,000 square feet and consists mostly of office space, with a large cafeteria on the top floor. Each deck is made of a composite steel system, where 3" of 4 ksi strength concrete lays on top of a 3" 20 gauge steel deck. Steel studs ¾" in diameter and 4 ½" long are used to create composite action between the beams and the deck. The plan is dominated by three rows of bays measuring 30' x 30'and one row measuring 30' x 38'. All bays contain two beams spaced 10' apart spanning parallel to the 38' long side of the larger bays. The steel members that comprise these bays are of A572 grade steel, that has a yield strength of 50ksi. Nearly every connection in the steel frame is a moment connection and contributes in lateral force resistance.

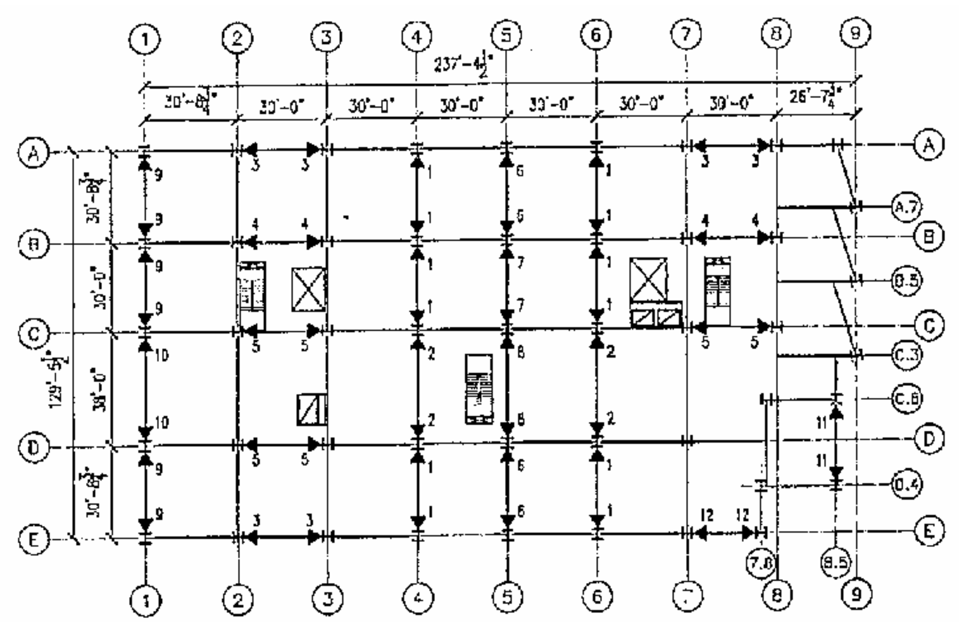
The foundation is a series of 45' auger piles. Columns sit on a pile caps covering varying numbers of piles. Concrete grade beams run along the perimeter. All foundational elements are made of 3ksi concrete.



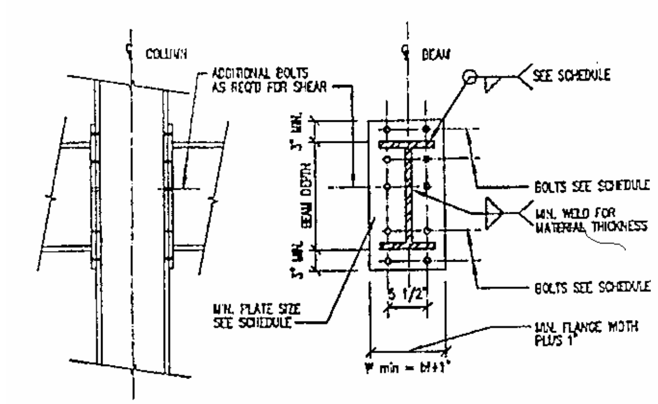
Typical Floor Plan

Problem Statement

As stated above Quantum II was designed for maximum adaptability during fit-out. The engineers needed a lateral system that would not obstruct the floor plan the way cross bracing and shear walls do. To achieve this fixed moment connections were utilized. Being that moment connections are less effective than their competition at resisting lateral forces, an extensive amount of the buildings connections had to be fixed. Indeed, nearly every beam column and connection is involved in the lateral system. The result of the moment frame's inefficiency is that beam and column sizes are forced to be so large that overall system cost is often greater than with other methods.



Moment Framing Plan



Moment Connection Diagram

Proposed Solution

An alternative to the moment connection frame would be one of lateral cross bracing, where vertical bays are filled with diagonal members to help absorb lateral load. The original designers of Quantum II avoided this method to create a completely open floor plan. However, with the advantage of the building's final architectural plans, the ability to design an alternative lateral system that does not obstruct the floor plan exists.

The main objective of this thesis is to design a system of lateral cross bracing to replace the existing moment frame system.

Solution Method

To redesign the lateral system first applicable loads must be defined. Dead loads will be calculated from the structure's own weight. Other gravity loads will be developed according to the International Building Code and ASCE 7-02. Also, Lateral loads applied to the system will be based on ASCE7-02 chapters 6 for wind and 9 for seismic.

The RAM Steel computer analysis program will be an instrumental tool in the design and analysis of the new system. Manual checks and calculations will be performed to verify the new design. The portal method of analysis will be utilized to check restrictions on drift and deflection.

Breadth Work

Topic 1: Technical Assignment #2 investigated options in various alternative floor systems. The most promising alternative floor system, hollow core concrete planks, will be further researched and considered.

Topic 2: The major focus of breadth work will be a cost analysis comparing the existing lateral system to the new redesign. Once the most economical system is identified a detailed construction schedule will be outlined.

Tasks and Tools

Task 1: Verify Loads
- A) Gravity
- B) Lateral

Task 2: Computer analysis
- A) Ram model

Task 3: Alternative design analyzed
- A) Drift
- B) Deflection

Task 4: Breadth Work
- A) Alternative floor system
- B) Cost Analysis and Scheduling

Task 5: Select system

Task 6: Final Report

Schedule

	January			February				March			April	
	15-19	22-26	29-2	4-9	12-16	19-23	26-2	5-9	12-16	19-23	26-30	2-5	9-13
Task 1									S.				
Task 2									B				
Task 3									R				
Task 4									E				
Task 5									A				
Task 6									K				