MOUNTAIN STATE
BLUE CROSS BLUE SHIELD
HEADQUARTERS

PARKERSBURG, WEST VIRGINIA

DOMINIC MANNO

STRUCTURAL OPTION

FACULTY CONSULTANT: DR. ANDRES LEPAGE

PROPOSAL

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EXECUTIVE SUMMARY

Mountain State Blue Cross Blue Shield Headquarters is a four story office building located in downtown Parkersburg, West Virginia. The building is approximately 130,000 square feet and reaches a height of almost 68' due to the mechanical screen wall that extends up from the roof. The building utilizes four steel braces to resist the lateral loads that impact the building.

The goal of my thesis will consist of two structural options: one being the addition of another floor to the building and positioning the building in an active seismic zone. The gravity members below the added floor and foundations will need to be investigated due to this addition. Moving the building to Las Vegas will change the lateral loads the building will need to resist. A redesign of the lateral system will be done to make the braces uniform and control these new loads. The breadth studies will focus on construction management and mechanical areas. The cost and schedule will be looked at regarding the addition of the new floor. The roof top air handling units will be resized and ductwork and VAV layouts for the new floor will also be designed.

INTRODUCTION TO MOUNTAIN STATE BLUE CROSS BLUE SHIELD HEADQUARTERS

Mountain State Blue Cross Blue Shield Headquarters Building consists of 4 stories that sit above grade and is mainly office space. It was designed by Burt Hill Architects. Its main purpose for being built was to expand to include an extra 170 employees that are to be hired this year. G.A. Brown was hired as the contractor and began construction in March of 2008 and is expected to be completed by April of 2009. MSBCBS is located in Parkersburg, WV, which sits on the north-western area of the state near the Ohio border. The building has a brick veneer façade which sits well into the site of downtown Parkersburg. It also has a large glass curtain wall which emphasizes the buildings entrance and gives the building a modern appeal.

The building is approximately 130,000 square feet and has mainly an open floor plan. The building's top of steel is at a height of 67' – 6.5" above grade due to the screen wall located on the roof for the mechanical units. The floor to floor height of the building is approximately 13'-4". The typical bay size is 30' x 30' being made by composite steel structure and concrete slab on steel decking. The lateral system of the building is made up of four braced frames, two in the north/south and two in the east/west building direction. The foundation contains caissons which extend approximately 70 ft. The ground level consists of a 4" slab on grade with grade beams surrounding the perimeter of the buildings footprint.

EXISTING STRUCTURAL SYSTEM

FOUNDATIONS

The foundation system is drilled caissons that range from 30” in diameter to 66”. They were designed to have an allowable skin friction of 550 psf. They contain a variation of No. 7 to No. 8 vertical reinforced bars, and have ties that are No. 3 reinforcing. Depending on the location on the plan the caissons are driven into the ground 59’ to 74’ below grade. The caissons support the steel framed system. The grade beams surrounding the perimeter of the building are 24” x 30”.

FLOOR SYSTEM

MSBCBS has a composite system with 30’ x 30’ typical bay size. A 3-1/4” light-weight concrete slab sits on a 2” – 20 gauge composite steel decking with ¾” studs. The deck is supported by mainly W18 x 35 beams that are spaced 10’ center to center. The majority of the girders are W21 x 62 which transfer the loads from the beams to the columns. This floor system is used for all floors except for the roof and the 4” slab on grade. The roof is made up of a 1-1/2” 20 gauge wide rib galvanized steel deck and is 3 spans continuous with 3” of concrete. The roof floor system is mainly supported by K-series joists that are spaced 6’ center to center.

COLUMNS

The gravity columns for MSBCBS are typically W10’s. The gravity base plates have a 4 bolt connection and have a thickness varying from 1” to 1-5/8”. The lateral columns are W12’s. The lateral base plates typically have a 12-bolt connection with a thickness of 1-1/2” to 2-1/2”. The mechanical screen roof is composed of HSS 12 x 12 x 3/8 post, which connects to the beam, with a 1” thick base plate.

LATERAL SYSTEM

Four braced frames make up the lateral force resisting system for the building. The placements of these braces were based on the location of interior walls throughout the building. The purpose was to be able to conceal the braces within the walls. Several different types were used, from diagonal bracing to x bracing to uneven inverted chevron bracing. All of these braces are laid out in between floor to floor spaces. The braces range from HSS 8x8's to HSS 10x10's. The braces are connected using gusset plates with a minimum thickness of the beam's web thickness. Typical base plates for these lateral columns are 2-1/2" thick with large caissons to transfer the shear forces. Below is the layout of the lateral braces (Figure 1).

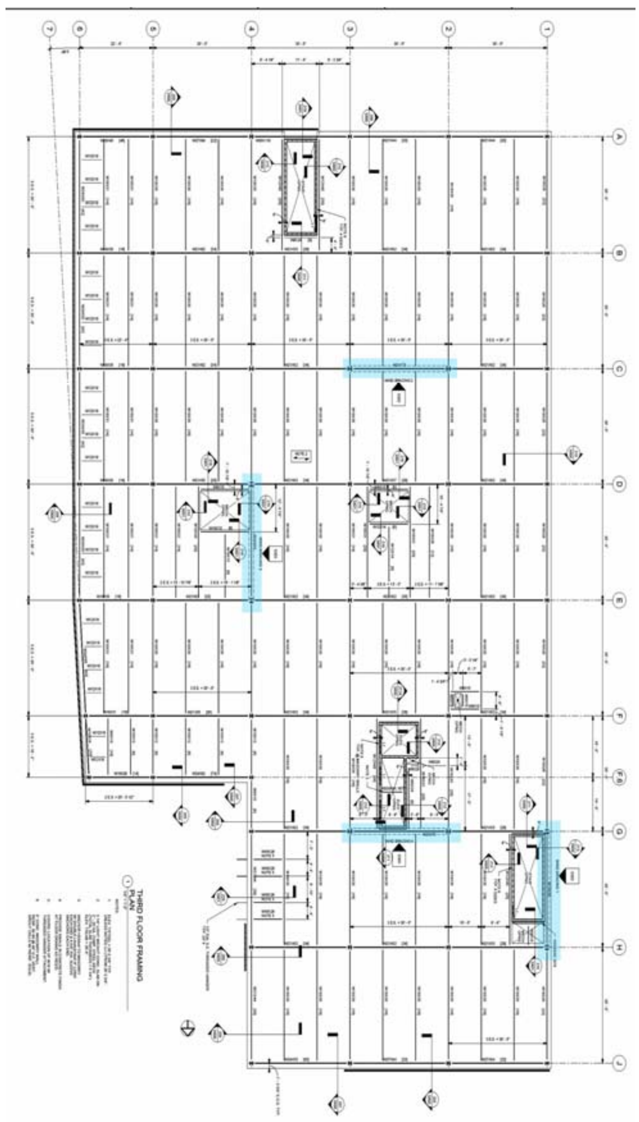

Figure 1: Lateral System Layout

PROBLEM STATEMENT

After investigating the current structural design in previous technical assignments I found that the system is appropriate for handling the gravity and lateral loads. I am trying to simulate that an owner would like to build almost the same building with an additional floor in Las Vegas, Nevada. Due to the additional weight of an additional floor and change in seismic zone, the building's columns and lateral system will have to be redesigned.

SOLUTION

The existing gravity members in the structure were adequate for the original design. The addition of another floor will implicate that the columns below the additional floor on the first level will need to be redesigned. The columns will be redesigned using AISC Steel Construction Manual, 13th Edition.

The change in building weight due to the addition of a floor, and the change in seismic zone will require an in depth analysis of the lateral system. The four steel braces that currently resist the lateral forces will need to be investigated for the new seismic loads. The redesign of the lateral system will be monitored for effects in floor to floor heights and also additional loads that the foundation system will need to handle. The braces were originally designed as diagonal and cross braces. In redesigning the system, I plan on looking into different bracing schemes that could be used uniformly in the four braces. The bracing systems will be compared against each other using story drifts. An ETABS model will be created in order to determine the feasibility of the new lateral system.

The gravity members of the additional floor will be designed according to ASCE 7-05 using RAM Structural System. The roof top air handling units will be redesigned to provide air for the additional floor. This will also increase the weight on the roof meaning the roof structure will have to be analyzed again for the loads.

BREADTH STUDIES

CONSTRUCTION MANAGEMENT

The scheduling and cost impact of the additional floor and change to the lateral system will be investigated in this breadth analysis. The schedule will be looked at for the increase in the amount of critical path time needed for the addition of another floor. The cost of the original design will be compared to cost of the proposed new design. This would include any member changes and the increase in construction time and labor. The revenue of the addition will also be taken into consideration.

MECHANICAL STUDY

The current mechanical system in the building is comprised of two 65000cfm roof top air handling units with a capacity of 2400Mbh. They supply air to Variable Air Volume, (VAV) boxes which then supply the office spaces. The additional floor will require that the roof top air handling units be resized to supply additional air. Correlating components will need to be resized and the layout of the duct work and the VAV boxes will be completed for the additional floor.

MAE OPTION

In order to cover the requirements for the MAE program, the building will be modeled in both ETABS and RAM Structural Systems. The ETABS model will provide a detailed lateral analysis of the building due to the seismic loads enforced by the new seismic zone. The RAM model will be used for the design of the new gravity members for the additional floor. Inherent torsion, accidental torsion, and P-Delta effects will all be considered in the ETABS model.

TASKS

1. Structural – Addition of an office floor and uniform lateral system
    i. Determine dead, live and controlling lateral loads
    ii. Design the gravity members of additional floor using RAM
    iii. Determine different bracing schemes
    iv. Using ETABS compare different bracing schemes and choose most efficient
2. Structural – Different Seismic Zone
    i. Determine new governing lateral loads
    ii. Using ETABS design members of lateral system for new loads
    iii. If lateral system can not handle the loads incorporate another brace throughout the layout of the building
3. Construction Management – Schedule and Cost Analysis
    i. Compare the original cost of the building to the new cost for the additional floor and construction time
    ii. Develop schedule to determine the additional time needed for construction of the new floor
    iii. Analyze the benefits for this additional floor
4. Mechanical – Resize Roof Top Air Handling Units and develop ductwork and VAV layout for additional floor
    i. Resize Roof Top Air Handling Units
    ii. Layout additional Ductwork and VAV's for new floor
    iii. Resize correlating system components
5. Final Preparation
    i. Organize and format final report
    ii. Arrange final presentation

SCHEDULE

Week -(January through February)							
Task	1/12-1/16	1/19-1/23	1/26-1/30	2/2-2/6	2/9-2/13	2/16-2/20	2/23-2/27
1.i							
1.ii							
1.iii							
1.iiii							
2.i							
2.ii							
2.iii							
3.i							
3.ii							
3.iii							
4.i							
4.ii							
4.iii							
5.i							
5.ii							

Week -(March through April)							
Task	3/2-3/6	3/9-3/13	3/16-3/20	3/23-3/27	3/30-4/3	4/6-4/10	4/13-4/17
1.i							
1.ii							
1.iii							
1.iiii							
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