Executive Summary

This report is an analysis of the existing lateral force resisting system. Included in the report are seismic and wind analyses to determine the critical load condition, followed by subsequent checks of the existing system for strength, drift and overturning.

Sojka Pavilion and the Kinney Natatorium are 122,000+ Sqft addition to the Robert Langone Recreation and Athletic center build to house a 4000 seat basketball arena and NCAA regulation size swimming pool on the campus of Bucknell University in Lewisburg Pennsylvania. The superstructure of the two buildings consists of cold formed steel W shape bearing walls. The floor system is a 5" deep concrete slab on grade, reinforced by 6x6 W2.9x W2.9 welded wire fabric on the ground and on the second floor of each building is a composite construction, using 2" deep 18 gauge metal decking with ¾" x 5" shear studs and 6 ½" deep concrete slab. The roof system is prefabricated cold formed steel W shape trusses. All of this is supported by strip footings.

The existing lateral force resisting systems consists of X braced frames. The frames are located on both the long and short sides. On the long side of the building there are two identical side by side frames. These frames are each 31' 3" wide by 32' 6" tall and are braced by 4" diameter extra strong steel pipe made of ASTM 501A steel. The braces are divided into four sections and are connected at the center and to the frame by ½" thick steel gussets.

The short sides of the building have only one braced frame. These frames are 36' wide by 32' 6" tall and are braced by 5" diameter extra strong steel pipe. This bracing is divided into four just as the long side was and is connected in the same manor.

After applying and distributing the lateral loads, it was determined that the wind forces control the design. The worse case shear frame loading was modeled using RAM to determine the drifts and the spot checks from technical assignment 1 to determine the strength capacity. After these analyses, it could be determined that the X braces were underdesigned to carry the intended loading. Also, because of there undersizing, the drift of the building also exceeds the allowable limits for the building.

The reason for the members being underdesigned can be attributed to the higher calculated wind loads in this report then in the original design.

Introduction

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Because of there functions both buildings require clear spans of over 100’ which could affect the distribution of lateral forces. For the purpose of this report the lateral loads will be applied along the length of the building.

Included in this report is a description of the existing system, determination of design control, spot checks, and a conclusion of the results.

Existing System

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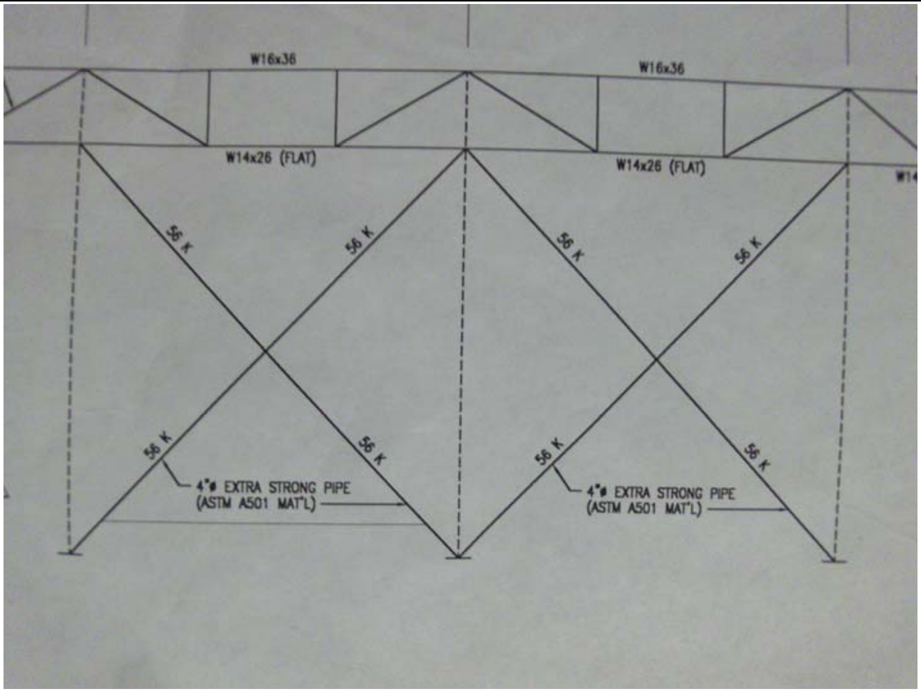

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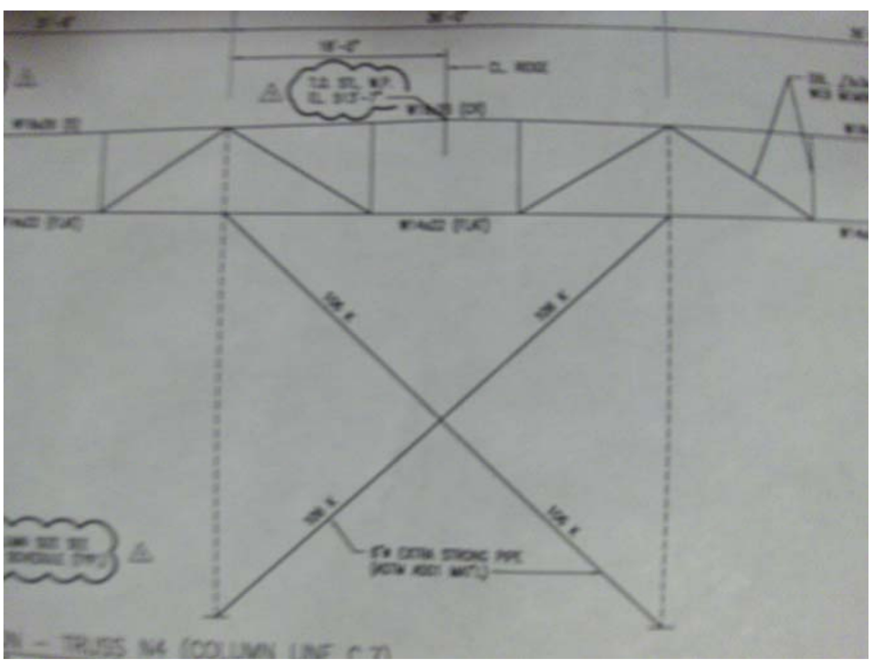
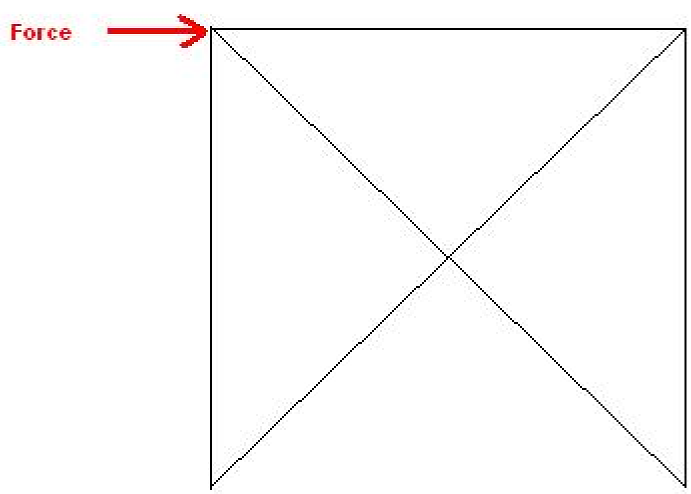


Lateral Design Control

The lateral design forces acting on this building is controlled by wind. This can be determined by comparing the base shear forces of both wind and seismic. The seismic forces on this building created a base shear of 15192 pounds, while the wind forces created a base shear of 54084 pounds.

Distribution of Lateral Forces

Distributing the forces for each frame was rather simple with the frame taking up the entire height of the wall. The wind force was first determined using the determined pressures applied over there appropriate areas and then used to determine the base shear. The base shear is then split equally between the two sides of the building and applied to the top of each frame.



Strength Check

In a spot check performed in Technical Assignment 1 it was determined that under the determined wind loading the lateral bracing members are not adequate. This is likely caused by an increase in the wind loading from the original design loads when using the current ASCE 7.

Drift Check

In addition to a strength check, the drift was also determined and compared to allowable values. The total building drift was determined to be 14.1". This far exceeds the allowable drift of 7.8". The allowable drift is calculated from ASCE 7 table 9.5.2.8.

$$\Delta_{ALLOW} = 0.02H_X$$

Since the loads are higher then the original design loads and the members are under designed, it makes sense that the drift is exceeded.

Overturning

The lateral forces on a building can cause problems with the footings trying to prevent overturning. The overturning moment and resisting moment are calculated below.

OM = (54kips)(32.5') = 1755 'k

RM = ((9035kips)/2)(51') = 230393 'k

230393 'k > 1755 'k

Therefore, the dead weight of the building can resist the overturning moment caused by the wind forces. Additionally, the footings are not required to resist the overturning moment in addition to the gravity loads.

Conclusion

In conclusion, the lateral resisting system is not sufficiently designed to resist the newly applied calculated loads. The X braces can not resist the wind loading and would therefore fail allowing for the entire frame to deflect freely.

The Dead weight of the structure is sufficient to resist the overturning moments caused by the seismic forces. Therefore, the footings are not required to help resist the overturning moment, and are controlled in design by the compressive forces of the weight above.