

Executive Summary

To begin the semester long project, the gravity and lateral loads were determined according to ASCE 7-10 guidelines. Assumptions had been made to predict the overall weight and height of the building. The accurate weight of the building was found to be 11518 kips while the overall height was 73' of 18.2' for each level. A schematic design was then created in ETABS. Upon the completion of the gravity system, the locations of lateral elements were experimented in ETABS to best resist seismic and wind loads. It was worth noting that most braced frames were determined to locate near elevator shaft and stair core to resist lateral loads. The braces were designed in a way that would account for any opening along the frame's elevation. All the frames in the model had their beams and braces end released because there were no moment connections. After all the members had been modeled properly, ETABS performed the analysis to find the optimal size of the members according to the inputted gravity and lateral loads. Hand calculations of the center of mass and center of rigidity were performed to check the adequacy and accuracy of the model. Column C-2 was chosen to check the member sizes selected by ETABS. It was determined that the model was accurate and the selected member sizes met both serviceability and strength requirement.

The outputs of the final ETABS model were used to determine building torsion, lateral load distribution, allowable story drift, and overturning moments. These values were then compared to the values of the existing concrete design. Since the seismic loads were decreased by 2 fold in the proposed design, its building torsion were also reduced by 60% in the north-south direction and 75% in the east-west direction. Both allowable story drift and overturning moment requirements were determined to be adequate for the new redesign.

A construction breadth study was conducted to determine the construction cost and time of the proposed design. Detailed cost estimation was performed to find the new structure system's cost, which turned out to be 41,171,435 US dollars. Although the steel system was more expensive than the existing concrete system, the expertise of the labors in steel construction at the building's location is still quite vast. A construction schedule for the new redesign was developed using Microsoft project. According to the schedule given by Cannon Design, the new system would decrease construction time by as much as 3 months compared to the existing concrete system. The author also considered constructability of the proposed design. Hence, a construction site logistics were established to map out the existing condition, excavation/mobilization, structure, and finishes phase of the project.

In the sustainability breadth, an energy analysis was conducted for the proposed extensive green roof system. It was found that this proposed roof system would reduce annually cooling load by 10% in summer and heating load by 25% in winter. The extensive green roof also featured lightweight, fast installation, cost effective, and low maintenance. The benefits of green roof included but not limited to improve acoustic performance and to reduce storm water run-off time. LEED and installation process of the green roof were also discussed.