Executive Summary

The following document has been the work of a year-long thesis project that integrates five years of studying Architectural Engineering at the Pennsylvania State University. The final report includes a structural depth of the existing framing system of 360 State Street—a thirty-two story residential tower located in the heart of New Haven, Connecticut. Additionally, two breadth topics have been completed in conjunction with the main study. The overall intent of the presented information is to illustrate a sufficient level of understanding behind the engineering design decisions that go into large projects.

The original structure of 360 State Street consisted of a cast-in-place structural system throughout the entire residential tower. Due to local trades being unable to provide a competitive cost and schedule, the design was later changed to staggered steel trusses. It was assumed that the engineers were not able to fully investigate alternative design solutions in order to meet the deadline for complete construction documents. The intent of this report therefore; is to verify the existing design by comparing it to an alternative.

The structural depth study investigates a more traditional steel frame that potentially could have provided a more competitive cost and schedule. Two rows of columns were added to the existing gridlines as well as beams to frame the structure together. Diagonal bracing and moment connections were also added to provide stability. An analysis was then conducted to provide preliminary member sizes for the gravity and lateral systems.

The new framing system boasts a lower overall building weight while increasing the strength and rigidity of 360 State Street. Although, shortening spans did not decrease floor depths or provide an extra level, the original architectural floor plans were maintained. The lateral systems passed inspection however; more time could have been spent with alternative beam and column placement. Overall, half the design goals were met for the alternative design.

The breadth topics of the report include a building envelop study which proposes an all-glass façade and a cost & schedule comparison of the mentioned systems. The alternative façade incorporates spandrel glass panels to increase thermal performance while maintaining an interesting aesthetic. Compared to the existing system, the alternative can save up to $120,000 a year in electricity costs.

The cost comparison of the framing systems conclude that both designs are priced roughly the same—$9.5 million. Additionally, the estimated construction time of both systems is within 110 days provided a 40 hour work-week. Furthermore, the analysis of the façade design provided base numbers for basic materials however; more conclusive numbers would have to be gathered from manufacturers for a better assessment.

Overall, the intent of this report was to justify the use of staggered steel trusses in 360 State Street. Both framing systems provide a competitive design however; the trusses provide more flexibility in terms of architectural layout and ease in construction. The cost assessment additionally verified that the staggered trusses provide more performance and durability for the same cost of a more complicated system. Therefore, it can be concluded that the initial redesign of 360 State Street utilized the best system possible.