9.0 Conclusions & Recommendations

Through both the depth and breadth topics, I have been able to analyze and assess a few of the many systems at work throughout the Barshinger Life Science and Philosophy Building at Franklin and Marshall College in Lancaster, Pennsylvania. The lateral force resisting system was streamlined for efficiency. A new foundation system of drilled concrete piers was designed to carry the building loads directly into the intact limestone less than 25-feet below finish grades. The structural device that is the Vierendeel truss was assessed based on the design of a potential alternative. After the designs were complete, I reached into construction management, architecture, and HVAC ductwork design to properly compare the new systems with their existing counterparts. The following conclusions were made based on the analyses from this senior thesis project:

- The existing lateral force resisting system of ten concentrically braced frames is oversized for the calculated seismic loads. The number of frames can be safely reduced to six, saving nearly $18,000 in material and construction costs.

- Replacing traditional spread footings with drilled concrete piers is not cost effective. Although the geotechnical engineers mapped the intact rock depth as enticingly close to the planned ground floor level, the drilled pier system ($325,000) was estimated to cost twice as much as the spread footing system ($163,000). However, the drilled pier system did reduce steel reinforcing quantities by 24% and concrete consumption by 35%. Geotechnical investigation is an extremely difficult job to complete accurately. As a result, excavation contractors are wary of deep foundation systems and charge accordingly.

- The Vierendeel truss is extremely effective and efficient for carrying significant loads over a large span. It can be manipulated to accommodate various configurations of rectangular openings, such as windows in a façade. A system of long span steel joists can be designed as an alternative to the rigidly-connected and weighty Vierendeel truss. However, the long span joists required bay in-fill members that were significantly deeper than those used with the truss. Those deeper members created a heavily congested above-ceiling plenum space and required that some HVAC ducts be resized to preserve the prescribed ceiling height.

- HVAC ducts can be flattened out without increasing friction loss or system energy consumption by simply maintaining the hydraulic diameter.

- For each individual building system that is changed, ten other systems are subsequently affected…