The proposal of an expansion of 329 Innovation Boulevard was explored in three areas: structural, architectural, and mechanical. Obviously, an additional two stories will affect the structure, the façade, and the mechanical system of the building.

Structurally, a new resisting system was explored to withstand the new wind pressures applied to the building. This affected the gravity members, as well. A new flooring system was impleted and consisted of non-composite beams with a composite slab rather than the orifinal composite beams with a composite slab. The typical beam sizes increased from W18x35 beams and W24x55 girders to W21x44 beams and W24x68 girders. A price analysis was performed and it can be concluded that the additional cost due to an increase in member sizes does not surpass the cost of shear studs. The deeper beams and girders do mean that the finished floor to finished ceiling may be affected. However, I feel that since top of steel to top of steel is 14', there is plenty of room for any possible mechanical equipment involved.

The columns decreased in size. They were typically W12x96s for the first two floors and spliced to W12x65s for the remaining two. The columns also got as large as W12x190s. This was due to the fact that they were utilized to resist large moments in the moment frame system. The new system of braced frame allowed for a reduction of size due to the interaction between brace and column. The gravity columns were all able to be W10s of numerous sizes ranging from W10x33 to W10x68. The columns in the braced frames were required to be larger than the gravity members, due to the additive moments. The largest columns were located at the corners of the "L" frames. The consisted of a W12x79 spanning the first three floors, and a W10x49 spans the remaining.

The existing moment frames allow the interior space to have minimal obstructions, but may become too costly with the expansion. The lateral resisnting system was switched to a braced frame system for the entire building. The braces would consist of HSS shapes and be in the form of chevron braces. Architectural and structural aspects were considered when placing the braces, and they were located concentrically around the geometric center of the building and in the central bay of the building. The braces were dictated by the strength code, and altimately formed an extremely rigid structure, yielding minimal deflections. RAM Structural System was utilized to size the appropriate members and find the forces applied to the members. The members ranged from HSS6x6x3/8 to HSS9x9x3/8, and they saw a maximum of 85 kips of tensile and compressive forces. These forces were used to design the connections of the frames. Field

welds were used, and were ¼" in size, and ranged from 6-8" in length on all four sides of the HSS shapes. A cost analysis between raw materials in a six-story 329 Innovation Boulevard building with moment connections (from initial design) was compared to the cost of the six-story building with the new braced frame system. The braced frame system was clearly cheaper, and may justify taking the time to redesign if a two-story expansion was proposed.

Architecturally, the façade of the building would have to be altered for the expansion. A façade study was done to maintain an appearance that would fit the mold of the buildings surroundings – Innovation Park. Numerous characteristics of other buildings in the park were implanted in the redesign of 329's façade. These characteristics included: ribbon windows and metal cladding among others. A thermal and moisture analysis was performed and helped dictate the selection of materials for the façade. Ultimately a comfortable thermal level was achieved, but required "top-shelf" materials. The additive costs may be absorbed by the savings of the structure system, but overall it may be concluded that the existing façade is more than adequate to be continued for the two-story expansion.

Mechanically, the two-story expansion would increase the mechanical laod of the building. The initial design, which consists of heat pumps, is temporary, and able to be adjusted for when tenants lease the space. Research done showed a shift to VAV systems in office buildings, so the redesign of the mechanical system was chosen to be VAV. Trace 700 was utilized to create the design loads (based on ASHRAE standards) and to model the VAV mechanical system. The output obtained was used to size appropriate equipment such as: VAV boxes, ductwork, and air handler units. A single AHU was used, which meant that it would have to custom, but would help alleviate coordination problems with syncing multiple units through shaftwork and connections. Once again, the redesign of the mechanical system may be more costly, but it does have multiple benefits. Compared to the heat pumps, it will have less maintenance costs and very little operational costs. The benefits may justify the switch in systems and the overall shift seen in office buildings.

Overall, an expansion of 329 Innovation Boulevard would ultimately equate to more work no matter what. An exploration of different systems allowed me to get a better understanding of the whole design process, and may have uncovered some unique findings. The new structure is extremely rigid, and may have been better off with less braced frames, but it still would be less costly than a moment framed structure. The new façade may be thermally efficient and moisture controlled, but can be deemed costly. The new mechanical system may be costly up front, but has long-term benefits, and is based on realistic loads. I feel that each of the newly designed systems have multiple benefits, and are effective solutions to an expansion of 329 Innovation Boulevard.