THESIS PROPOSAL

COMPLETE PROPOSAL

329 INNOVATION BOULEVARD
STATE COLLEGE, PA

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STRUCTURAL OPTION
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THESIS PROPOSAL

EXECUTIVE SUMMARY

329 Innovation Boulevard is a completed design in terms of the design phase, and is currently undergoing the construction phase. The structure will house multiple commercial tenants. It is located in the Innovation Park at Penn State, State College, PA. It will face Innovation Blvd. directly across from 328 Innovation Boulevard, which hosts the buildings designers, L. Robert Kimball & Associates. Due to the fact that tenants have not currently leased the provided space, the building utilizes an open floor plan to help facilitate any possible tenants.

The building is four stories tall, with a mechanical penthouse located on the roof. The total height is 58', and the footprint is 21,000 SF. It is a steel framed structure with a concrete composite flooring system. The veneer includes brick, aluminum panels, and glass curtain walls. It typically follows the style of the current buildings of Innovation Park.

I have proposed an addition to the existing plans of 329. The addition consists of two additive floors. A full structural system redesign must take place to ensure that the chosen system can withstand the new lateral loads. Previous findings have led me to believe that a joist/joist girder system may be more proficient, so a more in-depth analysis (including vibration and fire protection aspects) will be done to conclude which is best. The upsides of the joist/joist girder may not trump the benefits of simply modifying the existing plans, and therefore, the modification of the existing plans will also be considered. Zoning restrictions must be taken into consideration, and proposed compromises may be required due to any violations.

Two other areas will be explored, as well. The architecture of 329 will be analyzed, and a materials study will be done to provide 329 with the most efficient façade. The façade will take into consideration the overall appearance that Innovation Park has been provided with by the previous architectural works.

The other breadth includes a look into the mechanical systems. Mechanical plans must be provided for the new floors. Also, additive mechanical loads will be introduced due to the added floors. The mechanical system will be redesigned to withstand these new loads.

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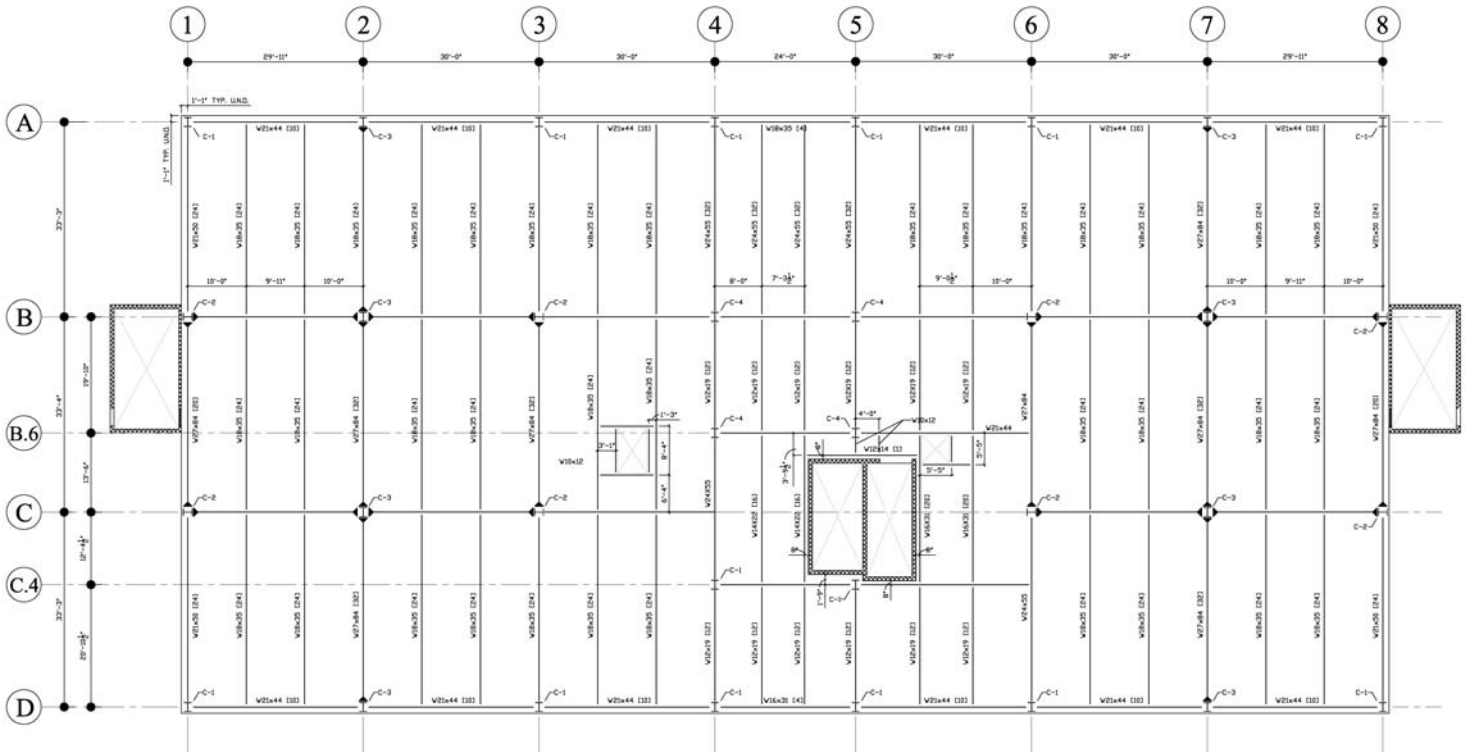

Figure 1.1 Typical Framing Plan

Figure 1.2 North Elevation

FOUNDATION

The foundation consists of a spread footings, pile caps, and piers. The tops of all exterior footings are 3'-4" below grade (unless noted otherwise), and the tops of all interior footings are 0'-8" below grade (unless noted otherwise). The typical footing size is 5'-0"x5'-0"x1'-9". They range from the size to the largest, which is 9'-0"X9'-0"x2'-9". The typical footing does not require reinforcement in the top; however the larger footings receive reinforcement in the top and bottom. There are three pier sizes; they include a 22"x22", 36"x36", and 32"x40". Each pier frames into a pile cap. Each of these components are designed with a minimum compressive strength, f'_c=4,000 psi, and the reinforcement required ranges from none to #6's through #9's.

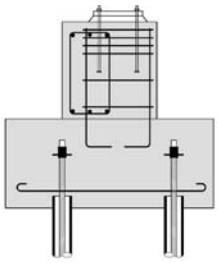

Figure 2.1
Typical Pier and Cap Section

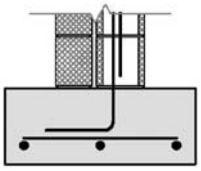

Figure 2.2
Typical Footing Section

FLOOR SYSTEM

The floor framing system consists of a composite slab and metal deck on wide flange beams and girders. The concrete used is 3½" lightweight concrete with one layer of 6x6xW1.4xW1.4 WWF. The metal decking used is 3" galvanized wide rib type composite deck. The decking is to be continuous over a minimum of three spans. The total thickness of the flooring system comes to 6½" and therefore, the top of steel (beams and girders) is located at -6½" from the finished floor. The typical size of the beams is W18x35 and they span 33'-3" and the girders range from W18x35 to W21x44 and typically span 30'0". There are minimal interferences on each floor, making each of the three floor systems practically identical.

COLUMNS

There are four different column designations in the building. The columns start on the ground floor and span from the ground floor to the third floor, which is the splice level. Typically a smaller column is used to span the remainder (third floor to roof.) Wide flange steel shapes ranging from W12x40 to W12x96 are utilized. To induce an open floor plan, the column grid is very regular and remains so throughout the four floors. Three different plate sizes are used, and each column requires four anchor bolts ranging from ¾" to 1½".

ROOF SYSTEM

The roof construction consists of 1½" galvanized wide rib steel roof deck. The members consist of wide flange beams and girders, as well as steel joists. The roof slopes towards the middle, where the drainage system is placed. The mechanical penthouse is located in the center of the roof. The roofing system that supports this additive load consists of 3½" lightweight concrete with one layer of 6x6xW1.4xW1.4 WWF on 3" (20 Ga.) galvanized wide rib type composite steel deck.

LATERAL SYSTEM

Lateral resistance is provided by several full moment connections of beams, girders, and columns. These connections can be found in the middle bay of the building on each end of the building. There are two columns on each end where the two beams and two girders are all connected by full moment connections. Refer to Figure 1.1 for the locations of the moment connections. Majority of the moment connections occur in the interior of the building, and there are total of twelve moment connections on the exterior frame. The mechanical penthouse located on the roof utilizes flat strap bracing in plane with the stud wall.

MECHANICAL

329 Inn. Blvd. will have one GPM 90.0 ton cooling tower with four 285 GPM condenser pumps, two 150 GAL electric boilers, four rooftop heat pumps provided with enthalpy exchange wheels, and fourteen indoor heat pumps each with a micro-processor control board for regulation.

TRANSPORTATION

The building is anchored by two stairwells on each end. A central elevator is provided in the middle of the building. Both the stairwells and elevator access all four floors. A pre-engineered bridge is provided for pedestrians crossing Innovation Boulevard. Two CATA bus stops are located in Innovation Park and are located on the Red Link route.

ARCHITECTURE

329 Innovation Boulevard is to maintain the current architecture of Innovation Park. A unique feature of the building is the proposed pedestrian land bridge into the first story of the building.

The building will consist of a steel framed structure with brick, metal panel, and curtainwall skin. This will allow the building to be aesthetically analogous to the existing and surrounding buildings in Innovation Park. The main entrance located in the center of the building and off of Innovation Boulevard will host double height curtainwalls. This technique is used throughout the park to implement a welcoming sensation.

PROBLEM STATEMENT

329 Innovation Boulevard is a commercial office building with a set amount of available spaces for future tenants. After all the available spots were filled, the demand for space in Innovation Park was still high. In attempt to accommodate more tenants, an expansion of 329 Innovation Boulevard was proposed. Due to the property size and set-back regulations, the only way to expand was vertically. A two-story expansion was proposed. The building must be redesigned to withstand the loads of the additional two stories.

PROPOSED SOLUTION

The proposed expansion of 329 Innovation Boulevard is intended to accommodate more tenants. As is the case with all commercial office buildings, the more space that is provided, the more profit can be obtained.

My thesis will explore the re-design of 329 Innovation Boulevard. The re-design process will take into consideration cost and materials. Other factors that will be considered include fire protection, constructability, scheduling, and additive costs due an extended schedule. The current structural system was found to be extremely adequate for the existing design. However, other options may be more beneficial for the modified design. The design will incorporate both hand and model calculations. RAM Structural System will be utilized for initial sizing of members, and hand checks using AISC Steel Manual will be used to confirm the design.

The results of Technical Assignment II provided me with the notion that a joist/joist girder flooring system may be beneficial to the design of 329, so that option will be explored with a more in-depth analysis. However, the easiest approach would be to modify the existing system. If the existing member sizes aren't affected greatly, then it would be more efficient to modify the existing plans.

The following page explains the other topics that will be covered in my thesis.

ARCHITECTURE

As mentioned before, the architecture of 329 fits into the style of all buildings located in Innovation Park. An in-depth look at the façade will be done to provide 329 with materials that are energy efficient, as well as provide an analysis of the moisture, thermal, and structural performance. The intent is to provide 329 with a highly efficient façade, and to stay within the mold that has been established by the previous architectural works of Innovation Park.

MECHANICAL

Due to the proposed expansion of 329 Innovation Boulevard, the mechanical load will be, more than likely, greatly affected. The mechanical systems must be redesigned to be able to handle the increased load. The redesign will include resizing all necessary mechanical equipment, as well as, placing the ductwork in the new floors. A full mechanical system redesign analysis will be provided.

STRUCTURAL

1.1 Research Modified Existing vs. Joist/Joist Girder Systems
1.2 Analyze Modified Existing vs. Joist/Joist Girder Systems
1.3 Determine Structural System
1.4 Draft Structural Plans
1.5 Complete Structural Model
1.6 Compute Hand Calculations
1.7 Completion of Redesign of Structural System

ARCHITECTURE

2.1 Research Façade Materials/Innovation Park
2.2 Determine 329 Materials
2.3 Redesign Façade

MECHANICAL

3.1 Determine New Mechanical Load
3.2 Select System Components
3.3 Draft Mechanical Plans
3.4 Design Complete Mechanical System

MISCELLANEOUS

4.1 Write/Edit-Revise Paper
4.2 Complete Final Technical Report

Schedule		
Week #	**Dates**	**Tasks**
1	Jan. 14 - 18	1.1, 1.2
2	Jan. 21 - 25	1.3
3	Jan. 28 - Feb. 1	1.4
4	Feb. 4 - 8	1.5
5	Feb. 11 - 15	2.1, 2.2
6	Feb. 18 - 22	2.3
7	Feb. 25 - 29	3.1, 3.2
8	Mar. 3 - 7	3.3, 3.4
9	Mar. 17- 21	1.6
10	Mar. 24 -28	1.7, 4.1
11	Mar. 31 -Apr. 4	4.1
12	Apr. 7 - 11	4.2