THESIS PROPOSAL

Gen*NY*Sis Center for Excellence in Cancer Genomics

Rensselaer, NY

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Structural Option

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The Gen*NY*Sis Center for Excellence in Cancer Genomics is a medical research facility concentrated on investigating the molecular mechanisms of cancer. Located on the East Technology Campus of the University at Albany, it is a symbol of the co-existence of academia, industry, and government. All 117,400 square feet stand four stories tall with a maximum of 87 feet above ground. The structural system consists of composite steel decking on composite columns with a eccentrically steel braced lateral system.

The chief goal of this thesis is a redesign of the framing system using a concrete flat plate system. This system will be compared to the existing composite steel framing system. The aim is to allow for a more controlled vibration of the floors as well as a more sustainable system that can accommodate a green roof. An additional study will be the overall sustainability rating of the building and the cost analysis to make it a LEED and Penn State accepted building.

Gen*NY*Sis Center for Excellence in Cancer Genomics is University at Albany owned, state-funded medical research lab. Standing four stories tall with the first floor partially below grade, the Center for Genomics sits atop a hill with a beautiful outlook over Rensselaer, NY and the Hudson River. The Research Center houses research laboratories, offices, an animal facility, a seminar room, mechanical rooms and a loading dock.

As the signature building of University at Albany's East Campus Technology Park, the Research Center is a model for the co-location of academia, industry, and government. To signify its technological presence, a glass curtain wall and exposed frames promote a fresh, new look for the campus.

A main design goal was to maximize vertical space for utilities in the corridor and in the laboratories. Another concern was the minimization of vibration from foot-traffic in the corridor through the center of the building so a 100 psf live load was predominantly used for designing. The use of composite steel with concrete slab on deck forms the 117,400 square feet plan with a typical bay size of 21 feet by 27 feet. The lateral system is a series of braces frames spaced throughout the plan of the building.

The driving force of design on this project was a need for an open floor plan for the laboratories and a fast track construction. Because of these criteria, long spans and a fast construction with minimal lead time were needed. Increasing the live to 70 psf, the structural system was arranged to accommodate for any future adaptation to changes in laboratory use or space needs. As was the reasoning for special provisions for location of future plumbing and other infrastructure demands.

Foundation

Bearing on fill and the indigenous soils was selected to simplify the excavation techniques. With this option, rock encountered above the desired footing elevation must be over-excavated 18-inches, and a fill "cushion" placed beneath the footings. The allowable bearing capacity of this foundation system is 4000 psf. Typical footings are 9-feet square 25-inches deep calling for 11#9 reinforcing bars each way on bottom. Typical continuous wall footings are 1-foot deep by 2-feet wide calling for 3#5 continuous bars and 1#5 bar at 12-inches on center, transverse.

Floor Framing

The floor system of the Center for Genomics is composed of a composite steel system with a typical bay of 21 feet by 27 feet. It includes 2.0 inch, 20-gage composite decking with a 4.5" normal weight concrete slab, and ¾" diameter, 4" long studs. A 2 hour-rated construction is provided for all columns and beams supporting all floors. Typical floor beams (displayed in teal to the right) are W16x31 spaced 7-feet apart and 20 shear connectors. Filler beams across the 10-foot corridor are W10x12 spaced 7-feet apart. Girders along the interior column lines and along the exterior walls are W18x35 with 32 shear connectors. Camber is not be accounted for due to relatively short spans.

Figure 2: ***2nd Floor Plan***

Lateral Force Resisting System

Steel braced frames (displayed in red above) will resist wind and seismic lateral loads. An expansion joint at the intersection of the two building wings will isolate the two sections from each other. The expansion joint will require a row of columns along each side of the joint, with the building structures separated by a distance sufficient to provide seismic isolation—approximately 6 to 8-inches. Each building section has braced frames across the ends, and two bays of bracing along the length of each exterior wall. Bracing diagonals are typically HSS8x8x5/16 in non-moment-resisting eccentrically braced frames.

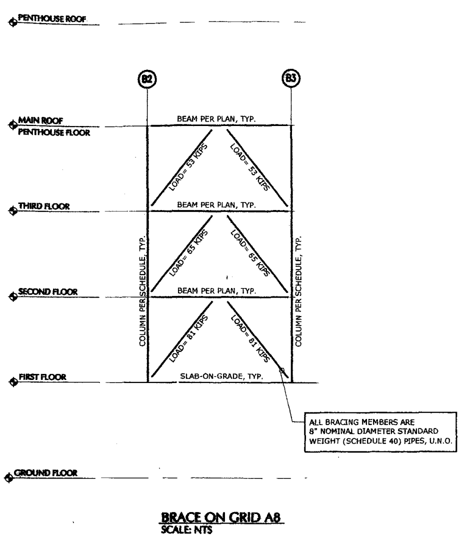


Figure 3: ***Typical Lateral Brace Frame***

Problem Statement Gen*NY*Sis Proposal

According to the schematics for the original design of the Gen*NY*Sis Center for Excellence in Cancer Genomics, sustainable design was to be implemented for a sound environmentally sensitive design and use materials wherever possible. Also, due to the speed of design and construction, a composite steel system seemed most suitable for the project.

It seems as though perhaps there might be a better design decisions for such a landmark building of technology. Furthermore, steel does not hold down vibration control over long spans which is what is needed for the layout of the laboratories.

The required amount of air supply is met by the large mechanical penthouse on the roof, but it creates dead space. Lighting seems to be adequate for the needs of the experiments done in the building, but there could be some improvement in the aspect of sustainability.

Proposed Solution

This proposal has one main idea behind it: provide the same building at Penn State University using a different structural system and the innovative and unique Penn State LEED requirements.

A concrete structural system could prove more effective than the current composite steel system in many ways. For one, long spans may be achieved to keep the floor plan as is. Although, the lateral system will have to be remodeled to include shear walls. This could require some adjustment to the floor plan if the shear walls need more space. Furthermore, a concrete system can accrue LEED credits just as well as steel can. Most importantly, concrete can minimize the amount of vibration that goes on in the laboratories. The two systems will be compared for LEED credits, the amount of floor vibration in the laboratories, and the use of an open floor plan.

As an addition to the overall change of the structural system, all the rules of Penn State's LEED Policy will be applied to the building, which is based on LEED-NC, version 2.2. Not only does this increase the marketability of the building, but it also increases the innovative intention of it being a signature building of technology. All sections of the Penn State Policy are split into mandatory, significant effort, minimal effort or no effort as required by Penn State's Office of the Physical Plant. Two sections of focus will be the addition of green, habitable space on the roof in between the penthouses and the investigation of a storm water system that returns runoff water back to the building. Furthermore, there will be a comparison between placing the building on main campus or the Hershey Medical Center campus. In addition to these changes, a cost analysis will be completed for the change to the structural system and the addition of all the sustainable alterations.

The following tasks will be carried out to reach the solutions aforementioned. A further schedule of the timeframe for these tasks has been put together on page 8.

Structural Depth

I. Task 1: *Redesign Gravity System*
   a. Establish live load and spans (including green roof load)
   b. Develop reinforcement for each floor and check with pcaSlab
   c. Recalculate dead loads
   d. Check deflection using RAM Concept
   e. Size columns for new gravity load using pcaColumn
   f. Check impact on foundation design and resize footings
   g. Check vibration control
II. Task 2: *Redesign Lateral System*
   a. Recalculate lateral loads using ASCE 7-05
   b. Design shear walls and concrete frames
   c. Check that governing loads (wind or seismic) are covered
   d. Determine moments transfer moments using RAM Structural System or ETABS
   e. Check beam to column capacity based on ACI 318-05
III. Task 3: *Comparison of Vibration Control*
   a. Determine vibration for new structural system in typical laboratory
   b. Compare the vibrations between the two systems

Sustainability Breadth

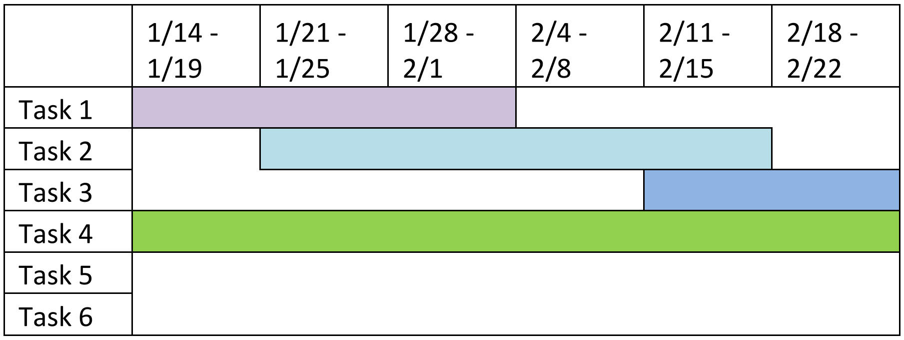
IV. Task 4: *Sustainability Evaluation*
   a. Check against Penn State Checklist for Sustainable Points
   b. Make a list of what needs to be upgraded
   c. Make sure the roof is strong enough for a green roof
   d. Research storm water design methods for this site
   e. Determine final changes for Penn State LEED points

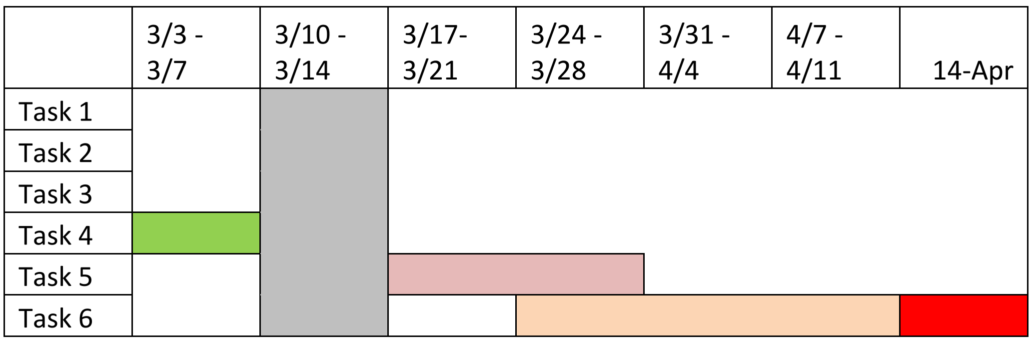
Cost Analysis Breadth

V. Task 5: *Cost Analysis*
   a. Calculate new building costs for structure
   b. Calculate new building costs for sustainability
   c. Make a comparison chart for cost

Presentation

VI. Task 6: *Presentation Preparation*

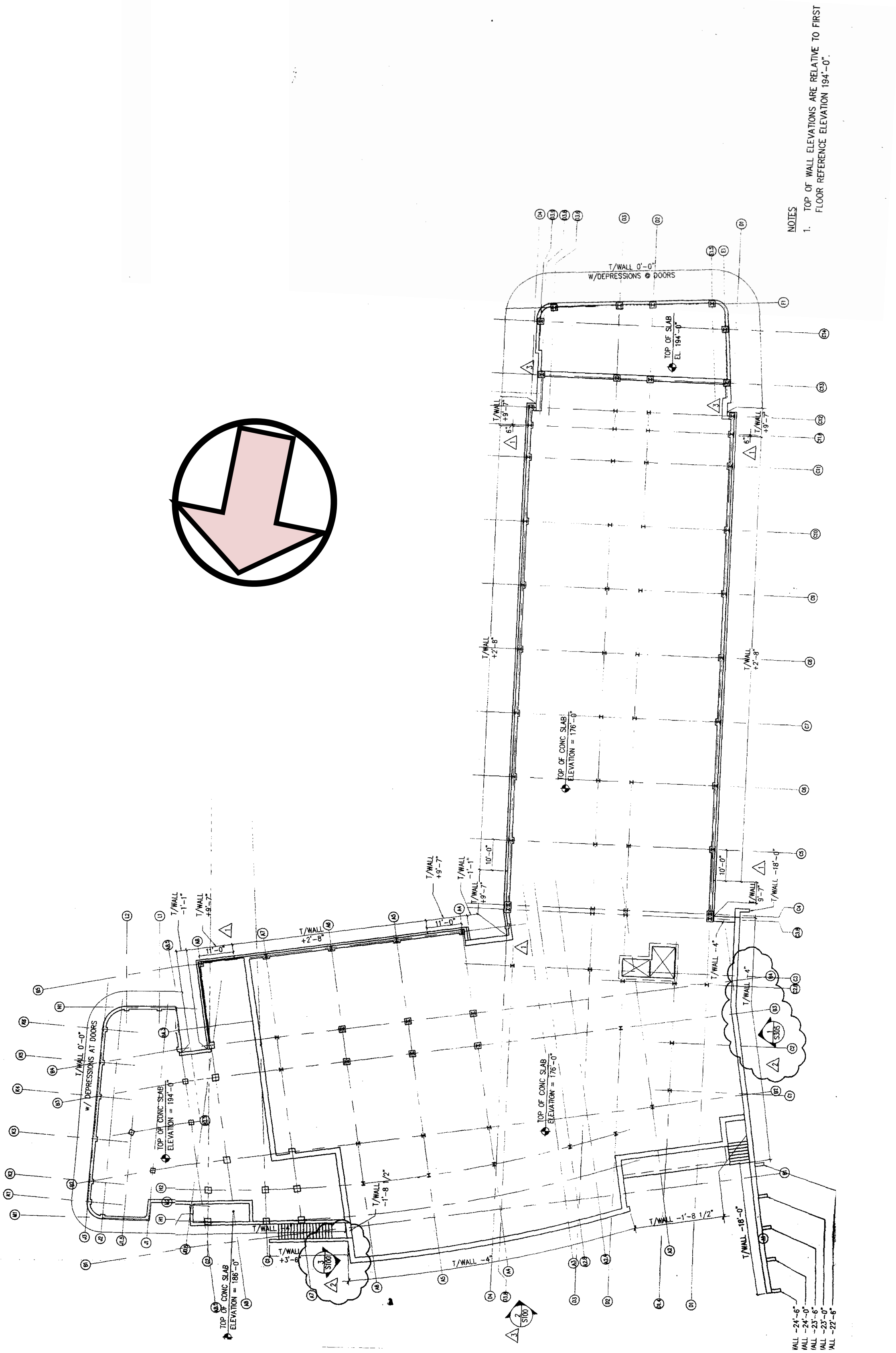




Task 1: Redesign Gravity System
Task 2: Redesign Lateral System
Task 3: Comparison of Vibration Control
Task 4: Sustainability Evaluation
Task 5: Cost Analysis
Task 6: Presentation Preparation

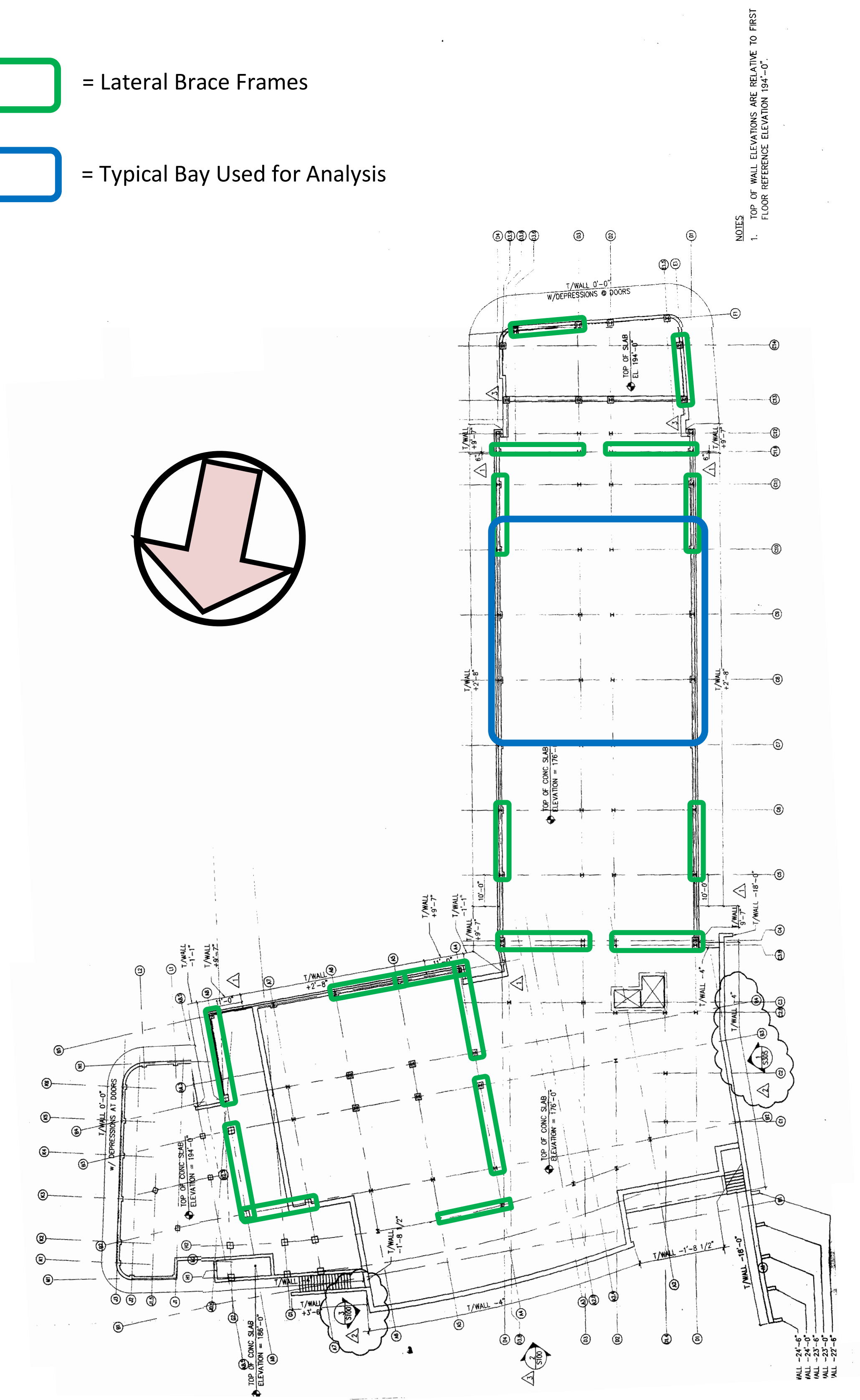
For the duration of the spring semester, a redesign of the structural system will be completed for the Gen*NY*Sis Center for Excellence in Cancer Genomics. This revamp will be evaluated mainly based on vibration control but also for its sustainability and then compared to the existing system in Rensselaer, NY. The study involves a complete gravity and lateral framing redesign for better vibration control in the laboratories. The breadth studies focus on a direct check for sustainability based on the Penn State LEED Policy, mainly concentrating on a habitable green roof and a new storm water system design. Based on all these changes, a cost analysis will be conducted to truly see what the cost of sustainability can be. The final recommendations will be put together in a presentation.

The target of this research is to understand the decisions of the original structural engineer. Also, I will gain experience with concrete structures and the differences between concrete and steel structural systems. Experience with vibrations will also be acquired for future design of laboratories and buildings with sensitive equipment. Lastly, it will provide me with a better understanding of the cost side that the construction manager must justify between the engineers and the owners. But above all, I get a deeper insight into the world of design.


NOTES
1. TOP OF WALL ELEVATIONS ARE RELATIVE TO FIRST FLOOR REFERENCE ELEVATION 194'-0".

= Lateral Brace Frames

= Typical Bay Used for Analysis



Picture 1: Typical Structural Column on Pier

Picture 2: View of Structural Frame

Picture 3: Interior View of 1st Floor

Picture 4: Typical Lateral Brace Connection

Picture 5: Typical Column-Girder Connection

Picture 6: Penthouse Mechanical Screen