Executive Summary

The Gen*NY*Sis Center for Excellence in Cancer Genomics was built as the signature building of University at Albany's East Campus of Biotechnology. The conditions of the site prior to construction included the old Sterling Winthrop Facility just off the Columbia Turnpike in East Greenbush, NY. A four-story steel framed laboratory, the Cancer Research Center falls on 117,400 square feet of space with about 26,000 square feet per floor. The Ground Floor is mostly below grade and houses laboratory space, an animal facility, mechanical rooms, and a loading dock. Just above on the First Floor, there is more laboratory space, offices, public space and a seminar room. The remaining Second and Third floors accommodate additional offices and laboratories.

The structural system is comprised of conventional framing with composite decking and composite steel beams at the floor levels and the roof. Column placement along exterior walls and on both sides of a ten-foot wide corridor allows for minimized foot-traffic vibration from the corridor to adjacent lab spaces and maximizes vertical space in the corridor. This column grid creates bays sizes of 21-feet by 27-feet. Upon exploration, structural steel was selected over reinforced concrete.

A new system of precast panels has been calculated and designed to research the difference in vibration control. Currently, steel braced frames are used to resist lateral forces and four concrete shear walls have been tested to take the job of resisting lateral forces. In this case, the wind load governs for the lateral forces and drift. The shear walls have been designed as 12 inches thick with columns as the boundary elements, which are 20 inches by 20 inches.

Further research into the redesign using precast concrete, the site, schedule and cost has been conducted to expose that while the concrete system was cheaper overall, the cost of the lateral concrete shear wall system was more expensive than the original lateral braced framing.

In addition to a green roof being added, the entire building has been fitted out to meet the approval of the Penn State LEED requirements, and to demonstrate some key elements of green building.

Introduction

As part of the Engineering program at Penn State University, a senior year project is required to graduate. Specifically in the major of Architectural Engineering, the senior project is molded into a year-long thesis research project which is based on the study of a newly constructed or a current construction project somewhere in the continental United States. A complete set of construction documents and specifications are donated by industry professionals to fully understand the inner-makings of the building, and execute a change in its original layout. During the fall semester, three technical reports are written to comprehend the structural, mechanical, lighting/electrical and construction management issues encountered by the professionals. An emphasis of analysis is completed based on the student's option: structural, mechanical, lighting/electrical or construction management. Based on this research, an idea to change and improve the original design is proposed for research throughout the spring semester. The proposal consists of a depth in the student's option and two breadth topics from other areas of architectural engineering.

This final report is a compilation of the technical reports and research completed throughout the past year on the Gen*NY*Sis Center for Excellence in Cancer Genomics at the SUNY University at Albany. The proposal consists of a change of lateral system from steel lateral braced frames to concrete shear walls. The overall structural system has been changed from composite metal deck with normal weight concrete and structural steel columns to precast planks and precast columns. The breadth topics include an addition of sustainable building concepts and a construction management evaluation.

All information pertaining to this research can be found on the following website: http://www.engr.psu.edu/ae/thesis/portfolios/2008/mgk145/. This report and all materials posted on this website are intended for educational purposes only.

General Information

The Gen*NY*Sis Center for Excellence in Cancer Genomics (abbreviated as CFG in this report) is a cancer research center for the University at Albany's East Biotechnology Campus located at the old Sterling Winthrop Facility. The Gen*NY*Sis program encourages collaboration between research institutions and emerging as well as established companies. The sharing of knowledge along with facilities and equipment has been shown to accelerate research discoveries and therefore the development of new techniques and products. In this particular building, cancer research is done at the center as a cooperative effort that links private biotech businesses with academia and government to conduct groundbreaking research and development in state-of-the-art facilities. Located at One Discovery Drive Rensselaer, NY 12144-2345, which is just off of Columbia Turnpike in East Greenbush, NY, the project was designed as the signature building of East Campus. The CFG features spaces for research laboratories with supports spaces, offices, seminar spaces, circulation spaces and a two story atrium.

Architecture

This 117,400 square foot building is four stories with a ground floor mostly below grade. Overall, the building stands between 70 and 90 feet above grade. Arranged at the entrance of East Campus, the CFG is the signature building of the new Biotechnology Park of the University at Albany as well as a symbol of hope for all those afflicted with cancer. Designed as a Business Occupancy (use Group B), the construction class is Type 2B (noncombustible) but with 2-hour rated construction to account for the storage of large amounts of chemicals in the research labs. Floor-to-floor heights of 16'-0" are proposed with an 18'-0" floor-to-floor height at the basement level.

National Codes

- New York State Building Code 2002
- The Comprehensive Zoning Law of the Town of East Greenbush New York (last revised on August, 11 1999)
- Minimum Design Loads for Buildings and Other Structures (ASCE 7)
- Building Code Requirements for Reinforced Concrete (ACI 318)
- Specifications for Structural Concrete for Buildings (ACE 301)
- Specifications for Structural Steel Buildings (AISC)
- Seismic Provisions for Structural Steel Buildings (AISC)
- Code of Standard Practice for Steel Buildings and Bridges (AISC)
- Structural Welding Code—Steel (AWS D1.1)

Building Envelope

The main exterior walls are comprised of solid Phenolic Resin wall panels, metal furring, 5/8" dense-glass gypsum sheathing, 1" rigid insulation, 6" LGMF, 6" fiberglass insulation, reinforced Polyethelene sheeting vapor retarder and 5/8" painted gypsum wall board.

The exterior of the CFG has been formed to give a sleek, clean look. It is comprised of a couple of different systems: exposed concrete site walls, Phenolic resin panels (installed over a metal furring rain-screen system), 2 different glazed systems, a curtain wall system (north façade and south end offices), a storefront system, and a glass wall panel (trusswall system at northwest wall).

The roof contains a composite metal panel system which rests upon open web steel roof joists with some slab on deck framing supported by steel beams to account for substantial amounts of HVAC equipment. In addition to the penthouses, a screen wall around the entire roof perimeter is installed to shield the view of the equipment from view.

Construction

A joint venture between U.W. Marx and Gilbane Building Company served as the construction manager for this project. The CFG was constructed on a fast-track delivery method to build the 2005 Project of the Year—Honorable Mention by the Construction Management Association of America, NY-NJ Chapter. Construction was designed around a module system of 10'-6" with a structural bay to provide for a clear dimension of approximately 21'-0" and a 7'-0" clear corridor width.

Structural

The structural system of the CFG is designed to justify future adaption to changes in laboratory use or space needs, with special provisions for location of future plumbing and infrastructure demands. The foundation uses typical footings 9'-0"x9'-0"x25" and 20" thick basement walls that retain 20'-0" of soil. Typical slab-on-grade is 5" thick and increased to 6" for mechanical equipment slab-on-grade. The floor and roof system are typically 6 ½" slab of normal weight concrete on 2", 20-gauge composite metal deck and 6x6-W2.9xW2.9 wire-welded-fabric reinforcement. Floor and roof filler beams are typically W16x31 spaced 7'-0" apart with 20 shear connectors and a frequency of 8 Hertz. Whereas the penthouse system is 1 ½", 22-gauge, galvanized wide-rib (type B) roof decking. The preliminary size of a penthouse roof joist spanning 40'-0", spaced 4'-0" apart is 30K10. Columns are placed along the exterior walls to form rectangular bays of 21'-0" by 27'-0". Columns are also put on either side of a 10'-0" corridor in order to minimize foot-traffic vibrations into adjacent lab spaces. The column placement also maximizes vertical space for utilities located in the corridor.

The lateral force resisting system uses steel braced frames to resist wind and seismic loads. An expansion joint at the intersection of the two building wings isolates the two sections from each other. The expansion joint requires 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"-8". 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 tube-shaped steel members (HSS8x8x5/16) in non-moment-resisting eccentrically braced frames. The building is designed for wind loading drift criteria of H/400, including second order effects.

Mechanical

The Research Center's mechanical system is designed to support offices, laboratories, and a vivarium to operate respectively, 10 hours/day, 10 hours/day and 24 hours/day, and respectively 5 days/week, 5 days/week and 7 days/week. In general, supply air to laboratory and laboratory animal spaces are 100% outdoor air. Ventilation rates are based on sensible cooling load, minimum dilution ventilation requirements, and/or exhaust air requirements. The ventilation rates for other spaces are based on minimum dilution ventilation requirements for occupant comfort, occupant density, pressurization criteria, and/or exhaust air requirements. Ventilation air is provided at a minimum rate of 20 cubic feet per minute per person. The air handling units serving the offices, laboratories and vivarium supply air through 30% ASHRAE efficient prefilters and 95% ASHRAE efficient afterfilters.

In general, the HVAC control system provides individual thermostat control for each laboratory. During "occupied" hours, systems maintain minimum air change rates. Room temperature is controlled using a wall-mounted thermostat, connected to a reheat coil control valve. Supply airflow exceeds exhaust airflow to assure positive pressure in barrier animal spaces relative to adjacent spaces. During "unoccupied" hours, the control system allows an energy-efficient reduction in supply and exhaust airflows provided that system maintains relative pressure within the laboratories. This design includes moisture addition for relative humidity control at the central station air handling unit and satisfies the requirements for the majority of the spaces served, but there is no individual room humidity control.

The calculated cooling, heating and process loads for the Research Center are respectively, 1100-tons, 18,500 MBH, and 5100 MBH. For cooling, there are three 375-ton, high efficiency water-cooled electric centrifugal water chillers to provide 42^0F chilled water throughout the building via a primary-secondary chilled water pumping system. The

primary pumps provide a constant flow of 600-gpm while the secondary pumps' flow is at a constant 1700-gpm (100% of the intended building-cooling load).

The heating plan consists of gas-fired, water-tube high-pressure steam boilers, and hot-water reheat with steam preheat coils. Two 250-BHP flexible water tube high-pressure steam boilers equipped with dual fuel burners provide100-psig steam with only a natural gas connection. The hot-water system is complete with an expansion tank, air separator complete with necessary apparatuses for a hot-water heating system. The high-pressure steam system and boiler system are complete with deaerator, chemical treatment system, four-pump feed water system, flash tank, condensate return system and all apparatuses for a complete hot-water heating system.

Lighting/Electrical

The incoming electrical service for the CFG comes from the existing campus 4800 Volt distribution loop. A 5 kV switchgear was added to allow for primary electric distribution routed across the site via underground ductbank to a new dual primary voltage, 13.2/4.8 kV, pad-mounted transformer located at the north side. Dual secondary feeders will be routed underground in the ductbank to the main switchboard and fire pump service entrance switchboard/disconnect switch.

The new main switchboard provides facility power distribution which includes: 3200 A, 277/480V distribution sections with individually mounted main and feeder circuit breakers, solid-state trip device and ground fault protection, customer metering, digital type and pulse initiator for kW demand, and transient voltage surge suppression.

Floor distribution of power includes two vertical busways fed from the main switchboard for power to each floor (one in each wing). Mechanical distribution of power includes the combination motor controllers and disconnect switches or variable frequency drives in mechanical equipment rooms (for pumps, fans, packaged equipment, etc.).

The generator provides power to the emergency side of each transfer switch and the main switchboard provides power to the normal side of each transfer switch. The load side of each transfer switch feeds the distribution switchboards. The lighting panels on each floor service the wing that they are located in, and the lighting panels serve a dry type transformer, 480 V to 208/120V for incidental 120V life safety power at selected locations. Standby power is provided for legally required mechanical equipment such as smoke control fans. The optional standy distribution provides power to loads determined to meet the needs of the building as directed by the University at Albany.

All lighting is hung from the building structure independently of the ceiling support system. In general, lighting is fluorescent with incandescent used where desired or appropriate.

Fire Protection

The fire protection is designed in accordance with the New York State Uniform Fire Prevention and Building Code, Title 9B, IBC, NFPA 13, 14, 20, and 45, and local regulations. The building construction class is type 2B (noncombustible), however due to use as a research lab and the need to store large amounts of chemicals, (2) hour rated construction for all columns and beams supporting all floors including the roof are provided. The sprinkler design in the laboratory is based upon Ordinary Group 2 hazard classification which requires a design density of 0.20 gpm per square foot over 1500 square feet of design area. Therefore, it requires approximately 300 gpm for sprinkler flow within the building and 250 gpm additional for hose allowance. Mechanical spaces require 0.15 gpm per square foot, and corridors, toilet rooms and offices require 0.10 gpm per square foot. Equipping the structure with an automatic sprinkler system, the area limitation is increased from 23,000 to 69,000, which forms the floor as one fire area. At each stair landing, a 2 ½" fire hose valve with a 2 ½" x 1 ½" reducer with cap and chain is installed. The standpipe system is designed to accommodate 1000 gpm. A four-way fire department connection is located at the front side of the building.

Transportation

The stairwells are located along the southeastern-most wall, the east end of the curtainwall system on the northern side, and against the northwestern corner of the building. 2 elevators are included in the building. The main passenger use elevator has a capacity of 2500 lbs. with a sheet vinyl floor, stainless steel walls, doors and hoistway doors. It is ADA compliant with emergency communications sytem. The large elevator has a capacity of 5000 lbs. with a sheet vinyl floor, stainless steel walls, doors, and hoistway doors. In this elevator, the door is 8'-0" high. Also, it is ADA compliant.

Telecommunications

The incoming service for the new facility comes initially from the existing services in the Administration buliding, or through the education center. These services include voice, data and video over copper, coax and fiber optic media. An underground duct bank connects the Cancer Research Center to an underground telecommunication vault; through this vault duct bank connections are made to the Administration building, the education enter, outside service providers and the rest of the campus. Each standard laboratory contains (1) Category 6 copper cable connecting a wall phone. Each A/V outlet has a wall

interface and/or a projector interface. Outlet types and locations are coordinated with the University of Albany's IT staff.

Acknowledgements

The author of this thesis study would like to acknowledge and thank the following individuals, design professionals and firms for their assistance, patience and encouragement in helping complete this thesis study:

E.Y.P.A.E.
Franklin Lancaster
David Clemenzi

Penn State AE Faculty
Dr. Ali Memari
Kevin Parfitt
Robert Holland

A special thanks goes out to my fellow AE 5th year students for the late but enjoyable nights, the Penn State Rugby team for their constant encouragement, and my family for listening to me complain over the past five years.