BUILDING STATISTICS

Part 2

Justin Green
Construction Management
AE Advisor: Professor Riley

PRIMARY ENGINEERING SYSTEMS

CONSTRUCTION

MEANS AND METHODS

Construction Sequence

The major sequence of work on this project is such that construction starts on the first floor and raises one floor at a time in a clockwise rotation until the penthouse is reached. This is similar to a Short Interval Production Schedule (SIPS) schedule where each trade is given a particular area of the floor in which it is allowed 5 days to complete their particular task before moving onto the next area. This type of schedule brings an assembly line approach to construction. However, SIPS schedules only work if there is some kind uniformity to the floor layouts and square footage of each area (like in this facility).

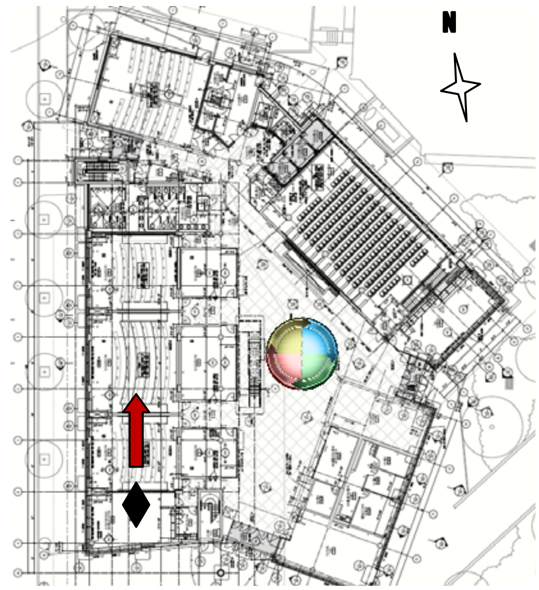

Figure 1: First Floor Layout Showing Sequence

Site Logistics - Tower Crane

A tower crane was utilized on this project to erect all of the structural steel members and all of the precast filigree slabs. This tower crane was also used for the placement of cast-in-place concrete by means of a crane and bucket for the upper levels of the facility. The tower crane was located in the center of the University Sciences Building's atrium space, and could reach every corner of the building. This type of crane was chosen because of the limited site laydown space available, and because of the convenience of the large open atrium space within the building. Locating the tower crane in the atrium allows for minimal interference of the work revolving around it.

Site Logistics - Limited Laydown Space and Site Congestion

Working in a city has its disadvantages. There is very little room for trailers, materials, equipment, trucks, or laydown space. This means that careful planning and scheduling of trades on site is critical. Areas within the building will need to be designated for storage and subcontractor on-site fabrication. Less space outside of the building typically equates to more congestion within the building. Turner must also coordinate with the city and campus officials about when deliveries or construction will require street and sidewalk closings.

Site Logistics - Site Excavation

Excavation supports for the University Sciences Building consisted of steel soldier beams with wooden lagging. The soldier beams were set in previously drilled holes, grouted around the base, and then excavated downward.

ELECTRICAL

The main power source for the University Sciences Building is coming from an adjacent university building at 13.2 kV on a 15 kV medium voltage cable, and then stepped down to 480/277V, (3 phase, 4 wire).

For emergency power, the USB building will house a 600 kW, 480V, 3 phase diesel generator for back-up power. This generator is located on the roof of the building with a 2-hour fire rated cable.

LIGHTING

Most lighting fixtures will be T-8, straight tube, rapid start, multi-phosphor type with a medium bi-pin base, average rated life of 24,000 hours, 3,000 initial lumens, 2,820 mean lumens, a correlated color temperature of 3,500 degrees K, and a CRI of 85. U-tube lamps will not be used within this facility. Only GE Ecolux, Osram/Sylvania Ecologic, or Philips Alto type fixtures are to be used.

Compact fluorescent lamps within the building are 4 pin, 13 watt minimum with a color temperature of 3,500 degrees K, a CRI of 80, and suitable for use with electronic ballasts. Self-ballasted compact fluorescent lamps are not acceptable except for retrofitting existing incandescent fixtures. Only Osram/Sylvania Dulux D/E EOL compact fluorescents are to be used.

All incandescent lamps should be rated 120 volts and shall have a minimum life of 3,000 hours.

Unless indicated otherwise, fluorescent fixtures with three or four T-8 lamps will have two ballasts to accommodate dual switching. Fluorescent fixtures with multiple compact fluorescent lamps are allowed just one ballast.

Fluorescent ballasts will be of the electronic type, programmed rapid start, series circuited, and completely solid state. Ballasts will be rated for the specific lamps they are supplying and will have a maximum crest factor of 1.5, a maximum current total harmonic distortion of 10 percent, a minimum starting temperature of 0 degrees F, and a sound rating of "A". Ballasts, for T-8 lamps are required to be Osram/Sylvania Quicktronic Professional PSN-F type ballasts. Ballasts for compact fluorescent lamps will be the fixture manufacturer’s standard electronic type.

Fluorescent dimming ballasts will be electronic, comply with the other requirements for electronic ballasts, be capable of smoothly and consistently dimming the lamps from full output to 10 percent or less output, and maintain a cathode voltage between 3 to 4 volts. Osram/Sylvania Quicktronic, Lightolier or Lutron dimming ballasts only.

The University Sciences Building has a total of 59 different fixture types. Some of the key fixtures and spaces are as follows:

<u>Auditorium</u>

CD3 - Recessed in sloped ceiling, 277v, 4.5”x 9” single lamp rectangular florescent.
FA4 - Recessed in sloped ceiling, 277v, 4”x 48” 2-lamp linear fluorescent.
FB3 - Surface mount, 277v, linear fluorescent uplight with asymmetric reflector in 3’- 4’ lengths.
FT3 - Recessed, 277v, 4’ or 8’ long single lamp linear fluorescent wall washer on white boards.

<u>Classrooms</u>

CD1 / CD3 - Recessed in sloped ceiling, 277v, 4.5”x 9” single lamp rectangular florescent.

FB2 - Surface mount, 277v, linear fluorescent staggered strip in 3'- 4' lengths.
FP1 - Recessed, 277v, 1'x 4' 2-lamp fluorescent direct/indirect fixture.
FT1 - Recessed, 277v, 4' or 8' long single lamp linear fluorescent wall washer on white boards.

Corridors

CC1 - Recessed, 277v, 7-3/8" single lamp compact florescent.
FA1 - Recessed, 277v, 6"x 48" 2-lamp florescent with acrylic diffuser.
FA3 - Recessed, 277v, 2'x 2' troffer, 2-lamp compact florescent with acrylic lens.
FG3 - Surface mount, 277v, 4' 2-lamp linear fluorescent with a vapourtight lens

Labs

CC3 - Recessed, 277v, 7-3/8" 2-lamp compact florescent.
FJ1 - Rigid stem suspended from slab, 277v, 7"x 2-1/2" 2-lamp linear direct/indirect fluorescent.
FJ2 - Aircraft cable suspended from slab, 277v, 8' 2-lamp pendant, linear fluorescent direct/indirect fixture with parabolic louver.
FJ6 - Aircraft cable suspended from slab, 277v, 8' 2-lamp pendant, linear fluorescent direct/indirect.
FT2 - Recessed, 277v, 4' or 8' long single lamp linear fluorescent wall washer on white boards.

Offices

FJ2 / FJ7 - Aircraft cable suspended from slab, 277v, 8' 2-lamp pendant, linear fluorescent direct/indirect fixture with parabolic louver.

MECHANICAL

There are 3 different areas of mechanical spaces with the University Sciences Building. One mechanical room is located in the basement of the building, another room is located on the 5th floor of the building, and another two out of three wings of the building on the penthouse level are dedicated to mechanical space.

All of this space is required to house the 2 Cooling Towers, 2-620 ton Chillers, 6 Heat exchangers, and 9 Air Handling Units ranging from 6,000-42,000 CFM (1 - auditorium, 4 - labs, 1 - offices, 1 - classrooms, 1 - atrium, and 1 - electrical/telecom).

The type of air distribution system used within the building is a Variable Air Volume (VAV) system with reheat coils throughout the building. This system also feeds exhaust air through the living biowall to be cleaned and recycled. This helps reduce some of the need for natural outdoor ventilation because the plants from the biowall do a better job cleaning the air then if you were to bring in outside air from the city atmosphere. However, all laboratories are supplied with 100% outdoor air in order to properly ventilate the spaces that contain material with harmful contaminants.

Heating for the building is provided by the university's underground steam system. As a result, this eliminates the need for boilers within the building. The only combustion equipment within the building is that required which is required to operate the emergency diesel generator. This generator is located on the roof of the building for easy venting of exhaust, and is positioned away from the AHU's in order to avoid contamination of the air intake for the building.

Indoor relative humidity level will be around 55% during the summer months and 30% during the winter months of operation. This complies with the maximum 65% relative humidity limit set by building code. Humidification is provided by direct steam injection into the AHU's.

STRUCTURAL

CONCRETE / STEEL FRAME

The majority of the building is comprised of both precast and cast-in-place concrete (with the only exception being that of the penthouse floor levels). Concrete columns support the filigree slabs, and the filigree slabs support the cast-in-place concrete resting on top.

While most of the building is supported by a concrete frame and shear walls, the upper penthouse levels are supported by a steel frame with moment connections. Sizes of members include W8x40, W8x48, W8x67, and W12x65.

One feature that is typically present in buildings today is the use of a composite floor slab. The University Sciences Building utilizes this construction technique in situations where steel decking is present with cast-in-place concrete resting on top. By rigidly joining the two systems together (steel and concrete), the resulting system is stronger than if the two were independent of one another. While concrete is great in compression but poor in tension, the steel members are strong when in tension.

PRECAST CONCRETE

All of the elevated slabs within the building are supported by filigree precast slabs. Filigree slabs are essentially really thin concrete precast panels (2-1/4" thick) with prestressed reinforcement throughout. They also act as the formwork for the cast-in-place concrete on site. The slabs are first made off-site and then shipped to the jobsite for assembly and shoring. Once secured, the second layer of concrete with reinforcing is placed on top of the precast panels. This process can effectively and efficiently accelerate the construction of structures with improved physical and aesthetic properties.

Sequencing and connection details are a critical component of the installation of any type of precast concrete. Installation for this project starts at the southwest corner of the building, and progresses in a clockwise manner around the site.

These precast slabs can also be considered a sustainable feature of the building because they replace the need for any wooden or metal formwork when placing concrete, meaning fewer materials wasted on the project. The most sustainable kind of construction is the type that chooses not to use unnecessary materials.

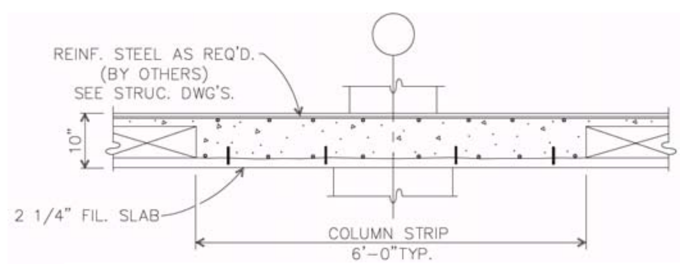

Figure 2: Typical Floor Section Showing Precast Filigree Slab

CAST-IN-PLACE CONCRETE

Reinforced cast-in-place concrete was used for the University Sciences Building's drilled caissons, grade-beams, foundation walls, slab-on-grade, columns, beams, and elevated slabs.

A smoothed-formed finish was used for all of the building's cylindrical columns because they will remain exposed to public view when the project is completed. Any other type of permanently exposed concrete within the building also requires a smooth finish and that all corners/edges be chamfered.

ADDITIONAL ENGINEERING AND ENGINEERING SUPPROT SYSTEMS

FIRE PROTECTION

The entire building will be sprinkled with a wet pipe fire suppression system. A Glycol fire suppression system will be used in the loading dock area to prevent the pipes from freezing during the winter months. All water supply requirements are based on a minimum 2-hour duration, and must be in accordance with the NFPA 13 code requirements.

Sway bracing is required to restrict movement of sprinkler heads upon activation, in any direction, to less than 1/8” for window sprinklers.

Figure 3 below shows a breakdown of the different spaces within the building, and their corresponding hazard classifications.

Space	Hazard
Loading Dock, Chemical Storage	Ordinary Hazard - Group 2
Mechanical and Electrical Rooms	Ordinary Hazard - Group 1
Office Areas, Classroom, Auditorium	Light Hazard
Laboratory	Ordinary Hazard - Group 1

Figure 3: Building Spaces and their Hazards

TRANSPROTATION

ELEVATORS

The University Sciences Building houses two elevators. One is a 3,500 lb. capacity geared traction passenger elevator that operates at 350 feet per minute, and the other is a 5,000 lb. capacity geared traction service elevator that also travels at 350 feet per minute.

These elevators are not intended to be a primary means of travel within the building, but will instead serve handicapped users and provide a travel path for equipment within the facility. These elevators are located between the two northern-most wings of the USB.

TELECOMMUNICATIONS

The main telecommunication room is located in the basement of the University Sciences Building on the northern end of the building, right beside the underground mechanical room. Telephone and data systems are brought in from a nearby city communication manhole and distributed to each of the floors via a chase that runs from the basement communications closet to the 5th floor communications closet. Conduit size varies from 2” conduit with 20 cables (in the basement) to 1” conduit with 6 cables (on the 5th floor). All distribution panels are required to have 1200mm x 2400mm x 19mm fire rated plywood backing.