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Technical Assignment 1

Construction Option

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Executive Summary

The following report details the new construction commercial high rise project and the construction techniques employed to build it. The exact project location and name is to be held confidential but it can be known that the project is located in a major US city. In this technical assignment the project schedule, cost, existing conditions, project delivery system, and information about the client will be presented.

Figure 1: Image courtesy of Hines

Client Information

The owner, Hines, is a privately owned real estate firm, specializing in developing and investing in various properties throughout the world. Hines has offices in 18 countries and has a presence in more than 100 cities. One of the main reasons for pursuing the project was because it is an investment for Hines. Hine's has experience in investing in projects in major cities such as this project and is confident that it is profitable and feasible. The main goal for Hines is to construct the project safely but also ensure quality for potential tenants. A rendering of the building is shown in Figure 1.

Project Delivery System

The project delivery system is a Construction Manager at risk with a Guaranteed Max Price contract. Hines has been actively pursuing the project for 10 years and once the project was awarded to Hines they hired the design/production architect Pei Cobb Freed & Partners to design the building. Lump sum contracts were then established between Pei Cobb Freed and Hines. Hines leased the land where the project will be built upon from Pacolet/Milliken for 100 years and was then awarded to Turner Construction Company. Turner had established lump sum contracts with the subcontractors and Pei Cobb Freed also established contract with the trade engineer firms. A project organizational chart can be seen in the following presentation.

Staffing

Sixteen major roles are filled by Turner personnel for this particular project. The office is located a block away from the project site and everyone works out of this office except the Project Executive Patrick Murray. Pat is the Project Executive on various projects and cannot always be onsite, The role of Project Manager is filled by Mike Nolan and the General Superintendent is Randy Brzenzinski. A BIM team has been place in the office which is led by Arthur D'Antonio. Each member of the team coordinated with the different trades of the project. An example is Chris Stafford, who is an MEP engineer and maintains relations with all MEP subcontractors and the MEP engineering firm Jaros, Baum, Bolles. A detailed staffing plan can be found in the presentation.

Existing Conditions

Once construction is completed the building will be the tallest in the vicinity at 450 feet with 29 floors above grade. All utility lines enter into the building from the north and south ends of the building. Due to the project sights location future deliveries will difficult because of the one way and one lane streets at the north and south ends of the site. The surrounding streets make the project sight very tight. Jersey barriers have been placed to separate the path from traffic patterns.

Project Schedule Summary

The GMP preparation for the project started on July 2 2012. With a start construction date of December 24th 2012 various milestones needed to be accomplished. An interesting portion of this project is the addition of a Metro tunnel connection to the existing tunnel. With this having the longest duration it was critical that this portion of construction started as soon as the excavation had reached the proper depth. Various milestones that the owner and the project team had set for themselves include the start of steel erection on December 5 2013, the construction start of the curtain wall on March 24 2014, topping out of the structure on May 19 2014, and substantial completion of March 3 2015.

Building Systems

As seen in Figure 2 the project includes a mix of systems. No demolition was required by Turner as the project site was a flat lot when they were awarded the project. The structural steel supports the concrete core for the building and beams range in a variety of sizes.

Yes	No	Scope of Work
	X	Demolition Required
X		Structural Steel Frame
X		Cast in Place Concrete
	X	Precast Concrete
X		Mechanical System
X		Electrical System
	X	Masonry
X		Curtain Wall
X		Support of Excavation

Figure 2: Systems Summary

- Beams throughout the floors range from W12x14 to W40x593
- 6" and 9" NWC slabs
- WWF (6x6 –W2.9xW2.9) and #4 Rebar used depending on floor
- Cast in place concrete core
- Core contains nine elevators, mechanical, telecom, and electrical rooms
- Core poured using pneumatic formwork system

Figure 3: Image Courtesy of Turner

With this being the second building in this major city using a concrete core, the safe construction of this system was of high priority. This hydraulic system is an efficient system used more regularly in high rise construction as it allows the working deck to rise with the system resulting in lower construction costs. A photo of this formwork system can be seen in Figure 3

The mechanical system utilizes seven condenser boilers to provide heating and cooling to the building. Three chillers can be found on top of the roof with a space for an additional chiller in the future. Along with this a combined heat and power system is used a secondary circuit which uses three 65 kW micro turbines. These turbines can be found in the mechanical penthouse and are sized to handle the base load of the building. A still water retention tank is installed on the roof which collects rain water and stores it in case a loss of power. It is also used to prevent water directly discharging into the sewer during heavy storms.

A complex electrical system is used for the building using three transformers provided by Con Edison which are located in Lower Level 1. There is also space for an additional transformer in the future. These transformers are responsible for stepping down the power to a 265/460V. A diesel generator at 750 kW 3 phase 4 wires is also found in the mechanical penthouse. This is a backup system if there is a loss of power.

The entire exterior of the building consists of high vision glass with low iron IGU and a low E coating. A flatter portion of 1 ¼" and a curved glass at a size of 1 ¾" is used. There are mullions made of aluminum and the wall is considered as a canopy type structure. The curtain wall is installed using various types of brackets depending on the location of the glass and is attached to steel from the structural slabs. The interior portion of the wall has a combination of insulation, vapor barrier, firesafing, and a smoke seal. During construction a monorail is used on the sides of the building which raises the panel and places it.

Figure 4: Image Courtesy of Turner

A depth a 34 ft was dug for the excavation portion of the project. The support system is a concrete tangent wall with grout columns drilled and this support system was very critical as the site is surrounded by existing streets. During this phase a temporary dewatering system was used. Figure 4 shows this support

Figure 5 below shows a summary table of the cost evaluation. There are a few discrepancies between Turner's estimate and bid prices compared to my own square foot estimate. The excavation and foundation estimate was significantly lower than the actual estimate of Turners because RS Means only counted for a standard substructure. This can be due to the fact that the building uses high end systems and it seems that no item would be considered cost prohibitive. Also, estimating references do not carry square foot estimate data for a high rise with this amount of stories due to their high variability in price. The total project was approximately $398.72 per square foot with the most expensive system being the curtain wall followed by the electrical and mechanical systems

The project is on track to achieve a LEED Gold Certification upon completion. Green walls and a green roof along with the water retention tank and hydraulic formwork system contribute to achieving this certification.

Building System	System Total (Turner)	System Total (SF Estimate)	$/SF (Turner)	Percent of Total	$/Sf (SF Estimate)	Percent of Total2
Excavation and Foundations	$ 12,292,510.00	$ 3,516,000.00	$ 28.43	7.13%	$ 8.36	4.35%
Superstructure Concrete	$ 19,457,000.00	$ 16,492,500.00	$ 45.01	11.29%	$ 38.67	20.40%
Curtain Wall/Storefront Panels	$ 26,154,000.00	$ 16,560,000.00	$ 60.50	15.17%	$ 38.62	20.50%
Roofing and Waterproofing	$ 1,296,000.00	$ 521,000.00	$ 3.00	0.75%	$ 1.28	0.64%
Electrical	$ 22,276,380.00	$ 12,291,500.00	$ 51.53	12.92%	$ 28.84	15.20%
HVAC	$ 21,009,090.00	$ 10,638,500.00	$ 48.60	12.19%	$ 24.91	13.20%
Equipment/Hoisting	$ 5,042,000.00	$ 3,678,000.00	$ 11.66	2.93%	$ 8.61	4.55%
Plumbing	$ 4,833,000.00	$ 2,534,500.00	$ 11.18	2.80%	$ 5.93	3.13%
Construction Cost	$ 162,803,910.00	$ 80,855,000.00	$ 379.74		$ 189.54	
Total Project Cost	$ 208,000,000.00	$ 107,132,000.00	$ 398.72		$ 251.14	

Figure 5: Project SF Estimate Summary