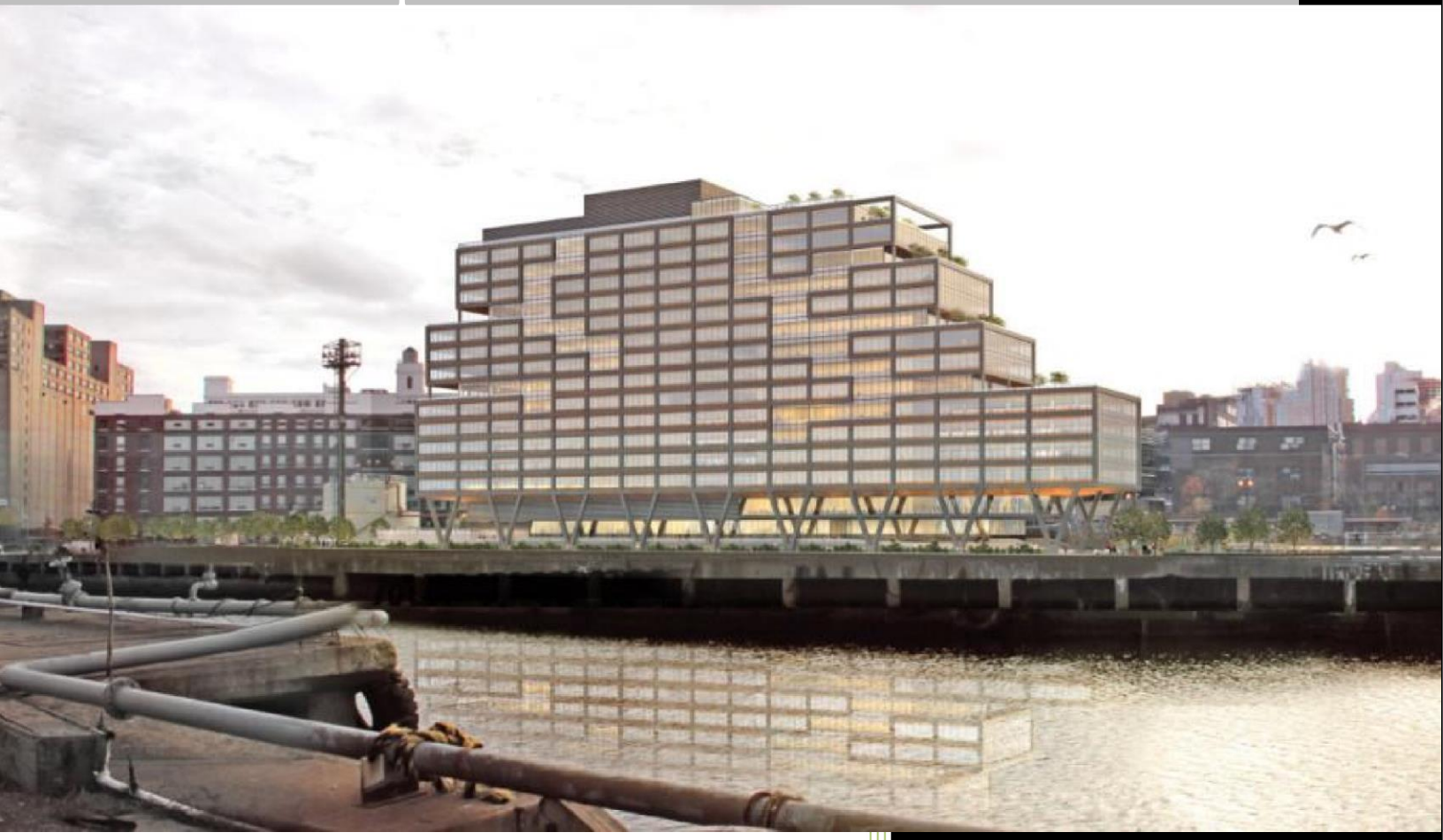
Trinity Plaza _ Building 52

MID-ATLANTIC REGION, U.S.A.

2015

Technical Report 1



Nicholas F. Boccia| 16 September 2015Construction Management

Advisor: Dr.Leicht

Executive Summary

Breaking ground in October 2015, Trinity Plaza-Building 52 is an ongoing construction project located in the Mid-Atlantic Region of the United States. The purpose of this report is to analyze and reflect on a construction project from start until building turnover. The report will focus on in depth studies and analyzing the conditions under which the building is constructed as well as the preliminary scope of work. Throughout the entirety of the project, the AE Senior Capstone Thesis study will focus on a wide range of information including, client goals and expectations, project delivery system, project schedule and budget, general contractor staffing plan, existing conditions, and major building system designs.

Trinity Plaza-Building 52 is a 675,000 square foot commercial office building. It is the first ground-up building focused on the growth of the job marketplace. This building will be an impressive 264 ft, 16-story structure, becoming the tallest out of the 5 buildings. Located in an urban industrial center, the building will offer 525,000 SF of commercial use, 100,000 SF of retail space, and 50,000 SF of usable roof space. The building consists of high ceilings, large open spaces, eight-foot windows, state-of-the-art wiring and HVAC systems, tenant controlled A/C, Di-BOSS building management system, and amenities like outdoor terraces, green areas, basketball court, cafeteria, bike valet, roof conference center and health and wellness facilities.

Construction management holds a great responsibility when it comes to building the project on time, within budget and safely. Logistical issues tend to result in the design as well as the construction process which impacts one or all of the areas above. To avoid these project constraints, it is important to have a dedicated team of engineers, architects, and contractors that will solve these problems throughout the job. As a team their overall goal is to offer an efficient, smooth, and successful construction process. Along with providing a successful construction process, a major goal of the project constituents is to achieve LEED silver certification under the LEED Green Building Rating System for New Construction. The engineers, architects, and contractors all work together to offer a variety of methods which ultimately offer energy efficient building systems as well as sustainable construction practices.

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Project Analysis

Client Information

Boston Properties Inc. and Rudin Development are backing a new development project in the Mid-Atlantic Region for an undisclosed client. Trinity Plaza- Building 52 will be one of the largest commercial buildings in the market as well as one of the largest concentrations of startups and small businesses in the region. This project will be developed under an agreement between the developers and the corporation that requested to remain undisclosed. The developers will hold a 10% equity stake in the new project. The development agreement requires tenants to pay a "living wage" and hire local residents. The objective of this project is to put thousands of locals to work and help launch the next great wave of home-grown innovation. Construction of the LEED- certified building is located on a land parcel that pokes out into an open body of water. Due to the potential market growth and the urban industrial area that the project site is located, played a major role in the development of Trinity plaza. The potential for growth in the workforce as well as profitability margins is one of the major influences towards the owner's decision to go forth and build.

Prior to the construction of the project, the owner always has the highest expectations as well as concerns. The concerns for this project are of course, logistics, scheduling, budget and safety. Since the project is located on the water, the foundation is one of the most important parts to building a safe and sustainable building. If the site logistics don't meet the needs for the project design then the project schedule and budget can be in danger. Due to limited site layout areas it will be important to offer a variety of options for materials to be delivered to the project and allow for safe building practices. Since site logistics are an important factor to the start of a successful construction progress, the schedule will account for weather conditions and offer prefabricated parts of the structure that can be delivered on a barge and installed immediately. This will allow for the building to get closer to the watertight enclosure prior to the harsh cold weather conditions. As for change orders, the owner agreed to have $1-million-dollar contingency to be given to the general contractors in order to stay within budget as well as on schedule. Throughout all this, safety is the most important to the owner but the site logistics for this project will either cost or save the owner money depending on how effectively materials are delivered and installed. The owner wanted to work with the general contractor to offer multiple site plans prior to the construction. The reason behind this agreement is if future problems occur they have alternatives to lean on.

Figure 1: Project Set of Expectations

Project Delivery System

The delivery system for this project is Design-Bid-Build, which involves three sequential project phases. These design phases are design, procurement, and construction. The design phase will require services from the designer, when the contractor is procured; and build phase, when the project is built by the General Contractor. This leaves the owner and the developer to control costs from the joint venture established. Therefore, the general contractor provides a sealed bid which holds a Guaranteed Maximum Price (GMP) with the owner. Figure 2 defines the project organizational chart which correlates the Owner/developer with the designers and the General Contractor. The General Contractor was chosen through a competitive bid method in which their proposal for budget, scheduling, and experience with projects built on the water exceeded the expectations from the owner. The General contractor is responsible for hiring sub-contractors. The method allows sub-contractors to bid on the project by providing sealed bids that include GMP's for the scope of work. From here, the GC will hire the most competitive sub-contractors in which they feel meet the criteria of the job. All parties including the designers will work together throughout the project having meetings to communicate opportunities for the project's success.

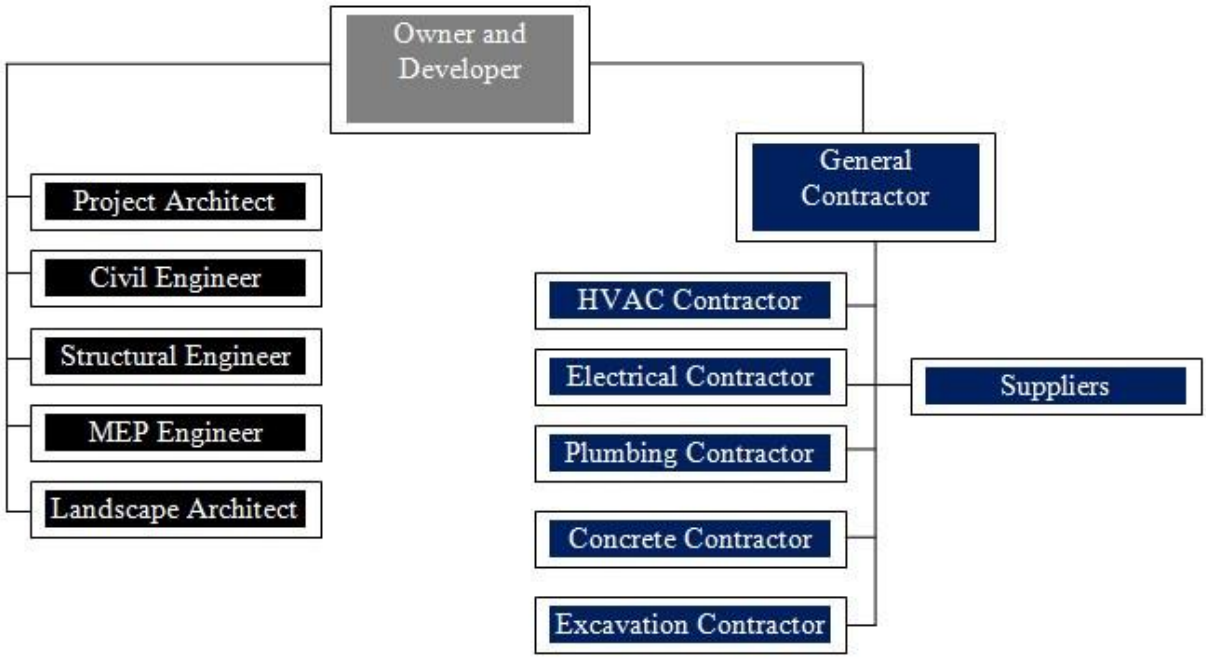


Figure 2: Project Organizational Chart

Staffing Plan

The project staffing plan consists of a corporate team that works together with the Preconstruction team as well as the construction team. The corporate members are critical to the organizational structure to successfully achieve goals outlined by the project team. To maintain continuity of the management of the project, the Project Executive and Project Manager will be an intricately working team, familiar with one management system and able to work together as one. The Project Manager will be the onsite extension of the Project Executive, responsible for the day-to-day management of the project success. The project superintendent and Project engineer will work together with the Project Manager to assure coordination and project buildouts are constructed successfully.

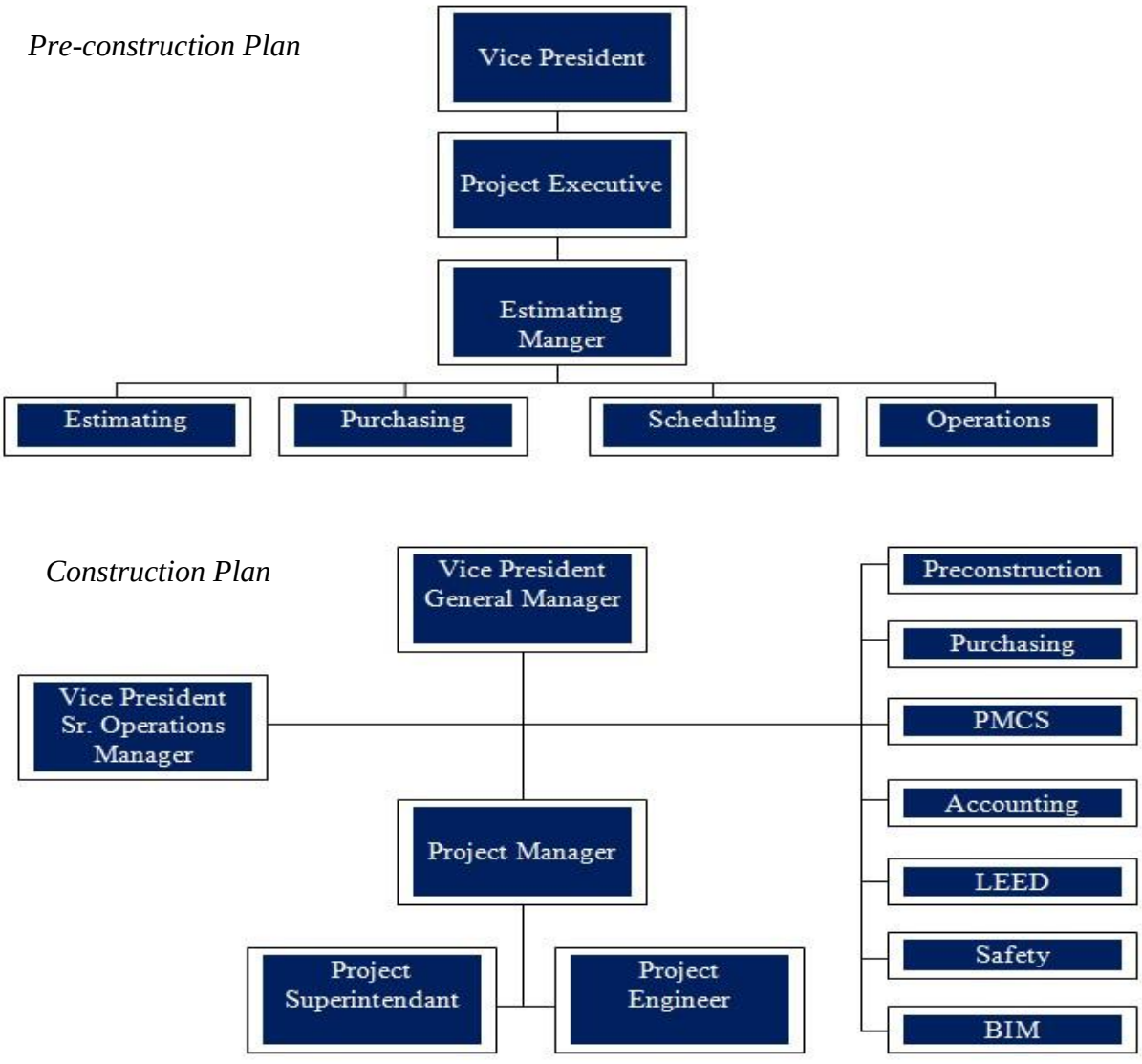


Figure 3: Project Preconstruction/Construction Plan

Existing Conditions

Existing Conditions play are key factor when planning a project. Some of the existing conditions for Trinity plaza are the limited amount of site space that can be utilized. The site is centrally located within the yard on a 60,000 square-foot strip poking out into the open water. The project team will focus on the sediment and erosion planning in coordination with the geotechnical report. During the excavation process sump pumps will be used to minimize the amount of water that they will run into when digging into the ground. The first layer of stones will be applied and compressed using mechanical operated compressors. The reason for this is that water typically penetrates from the underground soil easily.

Project Budget

This project was estimated using a square foot estimate with values from the RS Means book. This building was defined as an office building which may alter the overall cost compared to the pre-construction estimates established by the General Contractor. Although the square foot estimates were lower than the actual cost, this is subject to different costs per square foot.

RS Means Cost: $271.3 Million
Budgeted Cost: $276.5 Million
Actual Cost: $275.4 Million

Location, materials, and additional specialty items can drive the cost per square foot up. Although this is a rough estimate, it shows that the materials being used as well as the location of the project impact the overall cost of the construction process. It is important that close studies of all these conditions are examined and observed so that the price of the project is accurate which ultimately offers the General Contractor increased profitability margins as well as owner's satisfaction.

Project Schedule

The project began in May 2015 and completion of the project is estimated to be in May 2017. This project will take about 2 years. This period excludes the design and preconstruction phase. Some of the major milestones will include steel piles, footings and foundation slab on grade pouring. These milestones are crucial because they are the most important components prior to steel erection of the structure. Finish sequences also will occur throughout the year until the building is watertight. (For more details please refer to appendix A)

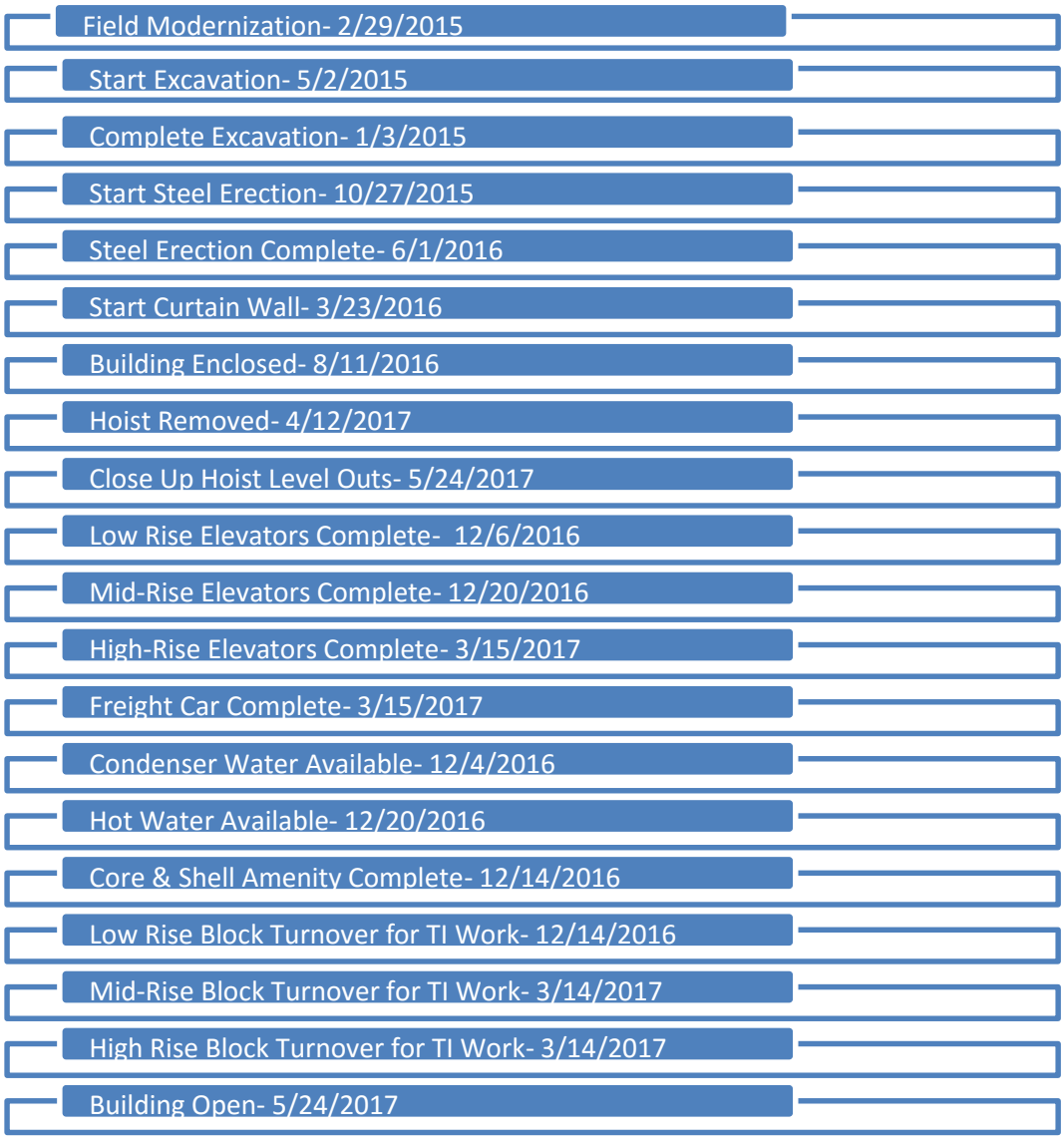


Figure 4: Project Construction Schedule

Building Systems

Structural System

The foundation consists of 18" steel pipes that will be piled into the ground. 79"x79"x49" V-Column pile caps will be laid on top of the steel piles along with a 4' square footing. Finally an 18" concrete slab will be poured to support the structure of the building. Overall the buildings structural system is supported by SOG foundation, grade beams, structural piles, and footings accompanied by a backfill of crushed concrete. The structure above grade will consist of W14 wide flanged columns that will span several stories. The columns range from W14x43 to W14x665. Between the spans of the columns are girders and wide flanged beams to support each floor and slab. These beams and girders vary in a range from W24-W76. The entire buildings structural system will be supported by a steel frame. The steel frame will consist of concentrically W12x65 braced frames that resist lateral loads through a vertical concentric truss system. The axes of these members will align at the joints of the structure.

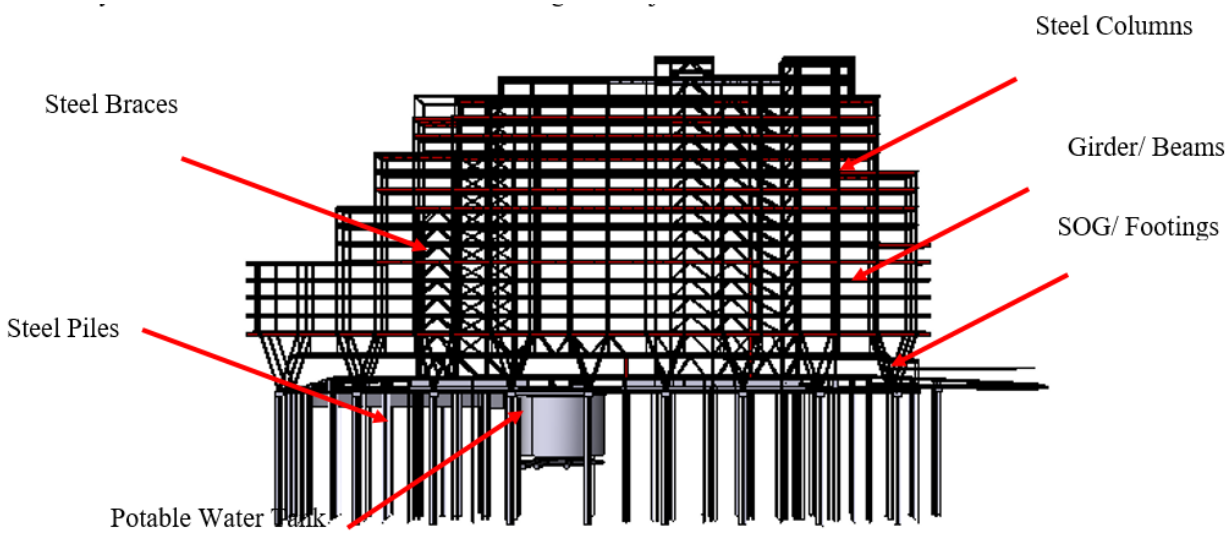


Figure 5: Project Structural System

Mechanical System

The major mechanical system in the building consists of 31 self-contained air handling units that have roughly 2 units per floor. Each of the units are located in the center interior core of the building The Units are broken down into ACU-A,B,C,D,E,F. The supply airflow of these units vary in a range from 14,000 CFM- 41,000 CFM. These units will individually supply the east and west sides of the building. Three cooling towers are located on the rooftop- penthouse area along with boilers and condenser pumps. VAV control boxes will be used to serve amenity spaces. The commercial spaces will be composed of glycol and electric unit heaters.

Electrical System

Electrical power provided throughout the building will be composed of two 13.8 kV feeders located in two manholes. These manholes have access doors that are located on the east side of the buildings property line. These utility connections feed 4 main switchboards at 4,000 Amp, 3 phase, 4 wire feed. These switchboards are located on the east side of the 2nd floor along with a 500 kW emergency generator and a 15 kV switchgear. The switchgear controls, protects and isolates the electrical equipment. For each transformer that supply a panel with an isolated ground bus will have an isolated ground conductor in each conduit of the secondary feeder.

Glazed Aluminum Curtain wall

The façade of this building is limited with the amount of materials used. The curtain wall system consists of framing with internal reinforcing as needed. Metal panels and louvers are used as well and will be painted with primer finishes. The curtain wall system is thermally broken from the interior in order to tolerate both vertical and lateral motion. The framing system will accommodate egress door, terrace doors, and aluminum composite panel system. The ACM panels will be placed on an aluminum sub frame that will be mounted to the curtain wall unit.

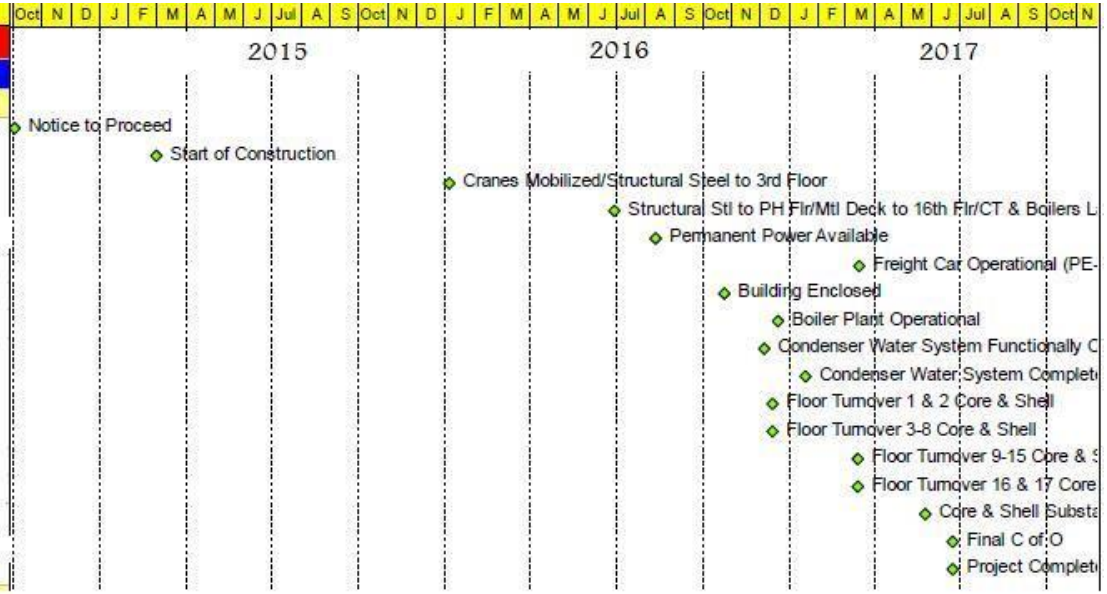
ACM Panel System

These panels consist of punched windows that allow for vertical load carrying elements at the jambs of the windows and horizontal members, which can be connected to the jamb members. The overall objective of this system is to provide lateral resistance for horizontal loads. It is important to note the limited amount of structural connections between adjacent and horizontal panels in this design because the panels are used as a lateral-force-resisting system. From this the design stresses will be limited so that the vertical stacks of panels can act independently, which ultimately limits the temperature performance effects.

APPENDIX A

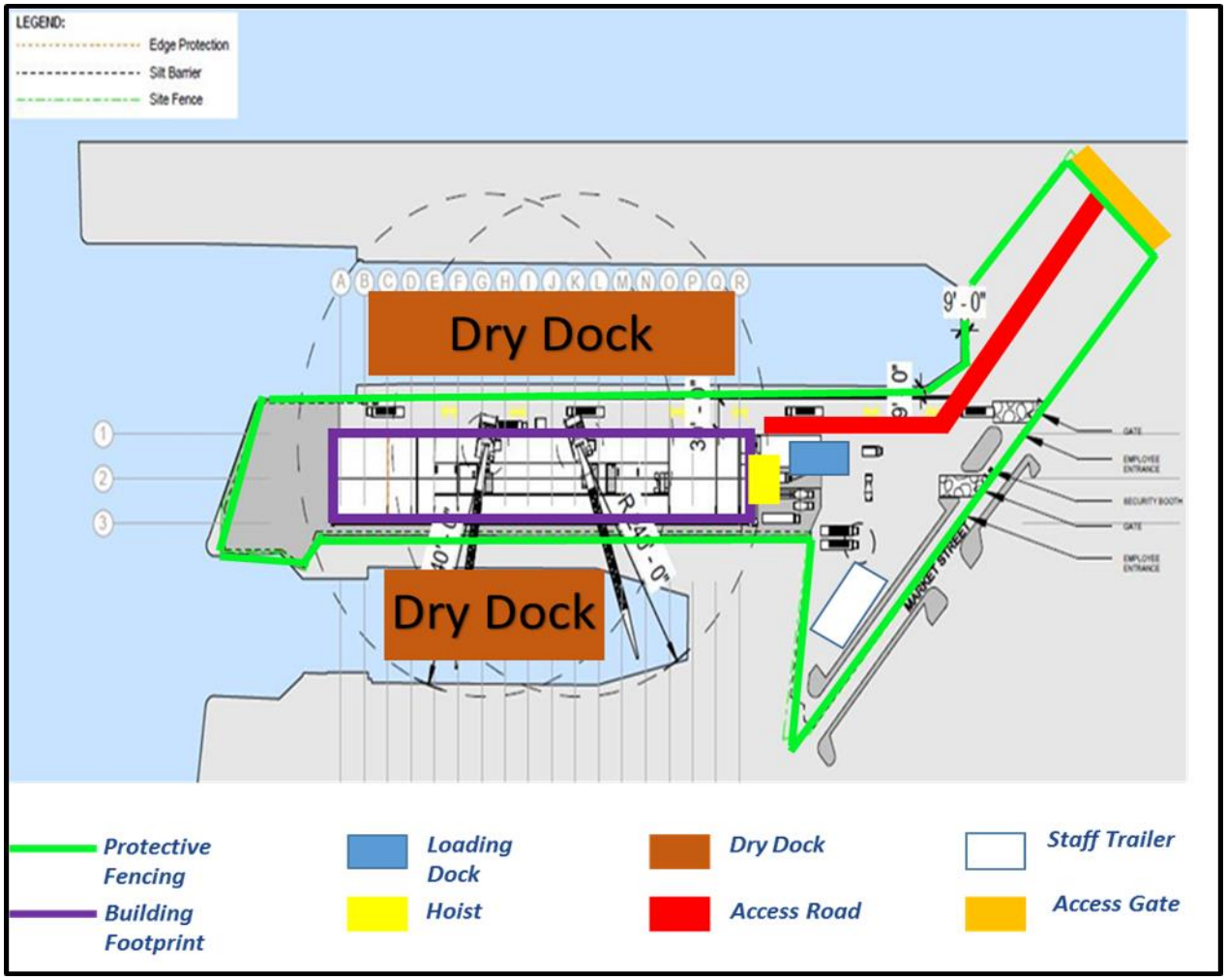
Project Schedule Summary

		Duration
Building 72		
EARLY CONSTRUCTION		
MILESTONES		
M001	Notice to Proceed	0
M005	Start of Construction	0
M015	Cranes Mobilized/Structural Steel to 3rd Floor	0
M025	Structural Stl to PH Flr/Mtl Deck to 16th Flr/CT & Boilers Landing	0
M030	Permanent Power Available	0
M035	Freight Car Operational (PE-7)	0
M045	Building Enclosed	0
M055	Boiler Plant Operational	0
M065	Condenser Water System Functionally Operational	0
M075	Condenser Water System Completed	0
M095	Floor Turnover 1 & 2 Core & Shell	0
M105	Floor Turnover 3-8 Core & Shell	0
M115	Floor Turnover 9-15 Core & Shell	0
M125	Floor Turnover 16 & 17 Core & Shell	0
M135	Core & Shell Substantial Completion/TCO	0
M150	Final C of O	0
M160	Project Complete	0



APPENDIX B

Project Site Logistics Summary


LEGEND:
Edge Protection
Silt Barrier
Site Fence
Dry Dock
Dry Dock
9' - 0"
MARKET STREET
GATE
EMPLOYEE ENTRANCE
SECURITY BOOTH
GATE
EMPLOYEE ENTRANCE
Protective Fencing
Building Footprint
Loading Dock
Hoist
Dry Dock
Access Road
Staff Trailer
Access Gate

APPENDIX C

Project Budget Summary

	OVERALL SYSTEM TOTALS	604,028 $/GSF
FOUNDATION	$13,666,000	$22.62
STRUCTURAL FRAME	$44,696,500	$74.00
ROOFING & WATERPROOFING	$5,947,100	$9.85
EXTERIOR WALL	$45,946,900	$76.07
INTERIOR PARTITIONS & FINISHES	$18,797,724	$31.12
SPECIALTIES	$1,038,100	$1.72
FURNISHINGS & EQUIPMENT	$570,000	$0.94
VERTICAL TRANSPORTATION	$6,559,000	$10.86
PLUMBING	$7,070,600	$11.71
FIRE PROTECTION	$2,167,400	$3.59
HVAC	$22,950,560	$38.00
ELECTRICAL	$18,747,800	$31.04
DEMOLITION	$0	$0.00
SITEWORK	$8,891,840	$14.72
HOISTING & PROTECTION	$1,774,200	$2.94
SUBTOTAL: TRADE COST	$198,823,724	$329.16
SUBTOTAL: DIRECT WORK COST	$207,348,300	$343.28
TOTAL CONSTRUCTION COST	$246,397,800	$407.92

Building Parameters

Building Type: Commercial Office Space, 8-24 Story with Steel Structure

Location:
Stories: 16
Height: 264 FT
Floor Area: 675,000 SF
Labor Type: Standard Union
Data Release: 2014 Quarter 3

Cost Per SF: $401.94 **Actual Cost Per SF: $407.92**
Building Cost: $271,309,500 **Actual Building Cost: $275,346,000**

(Actual project building costs are located on Page 13 APPENDIX C)

APPENDIX D

Presentation Slides

Client Information

Owner
- *Anonymous*

Developer
- *Rudin*

Reason for Construction
- *Company Growth*
- *Job Market Growth*
- *Profit*

Expectations & Concerns
- *Site Logistics*
- *Schedule*
- *Safety*
- *Budget*

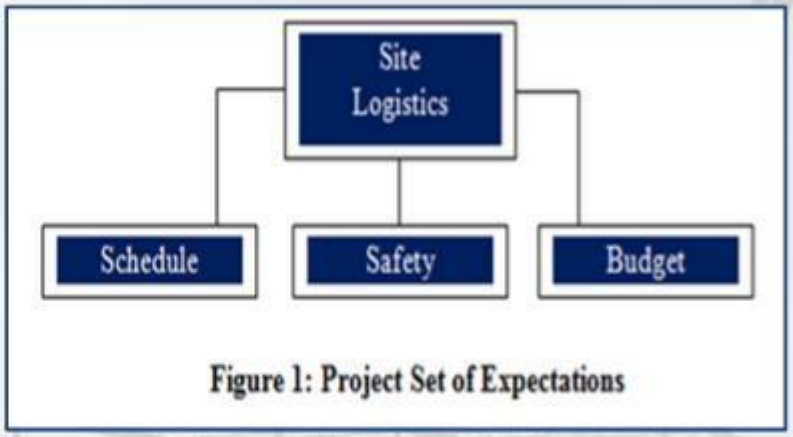


Figure 1: Project Set of Expectations

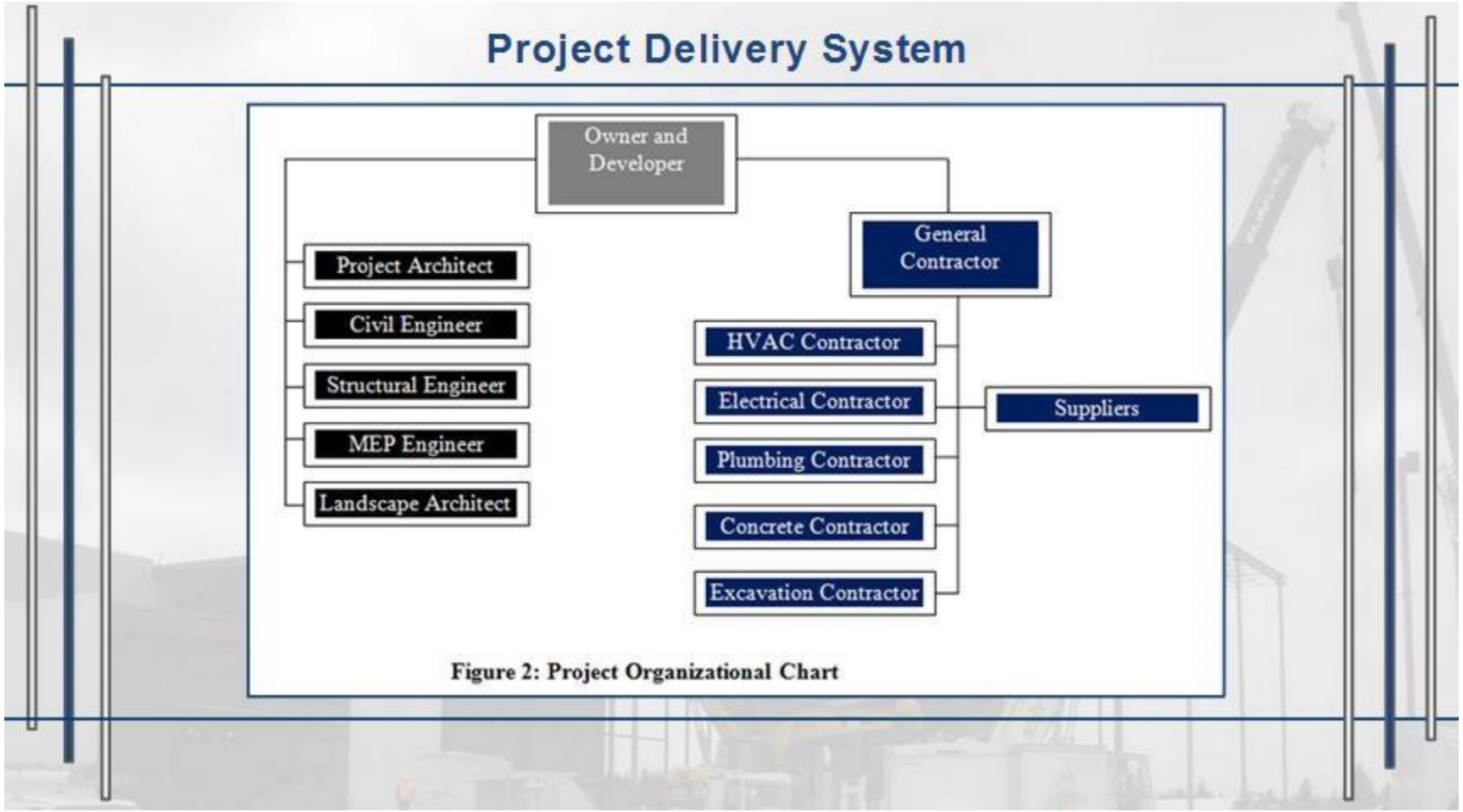


Figure 2: Project Organizational Chart

Staffing Plan

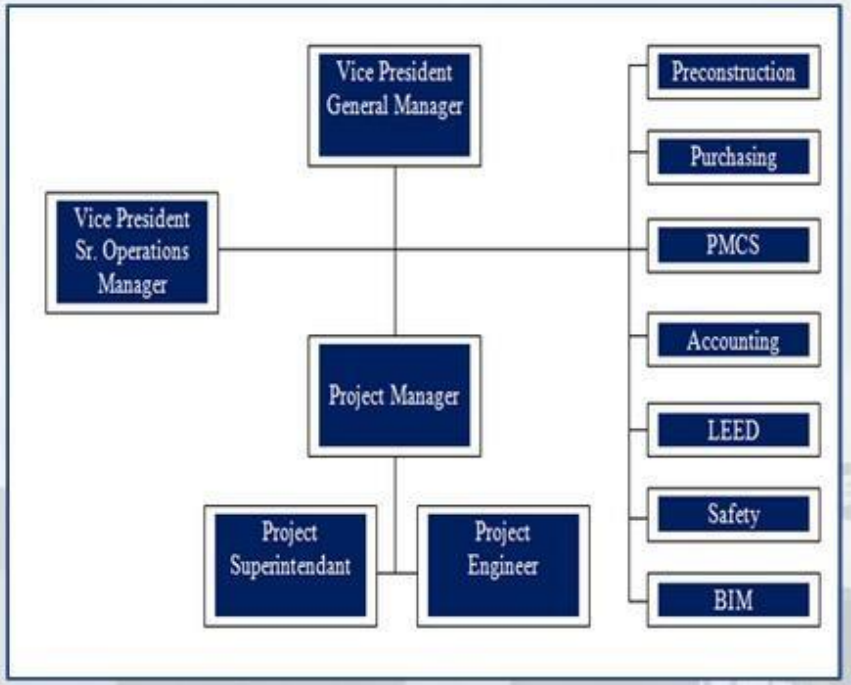


Figure 3A: Construction Staffing Plan

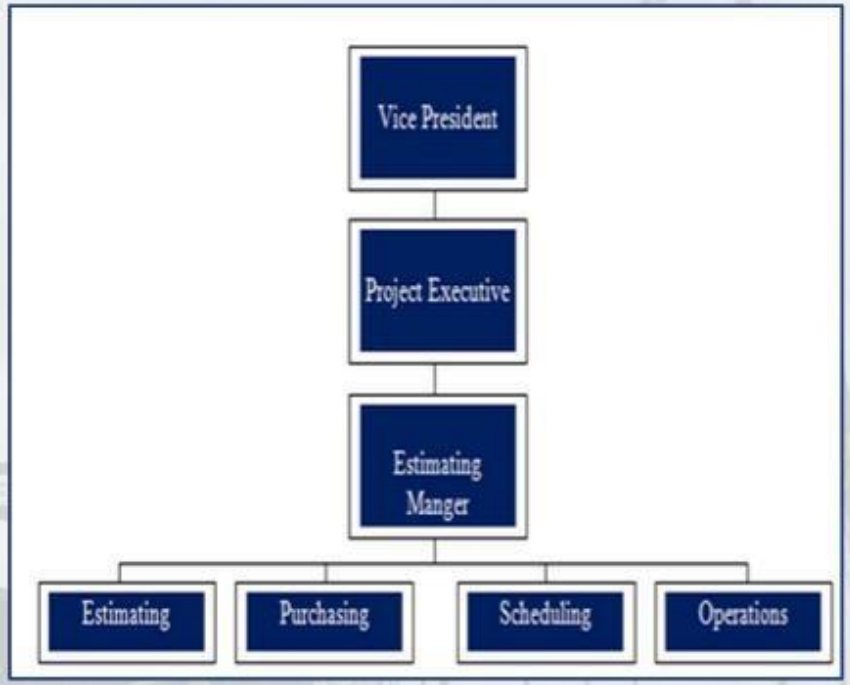


Figure 3B: Pre-Construction Staffing Plan

Project Schedule

EARLY CONSTRUCTION		
MILESTONES		
M001	Notice to Proceed	0
M005	Start of Construction	0
M015	Cranes Mobilized/Structural Steel to 3rd Floor	0
M025	Structural Stl to PH Flr/Mtl Deck to 16th Flr/CT & Boilers Landing	0
M030	Permanent Power Available	0
M035	Freight Car Operational (PE-7)	0
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M115	Floor Turnover 9-15 Core & Shell	0
M125	Floor Turnover 16 & 17 Core & Shell	0
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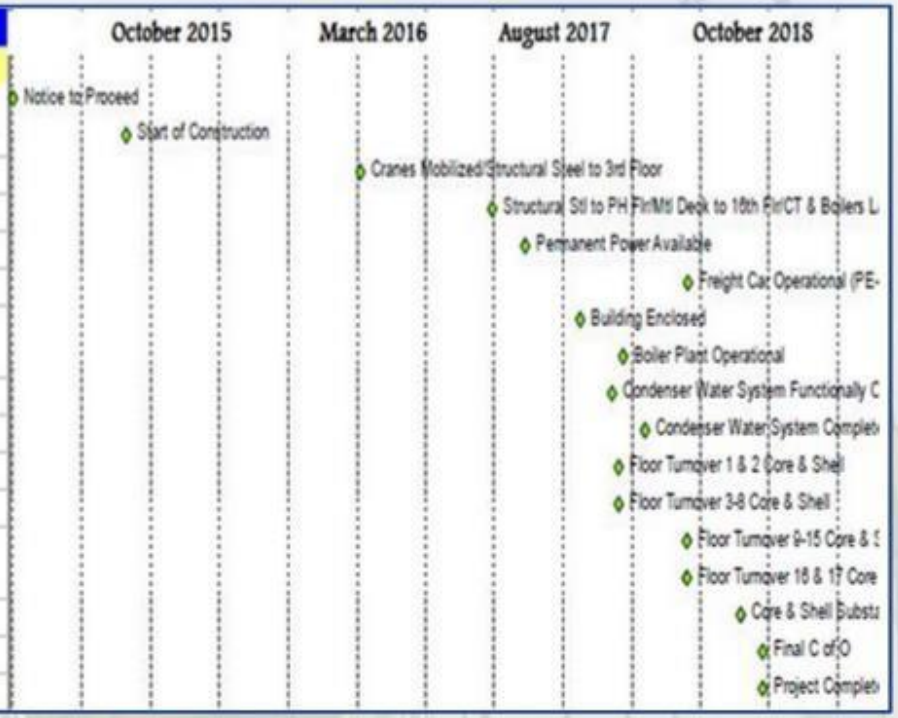
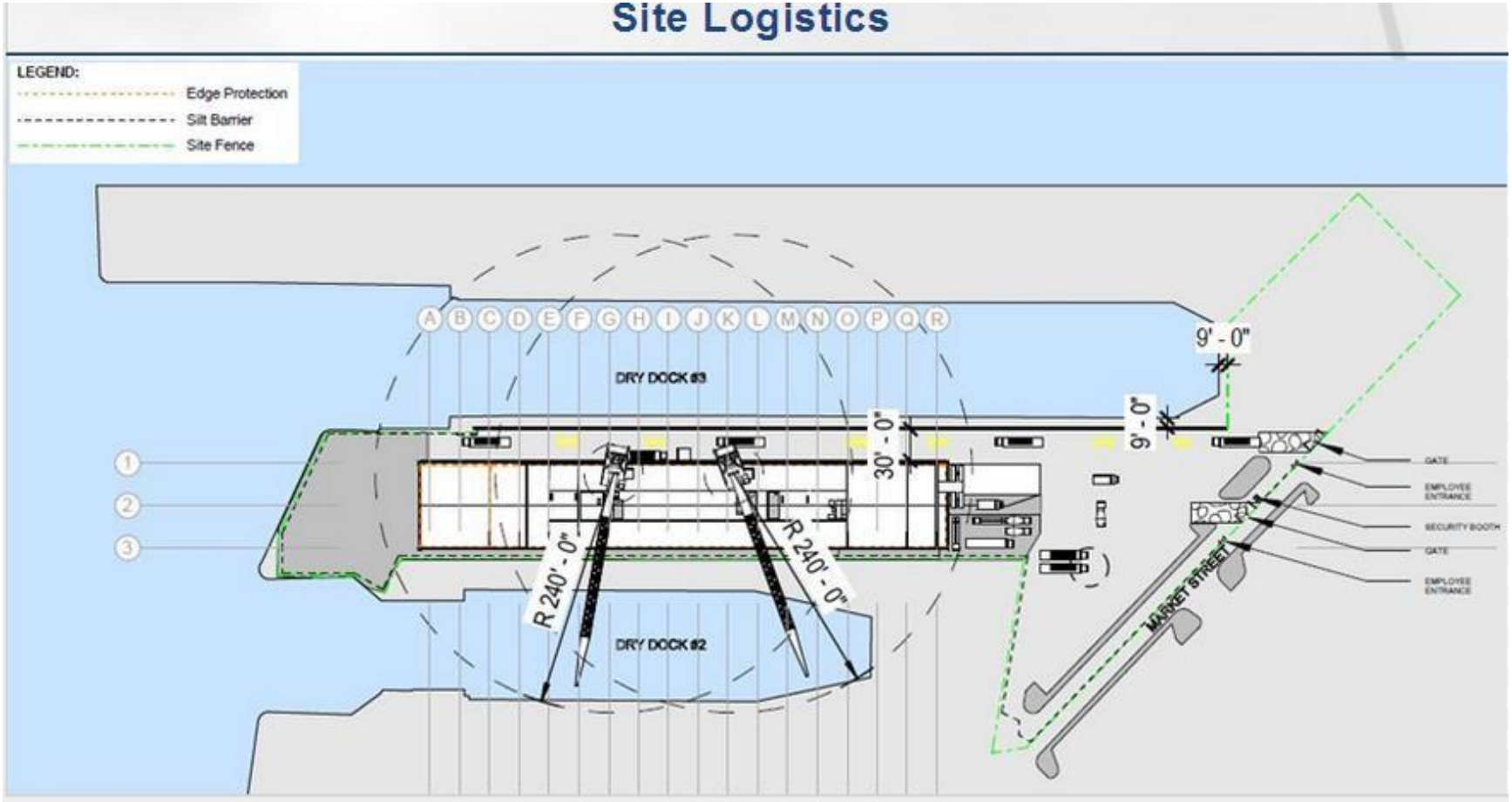


Figure 4: Project Schedule


Project Schedule Milestones
Field Modernization - 2/29/2015
Start Excavation - 5/2/2015
Complete Excavation - 1/3/2015
Start Steel Erection - 10/27/2015
Steel Erection Complete - 6/1/2016
Start Curtain Wall - 3/23/2016
Building Enclosed - 8/11/2016
Hoist Removed - 4/12/2017
Close Up Hoist Level Outs - 5/24/2017
Low Rise Elevators Complete - 12/6/2016
Mid-Rise Elevators Complete - 12/20/2016
High-Rise Elevators Complete - 3/15/2017
Freight Car Complete - 3/15/2017
Condenser Water Available - 12/4/2016
Hot Water Available - 12/20/2016
Core & Shell Amenity Complete - 12/14/2016
Low Rise Block Turnover for TI Work - 12/14/2016
Mid-Rise Block Turnover for TI Work - 3/14/2017
High Rise Block Turnover for TI Work - 3/14/2017
Building Open - 5/24/2017


Site Logistics
LEGEND:
Edge Protection
Silt Barrier
Site Fence
A B C D E F G H I J K L M N O P Q R
1
2
3
DRY DOCK #3
DRY DOCK #2
30' - 0"
9' - 0"
9' - 0"
R 240' - 0"
R 240' - 0"
MARKET STREET
GATE
EMPLOYEE ENTRANCE
SECURITY BOOTH
GATE
EMPLOYEE ENTRANCE

Project Cost Summary

- *Actual building cost per SF: $407.92*

- *Total construction cost: $275,346,000*

	OVERALL SYSTEM TOTALS	604,028 $/GSF
FOUNDATION	$13,666,000	$22.62
STRUCTURAL FRAME	$44,696,500	$74.00
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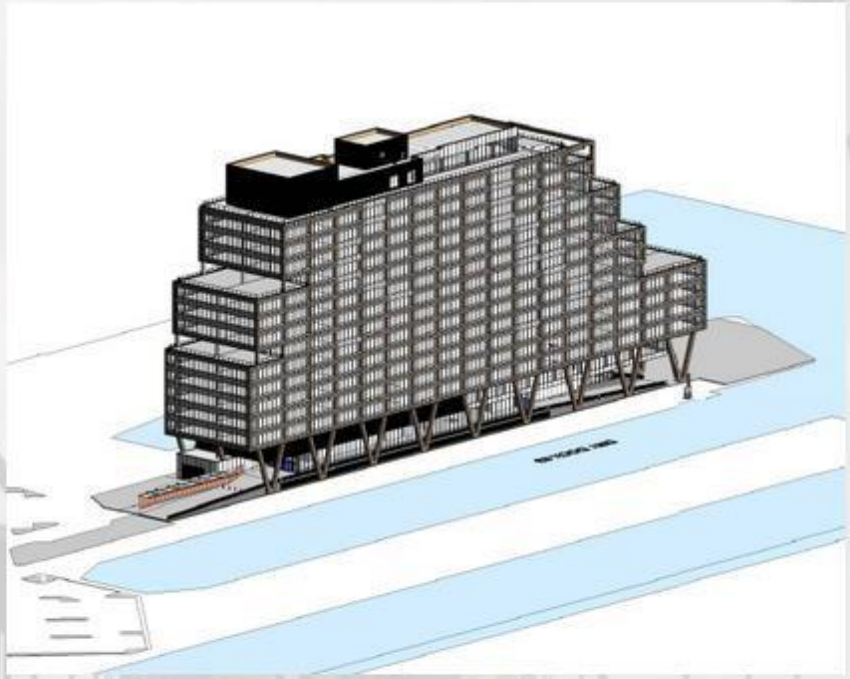
Building Systems Summary

Structural System

- *16 Story Steel Structure*
- *18" Steel Piles*
- *79"x79"x49" V-Column pile caps*
- *18" Foundation Slab*
- *W14 Wide Flange Columns*
- *Girders/ Wide Flanged beams in between the Columns*
- *Braced frame used to resist Lateral loads*



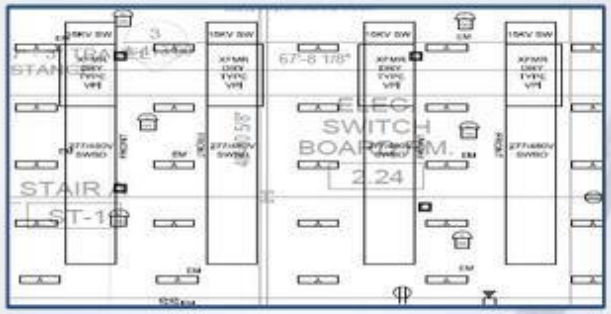
Building Systems Summary

Electrical System

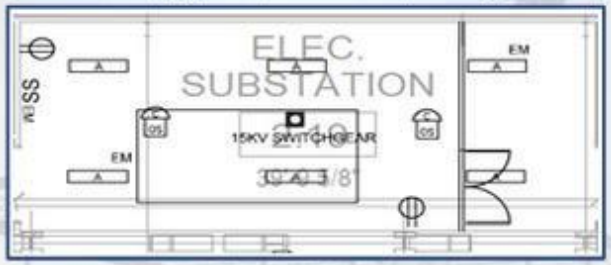
- *Two 13.8 kV Feeders serve as buildings power source*
- *Feeders are located in 2 man holes located on the east side of the buildings property line*
- *Utility serves 4 main switchboards:*

  Four 4000 Amp @ 277/480V 3 Phase, 4 Wire

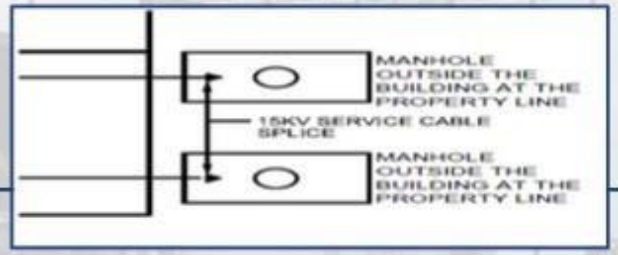
- *15kV Switchgear used to control, protect and isolate electrical equipment*



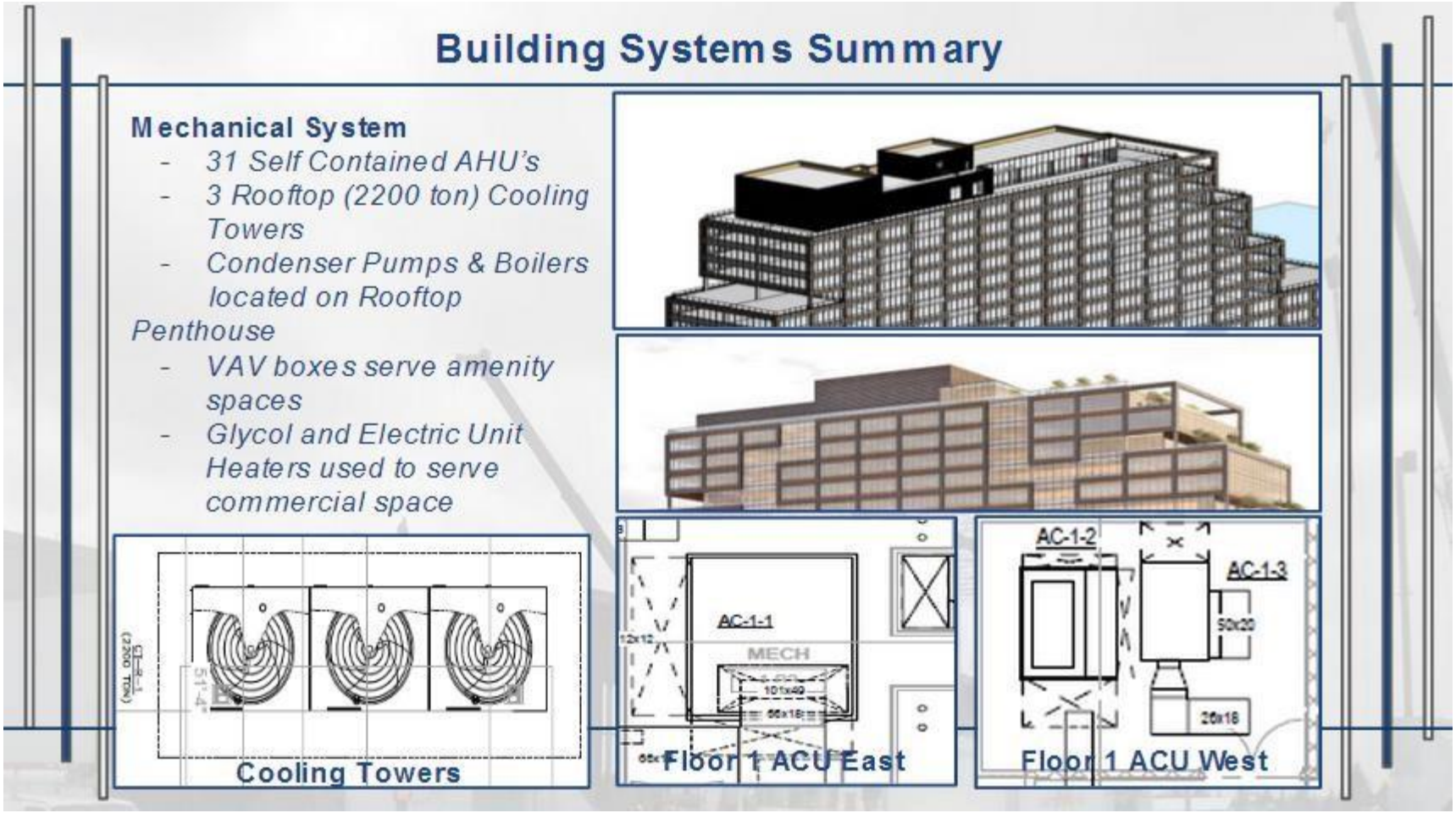
Floor 2
East Side



Floor 2
East side



Ground Level
East Exterior of
Building


Building Systems Summary
Mechanical System
- 31 Self Contained AHU's
- 3 Rooftop (2200 ton) Cooling Towers
- Condenser Pumps & Boilers located on Rooftop
Penthouse
- VAV boxes serve amenity spaces
- Glycol and Electric Unit Heaters used to serve commercial space
Cooling Towers
AC-1-1
MECH
Floor 1 ACU East
AC-1-2
AC-1-3
Floor 1 ACU West


Questions?
I would like to thank...
MiltonCheung Sr. Project Manager
Owner [Undisclosed]