Structural Existing Conditions Report

AC Hotel Philadelphia

Philadelphia, Pennsylvania

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Contents

Executive Summary

AC Hotel Philadelphia is a 15-story residential transient hotel (including penthouse) located in the heart of downtown Philadelphia. The corner of Florist and North 13th street marks the location originally occupied by NFL Films and Warner Brothers distribution center starting in 1947. Baywood Hotels plans to add a 12-story hotel with a penthouse on top of the original two-story structure, while still preserving the eastern, southern and part of the northern facade.

The original two-story (31') building is comprised of a masonry structure. In order to properly satisfy the proposed addition, a mat foundation of varying thickness will be installed and the building will be gutted and restructured with the bottom two floors composite steel, with a 12-story steel-frame structure atop, capped with a penthouse. Grade beams will be utilized in the foundation as well. Levels one and two vary in plan, then the building steps back 18ft due to historical requirements with the upper floors sharing a typical floor plan. Multiple 14" shear walls make up the lateral system until floor 3 where braced frames are utilized for economical reasons.

AC Hotel Philadelphia was designed using the 2009 edition of the International Building Code and ASCE 7-05 was used to determine lateral loads on the building. The City of Philadelphia Building Code with current amendments and the 2014 version of AC Hotels by Marriott Design Standards were also used as references. The Philadelphia Historical Commission also had influence on the project boundaries.

Purpose and Scope

This report is a detailed description of the structural systems and components that comprise the AC Hotel Marriott. Information discovered will serve as a basis for more technical assignments to come later in the semester. The scope of this project includes overall structural systems with an emphasis on structural components such as typical bays, foundation details, gravity and lateral systems, joint details and load determination. Materials and national codes will also be discussed.

Building Description

230 North 13th Street is a high-rise residential hotel located in downtown Philadelphia. This upper class hotel will provide 150 luxurious guest rooms, a private dining area solely for guests and underground valet parking accessible only by car elevator. There is also a rooftop penthouse with a small green roof along with green roofs on the second and third levels. The original two-story structure will be partially demolished and remodified in order to support the 192' superstructure. The building team and the Philadelphia Historical Commission came to an agreement that in order to historically preserve the existing facades, the building must step back 18ft on the southern and eastern sides.

Figure 1: Northeast Elevation (Courtesy Holbert Apple Associates)

SPG3 architects attempted to contrast the existing art deco facades (curved corners and large grid-windows) with a more modern-looking approach. They plan to achieve LEED Gold certification by including local materials, high-efficiency fixtures and several green roofs.

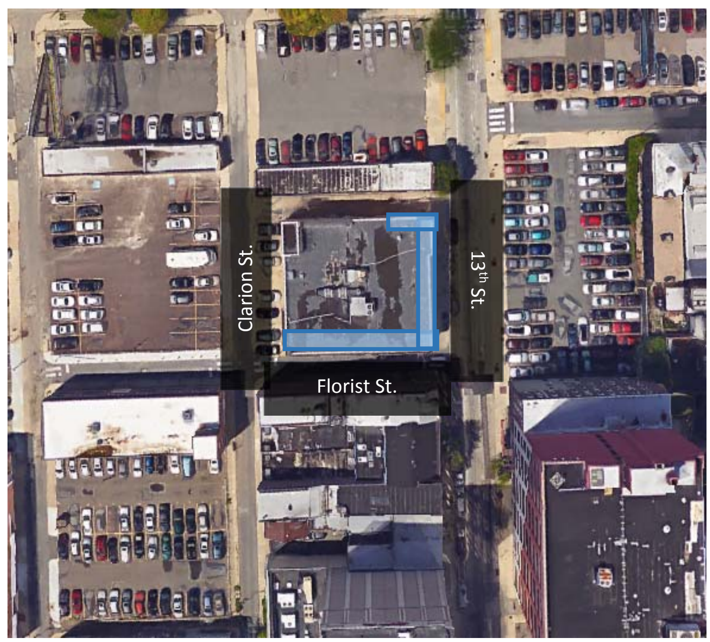


Figure 2: Existing exterior walls to remain after demolition (Courtesy Google Maps)

AC Marriott occupies 107,680 SF, with the typical floor occupying near 6,000SF. The lower three levels contain more buildable area. The bottom floor contains a lobby, café, lounge and a kitchen. The second floor is occupied by an indoor pool, meeting rooms and several guest rooms. Above this, the typical floor contains only guest rooms, and the penthouse has a fitness room, a green roof terrace and some of the mechanical equipment. The majority of the mechanical equipment is contained on the top level (mechanical penthouse).

Building Elevations

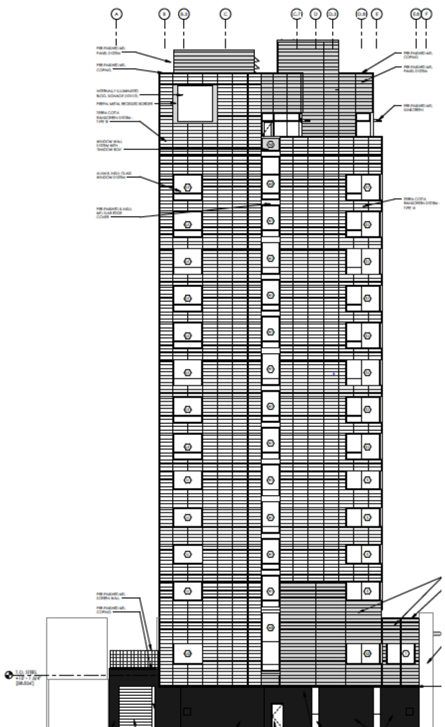


Figure 3: West Elevation

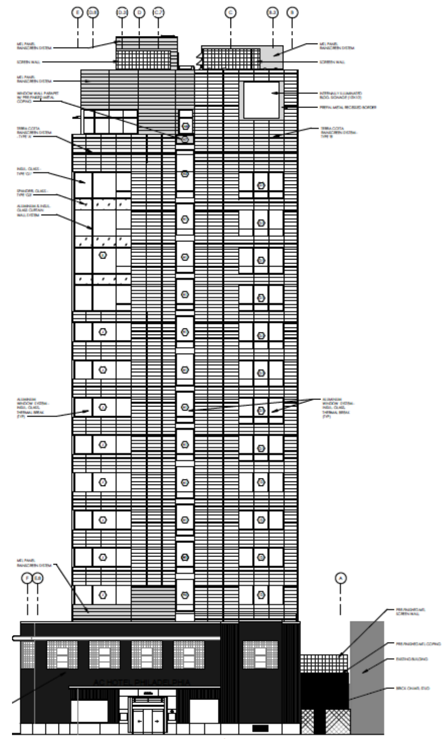


Figure 4: East Elevation

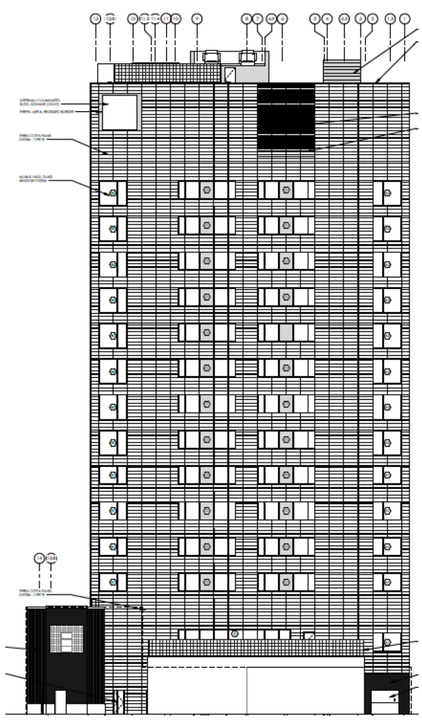


Figure 5: North Elevation

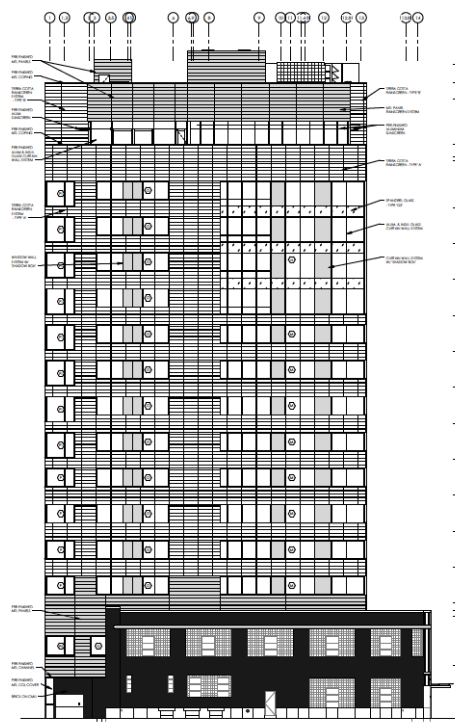


Figure 6: South Elevation

All Figures courtesy of Holbert Apple Associates

Design Codes and Standards

Relevant codes and standards used while designing AC Marriott Philadelphia are listed below:

- International Code Council
    - International Building Code 2009
    - Chapter 11 (IBC 2012) Accessibility Requirements
- American Society of Civil Engineers
    - ASCE 7-05
- AC Hotels By Marriott Design Standards 2014 edition
- AC Hotels By Marriott Module 14 FLS Design Standards January 2015 edition
- City of Philadelphia Building Code with Current Amendments

Gravity Loads

This section focuses on load determination used for the structural design of AC Marriott Philadelphia. Loads were determined using IBC 2009.

Dead Loads

Dead loads for AC Marriott Philadelphia can be found in the structural notes preceding the structural drawings. Listed below are the common dead loads used in design.

Table 1: Superimposed Dead Load Values

Superimposed Dead Loads (in addition to structure self-weight)	
Area	Loading [psf]
Typical Roof	30
Floors	10
Intensive Green Roof	200
Extensive Green Roof	60

Live Loads

Live Loads were determined using IBC-2009 and live loads on foundations, columns and beams are reducible in accordance with the IBC-2009, section 1607.9.

Table 2: Gravity Live Loads

Permissible Gravity Live Loads		
Area	Loading (psf)	Live Load Reduction Permitted
First Floor	100	Yes
Second Floor	100	Yes
Typical Floor	40+10 partitions	Yes
Loading Dock	250	No
Roof Live Load	30	No

Snow Loads

The ground snow load for Philadelphia, Pennsylvania is determined to be 25PSF. As for the flat-roof snow load, 20PSF is sufficient, however, unbalanced, drifting and sliding snow must be taken into account when applicable.

Lateral Loads

Wind Loads

Wind loads are determined using ASCE 7-05 chapter 6. Relevant wind load criteria is found in the table below.

Table 3: Wind Load Criterion

Criteria	Value
Basic Wind Speed (3 sec gust)	90 mph
Occupancy Category	II
Site Exposure Category	B
Wind Importance Factor (Iw)	1.0
Internal Pressure Coefficient (GCpi)	+0.18, -0.18
External Pressure Coefficient (GCp)	+0.88(windward), -0.50(leeward)

Seismic Loads

All though seismic design will not control over wind in Philadelphia, it is still proper engineering practice to exercise and determine seismic loads on the building. AC Marriott shall be designed for Seismic Design Category B.

Soil Loads

The soil loads on AC Marriott are the same as the geotechnical report determined which was performed by Whitestone Associates, Inc. The soil load was discovered to have a sliding resistance factor is 0.30. At rest condition, the soil has a net pressure of 70 PSF/ft of depth.

Foundation System

A geotechnical report for AC Marriott Philadelphia was conducted in spring 2015 by Whitestone Associates, Inc. The geotechnical engineer encountered split-spoon sampling refusal while acquiring test samples, therefore ripping tools may be required when attempting to penetrate subsurface obstructions. Based on the report, designers discovered that a reinforced mat foundation of varying depth (30"-42") would be most suitable and economical to distribute the building weight and loads. The mat foundation will sit 19ft above mean sea level and is designed to support a bearing pressure load of 5,000psf. Grade beams will be used to help distribute the loads from the foundation walls to the mat foundation. In order to successfully install the mat foundation, temporary shoring and bracing will be required since new excavation extends beyond site boundaries. Furthermore, the existing garage and three-story building to the north of the site will need to be underpinned to ensure proper support during construction.

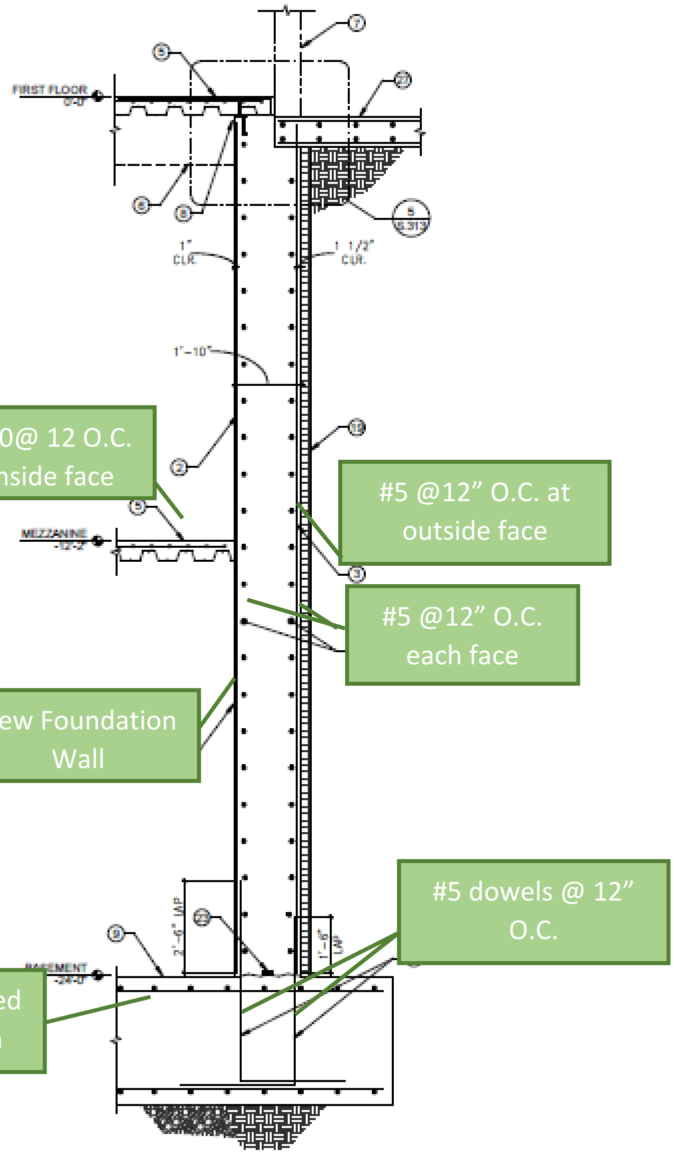


Figure 7: Foundation Wall Section Cut

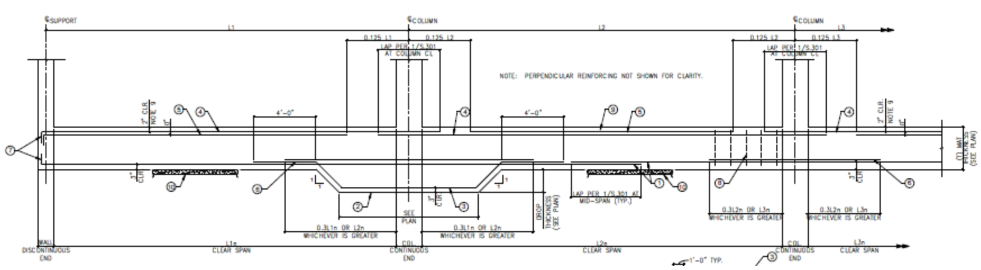


Figure 8: Typical Mat Foundation Reinforcing

Structural Framing System

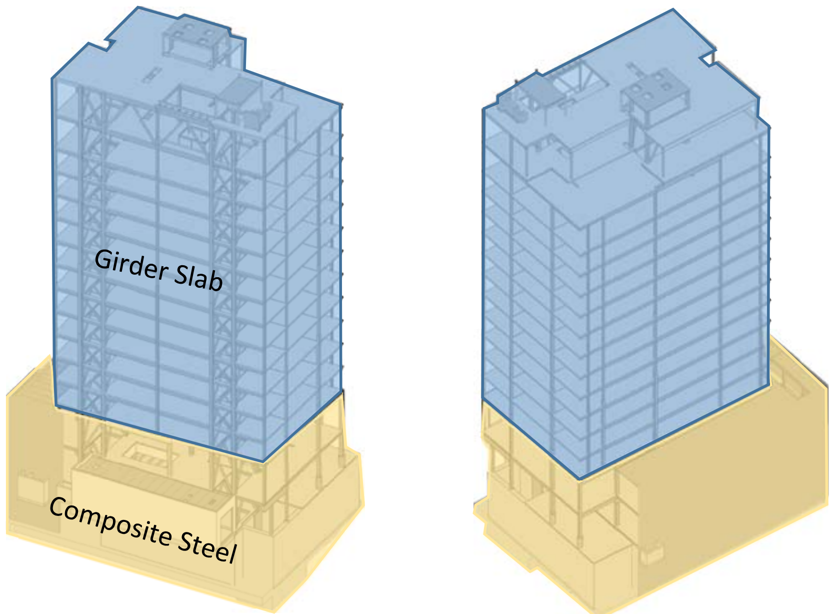


Figure 9: Structural skeleton of AC Marriott Philadelphia

The existing building is supported by exterior concrete foundation walls which sit on strip footings, interior concrete columns and a ground-supported concrete slab at the basement level. Partial demolition will take place to allow for the construction of AC Marriott Philadelphia. Underpinning will be needed for the one-story garage to the north and for a portion of the three-story building to the north. The AC Marriott Philadelphia building will be supported on a varying 30”-42” mat foundation, with a 10” slab on grade and some micropiles needed to support existing structures on the northern side. Continuous grade beams will be used to support the foundation walls. Extra steel columns will complement the concrete columns at the basement level to support the entire building load. At the base, a mix of concrete (30”x30” typ.) and steel columns (W10 and W14 typ.) are used. Starting at the first floor, steel columns (W10 and W14 typ.) are used. As elevation increases, column weight/foot decreases, however, column sizes remain the same from top to bottom to minimize connection detail. Laterally, multiple 14” shear walls are utilized up to level three, with brace frames

(HSS8x8 and HSS6x6) on the upper floors. Brace frames are primarily utilized around the stair towers located on the northern façade and the centralized elevator shaft.

Shown below is a section cut through the typical girder slab. This configuration allows precast hollow core planks to sit directly on the bottom flange, and protrude past the top flange, concealing the beam completely. Proper inspection requires 2’ width openings (minimum) at 24” O.C. in order to place #4 transverse rebar. Once all rebar is placed, openings are backfilled with grout.

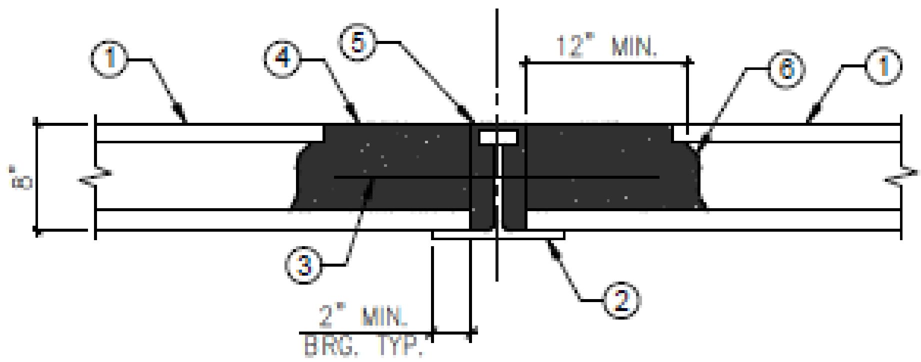


Figure 10: Typical Girder Slab Beam Section-Reinforced

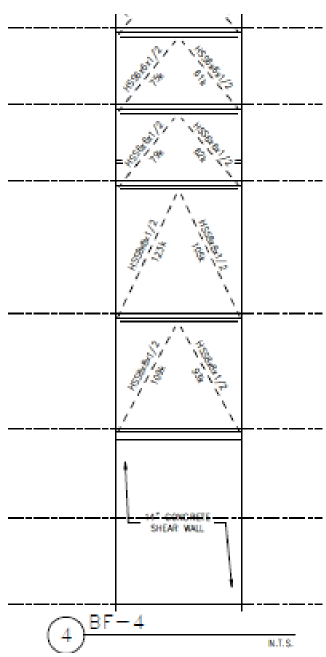


Figure 11: Elevation of Lateral Load Resisting Elements

Typical Floor Bay

The structural grid of AC Marriott is rectangular, however the bay sizes are all irregular. Bay sizes range anywhere from 4-14ft in width by 4-20ft in length. Due to the irregularity, the loads on each bay vary, hence why girder sizes range from W12's-W21's. Highlighted below are the smallest (approx. 4 ½'x4 ½') and largest (approx. 15'x20') typical floor bays. One can see that designers' attempt to open up occupiable floor space in the building by creating much larger interior bays than exterior bays.

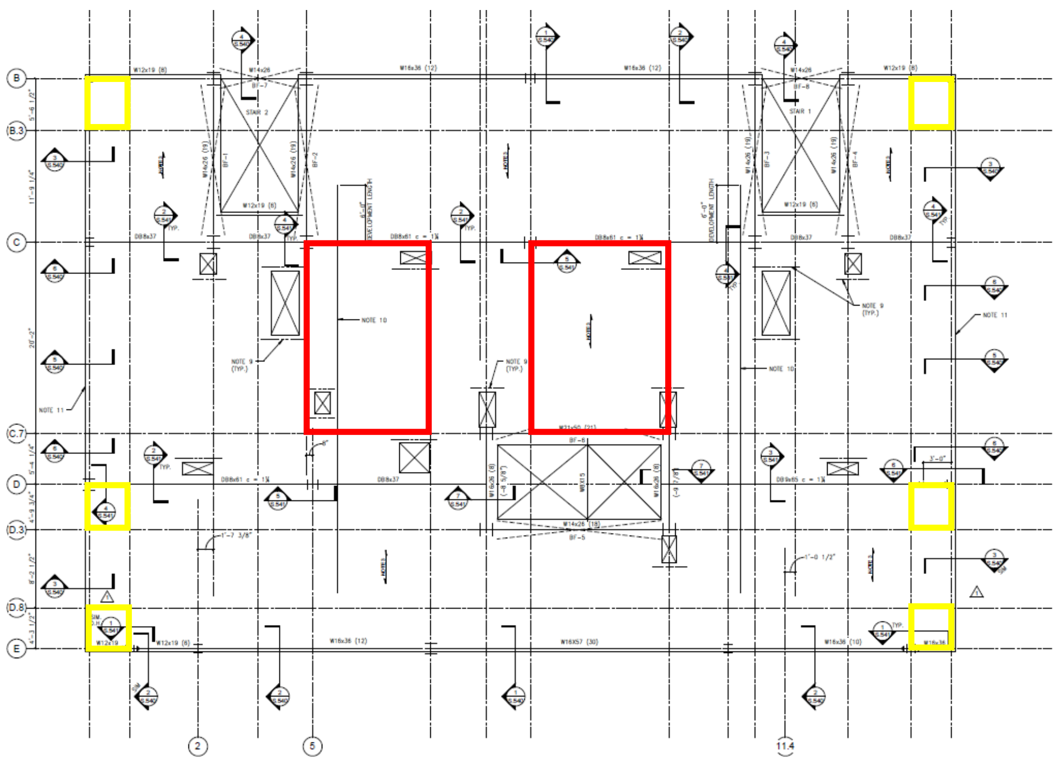


Figure 12: Typical Framing plan showing irregular structural grid

Load Paths

Gravity

Starting from the rooftop penthouse, loads are applied from the penthouse green roof and transmit through the floor decking onto the girder slabs (W12's-W16's) and then into the columns. Loads are brought down through the columns (W10's-W16's) into the column footings, which sit on grade beams. The load is then dispersed onto the mat foundation which will evenly spread out the full load into the soil beneath. Loads from the lower floors will follow the same path except for loads will transfer from the composite floor into the girders and down through the columns.

Lateral

Lateral loads are absorbed by the diaphragm and transferred into the column lines where the concentric brace frames and shear walls will capture the force. The bracing transfers the load down through the cross member and is collected at the base where the foundation walls distribute the load into the surrounding compact soil.

Based on the geotechnical report, the maximum anticipated design loads are as follows:

- Column Gravity Load- 1,200 kips
- Lateral Load- 70 kips
- Uplift Load- 500 kips

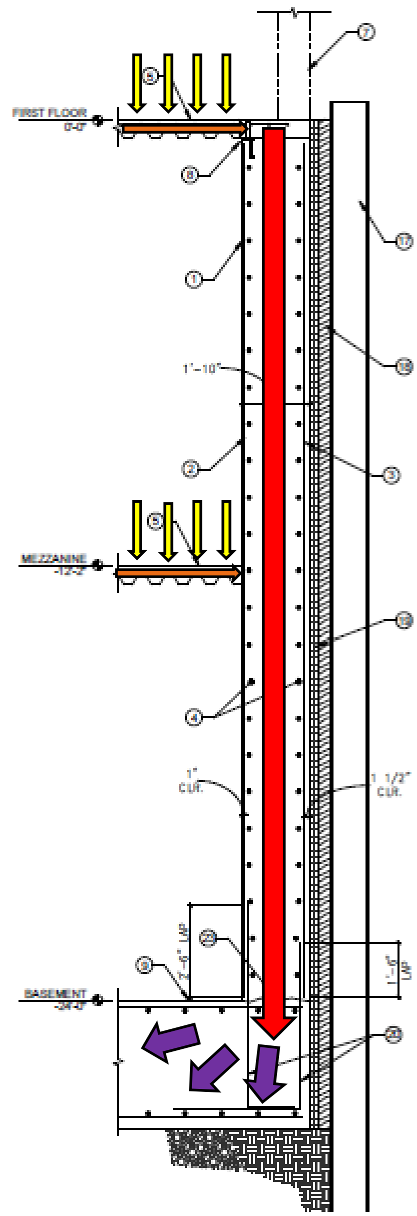


Figure 13: Gravity Load Path

Joint Details

Two of the most common connection details of AC Marriott are apparent where beams and columns meet. Girder slabs are exploited on the residential floors. The detail below shows how the girder slab sits on a ¾"x6"x ½" wide seat plate which is fastened by (2) ¾" diam. A325 high strength bolts. Slotted holes are used to allow for easier installation, however, some connections may require slip critical (SC) bolts to negate movement. Bracket plates are welded to the column and underside of the angle.

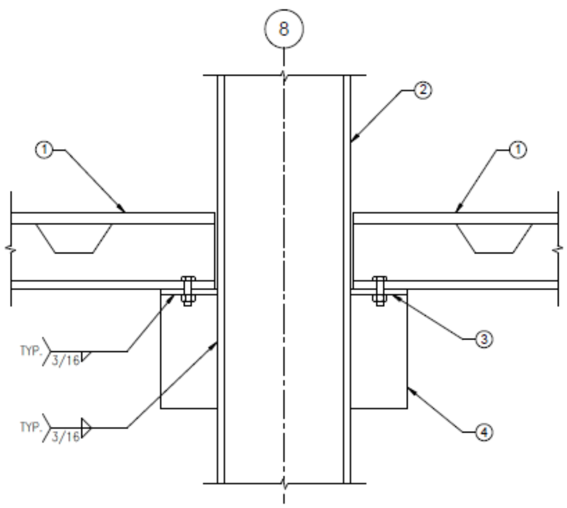


Figure 14: Girder slab beam to column connection

Frame to beam connection is also common. Table 1 shows the typical required number of bolts needed for sufficient connection.

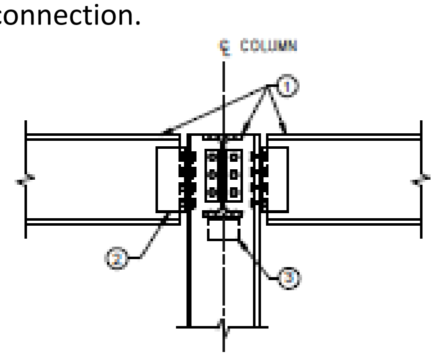
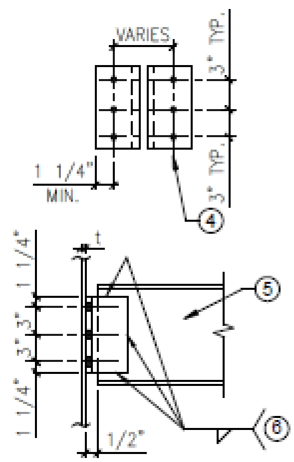


Figure 15: Typ. Framed beam to column connection

Table 4: Required # of bolts and their capacities.

TOTAL NUMBER OF BOLTS IN CONN. ANGLES	MINIMUM CONNECTION ON BEAM	MAXIMUM CONNECTION ON BEAM	3/4" DIA. BOLTS CAPACITY (KIPS)		E70xx WELD CAPACITY (KIPS) (1)					
			A325–N (2)	A325–X (2)	3/16"	MIN. WEB	1/4"	MIN. WEB	5/16"	MIN. WEB
4	W8,W10,W12	W8,W10	37.2	42.1	37.1	.286	49.5	.381	61.8	.476
6	W14,W16,W18	W12,W14	55.8	65.9	55.3	.286	73.7	.381	92.1	.476
8	W21,W24	W16	74.4	89.7	72.7	.286	97.0	.381	121	.476
10	W27,W30	W18	93.0	113	88.7	.286	118	.381	148	.476
12	W33,W36	W21	112	136	104	.286	139	.381	174	.476



1) WHEN BEAM WEB THICKNESS (Fy = 50 KSI) IS LESS THAN MINIMUM REQUIRED MULTIPLY LISTED CAPACITY BY RATIO OF ACTUAL THICKNESS TO LISTED MINIMUM THICKNESS. WELD SIZE SHALL CONFORM TO MINIMUM SIZE PER DETAIL 8/S.502.
2) MINIMUM SUPPORT THICKNESS (t) TO DEVELOP BOLT CAPACITY IN BEARING:
   SINGLE SHEAR (BEAM ONE SIDE): A325–N = 0.159", A325–X = 0.227"
   DOUBLE SHEAR (BEAM BOTH SIDES): A325–N = 0.318", A325–X = 0.454"
   WHERE ACTUAL SUPPORT THICKNESS IS LESS THAN MINIMUM INDICATED MULTIPLY TABULATED BOLT CAPACITY BY RATIO OF ACTUAL TO MINIMUM SUPPORT THICKNESS.
3) DO NOT USE THIS DETAIL FOR COLUMNS LESS THAN 8"x8".
4) ALL CONNECTION ANGLES TO BE L3 1/2x3 1/2x5/16 (L3 1/2x3 1/2x3/8 FOR 5/16" WELDS) W/ STD. ROUND HOLES OR HORIZONTAL SHORT SLOTS (IF NEEDED TO ACCOMMODATE BOLT GAGE VARIATIONS).
5) BEAM WEB.
6) FOR WELD SIZE, SEE TABLE.
7) WHERE BEAMS FRAME ON BOTH SIDES OF COLUMN WEB, OR BOTH SIDES OF GIRDER WEB OVER COLUMN, COMPLY WITH OSHA ERECTION RULES REGARDING DOUBLE CONNECTIONS BY PROVIDING AN ERECTION SEAT, STAGGERED CLIP ANGLES, OR OTHER METHODS AS APPROVED BY STRUCTURAL ENGINEER OF RECORD.

All though not common in the structure, several transfer girders are utilized to distribute column loads. Columns will be attached to the girder using (4) ¾" dia. bolts and stiffener plates are attached from flange to flange on the girder. Transfer girders tend to be larger than other members due to increased moment on the span. The main transfer girder is highlighted on figure 17.

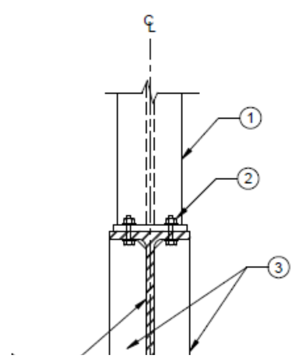


Figure 16:Typ. column to transfer girder connection

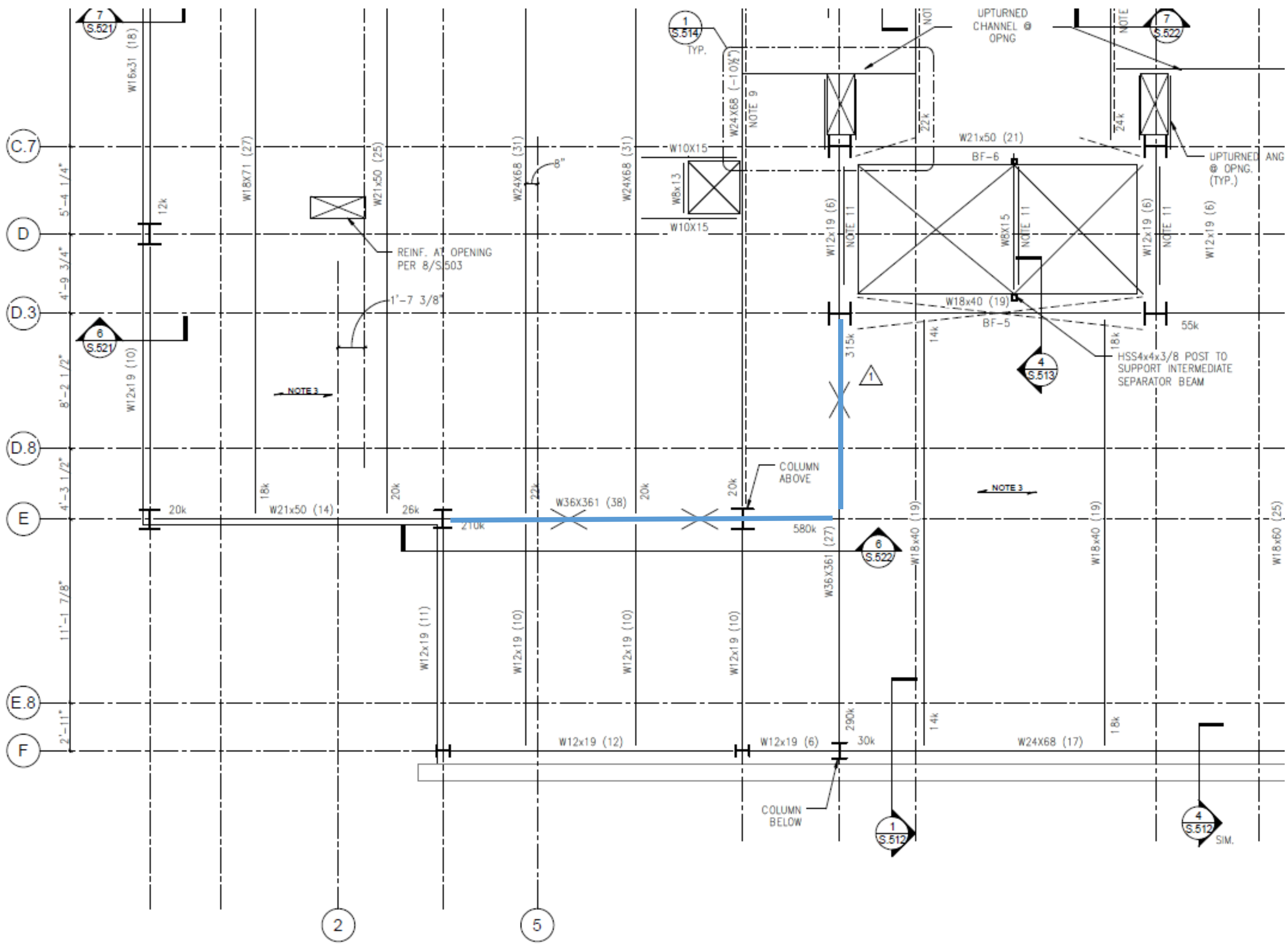


Figure 17: Transfer girder locations on 2nd level

Other Elements

Project designers of AC Marriott incorporated multiple green roofs (both intensive and extensive) in their design. On the second and third levels, smaller, extensive green roofs are utilized. On the upper penthouse level, a larger, intensive green roof was installed. Due to higher loads on the roofs, members must be robust enough to support the roof.

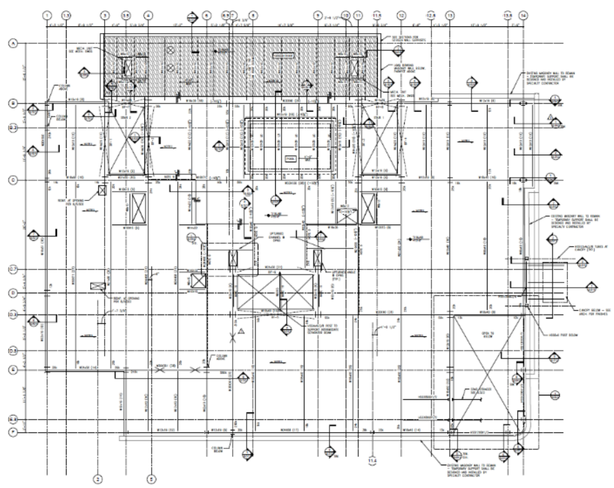


Figure18: 2nd Level Green Roof

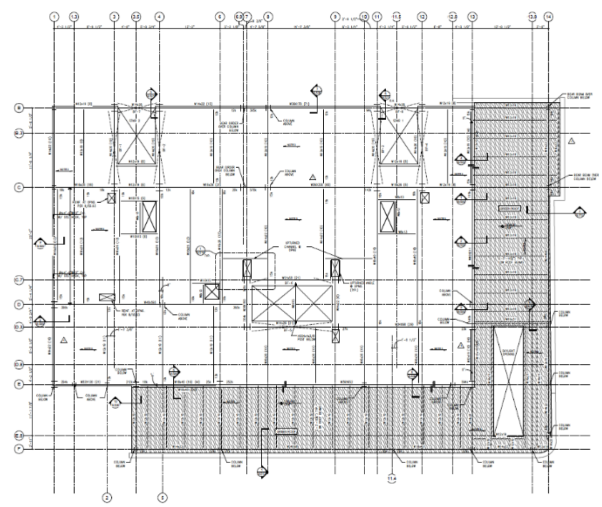


Figure19: 3rd Level Green Roof

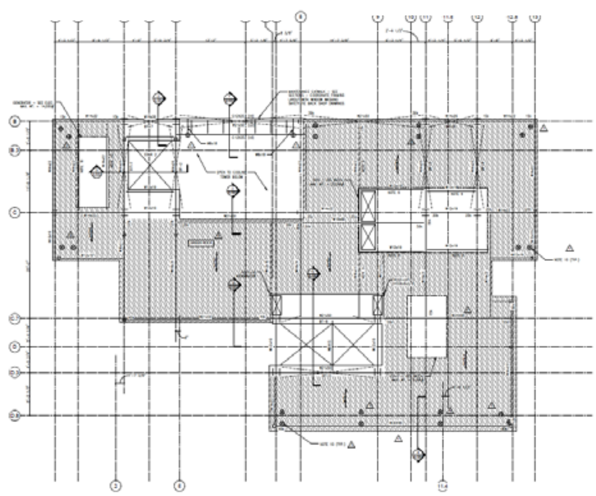


Figure20: Penthouse Level Green Roof

Conclusion

AC Marriott Philadelphia is a 15 story (including penthouse) transient hotel occupying a little over 107,000SF. This report explored the existing conditions of 230 North 13th Street. Design codes and standards were introduced first in order to clarify which editions are being utilized. The foundation is explained next followed by the superstructure and how all of the loads progress through the building and into the ground. The structural grid was analyzed along with joint connections. Finally, a closer look at the green roofs were taken in order to see if any conclusions can be made as of why the structural grid is the way it is.

Following the partial demolition of the current building (Big Brother Big Sister of America), the bottom two floors will be a composite system, and the tower portion (levels 3-14) have a girder slab system with precast planks. The geotechnical report advised that a mat foundation would be the most sufficient way to transfer all of the building loads into the ground. Due to the irregular structural grid, it will be interesting to explore the various column loads and what effect the multiple green roofs and pool will have on them. AC Marriott appears to be just another high-rise building set in Philadelphia, however the components it contains makes it a great educational tool to explore deeper and more thoroughly in the reports to follow.