DEPTH WORK – STRUCTURAL ANALYSIS AND DESIGN

Original Structural System

The Hyatt Regency at the Pittsburgh International Airport is a 275,000 square foot hotel and conference center. The building consists of a 12-story tower with a 2-story attached conference center; each has 1 level partially below grade. The building has a combination of structural steel and cast-in-place concrete framing. The conference center is primarily structural steel framing while the hotel tower is cast-in-place concrete.

Foundation Systems (Spread Footings, Pile Caps, and Piles)

Spread Footings

- Spread footings are used under the conference center.
- Bottom of footings is -3'-6" below grade.
- 15 different sizes of spread footings
  - 11 different square footings range from: 5' x 5' to 14' x 14'
    Footings are from 12" to 27" deep with rebar sizes from #4 to #8.
  - 4 different rectangular footings ranging from: 10' x 14' to 12' x 26'
    Footings are from 23" to 28" deep with rebar sized from #7 to #9.

Pile Caps

- Piles and pile caps are used under the main hotel tower.
- 3 sizes of pile caps are used, as follows:
  - Exterior pile caps are roughly triangular, see Pile Cap 1. They are 48" deep and have #11 rebar in 3 directions.
  - Interior pile caps are square, see Pile Cap 2. They are 43" deep and have #8 rebar in both directions.
  - Pile caps at stair wells are rectangular, see Pile Cap 3. They are 40" deep and have #11 rebar in the long direction and #4 rebar in the short.

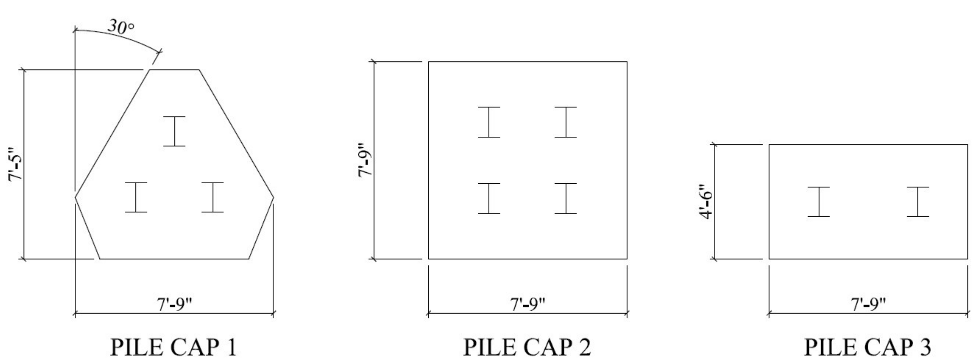


Figure 3. – Pile Cap Dimensions

Piles

- Allowable gross bearing capacity of soil is 2ksf, requiring piles below the tower.
- Piles are typically HP14x117 Bearing Piles.
- Piles are driven to depths of around 90-100 feet until shale is reached.

Floor Systems

Tower (Guest Rooms)

The tower is framed as cast-in place concrete. The concrete moment frames act as a lateral resisting system for the building as well as providing the primary gravity system. Each floor of the tower is approximately 17,000 square feet.

The tower is a system of concrete columns and a one-way slab system. There are 44 columns in the typical tower floor plan, 22"x28" or 22"x32", with 4 smaller columns, 12"x18" or 16"x24" columns around each of the two stair towers. Typical bay sizes are: 27'-0"x18'-0" and 27'-0"x23'-0". *(See plans, next page.)*

6' wide, 8" deep column strips are oriented N-S on the typical tower plans. The floor slab consists of an 8" thick slab with polystyrene voids in a typical layout between column strips (see plan and section views below).

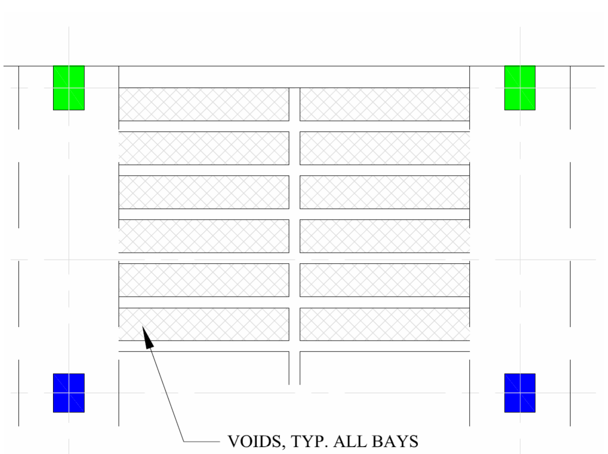


Figure 4. – Plan of Typical Bay Void Layout

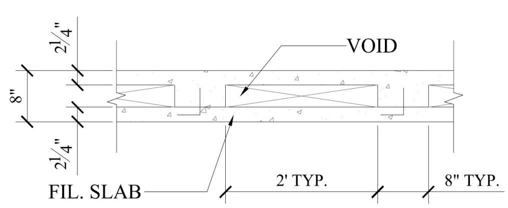
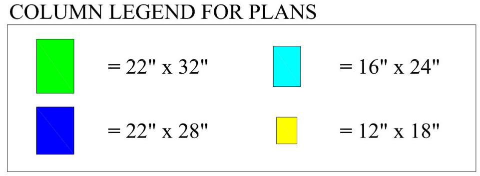
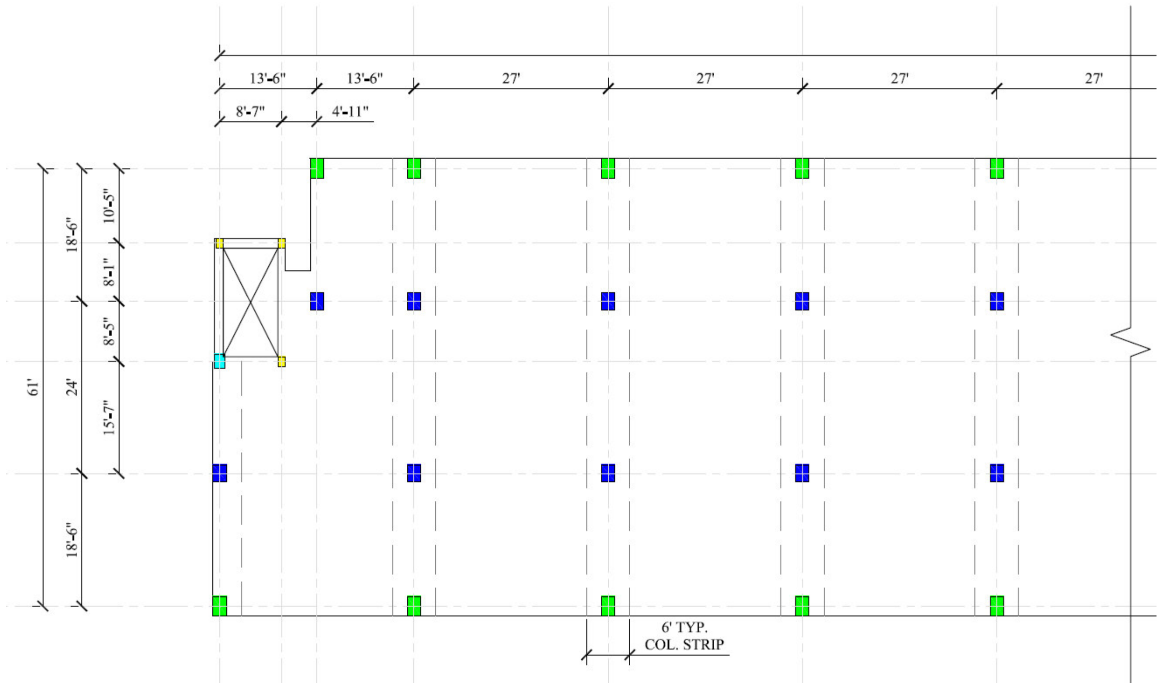


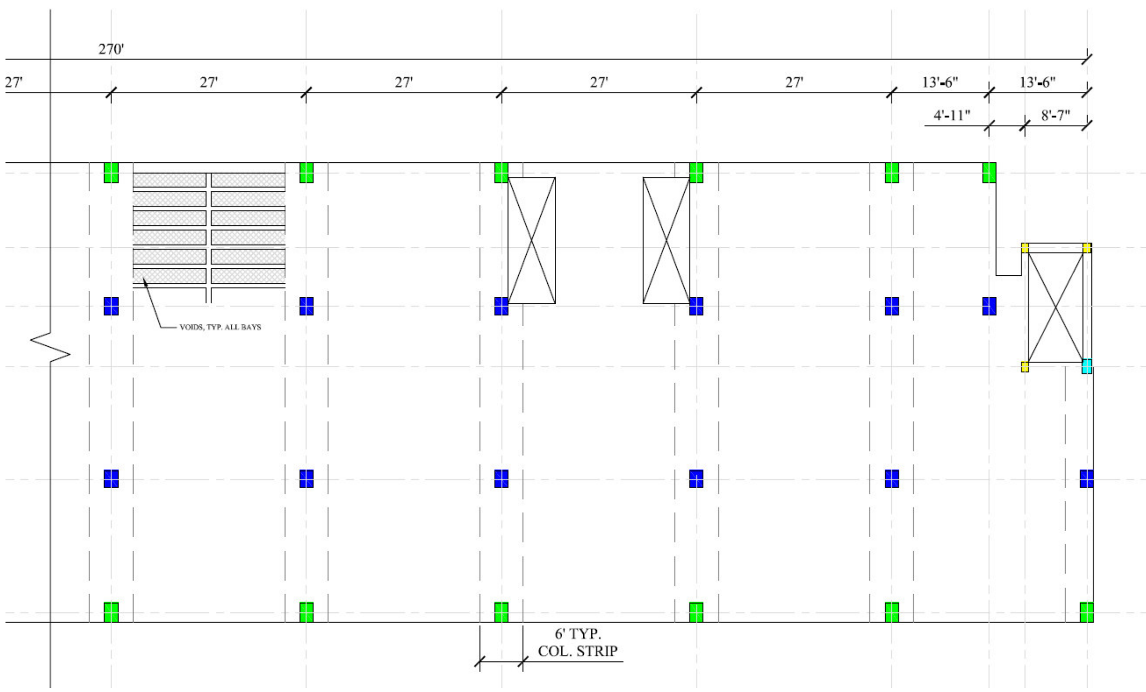
Figure 5. – Section Through Voids

COLUMN LEGEND FOR PLANS





TOWER FRAMING PLAN – WEST END



TOWER FRAMING PLAN – EAST END

Figure 6. – Layout of Existing Floor Plan (Tower)

Conference Center - As the tower is the primary structural system investigated in this report, information on the conference center will be of a more general nature.

The conference center portion of the building is framed with structural steel; approximately 17,000 square feet on the ground floor (partially below grade) and approximately 50,000 square feet on the first floor. Steel connections are made with standard A325 or A490, ¾" bolts and welds are specified on the structural drawings as being no smaller than ¼". At moment connections, the connections are designed for the full moment capacity of the beams.

- Ground Level: The ground level framing supports a composite steel deck and concrete floor slab. A continuous 14" concrete foundation wall contains embedded plates to attach to the steel framing. The wall also acts as a retaining wall for soils around the section that is below grade. The steel framing for the first floor is typically W12X19 for 12'-16' spans, W14X22 for 25' spans, and W21X44 for 35' spans. Column sizes range from W10X33 to W10X49.

- First Floor: The first floor is the top level for the conference center. The framing for the roof consists of both W-sections and joists. There is a large size difference in all steel beams, ranging from W12X14 to W21X50 and girders ranging from W24X55 to W27X94. Long-span joists are used over the large span of the main conference center located in the middle of the conference center. 68DLH17(s) frame over the 73' span, with diagonal bracing between joists for stability. Framing supports 3"-18 gage steel roof deck.

Codes and Material Requirements

Codes

- BOCA 1996 – adopted by the Township of Findlay, PA.
- AISC 1989 – "Specification for Structural Steel Buildings – Allowable Stress Design and Plastic Design" (Note: new load checks performed use LRFD design)
- ACI 318-89 – "Building Code Requirements for Reinforced Concrete"

Structural Steel

• Rolled Shapes	ASTM A572, Grade 50
• Plates, Angles, Channels, Connection Materials	ASTM A36
• Tube Sections	ASTM A500, Grade B
• Pipe Sections	ASTM A53, Grade B
• Anchor Bolts	ASTM A307

Cast-in-place Concrete (Normal weight)

• Pile Caps and Basement Slab-on-Grade	3000 psi
• Columns	5000 psi

• Walls, Grade Beams, Structural Slab-on-Grade	4000 psi
• Slabs on Metal Deck	3500 psi
• Tower Slabs and Beams	4500 psi

Reinforcement

• Deformed Rebar	ASTM A615, Grade 60
• Welded Wire Fabric	ASTM A185, Grade 60

Bolts and Welds

• Welding Electrodes	E70XX Low-Hydrogen
• Bolting Materials	ASTM A325 or A490

Gravity Loads

Design loads with updates from ASCE 7-02 – Minimum Design Loads for Buildings and Other Structures.

Live Loads

• Basement – Slab-on-grade	75 psf
• First Floor – Structural Slab	100 psf
• Lobby	100 psf
• Conference Center Roof	12 psf
• Tower Roof	20 psf
• Guest Rooms	40 psf
• Tower Corridors	100 psf

Dead Loads

• Basement – Slab-on-grade	75 psf
• First Floor – Structural Slab	125 psf
• Lobby	60 psf
• Conference Center Roof	30 psf
• Tower Roof	80 psf
• Guest Rooms	80 psf
• Tower Corridors	80 psf

Superimposed Dead Loads

• Basement – Slab-on-grade	20 psf
• First Floor – Structural Slab	20 psf
• Lobby	40 psf
• Conference Center Roof	30 psf
• Tower Roof	20 psf
• Guest Rooms	20 psf
• Tower Corridors	20 psf

Snow Load

• Roof Snow Load	25 psf

Lateral Loads

Typical tower frames shown in figures 7 and 8, below. Orientation of columns is shown with respect to the elevation. Column sizes are color coordinated per the column legend.

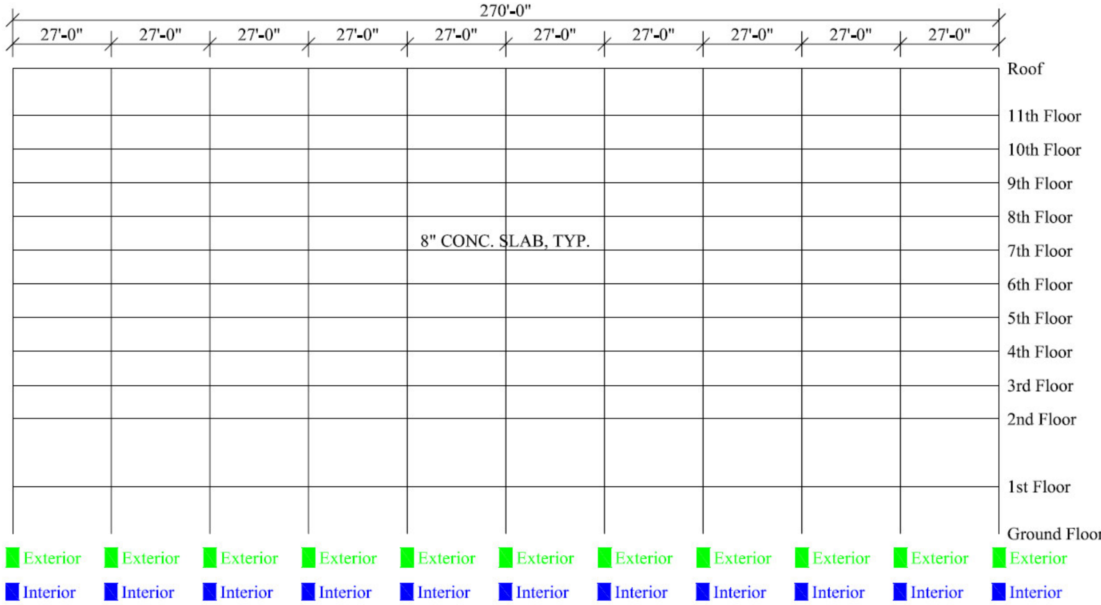


Figure 7. – Typical frame resisting lateral loads in E/W direction (See column legend for sizes)

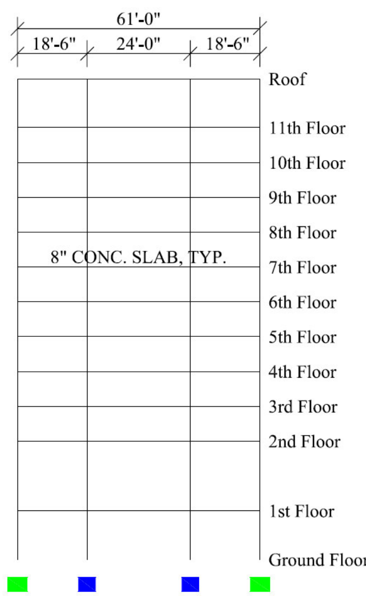


Figure 8. – Typical frame resisting lateral loads in N/S direction (See column legend for sizes)

Wind Loads

The design wind loads have been determined in accordance to IBC 2003 and ASCE 7-02. Wind loads have been calculated based on the 12-story, 140-foot tower of the building. The main building factors for determining the wind loads are the basic wind speed of 90mph, exposure C, importance category II. The calculations assume that the building behaves as a rigid, rectangular structure. There is some variation between the calculated loads and those in the design documents; however, this is most likely due to code changes, and the values are not significantly different. Story Shears have been determined from the tributary area to each story. See Appendix A for calculations.

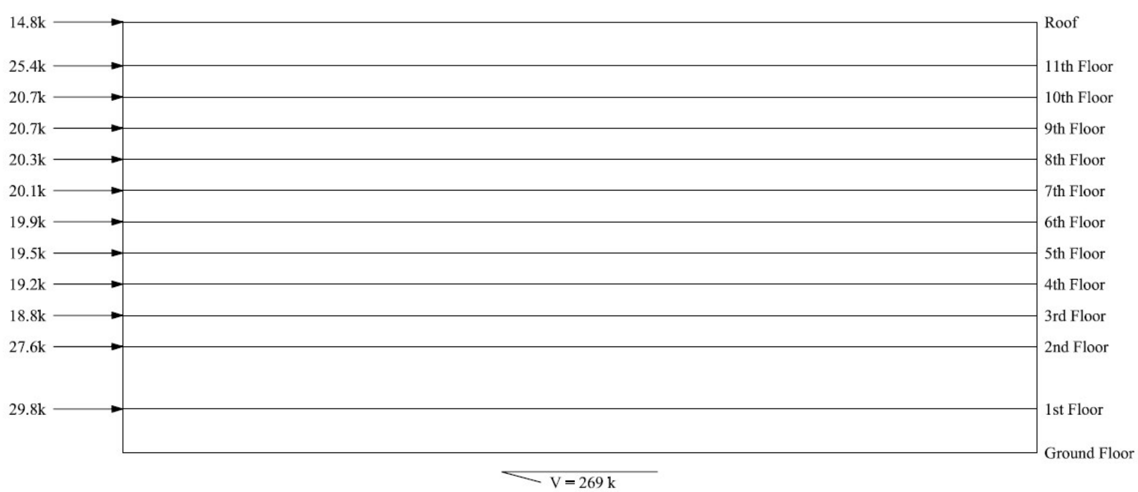


Figure 9. – Original E/W Wind Story Shears and Base Shear Value

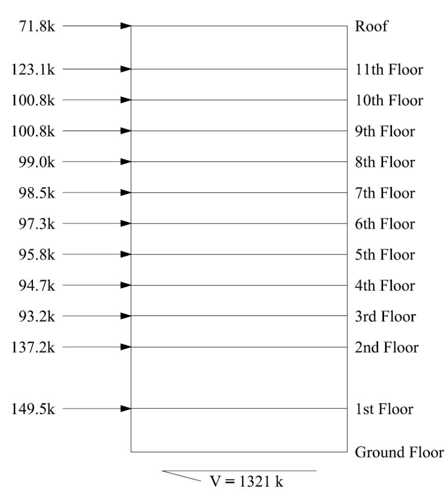


Figure 10. – Original N/S Wind Story Shears and Base Shear Value

Seismic Loads

Seismic calculations have been calculated using IBC 2003 and ASCE 7-02. The loads have been calculated based on the existing tower conditions. The original design of the building did not include seismic requirements, so these loadings were most likely not considered during the design of the concrete moment framing that serves as the lateral resisting system for the building. The calculations were made using the Equivalent Lateral Force Procedure. The building weight was approximated for the calculations based on a typical tower floor plan, so the value may vary slightly from the actual weight, but this should not change the loading significantly. Seismic loads are the same from each direction. See Appendix B for calculations.

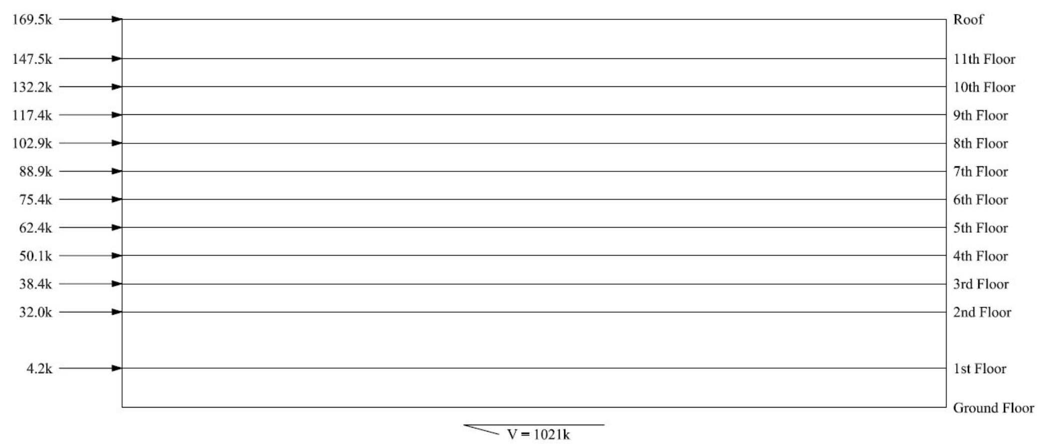


Figure 11. – Original E/W Seismic Story Shears and Base Shear Value

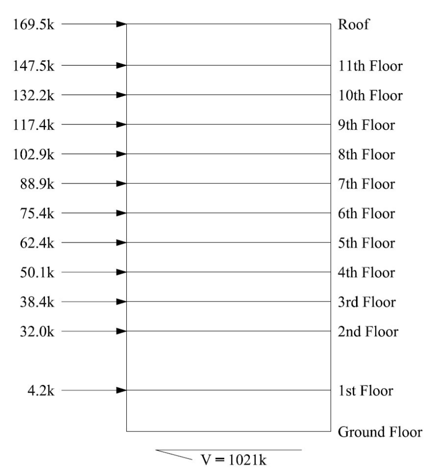


Figure 12. – Original N/S Seismic Story Shears and Base Shear Value