# HUNTER’S POINT SOUTH INTERMEDIATE & HIGH SCHOOL

## TECHNICAL REPORT I

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# EXECUTIVE SUMMARY

The objective of Technical Report I was to analyze and understand the existing structural of the Hunter's Point South School design. This was accomplished by exploring the structural concepts of the existing design, computing all gravity and lateral loads applied to the structural system, and performing spot checks on the existing member sizes and strengths.

First, this report dissects the different structural systems of the building, including foundation, floor, gravity frame, and lateral frame systems. This is followed by a breakdown of the design codes, material strengths, and gravity loads implemented in this design. Dead load, live load, and snow load will be determined for the different systems in this building design.

Then, a detailed analysis of wind and seismic loads will be executed to determine the controlling lateral system design. This report used ASCE7-10 to determine the wind and seismic loads on this building. After analyzing the effects of each for base shear and overturning moment, it was determined that wind controls the design of the lateral system with a design shear force of 1322 k and design moment of 61,324 k-ft.

Finally, a spot check will be performed on part of the gravity system to determine member design specifications. The sample beam, girder, and column were all determined to have been appropriately designed to meet all strength and serviceability requirements.

This report also includes an appendix that contains valuable tables and calculations used during this structural analysis. This report will be followed by two other technical reports. The first will analyze several different floor system designs that could be used in this structure, and the last will go into further detail on the lateral system design of this structure.

# INTRODUCTION

Hunter's Point South School is a new 5 story educational building being constructed as part of the first phase of New York City's new mixed-use development plan on a 30 acre site of waterfront properties in Long Island City, NY. The new development focuses on creating an affordable middle-income area that includes several new mixed use housing towers, along with supporting retail spaces, a school, and new waterfront park. Hunter's Point South School is being developed by the NYC School Construction Authority (SCA) along with Skanska contracting and FXFowle Architects. The structural engineer on the project is Ysreale A. Seinuk, PC. Construction of the school will last from January 2011 to October 2013, and cost approximately $61Million to complete. It will open its doors to students in the fall of 2013.

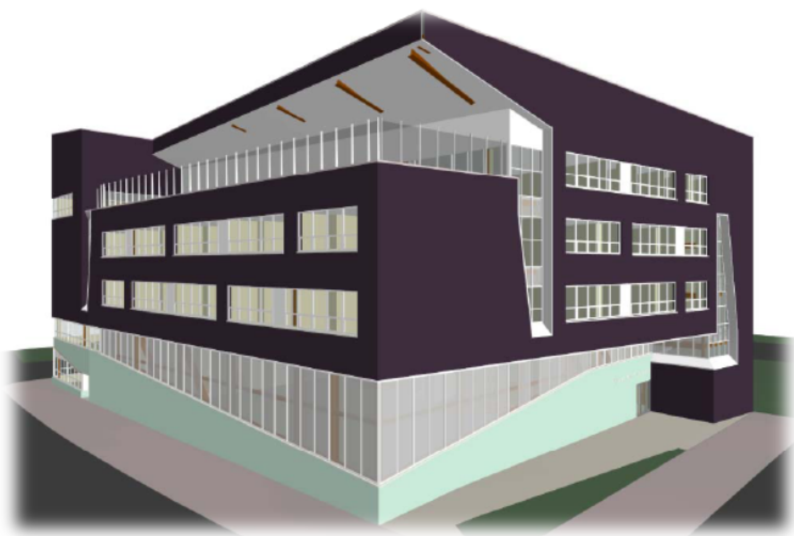


*Figure 1: Building design rendering*

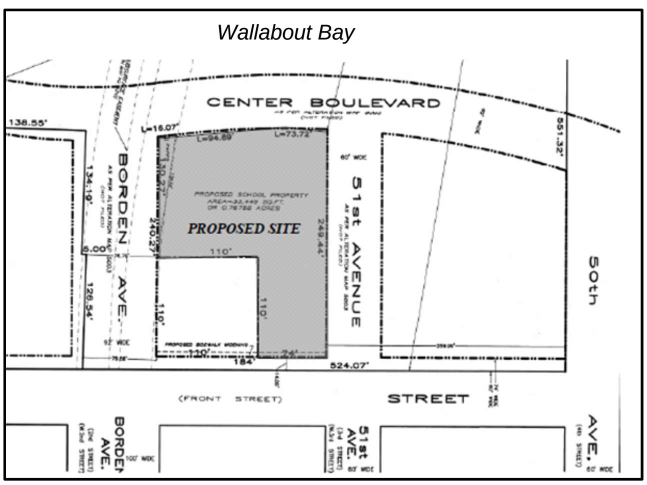



***Figure 2:*** *Building site plan*

The mixed use intermediate and high school will be nearly 154,500 square feet and house roughly 1100 students from grades 6-12 and District 75 (special needs) from the Queens School District. Being constructed on 51st Avenue, Hunter's Point will take up almost a full city block between 2nd Street and Center Boulevard with space in the corner of the lot reserved for the construction of a new 30 story housing tower to be built right next to the school. The site layout can be seen in Figure 2. It should also be noted that the site sits right across the street from the bay.

Following along with other city development ideals, the school building has a modern architectural feel as it incorporates interesting shapes, cantilevers, and sense of solids and voids together. The cubic shape of the building is broken up with vertical shafts, horizontal windows, and slanted edges. In addition, the SCA is aiming to achieve LEED Silver certification for this building through several different sustainable features and construction procedures.

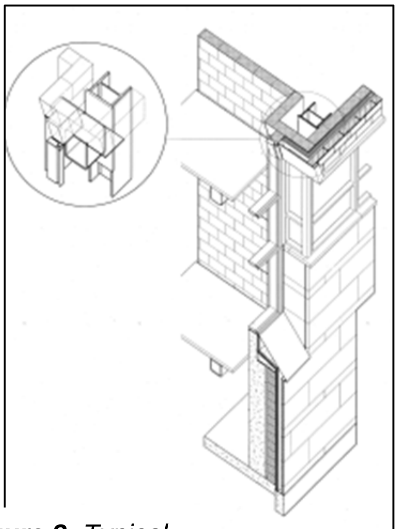


***Figure 3:*** *Typical Wall Section Axonometric Detail*

The 5 story school rises roughly 75 feet off finished grade, with an irregular parapet rising as high as 98 feet on some elevations. It is mainly a structural steel building, with concrete on metal deck floors and an assorted exterior. The exterior façade comprises of a unique blend of grey brick, slate veneer, concrete block, orange aluminum composite panels, and different types of glazing including translucent panels. Much of the shell is part of a curtain wall system that is supported by the floor above. There is, however, some load bearing masonry used in the design.

***Figure 4:*** *Building Section*

Inside, the building is vertically stacked to separate the schools, but includes ties to each other using shared spaces. The first floor contains athletic space, including a 2 story tall gymnasium and locker rooms for all grades. There are also support rooms/offices for the intermediate school and general storage areas. The second floor contains an auxiliary gym, library, and special education rooms for the District 75 students. The third floor contains a full sized 2 story auditorium that links the high school and intermediate school together, along with IS classrooms and IS support rooms/offices. The fourth floor contains high school classrooms with support rooms/offices and access to the auditorium. The fifth floor contains HS and IS cafeterias with a central kitchen space, a connecting 4000sf roof terrace, science labs, and support rooms/offices for the high school. There is a small mechanical penthouse on the top roof.

# STRUCTURAL SYSTEMS

This section provides a brief overview of the different structural systems implemented in the Hunter's Point design. The structure consists of a steel framing system with concrete on metal deck floors. There are no subgrade levels, and structural height of the building is 72.3 feet to the roof level with a 12'-15' parapet wall extending above. All exterior walls are non-loadbearing brick, slate, aluminum panel, or glazing. CMU masonry infill walls are used as a backup wall and are grout filled and reinforced against lateral forces. The steel frame makes up both the gravity and lateral load systems of this building.

### Foundation

The foundation consists of a 12" 4000psi reinforced slab on grade supported by a system of grade and strap beams, 14" caissons, and steel H-piles. Special isolation caissons, as seen in Figure 5, were used for locations within 50 feet of two subsurface tunnels used for the Queens-Midtown easement line that run E-W through the site. Each caisson has three 20" 75ksi steel threadbars within 8000psi grout, and can support 800kips of compressive force. A geotechnical survey performed by Langan Engineering showed soil type ranges from grey silty sand to clay, with bedrock consisting of Gneiss starting at about 40 feet below grade. Deep foundations are installed to this level.

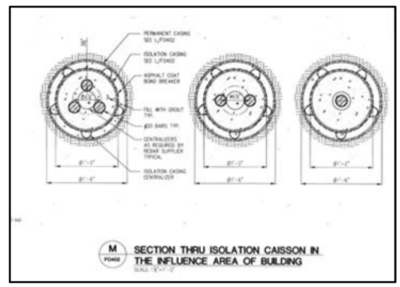



***Figure 5:*** *Isolation caisson cross section*

### Floor and Roof Systems

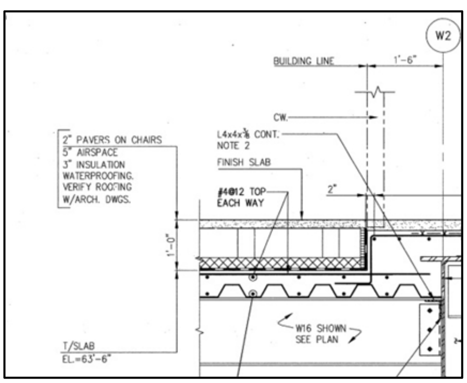



***Figure 6****: Typical floor system*

As seen in Figure 6, the floor system consists typically of 3 ¼" thick 3500psi lightweight concrete on 3" deep composite 18 gage galvanized metal deck (6 ¼" total depth) supported by a steel framing system. Concrete is reinforced with 6x6 W2.0xW2.0 WWF. The floor system above the gymnasium will consist of acoustical metal deck in place of typical deck. The auditorium stadium seating floor will have 16 gage deck in place of typical deck. The typical unsupported span length for the floor deck is 12'. All cast-in-place concrete slabs are reinforced by #4 reinforcing bars spaced 12" in both directions. The top roof and terrace roof will have 2"thick lightweight concrete pavers over hot applied asphalt roofing membrane on top of the concrete slab.

## Framing System

The superstructure of Hunter's Point is typically comprised of W10-W14 steel columns supporting W24 girders and either W14 beams at the building core or W16 beams towards the perimeter of the structure. Overall, sizes and span lengths vary greatly throughout the building and across every floor. The third floor includes special long span plate girders over the gymnasium space (red box, Figure 8). Spanning 80ft each with a flange thickness of 2-4 inches, these transfer beams allow for open gym space while adequately supporting the load transferred from the auditorium directly above. Gravity loads are transferred from the floor slab to the wide flange beams then to interior and exterior columns down to the foundation system. Exterior walls and cladding transfer their weight to exterior beams.

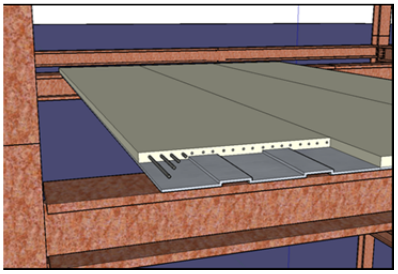


***Figure 7:*** *Typical frame layout*

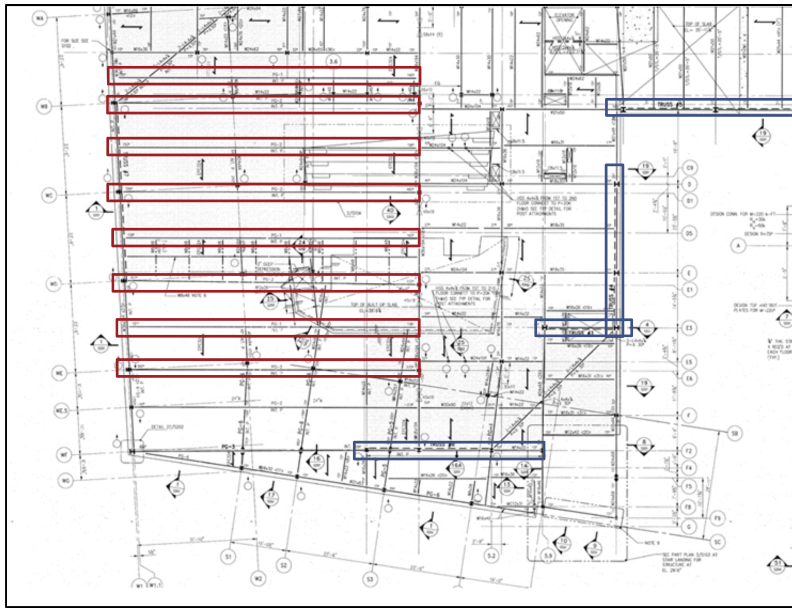


***Figure 8**: Partial 3rd Floor Framing Plan: Red box=Plate Girder Blue Box=Truss*

## Lateral System

The lateral force resisting system consists of both HSS and wide flange lateral truss bracing (blue box, Figure 8), along with steel moment connections at columns around the gymnasium and auditorium spaces. There are six different types of truss bracing systems, two of which are shown in Figure 9 to the right. Single bay trusses are primarily used along interior spaces, while double bay trusses are implemented along the exterior wall. Trusses run in both the N-S and E-W directions. The first three floors implement lateral force resisting systems the most. This is due to the 3 story cavity formed in the framing system to allow for open gym and auditorium space.

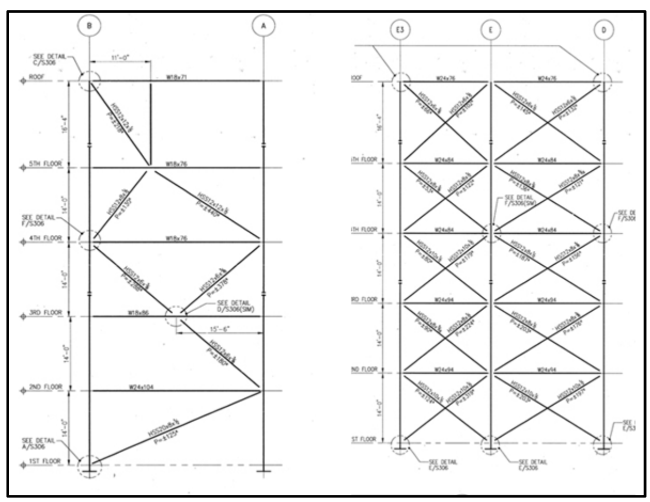


***Figure 9:*** *Two types of lateral bracing used in the design*

# DESIGN CRITERIA

This section provides data regarding codes, materials, and gravity loads for the design of Hunter's Point South. This thesis project will differ from the original design in that it will implement design criteria from ASCE7-10 rather than the NYCBC 2008 building code.

## CODES & REFERENCES

### Design Codes

#### Building Code

- New York City Building Code, NYCBC 2008

#### Reference Codes

- American Concrete Institute Building Code, ACI 318-02
- American Institute of Steel Construction, AISC 9th edition

### Thesis Codes

#### Building Code

- International Building Code, IBC 2009

#### Reference Codes

- American Concrete Institute Building Code, ACI 318-08
- American Institute of Steel Construction, AISC 14th edition
- American Society of Civil Engineers, ASCE 7-10

# MATERIAL STRENGTHS

Design Materials and strengths were found in the construction drawings on page S001.

| Material | Element | Type | Strength |
|---|---|---|---|
| Cast-in-Place Concrete | Pile Caps under Columns | NWC | f'c= 5950 psi |
| | Grade & Strap Beams | NWC | f'c= 4000 psi |
| | Column Pier and Butress | NWC | f'c= 4000 psi |
| | Slab on Grade | NWC | f'c= 4000 psi |
| | Floor Slab | LWC | f'c= 3500 psi |
| Reinforcing Steel | Concrete Reinforcing bars | | FY= 60 ksi |
| | Caisson Steel threadbars | | Fy= 75 ksi |
| Structural Steel | Steel Wide Flange Members | ASTM A992 | Fy= 50 KSI |
| | Steel HSS Tubes | ASTM A500 | Fy= 46 ksi |
| | Steel Base Plates | ASTM A572 gr 50 | Fy= 50 ksi |
| | Steel Deck | ASTM A653 | Fy= 40 ksi |
| | Steel Bolts | ASTM A325 | Fu= 120 ksi |
| | | ASTM A490 | Fu= 150 ksi |

*Table 1*

# DESIGN LOADS

Hunter's Point South was designed for gravity loads using the Allowable Strength Design (ASD) Method. This thesis project will implement the Load and Resistance Factor Design (LRFD) Method instead due to the fact that it is becoming the industry standard. All thesis design loads have been taken from tables out of ASCE7-10 unless original design load controlled.

| Dead Load | | |
|---|---|---|
| | Design (psf) | Thesis (psf) |
| NW Concrete | 150 | 150 |
| LW Concrete + Deck | 49 | 49 |
| Masonry Wall | 90 | 90 |
| Roof Paver | 15 | 15 |
| MEP | 20 | 25 |
| Ceiling | 10 | |
| Partitions | 12 | 12 |
| Curtain Wall | 20 | 20 |

*Table 2*

| Live Load | | |
|---|---|---|
| | **Design (psf)** | **ASCE7-10** |
| first floor, lobby, stair, corridor | 100 | 100 |
| classrooms | 40 | 40 |
| art room/ science lab | 60 | 60 |
| office | 50 | 50 |
| library stacks | 100 | 150 |
| library reading | 60 | 60 |
| mechanical space | 75 | 100 |
| book storage | 150 | 150 |
| roof (main) | 45 | 45 |
| Gymnasium | 100 | 100 |
| Cafeteria | 100 | 100 |
| Kitchen | 150 | 150 |
| Auditorium Stage | 150 | 150 |
| toilets | 60 | 60 |
| terrace | 100 | 1.5LL<100psf |
| corridor 2nd floor+ | 80 | 80 |
| Auditorium | 100 | 100 |
| stadium seating | 60 | 60 |

*Table 3*

| Snow Load | | |
|---|---|---|
| | **Design** | **ASCE7-10** |
| Ground Snow Load: | 25 psf | 25 |
| Flat Roof Snow Load | 22 psf | 22 |
| Snow Exposure Factor CB | 1.1 | 1.1 |
| Snow Load Importance IS | 1.1 | 1.1 |
| Thermal Factor Ct | 1.0 main roof/terrace<br>1.1 mech. bulkhead | 1 |

*Table 4*

# DESIGN ANALYSIS

## WIND LOAD SUMMARY

Wind load analysis of the Main Wind Force Resisting System (MWFRS) was determined using ASCE7-10 Chapter 26 and 27. Per this chapter, the building was designed as an enclosed building in Exposure Category C. The building was modeled as a solid rectangular shape to prevent unconservative values due to shorter building lengths. Hand calculations and Microsoft Excel were used to come up with net wind pressures, story shear forces, and overturning moments for both the North-South and East-West directions. Windward, leeward, and internal pressures were taken into account when calculating wind pressures.

**North-South Direction**

Results of wind load analysis in the N-S direction can be found in Table 5 and 6 and in Figure 10 and11 on the next several pages. The total base shear force due to wind loading is 1322 kip, and the overturning moment in this direction is about 61,324 k-ft. Though a wind load analysis was included in the original design drawings, no results are included to compare to the analysis done in this report.

**East-West Direction**

Results of wind load analysis in the E-W direction can be found in Table 7 and 8 and in Figure 12 and13 on pages 14-16. Total base shear force due to wind in this direction is 924 kip, and the overturning moment is 44,259 k-ft. This is slightly lower than the wind load forces in the N-S direction due to the shorter building length in that direction.

| Wind Pressure: North-South Direction | | | | | | |
|---|---|---|---|---|---|---|
| **Story Level** | **Floor to Floor Height (ft)** | **Story Height (ft)** | **Wind Pressure (psf)** | **Internal Pressure (psf)** | **Net Pressure -GCpi (psf)** | **Net Pressure +GCpi (psf)** |
| Roof | 15 | 72.3 | 29.488 | +/- 7.806 | 21.682 | 37.293 |
| 5 | 16.3 | 56 | 27.857 | +/- 7.806 | 20.052 | 35.663 |
| 4 | 14 | 42 | 26.257 | +/- 7.806 | 18.451 | 34.063 |
| 3 | 14 | 28 | 24.106 | +/- 7.806 | 16.301 | 31.912 |
| 2 | 14 | 14 | 21.256 | +/- 7.806 | 13.450 | 29.061 |
| 1 | 14 | 0 | 21.256 | +/- 7.806 | 13.450 | 29.061 |
| | | | | | | |
| Parapet | Windward | 87.3 | 67.954 | - | - | - |
| | Leeward | 87.3 | -45.302 | - | - | - |
| Leeward | - | - | -18.430 | +/- 7.807 | -26.235 | -10.624 |
| Roof | 0 to 36.15ft | - | -33.174 | +/- 7.807 | -40.979 | -25.368 |
| | 36.15-72.3ft | - | -33.174 | +/- 7.807 | -40.979 | -25.368 |
| | 72.3-144.6ft | - | -18.430 | +/- 7.807 | -26.235 | -10.624 |
| | 144.6-175ft | - | -11.058 | +/- 7.807 | -18.864 | -3.252 |

*Table 5*

| Wind Loads: North-South Direction | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Story Level** | **Floor to Floor Height (ft)** | **Story Height (ft)** | **Windward (kip)** | **Leeward (kip)** | **Total Story Force (kip)** | **Total Story Shear (kip)** | **Overturning Moment (ft-k)** |
| Parapet | 15 | 87.3 | 122.6 | -81.7 | 204.3 | 1322.3 | 16302.0 |
| Roof | 16.3 | 72.3 | 135.9 | -95.6 | 231.5 | 1118.0 | 16735.4 |
| 5 | 14 | 56 | 120.1 | -88.3 | 208.4 | 886.5 | 11671.1 |
| 4 | 14 | 42 | 114.7 | -88.3 | 203.0 | 678.1 | 8527.0 |
| 3 | 14 | 28 | 107.4 | -88.3 | 195.8 | 475.1 | 5481.9 |
| 2 | 14 | 14 | 97.8 | -88.3 | 186.2 | 279.3 | 2606.6 |
| 1 | 14 | 0 | 48.9 | -44.2 | 93.1 | 93.1 | 0.0 |
| | | | ∑ | | | 1322.3 | 61323.9 |

*Table 6*

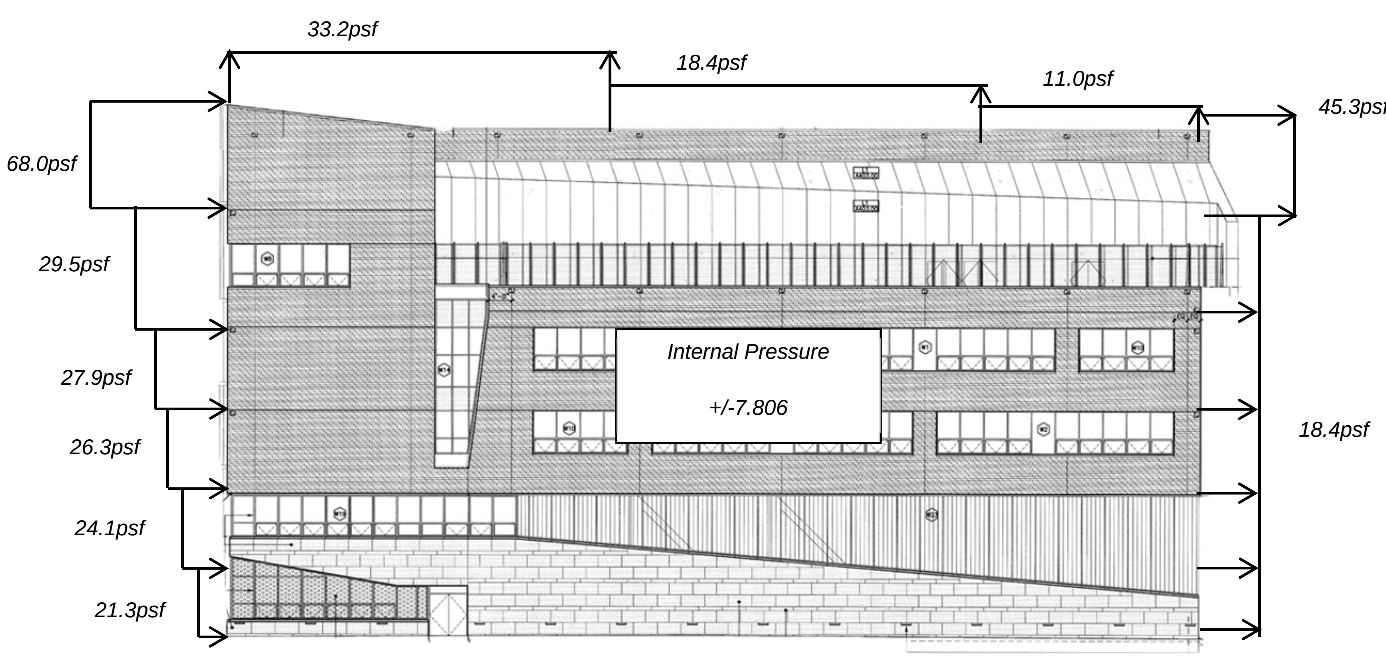



***Figure 10:*** *Wind Pressures, N-S Direction*

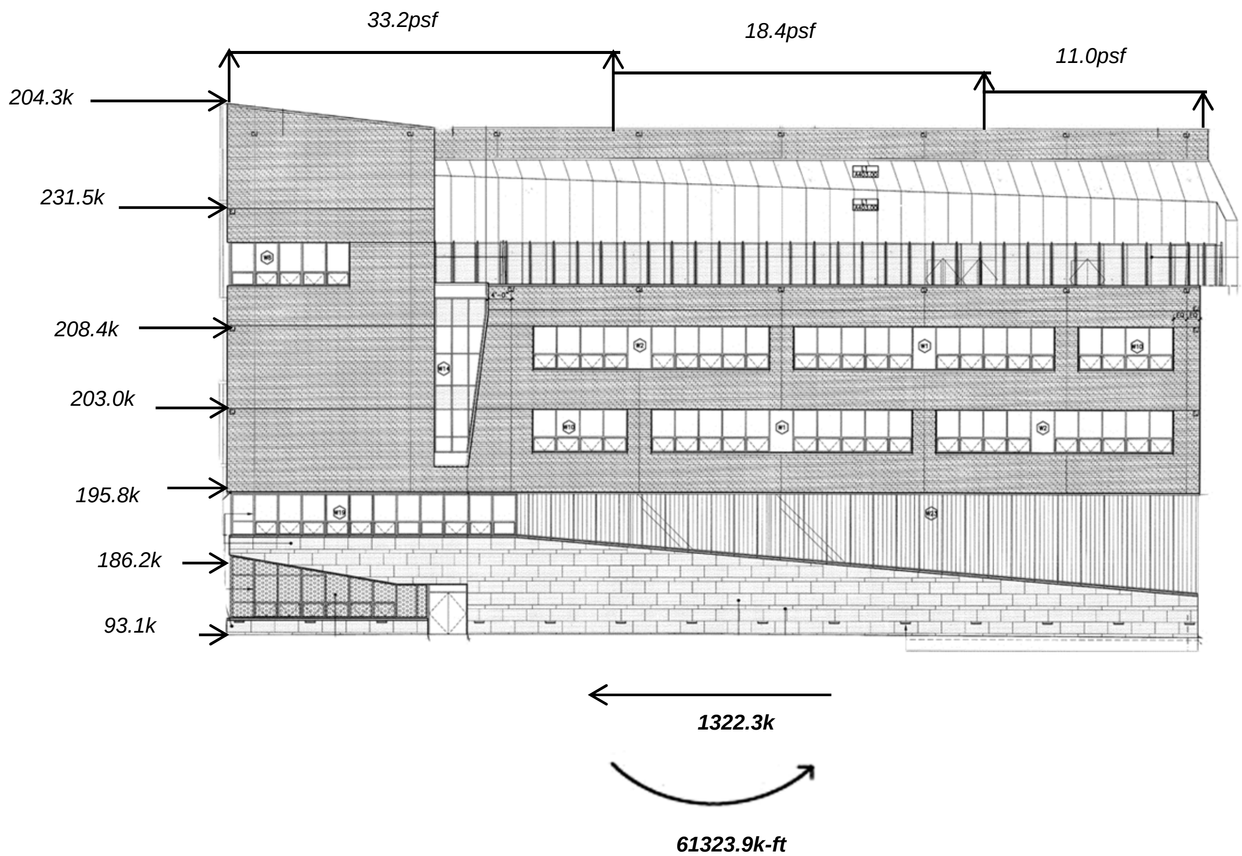



***Figure 11:*** *Wind Forces, N-S Direction*

| Wind Pressure: East-West Direction | | | | | | | |
|---|---|---|---|---|---|---|---|
| Story Level | Floor to Floor Height (ft) | | Story Height (ft) | Wind Pressure (psf) | Internal Pressure (psf) | Net Pressure -GCpi (psf) | Net Pressure +GCpi (psf) |
| Roof | 15 | | 72.3 | 29.488 | +/- 7.806 | 21.682 | 37.293 |
| 5 | 16.3 | | 56 | 27.857 | +/- 7.806 | 20.052 | 35.663 |
| 4 | 14 | | 42 | 26.257 | +/- 7.806 | 18.451 | 34.063 |
| 3 | 14 | | 28 | 24.106 | +/- 7.806 | 16.301 | 31.912 |
| 2 | 14 | | 14 | 21.256 | +/- 7.806 | 13.450 | 29.061 |
| 1 | 14 | | 0 | 21.256 | +/- 7.806 | 13.450 | 29.061 |
| | | | | | | | |
| Parapet | Windward | | 87.3 | 67.954 | - | - | - |
| | Leeward | | 87.3 | -45.302 | - | - | - |
| Leeward | - | | - | -15.665 | +/- 7.807 | -23.471 | -7.860 |
| Roof | 0 to 36.15ft | | - | -33.174 | +/- 7.807 | -40.979 | -25.368 |
| | 36.15-72.3ft | | - | -33.174 | +/- 7.807 | -40.979 | -25.368 |
| | 72.3-144.6ft | | - | -18.430 | +/- 7.807 | -26.235 | -10.624 |
| | 144.6-240.5ft | | - | -11.058 | +/- 7.807 | -18.864 | -3.252 |

*Table 7*

| Wind Loads: East-West Direction | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Story Level** | **Floor to Floor Height (ft)** | **Story Height (ft)** | **Windward (kip)** | **Leeward (kip)** | **Total Story Force (kip)** | **Total Story Shear (kip)** | **Overturning Moment (ft-k)** |
| Parapet | 15 | 87.3 | 89.2 | -59.5 | 148.6 | 924.3 | 12977.0 |
| Roof | 16.3 | 72.3 | 98.9 | -62.2 | 161.1 | 775.7 | 11647.6 |
| 5 | 14 | 56 | 87.4 | -57.5 | 144.9 | 614.6 | 8113.2 |
| 4 | 14 | 42 | 83.5 | -57.5 | 141.0 | 469.7 | 5920.2 |
| 3 | 14 | 28 | 78.2 | -57.5 | 135.7 | 328.7 | 3799.3 |
| 2 | 14 | 14 | 71.2 | -57.5 | 128.7 | 193.1 | 1801.9 |
| 1 | 14 | 0 | 35.6 | -28.8 | 64.4 | 64.4 | 0.0 |
| | | | ∑ | | | 924.3 | 44259.1 |

*Table 8*

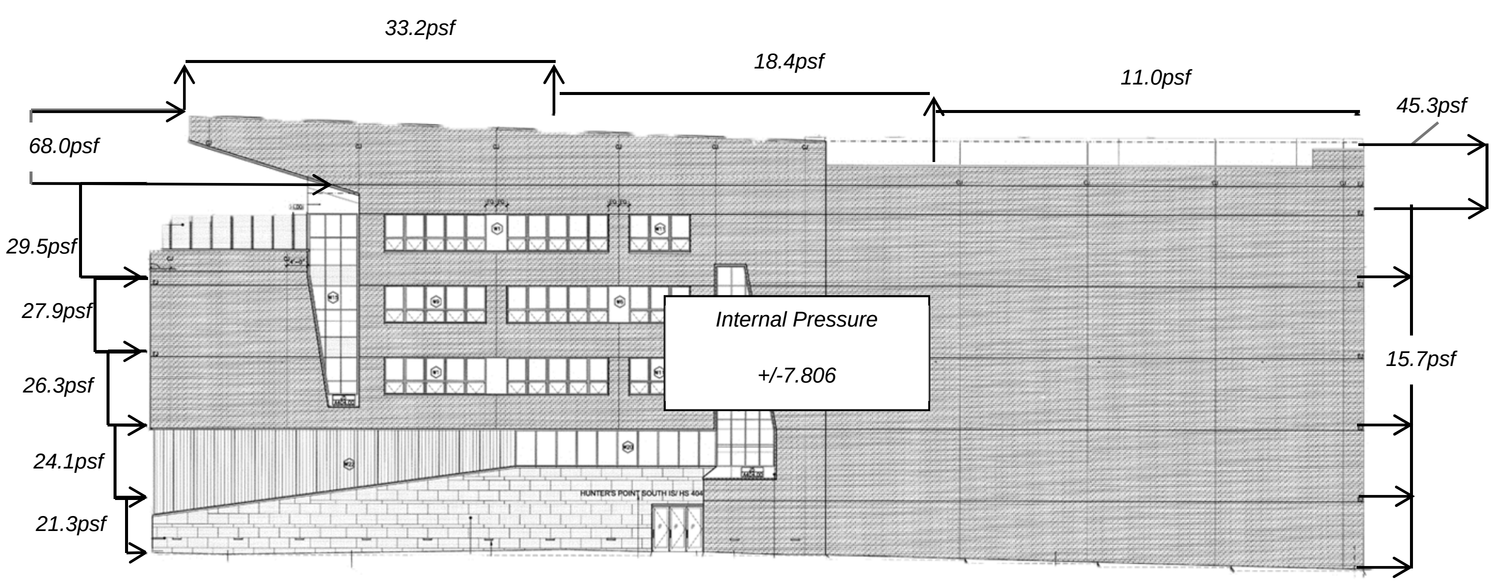



***Figure 12:*** *Wind Pressures, E-W Direction*

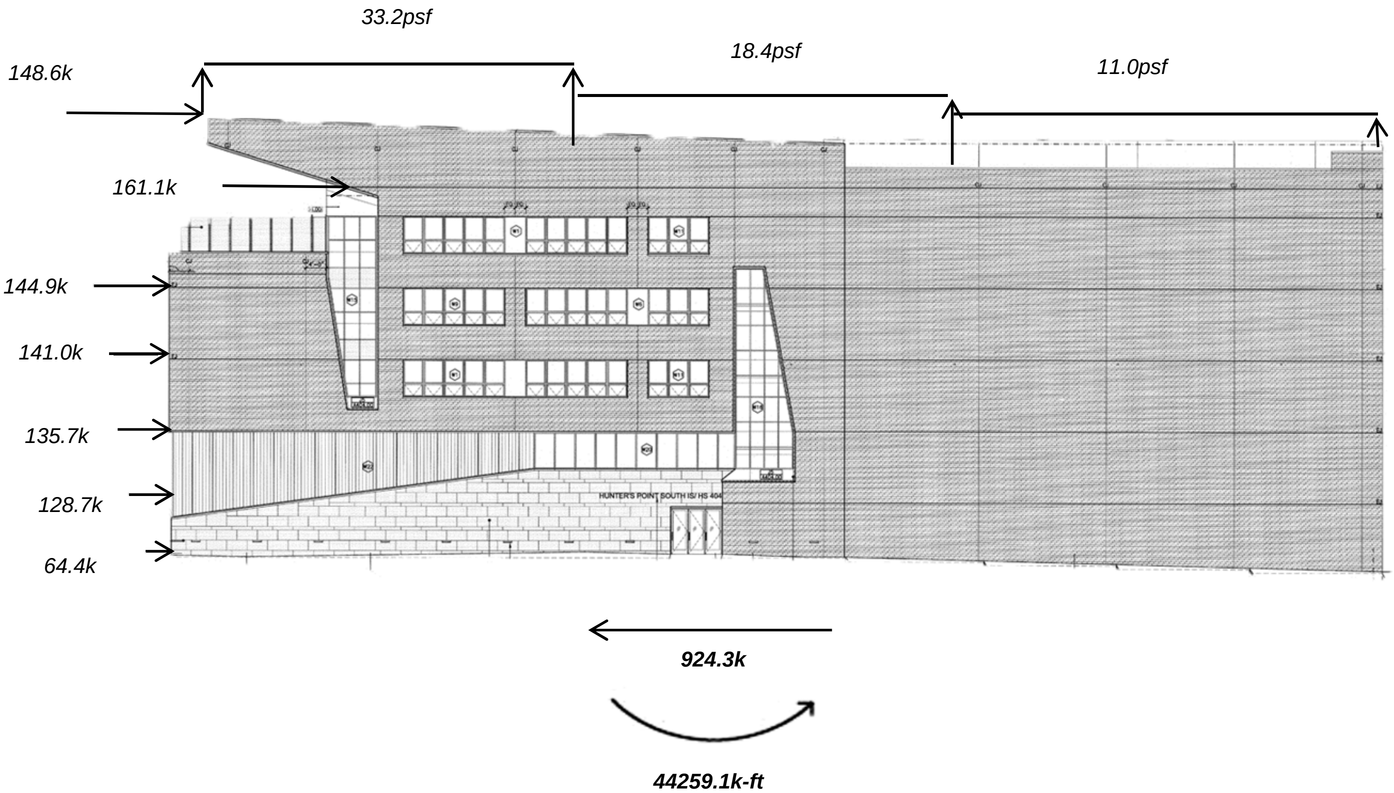



***Figure 13:*** *Wind Forces, E-W Direction*

# DESIGN ANALYSIS

## SEISMIC LOAD SUMMARY

Seismic load analysis was done following the Equivalent Lateral Force Procedure in Chapter 12 of ASCE7-10. Building weight was determined using the structural floor plan drawings, then entered into an Excel file to calculate individual story forces and shear and overturning moment at the base. Using the method prescribed in ASCE7-10, a building period of 0.794 seconds was determined. Total building weight of the structure was found to be roughly 14,200 kips. It should be noted that the weight of the third floor is on the high side due to heavy plate girders placed at long spans over the gymnasium.

**North-South Direction**

Table 9 shows a base shear of 1186 kips and overturning moment of 7763 k-ft in the N-S direction. A breakdown of individual story forces can be found in Figure 14. The original analysis done for this building came up with a base shear of 1061 k. This means the analysis in this report differs by 10.6%. This can be attributed to several reasons. The original design analysis used the 2008 NYC Building Code which could give different values when completing the reference analysis. Also, when determining floor weights, this report took slightly higher dead load weights than the original design reported (along with a more detailed analysis of weight), which could increase story forces and ultimately the base shear.

**East-West Direction**

Table 10 shows a base shear of 1270 kips and overturning moment of 11,292 k-ft in the E-W direction. A breakdown of individual story forces can be found in Figure 15. The increase of the overturning moment can be attributed to a longer effective building length in that direction.

## North-South Direction Loading

| | |
|---|---|
| T= | 0.794 s |
| k= | 1.147 |
| $V_b$= | 1186 kips |

| i | $h_i$ | h | w | $w*h^k$ | $C_{VX}$ | $f_i$ | $v_i$ | $B_X$ | $5\%B_y$ | $A_x$ | $M_Z$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ft | ft | kips | | | kips | kips | ft | ft | | k-ft |
| | | | | | | | | | | | |
| 6 | 16.33 | 72.33 | 2945 | 399348 | 0.390 | 462 | 462 | 131 | 7 | 1 | 3025 |
| 5 | 14 | 56 | 2563 | 259209 | 0.253 | 300 | 762 | 131 | 7 | 1 | 1964 |
| 4 | 14 | 42 | 2277 | 165596 | 0.162 | 192 | 954 | 131 | 7 | 1 | 1255 |
| 3 | 14 | 28 | 3500 | 159837 | 0.156 | 185 | 1139 | 131 | 7 | 1 | 1211 |
| 2 | 14 | 14 | 1978 | 40788 | 0.040 | 47 | 1186 | 131 | 7 | 1 | 309 |
| 1 | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | ∑ | **13262** | **1024779** | | **1186** | **=V** | | | | **7763** |

*Table 9*

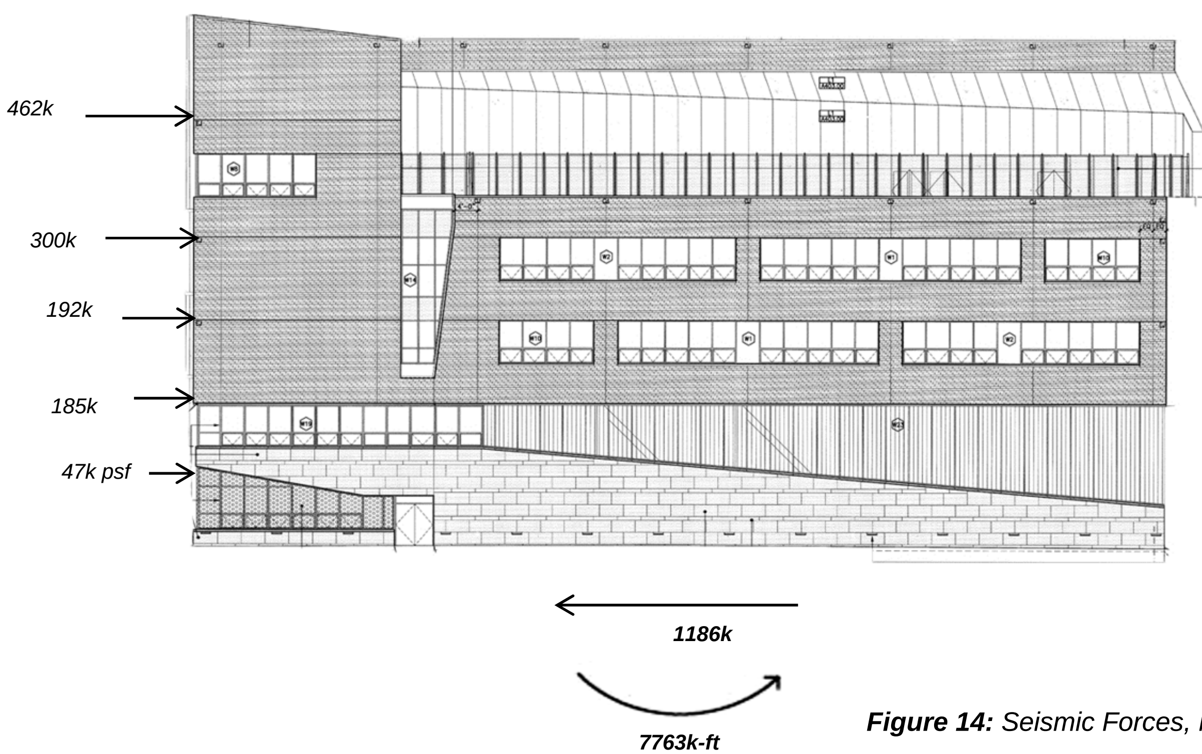



***Figure 14:*** *Seismic Forces, N-S Direction*

**East-West Direction Loading**

T= 0.794 s
k= 1.147
$V_b$= 1186 kips

| i | $h_i$ | h | w | $w*h^k$ | $C_{VX}$ | $f_i$ | $v_i$ | $B_y$ | $5\%B_y$ | $A_x$ | $M_Z$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ft | ft | kips | | | kips | kips | ft | ft | | k-ft |
| | | | | | | | | | | | |
| 6 | 16.33 | 72.33 | 2945 | 399348 | 0.390 | 462 | 462 | 178 | 9 | 1 | 4111 |
| 5 | 14 | 56 | 2563 | 259209 | 0.253 | 300 | 762 | 178 | 9 | 1 | 2668 |
| 4 | 14 | 42 | 2277 | 165596 | 0.162 | 192 | 954 | 178 | 9 | 1 | 1705 |
| 3 | 14 | 28 | 3500 | 159837 | 0.156 | 185 | 1139 | 178 | 9 | 1 | 1645 |
| 2 | 14 | 14 | 1978 | 40788 | 0.040 | 47 | 1186 | 178 | 9 | 1 | 420 |
| 1 | | | | | | | | | | | |
| | | ∑ | **13262** | **1024779** | | **1186** | **=V** | | | | **10549** |

*Table 10*

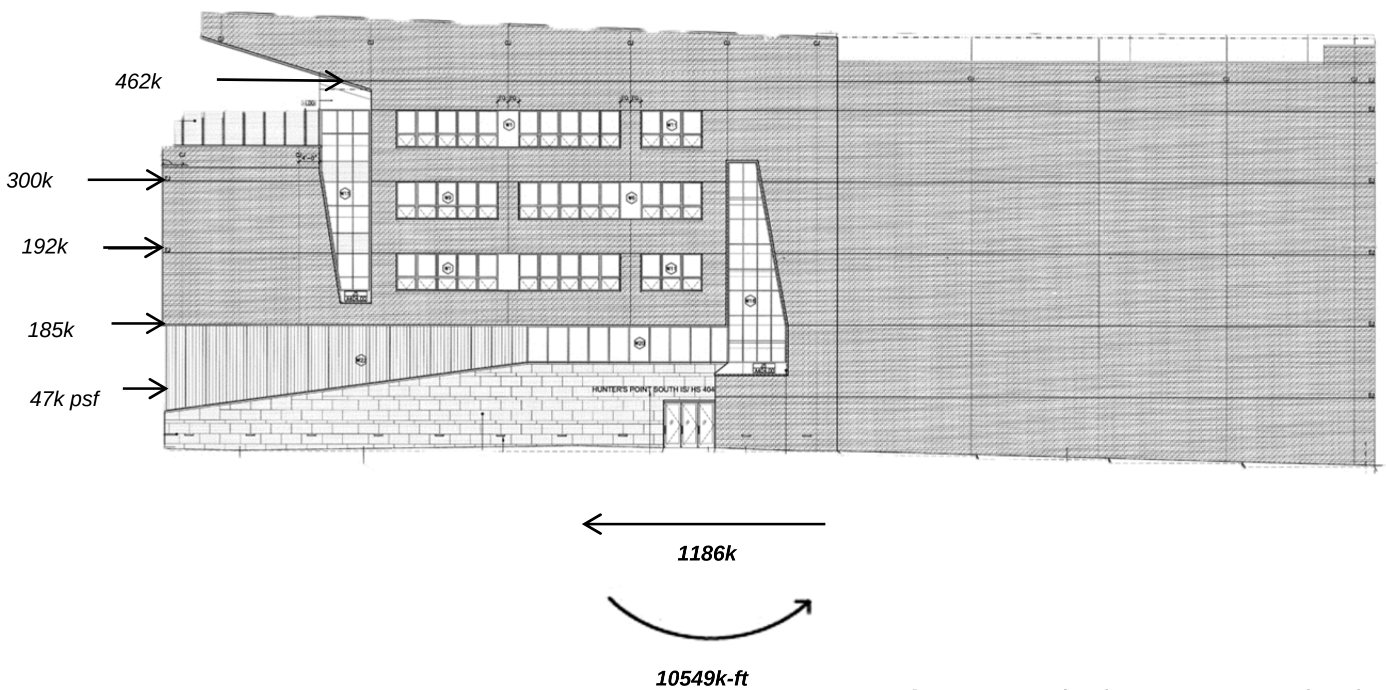



***Figure 15:*** *Seismic Forces, E-W Direction*

# DESIGN ANALYSIS

## GRAVITY LOAD SPOT CHECK

Spot checks were performed on several framing elements in the gravity system to explore whether the original design was conservative, unconservative, etc. A beam, girder, and column in the northeast wing of the fourth floor were chosen for calculations (See Figure16). As was done in the original design, The Allowable Strength Method (ASD) was selected for this analysis so that a comparable member size could be determined for reference. AISC 14th edition was used to determine member sizes.

To start, loads and serviceability were taken into account and sizes were chosen for each member. These results were then compared to the member sizes acquired from the original structural design. Calculations and AISC table references can be found in Appendix C.

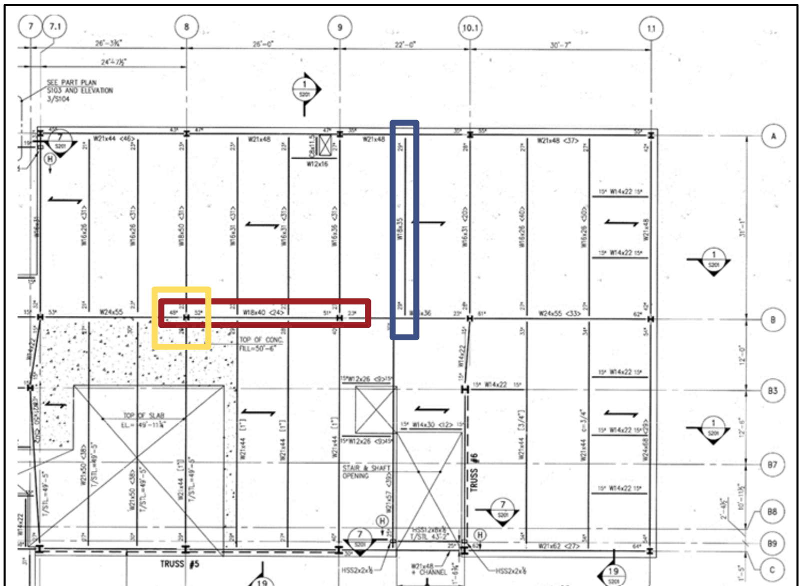



***Figure 16:** Frame Members: Fourth Floor*

**Spot Check for Beam 4-9.5**

This beam does not act compositely with the floor slab. After calculations were performed, a W18X35 steel beam was chosen from AISC. This was the same as the original design.

**Spot Check for Girder 4-B8-9**

This beam acts compositely with floor slab it supports. After calculations were performed, a W18X40 steel beam was chosen with 24 shear studs connecting it to the slab. Once again this was the same as the original design.

**Spot Check for Interior Column 4-B8**

After calculations were performed, a W12X58 steel column was chosen from AISC. This was once again the same as the original design.

It should be noted that different member sizes would have been determined if this report used the LRFD method of design. This was just a check on the original design though.

# EVALUATION AND SUMMARY

Technical Report I is an analytical report that focused on describing and dissecting the structural components and existing conditions of the Hunter's Point South School building design. It should be reemphasized that all analysis and descriptions done in this report were focused on the original design of the structure. This report began by introducing the structure by system, going into detail about foundations, floor systems, framing, and lateral supports. It also introduced the design criteria that will be used for future research on this project.

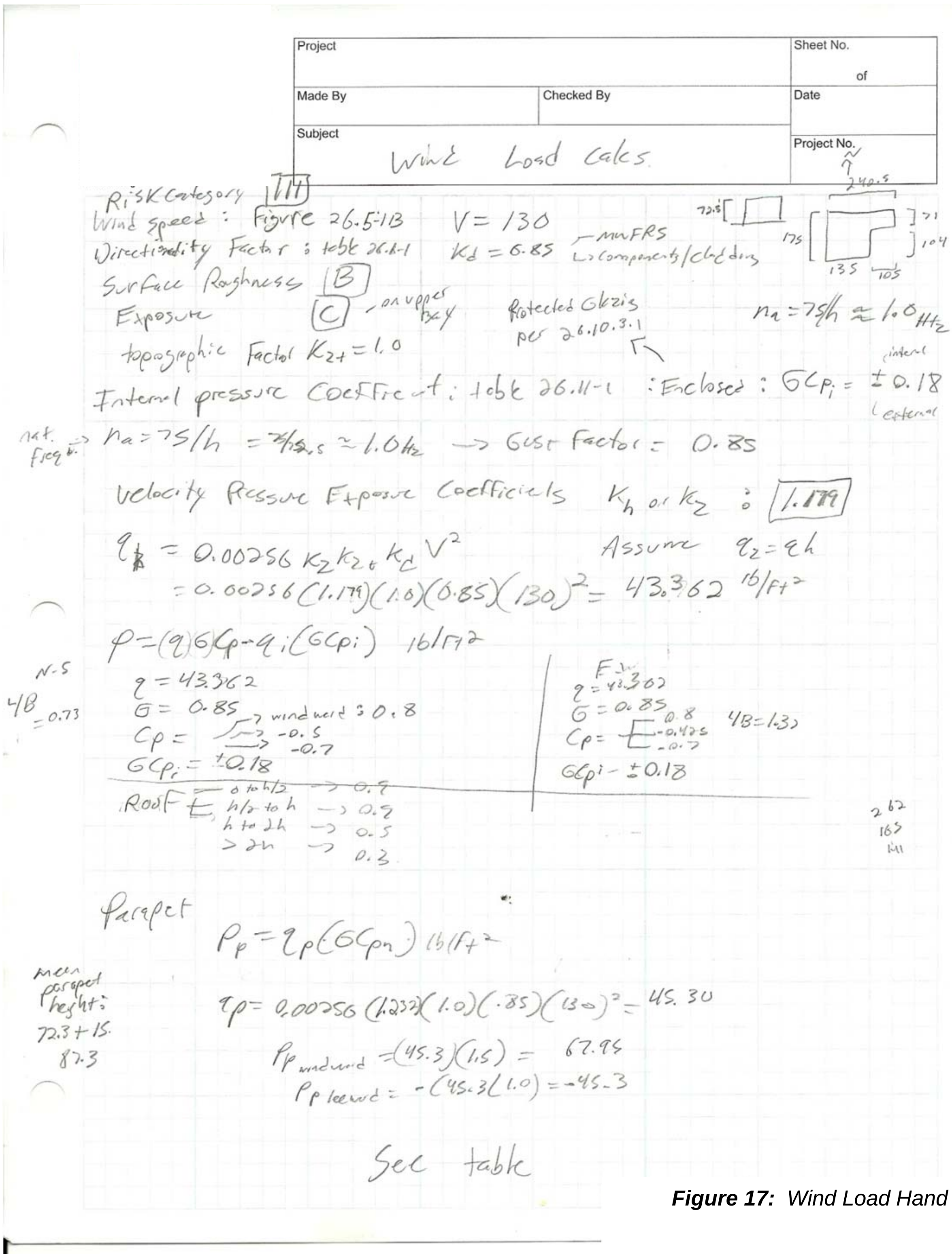
In addition, Material strengths and gravity loads to be used on this design were determined and analyzed. Using AISC7-10, suitable dead load, live load, and snow load were chosen. Some differences did show up when compared to the NYC Building Code used in the original design. Three point checks on the existing gravity system concluded that member sizes were chosen appropriately in accordance to minimum code design.

Lastly, detailed wind and seismic load analyses were performed for this building. After calculations were performed, it was found that wind loads controlled the lateral system design everywhere but in the E-W shear force. Seismic forces caused a base shear of 1186 k and overturning moment of 10,549 k-ft in this direction. This was 10.6% higher than the original design analysis. However, with wind loads creating a max base shear of 1322 k and overturning moment of 61,324 k-ft, it is determined that wind will in fact control the building design. Also, taking into account location, New York City is in a low seismic region and on the coast line where higher winds are present. Furthermore, a Response Modification Coefficient (R) of 3 will be used for lateral load design.

Technical Report II will analyze and discuss the advantages and disadvantages of different floor systems that could be applied on this design.

# APPENDIX A

## WIND ANALYSIS



Project | Sheet No. of
Made By | Checked By | Date
Subject: Wind Load Calcs | Project No.

Risk Category III
Wind speed: Figure 26.5-1B V = 130
Directionality Factor: table 26.6-1 Kd = 0.85 — MWFRS, Components/cladding
Surface Roughness B
Exposure C – on upper bay
Protected Glazing per 26.10.3.1
$n_a = 75/h \approx 1.0$ Hz
topographic Factor $K_{zt} = 1.0$
Internal pressure Coefficient: table 26.11-1 : Enclosed : $GC_{pi} = \pm 0.18$ (internal / external)
nat. Freq. ⇒ $n_a = 75/h = 75/72.5 \approx 1.0$ Hz → Gust Factor = 0.85
Velocity Pressure Exposure Coefficients $K_h$ or $K_z$ : 1.179
$q_h = 0.00256 K_z K_{zt} K_d V^2$ Assume $q_z = q_h$
$= 0.00256(1.179)(1.0)(0.85)(130)^2 = 43.362$ lb/ft²
$p = (q)GC_p - q_i(GC_{pi})$ lb/ft²

N-S, L/B = 0.73
q = 43.362
G = 0.85
Cp = windward 0.8, −0.5, −0.7
$GC_{pi} = \pm 0.18$
Roof: 0 to h/2 → 0.9; h/2 to h → 0.9; h to 2h → 0.5; > 2h → 0.3

E-W
q = 43.362
G = 0.85
Cp = 0.8, −0.425, −0.7
L/B = 1.37
$GC_{pi} = \pm 0.18$

Parapet
$P_p = q_p(GC_{pn})$ lb/ft²
mean parapet height: 72.3 + 15 = 87.3
$q_p = 0.00256(1.232)(1.0)(.85)(130)^2 = 45.30$
$P_{p\,windward} = (45.3)(1.5) = 67.95$
$P_{p\,leeward} = -(45.3)(1.0) = -45.3$

See table

***Figure 17:*** *Wind Load Hand Calc.*

| Windload Design Criteria | | |
|---|---|---|
| **Per ASCE7-10** | **N-S** | **E-W** |
| Risk Category | III | |
| Importance Factor | 1 | |
| Exposure | C | |
| Surface Roughness | B | |
| V | 130 | |
| $K_d$ | 0.85 | |
| $K_{zt}$ | 1 | |
| $n_a$ | 1.03 | |
| G | 0.85 | |
| $K_h$ | 1.19 | |
| h | 72.3 | |
| L | 175 | 240.5 |
| B | 240.5 | 175 |
| L/B | 0.728 | 1.374 |
| h/l | 0.413 | 0.301 |
| $C_p$ Windward | 0.8 | |
| $C_p$ Leeward | -0.5 | -0.425 |
| $C_p$ Side | -0.7 | |
| $C_p$ Roof | 0 to h/2 | -0.9 |
| | h/2 to h | -0.9 |
| | h to 2h | -0.5 |
| | >2h | -0.3 |
| Reduction Factor | 0.8 | |
| $GC_{pi}$ | +/-0.18 | |
| $K_h$ | 1.179 | |
| $q_z$ | 43.36 | |
| $q_p$ | 45.30 | |
| $GC_{pn}$ Windward | 1.5 | |
| $GC_{pn}$ Leeward | -1 | |

*Table 11*

| Velocity Pressure | | | |
|---|---|---|---|
| **Level** | **Height** | **$K_z$** | **$q_z$** |
| Parapet | 87.3 | 1.232 | 45.30 |
| Roof | 72.3 | 1.179 | 43.36 |
| 5 | 56 | 1.114 | 40.97 |
| 4 | 42 | 1.050 | 38.61 |
| 3 | 28 | 0.964 | 35.45 |
| 2 | 14 | 0.850 | 31.26 |
| 1 | 0 | 0.850 | 31.26 |

*Table 12*

# APPENDIX B

## SEISMIC ANALYSIS

| Project | | Sheet No. of |
|---|---|---|
| Made By | Checked By | Date |
| Subject: Seismic Loads ASCE 7-10 Chpt 11 | | Project No. |

fig 22-1 $S_S = .25 \rightarrow .25$ fig 22-12 $T_L = 6$ table 12.2.1 $R = 3$

fig 22-2 $S_1 = .073$ → .073 (.75) table 20.3.1 – Site class = E (soft clay soil)

fig 22-7 MCE$_G$ PGA = 15% g fig 22-17 $C_{RS} = 0.9$

fig 22-18 $C_{R1} = 0.9$ $I_e = 1.25$

table 11.4.1

$F_a = 2.5$ $S_{MS} = F_a S_S = (2.5)(.25) = 0.625$

table 11.4.2 $S_{M1} = F_v S_1 = (3.5)(.073) = 0.2555$

$F_v = 3.5$ $S_{DS} = 2/3 \, S_{MS} = 2/3 (0.625) = 0.4167$

$S_{D1} = 2/3 \, S_{M1} = 2/3 (0.2555) = 0.1703$

$T_0 = 0.2 \frac{S_{D1}}{S_{DS}} = (.2)\left(\frac{.1703}{.4167}\right) = 0.0817$

Seismic Design Category: C (table 11.6-1 & 11.6-2)

$T_S = \frac{S_{D1}}{S_{DS}} = 0.4087$

use Equivalent lateral Force Analysis method

$T_L = 6$

Equivalent Lateral Force Analysis Method

$V = C_S W$

$C_S = \min \begin{cases} S_{DS}/(R/I_e) \\ S_{D1}/(T(R/I_e)) \\ S_{D1}T_L/(T^2(R/I_e)) \end{cases} = \begin{cases} 0.4167/(3/1.25) = 0.173625 \text{ controls} \\ 0.1703/[0.7936679(3/1.25)] = 0.08940557 \\ (0.1703)(6)/[.7936679^2(3/1.25)] = 0.6758922 \end{cases}$

$T_a = C_t h_n^x = (0.02)(72.33)^{0.75} = 0.4960425$ (table 12.8.2)

$T \approx C_u T_a = (1.6)(0.4960425) = 0.7936679$ (table 12.8.1)

| Floor weights | |
|---|---|
| R | 3047.24 |
| 5 | 2951.28 |
| 4 | 2631.63 |
| 3 | 3895.83 |
| 2 | 2284.97 |
| | 14820 |

$V_{base} = C_S W = (0.08940557)(14,820) = 1325.0^K$

$W = 14,820 K$

$F_x = C_{vx} V$

(see Table)

***Figure 18:*** *Seismic Load Hand Calc.*

| Roof | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | weight/ft | length | weight | | | weight/ft | length | weight | | | | Area | DL | LL | SL | Tot | weight |
| **Column** | | | | | **Beam** | | | | | **Floor** | | | | | | | | |
| 10 | X | 49 | 17 | 833 | 24 | X | 76 | 24 | 1824 | 31.1 | X | 232.45 | 7229.195 | 85 | 45 | 22 | 85 | 614481.6 |
| 10 | X | 54 | 17 | 918 | 24 | X | 76 | 24 | 1824 | 39.25 | X | 198.45 | 7789.163 | 85 | | | | 662078.8 |
| 12 | X | 96 | 17 | 1632 | 24 | X | 68 | 21.3 | 1448.4 | 101.75 | X | 104.66 | 10649.16 | 85 | | | | 905178.2 |
| 10 | X | 54 | 17 | 918 | 24 | X | 68 | 23.08333 | 1569.667 | TOTAL | | | | | | | | 2181739 |
| 10 | X | 54 | 17 | 918 | 24 | X | 68 | 24.39583 | 1658.917 | | | | | | | | | 2181.739 |
| 12 | X | 96 | 17 | 1632 | 24 | X | 68 | 19.10417 | 1299.083 | | | | | | | | | |
| 10 | X | 68 | 14 | 952 | 24 | X | 68 | 26.3125 | 1789.25 | | | | | | | | | |
| 10 | X | 54 | 14 | 756 | 24 | X | 68 | 26 | 1768 | **PERIMETER** | | | | | | | | |
| 10 | X | 54 | 14 | 756 | 24 | X | 68 | 22 | 1496 | 19 | X | 592 | 11248 | 20 | | | | 224960 |
| 10 | X | 54 | 17 | 918 | 30 | X | 99 | 30.58333 | 3027.75 | 11 | X | 172 | 1892 | 20 | | | | 37840 |
| 12 | X | 53 | 17 | 901 | 14 | X | 22 | 12 | 264 | | X | | 0 | | | | | 262800 |
| 12 | X | 79 | 7 | 553 | 12 | X | 26 | 12 | 312 | | | | | | | | | 262.8 |
| 10 | X | 54 | 17 | 918 | 12 | X | 26 | 10.65 | 276.9 | | | | | | | | | |
| 12 | X | 40 | 17 | 680 | 14 | X | 22 | 10.19444 | 224.2778 | | | | | | | | | |
| 12 | X | 79 | 7 | 553 | 14 | X | 22 | 12 | 264 | | | | | | | | | |
| 12 | X | 79 | 7 | 553 | 12 | X | 26 | 12 | 312 | | | | | | | | | |
| 12 | X | 79 | 7 | 553 | 12 | X | 26 | 10.65 | 276.9 | | | TOTAL | 2944.57 | | | | | |
| 10 | X | 33 | 7 | 231 | 14 | X | 22 | 10.19444 | 224.2778 | | | | | | | | | |
| 10 | X | 33 | 7 | 231 | 12 | X | 26 | 11.54165 | 300.0829 | | | | | | | | | |
| 12 | X | 40 | 7 | 280 | 12 | X | 26 | 8.133333 | 211.4667 | | | | | | | | | |
| 12 | X | 40 | 7 | 280 | 14 | X | 22 | 11.72917 | 258.0417 | | | | | | | | | |
| 10 | X | 33 | 7 | 231 | 24 | X | 76 | 24 | 1824 | | | | | | | | | |
| 12 | X | 50 | 17 | 850 | 21 | X | 101 | 24 | 2424 | | | | | | | | | |
| 10 | X | 33 | 7 | 231 | 14 | X | 233 | 21.3 | 4962.9 | | | | | | | | | |
| 10 | X | 33 | 7 | 231 | 16 | X | 36 | 23.08333 | 831 | | | | | | | | | |
| 10 | X | 33 | 7 | 231 | 16 | X | 36 | 24.39583 | 878.25 | | | | | | | | | |
| 10 | X | 33 | 7 | 231 | 16 | X | 36 | 19.10417 | 687.75 | | | | | | | | | |
| 12 | X | 79 | 7 | 553 | 21 | X | 50 | 26.3125 | 1315.625 | | | | | | | | | |
| 10 | X | 33 | 7 | 231 | 21 | X | 50 | 26 | 1300 | | | | | | | | | |
| 12 | X | 50 | 7 | 350 | 21 | X | 50 | 22 | 1100 | | | | | | | | | |
| 12 | X | 79 | 7 | 553 | 24 | X | 62 | 30.58333 | 1896.167 | | | | | | | | | |
| 12 | X | 79 | 7 | 553 | 4 | X | 13 | 8 | 104 | | | | | | | | | |
| 12 | X | 79 | 7 | 553 | 4 | X | 13 | 8.5 | 110.5 | | | | | | | | | |
| 12 | X | 79 | 7 | 553 | 4 | X | 13 | 9 | 117 | | | | | | | | | |
| 14 | X | 53 | 15 | 795 | 4 | X | 13 | 10 | 130 | | | | | | | | | |
| 10 | X | 33 | 7 | 231 | 4 | X | 13 | 10.5 | 136.5 | | | | | | | | | |
| 12 | X | 40 | 7 | 280 | 4 | X | 13 | 11 | 143 | | | | | | | | | |
| 12 | X | 79 | 7 | 553 | 4 | X | 13 | 12 | 156 | | | | | | | | | |
| 10 | X | 33 | 7 | 231 | 4 | X | 13 | 12.5 | 162.5 | | | | | | | | | |
| 12 | X | 40 | 7 | 280 | 4 | X | 13 | 13 | 169 | | | | | | | | | |
| 12 | X | 79 | 7 | 553 | 4 | X | 13 | 14 | 182 | | | | | | | | | |
| 12 | X | 79 | 7 | 553 | 4 | X | 13 | 14.5 | 188.5 | | | | | | | | | |
| 12 | X | 79 | 7 | 553 | 4 | X | 13 | 15 | 195 | | | | | | | | | |
| 10 | X | 33 | 7 | 231 | 4 | X | 13 | 16 | 208 | | | | | | | | | |
| 14 | X | 61 | 7 | 427 | 4 | X | 13 | 16.5 | 214.5 | | | | | | | | | |
| 14 | X | 74 | 7 | 518 | 4 | X | 13 | 17 | 221 | | | | | | | | | |
| HSS | | | 7 | 0 | 4 | X | 13 | 18 | 234 | | | | | | | | | |
| HSS | | | 7 | 0 | 4 | X | 13 | 18.5 | 240.5 | | | | | | | | | |
| 14 | X | 109 | 14.25 | 1553.25 | 4 | X | 13 | 19 | 247 | | | | | | | | | |
| 14 | X | 193 | 13.5 | 2605.5 | 4 | X | 13 | 20 | 260 | | | | | | | | | |
| 14 | X | 233 | 12.75 | 2970.75 | 4 | X | 13 | 20.5 | 266.5 | | | | | | | | | |
| 14 | X | 283 | 12 | 3396 | 4 | X | 13 | 21 | 273 | | | | | | | | | |
| 14 | X | 342 | 11.25 | 3847.5 | 4 | X | 13 | 22 | 286 | | | | | | | | | |
| 14 | X | 342 | 10.75 | 3676.5 | 4 | X | 13 | 22.5 | 292.5 | | | | | | | | | |
| 10 | X | 49 | 7 | 343 | 4 | X | 13 | 24 | 312 | | | | | | | | | |
| 10 | X | 33 | 7 | 231 | 12 | X | 55 | 20 | 1100 | | | | | | | | | |
| 10 | X | 49 | 7 | 343 | 12 | X | 35 | 23.5 | 822.5 | | | | | | | | | |
| 10 | X | 33 | 14 | 462 | 12 | X | 35 | 23.5 | 822.5 | | | | | | | | | |
| 10 | X | 33 | 14 | 462 | 12 | X | 35 | 23.5 | 822.5 | | | | | | | | | |
| 10 | X | 33 | 14 | 462 | 12 | X | 35 | 20 | 700 | | | | | | | | | |
| TOTAL | | | | 46874.5 | 12 | X | 35 | 23.5 | 822.5 | | | | | | | | | |
| | | | | 46.8745 | 12 | X | 35 | 23.5 | 822.5 | | | | | | | | | |
| | | | | | 12 | X | 35 | 22.75 | 796.25 | | | | | | | | | |
| | | | | | 12 | X | 35 | 22.75 | 796.25 | | | | | | | | | |
| | | | | | 12 | X | 35 | 22.75 | 796.25 | | | | | | | | | |
| | | | | | 12 | X | 35 | 23.5 | 822.5 | | | | | | | | | |
| | | | | | 12 | X | 35 | 23.5 | 822.5 | | | | | | | | | |
| | | | | | 12 | X | 35 | 23.5 | 822.5 | | | | | | | | | |
| | | | | | 12 | X | 35 | 23.5 | 822.5 | | | | | | | | | |
| | | | | | 21 | | 101 | 20 | 2020 | | | | | | | | | |
| | | | | | 21 | X | 44 | 23.5 | 1034 | | | | | | | | | |
| | | | | | 21 | X | 44 | 23.5 | 1034 | | | | | | | | | |
| | | | | | 21 | X | 44 | 23.5 | 1034 | | | | | | | | | |
| | | | | | 21 | X | 44 | 23.5 | 1034 | | | | | | | | | |
| | | | | | 21 | X | 44 | 23.5 | 1034 | | | | | | | | | |
| | | | | | 12 | X | 35 | 23.5 | 822.5 | | | | | | | | | |
| | | | | | 21 | X | 44 | 22.75 | 1001 | | | | | | | | | |
| | | | | | 18 | X | 76 | 22.75 | 1729 | | | | | | | | | |
| | | | | | 21 | X | 73 | 20 | 1460 | | | | | | | | | |
| | | | | | 14 | X | 22 | 30 | 660 | | | | | | | | | |
| | | | | | 14 | X | 53 | 30 | 1590 | | | | | | | | | |
| | | | | | 14 | X | 22 | 30 | 660 | | | | | | | | | |
| | | | | | 14 | X | 82 | 30 | 2460 | | | | | | | | | |
| | | | | | 16 | X | 31 | 30 | 930 | | | | | | | | | |
| | | | | | 14 | X | 90 | 30 | 2700 | | | | | | | | | |
| | | | | | 16 | X | 40 | 30 | 1200 | | | | | | | | | |
| | | | | | 14 | X | 109 | 28 | 3052 | | | | | | | | | |
| | | | | | 14 | X | 22 | 26 | 572 | | | | | | | | | |
| | | | | | 14 | X | 90 | 24 | 2160 | | | | | | | | | |
| | | | | | 14 | X | 22 | 20 | 440 | | | | | | | | | |
| | | | | | 14 | X | 82 | 15 | 1230 | | | | | | | | | |

***Figure 19:****Part of Story Weight Calculations using Microsoft Excel*

| | | | | |
|---|---|---|---|---|
| 21 | X | 57 | 40 | 2280 |
| 24 | X | 68 | 10 | 680 |
| 24 | X | 62 | 22 | 1364 |
| 30 | X | 99 | 30.58333 | 3027.75 |
| 16 | X | 40 | 11 | 440 |
| 16 | X | 40 | 25 | 1000 |
| 24 | X | 55 | 23 | 1265 |
| 16 | X | 40 | 18 | 720 |
| 30 | X | 99 | 46 | 4554 |
| 30 | X | 99 | 45 | 4455 |
| 30 | X | 99 | 44 | 4356 |
| 16 | X | 36 | 21 | 756 |
| 16 | X | 36 | 20 | 720 |
| 16 | X | 36 | 20 | 720 |
| 16 | X | 36 | 30 | 1080 |
| 16 | X | 31 | 30 | 930 |
| 16 | X | 31 | 30 | 930 |
| 16 | X | 31 | 32 | 992 |
| 16 | X | 31 | 32 | 992 |
| 16 | X | 36 | 32 | 1152 |
| 16 | X | 36 | 32 | 1152 |
| 16 | X | 36 | 32 | 1152 |
| 16 | X | 36 | 32 | 1152 |
| 21 | X | 50 | 40 | 2000 |
| 21 | X | 50 | 40 | 2000 |
| 14 | X | 22 | 20 | 440 |
| 14 | X | 22 | 20 | 440 |
| 14 | X | 22 | 20 | 440 |
| 14 | X | 22 | 20 | 440 |
| 24 | X | 68 | 20 | 1360 |
| 24 | X | 68 | 20 | 1360 |
| 24 | X | 68 | 23.5 | 1598 |
| 24 | X | 68 | 23.5 | 1598 |
| 24 | X | 117 | 45 | 5265 |
| 24 | X | 162 | 45 | 7290 |
| 24 | X | 117 | 45 | 5265 |
| 24 | X | 162 | 45 | 7290 |
| 24 | X | 117 | 42 | 4914 |
| 24 | X | 117 | 40 | 4680 |
| 14 | X | 22 | 20 | 440 |
| 21 | X | 50 | 23.5 | 1175 |
| 14 | X | 22 | 23.5 | 517 |
| 14 | X | 22 | 23.5 | 517 |
| 14 | X | 22 | 23.5 | 517 |
| 14 | X | 22 | 23.5 | 517 |
| 14 | X | 22 | 23.5 | 517 |
| 12 | X | 19 | 10 | 190 |
| 12 | X | 19 | 10 | 190 |
| 12 | X | 19 | 10 | 190 |
| 12 | X | 19 | 10 | 190 |
| 12 | X | 19 | 10 | 190 |
| 12 | X | 19 | 10 | 190 |
| 16 | X | 36 | 11.5 | 414 |
| 24 | X | 62 | 27 | 1674 |
| 12 | X | 50 | 35 | 1750 |
| 24 | X | 62 | 35 | 2170 |
| 21 | X | 57 | 35 | 1995 |
| 24 | X | 62 | 35 | 2170 |
| 24 | X | 55 | 25 | 1375 |
| 24 | X | 55 | 20 | 1100 |
| 24 | X | 55 | 28 | 1540 |
| 24 | X | 55 | 12 | 660 |
| 24 | X | 55 | 22 | 1210 |
| 24 | X | 55 | 35 | 1925 |
| 24 | X | 68 | 25 | 1700 |
| 14 | X | 22 | 12 | 264 |
| 14 | X | 68 | 12 | 816 |
| 24 | X | 68 | 15 | 1020 |
| 24 | X | 68 | 20 | 1360 |
| 24 | X | 76 | 20 | 1520 |
| 12 | X | 19 | 10 | 190 |
| 12 | X | 19 | 10 | 190 |
| 12 | X | 19 | 10 | 190 |
| 12 | X | 19 | 10 | 190 |
| 12 | X | 19 | 10 | 190 |
| 12 | X | 19 | 10 | 190 |
| 12 | X | 19 | 10 | 190 |
| 12 | X | 19 | 10 | 190 |
| 12 | X | 19 | 10 | 190 |
| 12 | X | 19 | 10 | 190 |
| 12 | X | 19 | 10 | 190 |
| 12 | X | 19 | 10 | 190 |
| 12 | X | 19 | 10 | 190 |
| 12 | X | 19 | 10 | 190 |
| 12 | X | 19 | 10 | 190 |
| 12 | X | 19 | 10 | 190 |
| 12 | X | 19 | 10 | 190 |
| 12 | X | 19 | 10 | 190 |
| 12 | X | 19 | 10 | 190 |

| Floor Weight: | |
|---|---|
| **floor** | **weight** |
| roof | 2944.57 |
| 5th | 2563.12 |
| 4th | 2277.47 |
| 3rd | 3499.68 |
| 2nd | 1977.5 |
| **Total** | **13262.3** |

*Table 13*

| | Weight |
|---|---|
| **Misc** | |
| AHU1 | 37200 |
| AHU2 | 39600 |
| AHU3 | 39600 |
| AHU4 | 34900 |
| AHU5 | 21400 |
| AHU6 | 20700 |
| | 193400 |
| | 193.4 |

| | | | | | |
|---|---|---|---|---|---|
| | 12 | X | 19 | 10 | 190 |
| | 12 | X | 19 | 10 | 190 |
| | 12 | X | 19 | 10 | 190 |
| | 12 | X | 19 | 10 | 190 |
| | 12 | X | 19 | 10 | 190 |
| | 12 | X | 19 | 10 | 190 |
| | 12 | X | 19 | 10 | 190 |
| | 30 | X | 99 | 31 | 3069 |
| | 16 | X | 40 | 31 | 1240 |
| | 16 | X | 40 | 31 | 1240 |
| | 16 | X | 40 | 31 | 1240 |
| | 16 | X | 31 | 31 | 961 |
| | 16 | X | 31 | 31 | 961 |
| | 16 | X | 40 | 31 | 1240 |
| | 16 | X | 40 | 31 | 1240 |
| | 16 | X | 40 | 31 | 1240 |
| | 16 | X | 40 | 31 | 1240 |
| | 16 | X | 40 | 31 | 1240 |
| | 16 | X | 40 | 31 | 1240 |
| | 16 | X | 40 | 31 | 1240 |
| | 16 | X | 26 | 31 | 806 |
| | 16 | X | 26 | 31 | 806 |
| | 16 | X | 26 | 31 | 806 |
| | 16 | X | 26 | 31 | 806 |
| | 16 | X | 26 | 31 | 806 |
| | 16 | X | 31 | 31 | 961 |
| | 16 | X | 31 | 31 | 961 |
| | 16 | X | 31 | 31 | 961 |
| | 16 | X | 31 | 31 | 961 |
| | 16 | X | 31 | 31 | 961 |
| | 30 | X | 99 | 31 | 3069 |
| | 40 | X | 167 | 40 | 6680 |
| | 18 | X | 35 | 28 | 980 |
| | 21 | X | 50 | 40 | 2000 |
| | 21 | X | 50 | 40 | 2000 |
| | 21 | X | 50 | 40 | 2000 |
| | 21 | X | 50 | 40 | 2000 |
| | 21 | X | 50 | 40 | 2000 |
| | 21 | X | 57 | 40 | 2280 |
| | 21 | X | 57 | 40 | 2280 |
| | 21 | X | 57 | 40 | 2280 |
| | 21 | X | 57 | 40 | 2280 |
| | 18 | X | 22 | 12 | 264 |
| | 14 | X | 22 | 10 | 220 |
| | 14 | X | 22 | 10 | 220 |
| | 14 | X | 22 | 10 | 220 |
| | 14 | X | 22 | 10 | 220 |
| | 16 | X | 40 | 15 | 600 |
| | 16 | X | 40 | 15 | 600 |
| | | X | | | 0 |
| | | X | | | 0 |
| | | X | | | 0 |
| | | X | | | 0 |
| | | X | | | 0 |
| | | X | | | 0 |
| | | X | | | 0 |
| | | X | | | 0 |
| | | X | | | 0 |
| TOTAL | | | | | 259757.2 |
| | | | | | 259.7572 |

***Figure 20:**Part of Story Weight Calculations using Microsoft Excel*

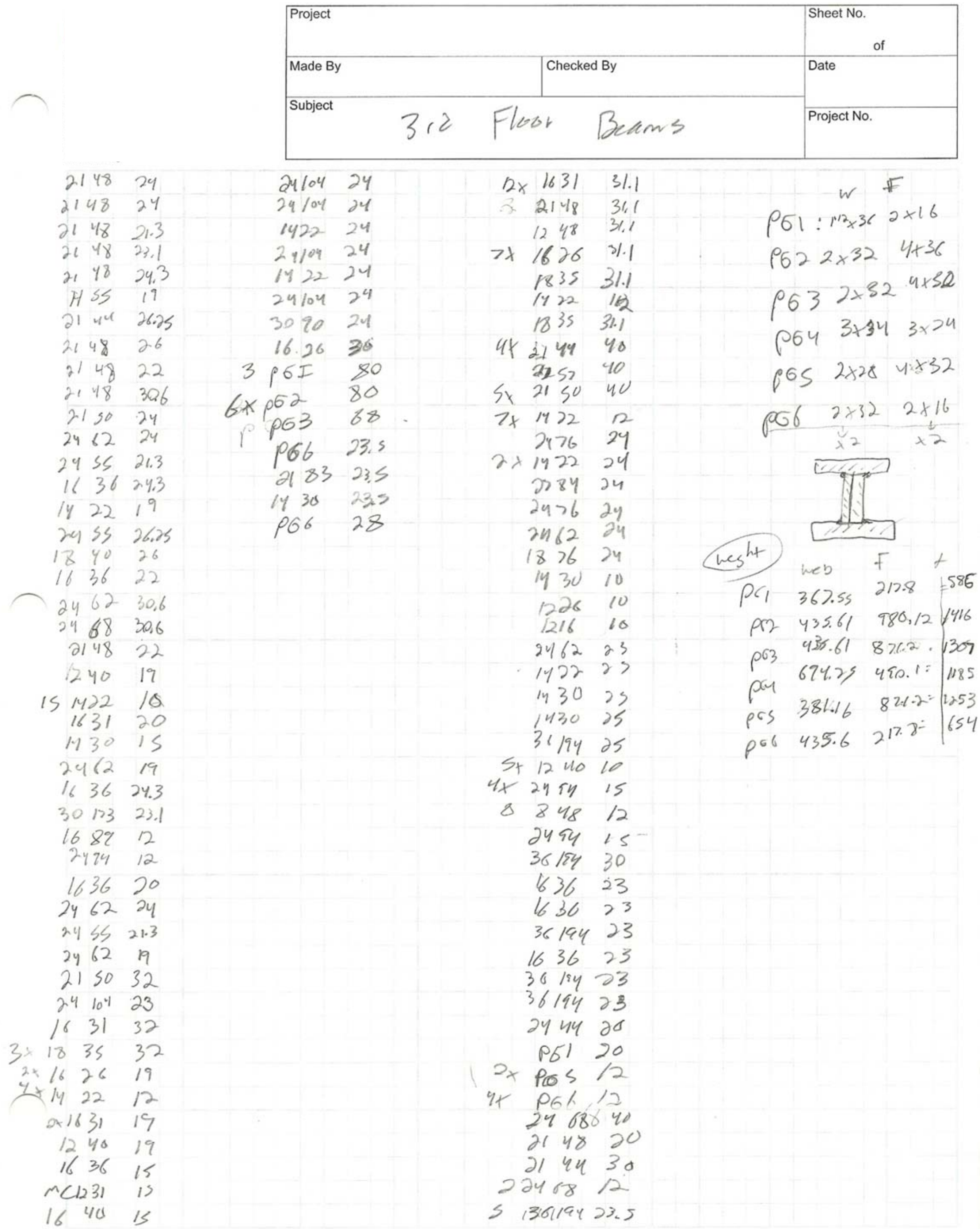



***Figure 21:*** *Part of Story Weight Hand Calc.*

# APPENDIX C

## GRAVITY SPOT CHECK

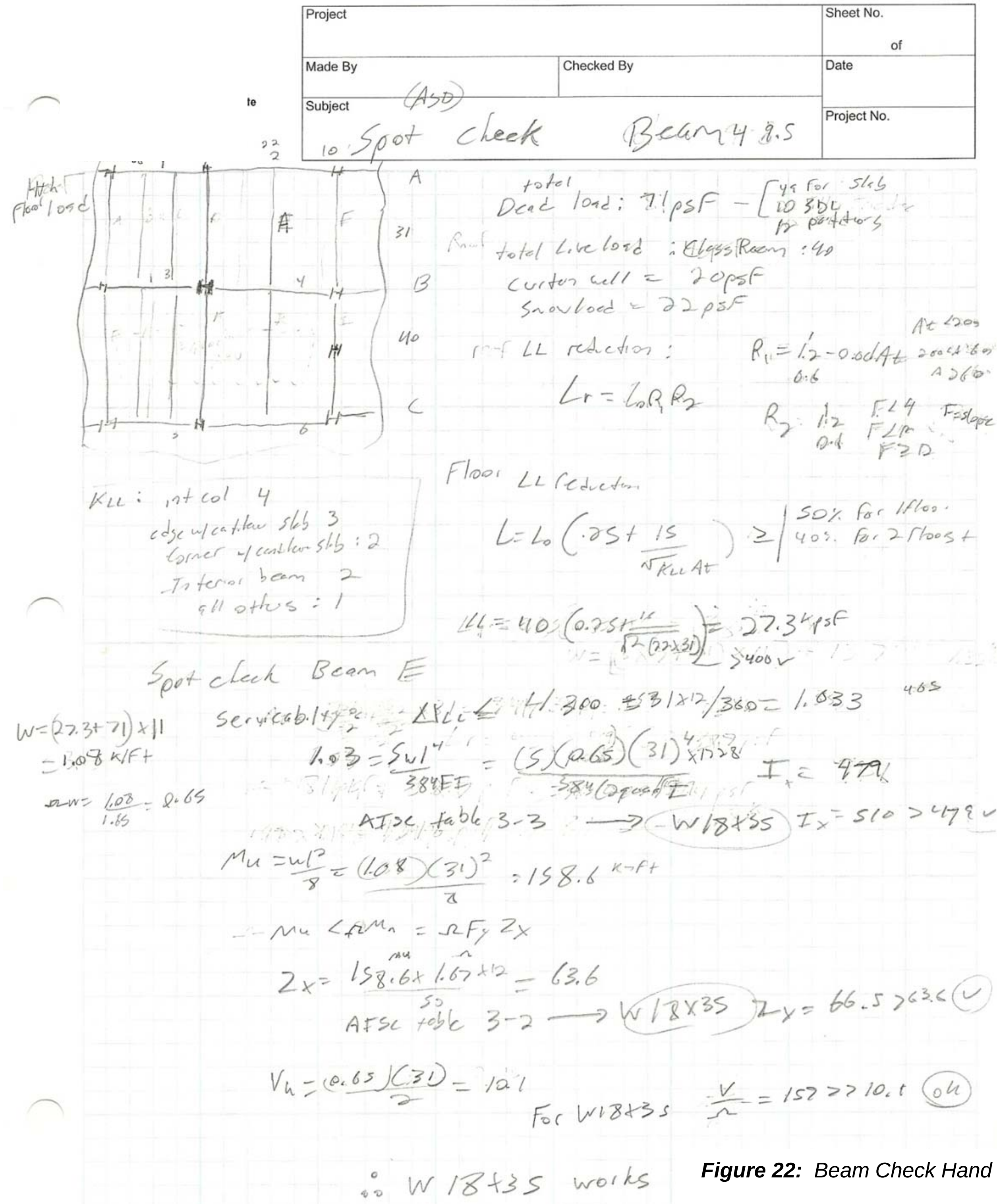



*Figure 22:* *Beam Check Hand Calc.*

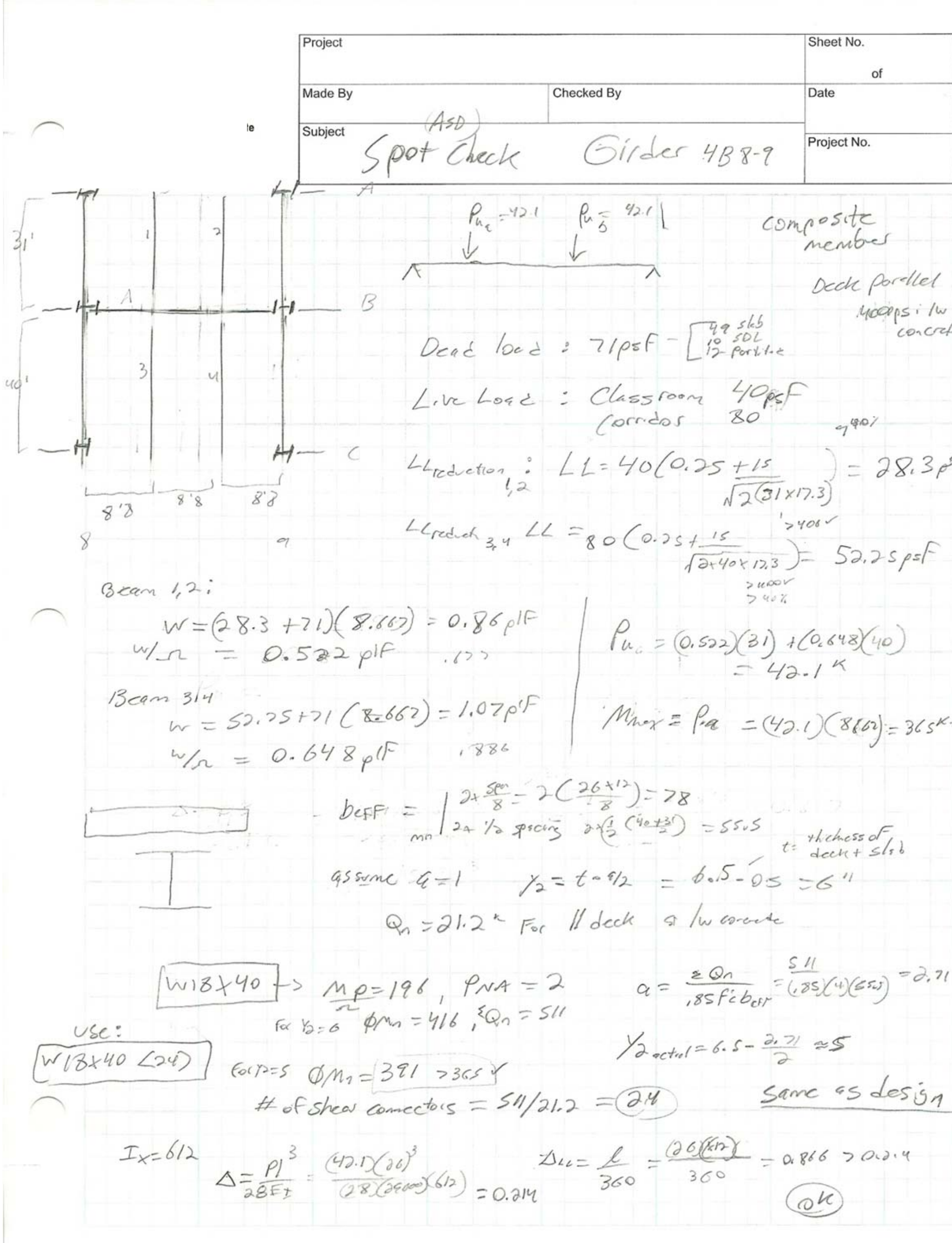



*Figure 23: Girder Check Hand Calc.*

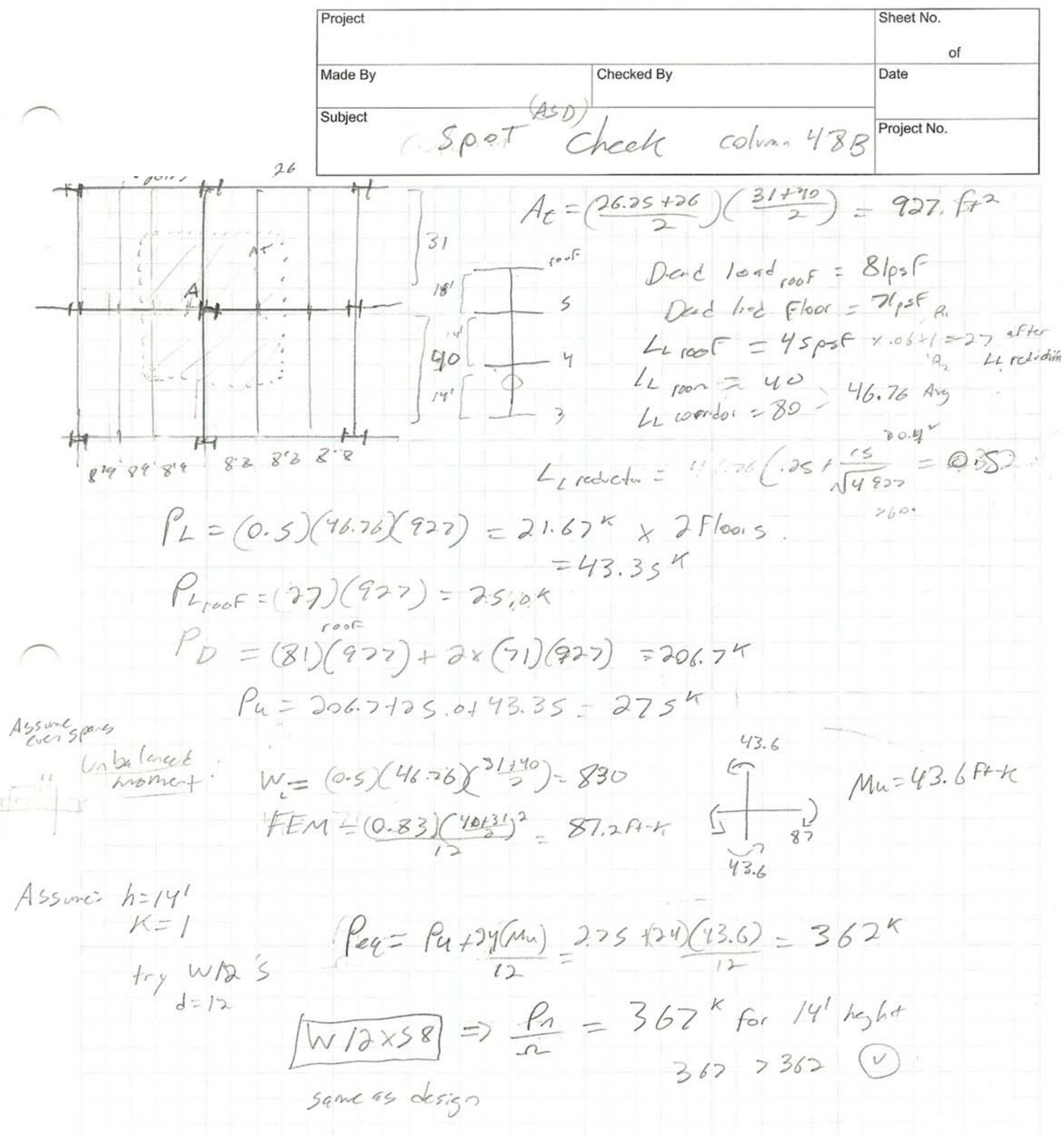
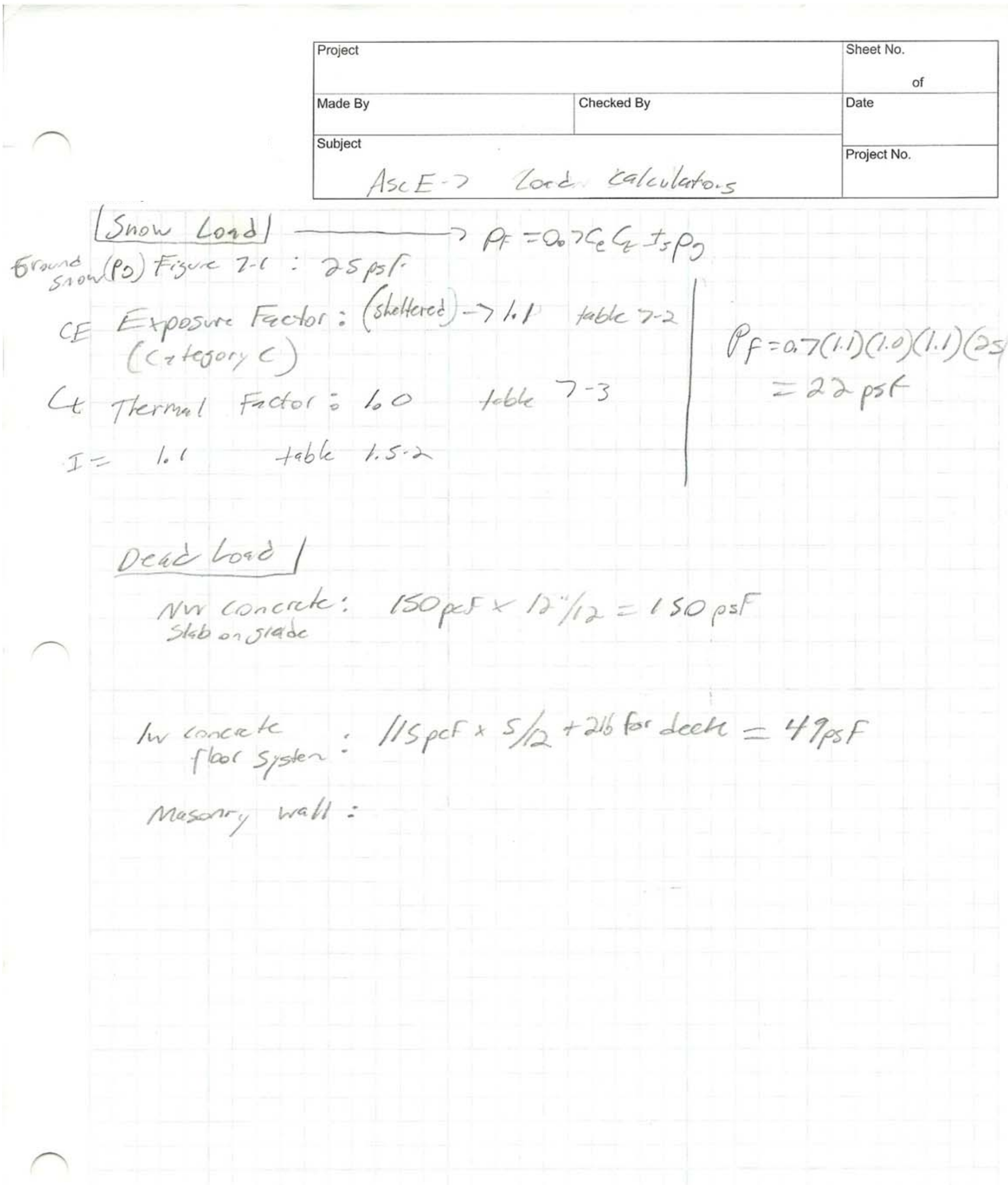



*Figure 24: Column Check Hand Calc.*



| Project | | Sheet No. of |
|---|---|---|
| Made By | Checked By | Date |
| Subject: ASCE-7 Load Calculations | | Project No. |

[Snow Load] → $P_f = 0.7 C_e C_t I_s P_g$

Ground Snow ($P_g$) Figure 7-1 : 25 psf

CE Exposure Factor : (sheltered) → 1.1 table 7-2
(Category C)

Ct Thermal Factor : 1.0 table 7-3

I = 1.1 table 1.5-2

$P_f = 0.7(1.1)(1.0)(1.1)(25)$
$= 22$ psf

Dead Load

NW concrete: slab on grade: 150 pcf × 12"/12 = 150 psf

lw concrete floor system: 115 pcf × 5/12 + 2lb for deck = 49 psf

Masonry wall :

***Figure 25:*** *Calculated Gravity Loads*

# APPENDIX D

## STRUCTURAL FRAMING PLANS

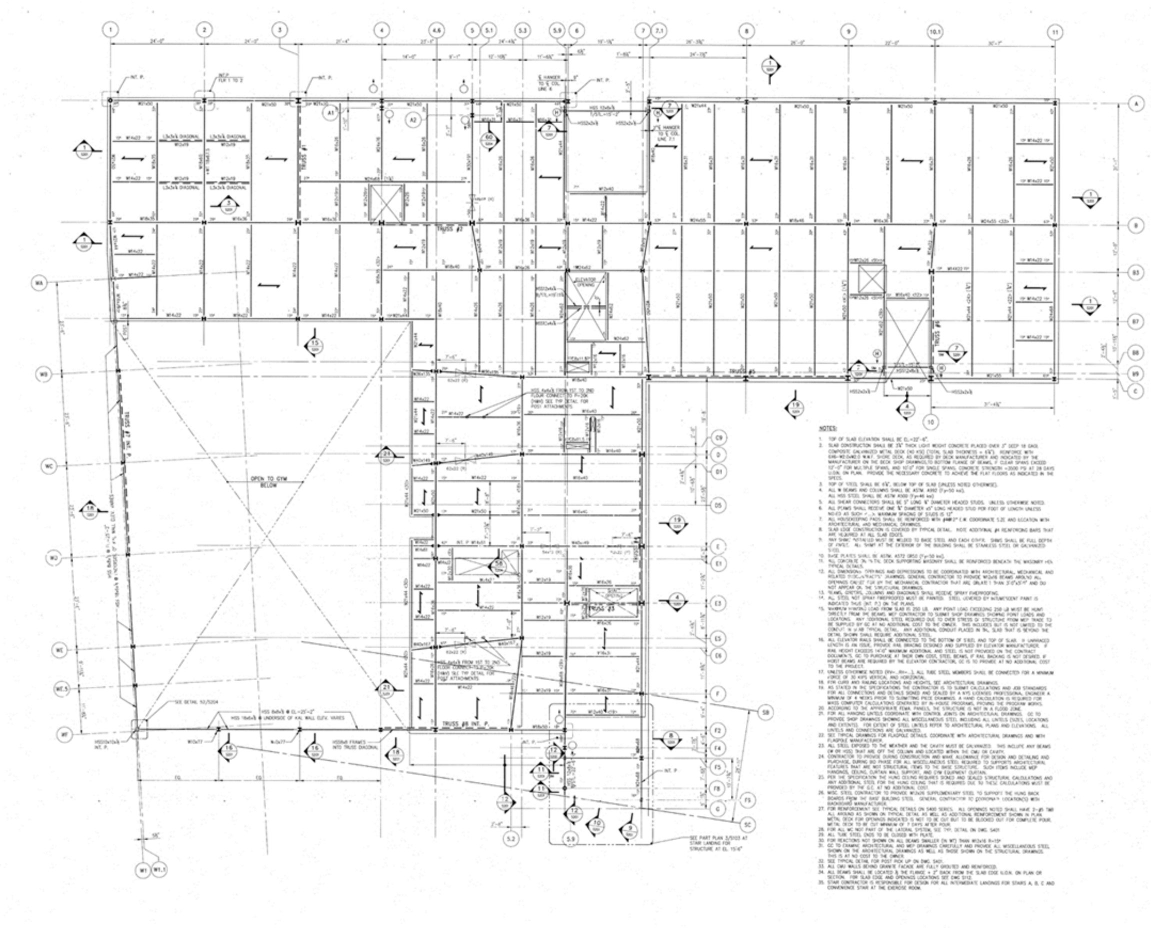


***Figure 26:*** *Second Floor Framing Plan*

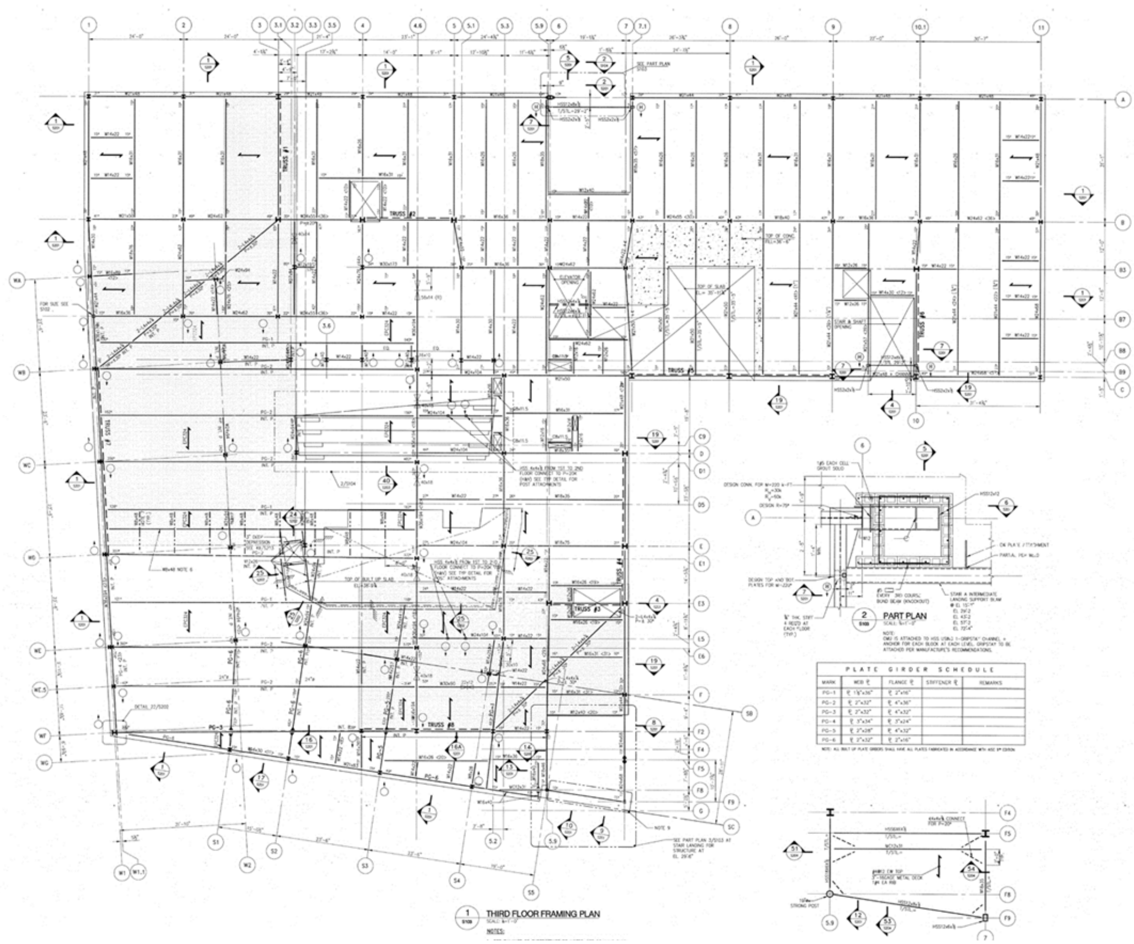


***Figure 27:*** *Third Floor Framing Plan*

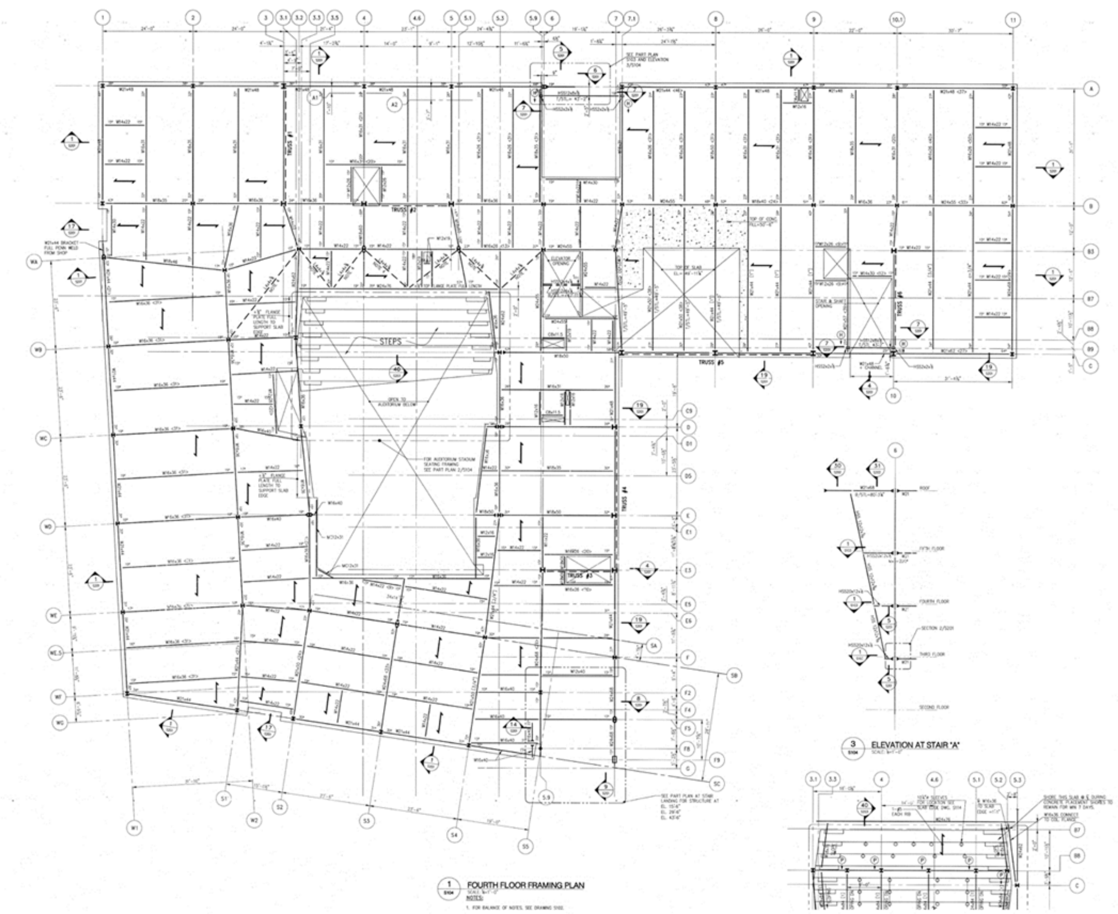


***Figure 28:*** *Fourth Floor Framing Plan*

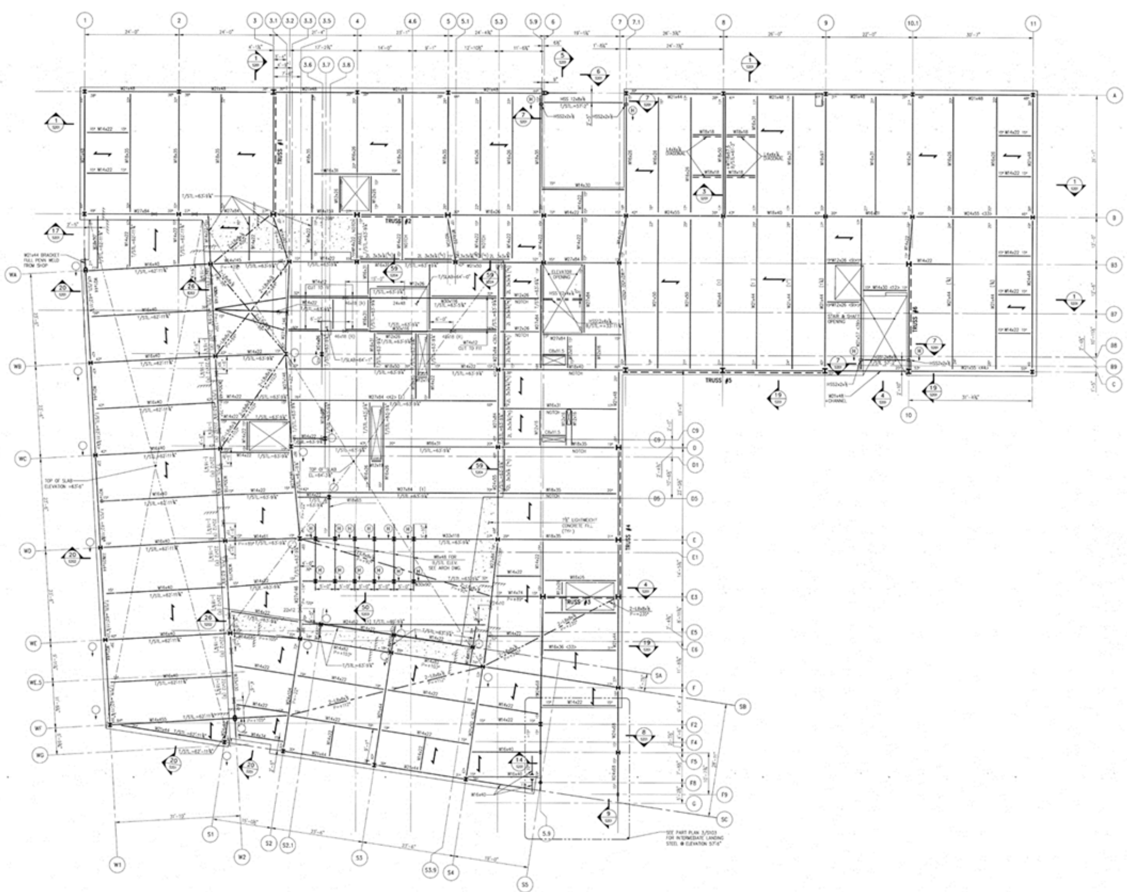


***Figure 29:*** *Fifth Floor Framing Plan*

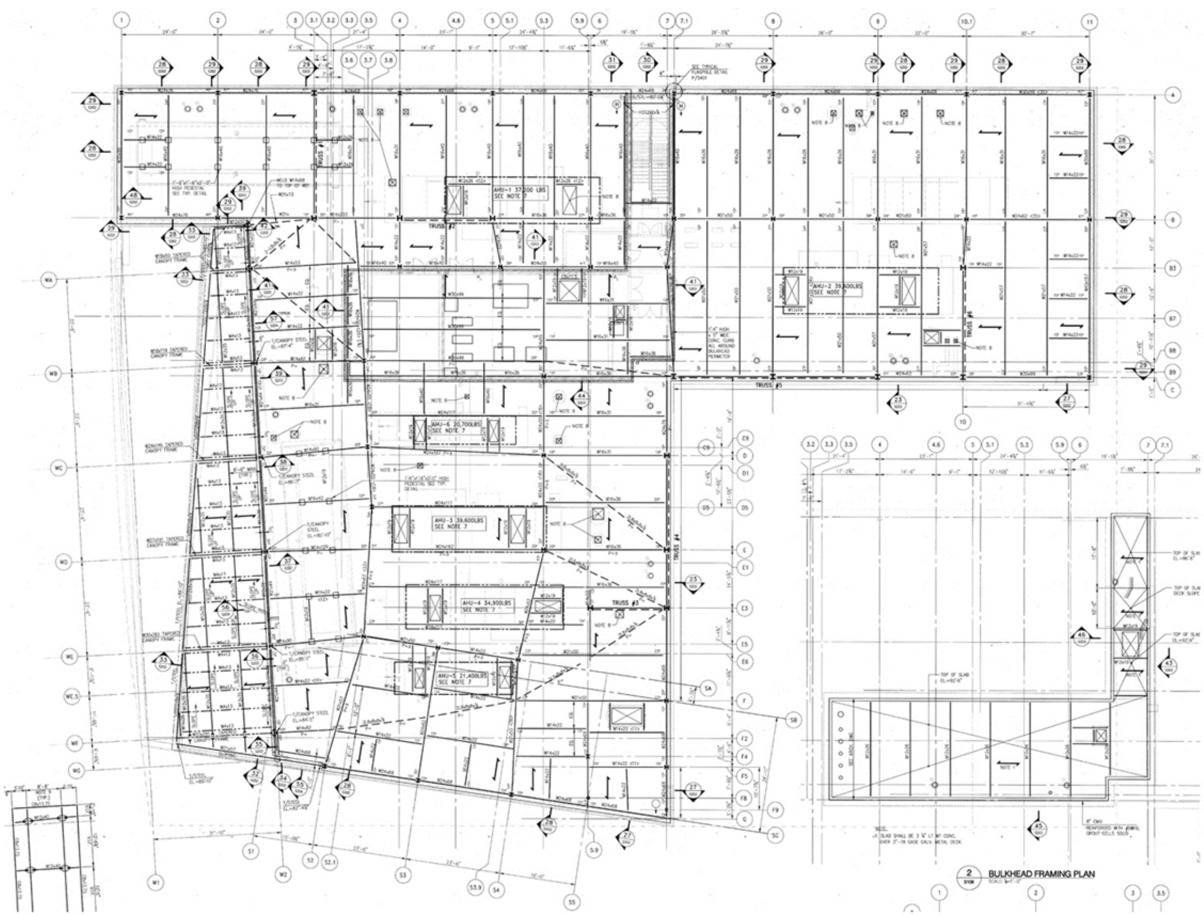


***Figure 30:*** *Roof Framing Plan*