Aric Heffelfinger
Fordham Place
Bronx, NY
Structural Option
Advisor - Dr. Hanagan

Existing Building

Mechanical

The Buildings HVAC system basically consists of a Water Cooled Air Conditioning system in combination with a gas fired Central Boiler Plant. As part of the Core and Shell, a cooling tower mounted on the Building's roof will provide condenser water (supply and return) via common pumps and piping, to adequately size valved taps terminating within each of the tenant spaces. Space heating will be accomplished via a gas fired Modular Central Boiler Plant (located in a mechanical room in the cellar level) which will deliver hot water to the building via common and insulated hot water heating risers, where similarly to the condenser water, adequately sized valved taps terminating at each of the tenant spaces will be provided under the core and shell work.

Electrical

Retail Tenants - Each retail tenant will be provided with a dedicated and separately (direct to utility co) metered electric service feeder emanating from the building's main electric service room. Tenant's service feeder will terminate at a pull box within the tenants space.

Office Tenants - Each office floor will be provided with a separate feeder and floor panels sized to handle an above average office use type space complete with breakers and/or switches for future connection of both lighting and power loads. The floor electrical loads (including HVAC units) will be provided with electronic sub-metering furnished by the LL at tenant's expense for reading energy consumption.

Plumbing

The building will be provided with a few sanitary risers/stacks (with vents) complete with capped outlets at each retail tenant space and at each of the office floors. Domestic cold water to the building will be delivered from a master metered service to the various floors of the building via a common insulated riser. Separate valved outlets terminating at each of the retail tenant spaces will be provided under the core and shell work.

Fire Protection

Building will be provided with a fully automatic sprinkler system in accordance with Code requirements and standard occupancy uses. System coverage will consist of a riser, loop and minimum grid with upright heads. An automatic fire pump will be required and provided under the Core and Shell work. A wet fire-standpipe system complete with hose rack stations,

risers, fittings and devices will be required under the building core and shell work.

Transportation

Building will be equipped with two escalators, 5 passenger elevators, 1 freight elevator, and 4 stair towers. Both escalators will be side by side (one going up and one coming back down), located at the northwestern corner of the existing building, and serving transportation from the concourse floor to the ground floor and from the ground floor to the second floor. Both escalators are almost 3 feet wide and travel at a speed of 100 feet per minute. Of the five passenger elevators, one is located in the existing part of the building while the other four are clustered together serving all 15 floors of the tower part of the building. All five passenger elevators have at least a 3500 lb capacity while traveling at speed of 400 feet per minute. The Freight elevator is located at west side entrance of the existing building and has a capacity of 5000 lb traveling at speeds of 200 feet per minute. The 4 stair towers are strategically located to comply with code. Two of which serve the existing building while the other two stretch from the concourse floor the rooftop of the impressive 15 story tower.

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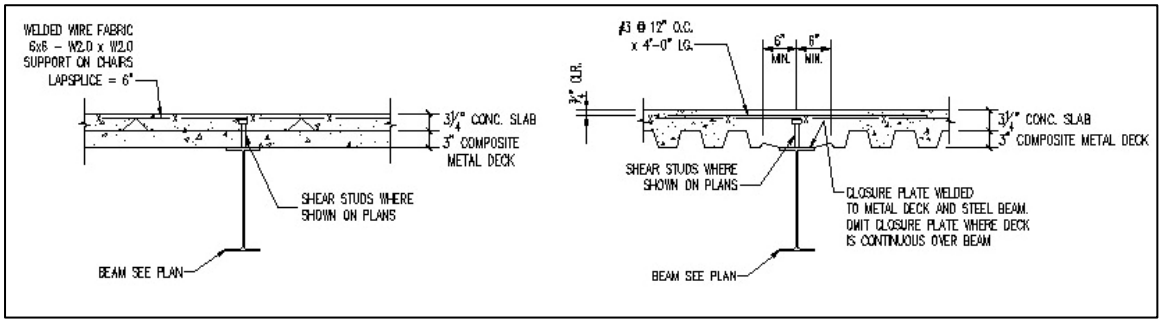
Telecommunication:

Fordham Place features a hi-tech, state of the art security system which consists of personal security at the lobby entrance with additional key cards for access of the building, and key card access of the elevators also. The reception desk will have computers with flat screens, telephones, and a concealed fire command station for security purposes. Pictures of visitors will also be taken upon entry of the building. Each tenant will be given an ample amount of roof space for use of satellite dishes, antennas, etc.

Structural

Floor System

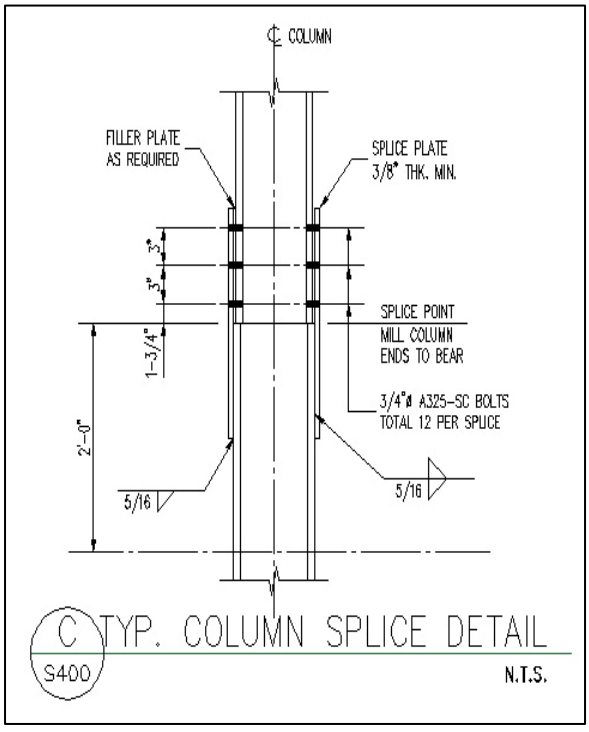
The floor system of Fordham Place consists of structural steel W sections that support metal deck and concrete slab. The W shape beams and girders are A992 grade 50 and support a light weight concrete (115pcf) slab of 6.25 in. The concrete's compressive strength is f'_c = 3000psi for all floors. Reinforcing of concrete is done with high strength billet deformed steel bars



with fy = 60,000psi as a minimum. All floor deck is 20 gage 3" deep galvanized composite deck and is continuous over 2 spans at the joints of the deck. All shear studs are headed studs of grade 1015 or 1020 cold finish carbon steel. Studs, at a maximum are spaced every 12".

Columns

Columns consist of rolled structural W14 shapes grade 50. However there are a few W10x39's that extend from the 14th floor to the roof at selected areas. Columns extend from the concourse floor to just above the second floor, extending 3 floors or 36'. From the second floor up to the roof, columns are spliced at every two floors or 27'. Column Splices consist of 2 – 3/8" plates applied to the flanges of the columns being spliced. The plates are then connected to the bottom column with a 5/16" fillet weld all around the plate. The top column is then connected to the splice plate with 12 - 3/4" Ø A325 S.C. bolts.



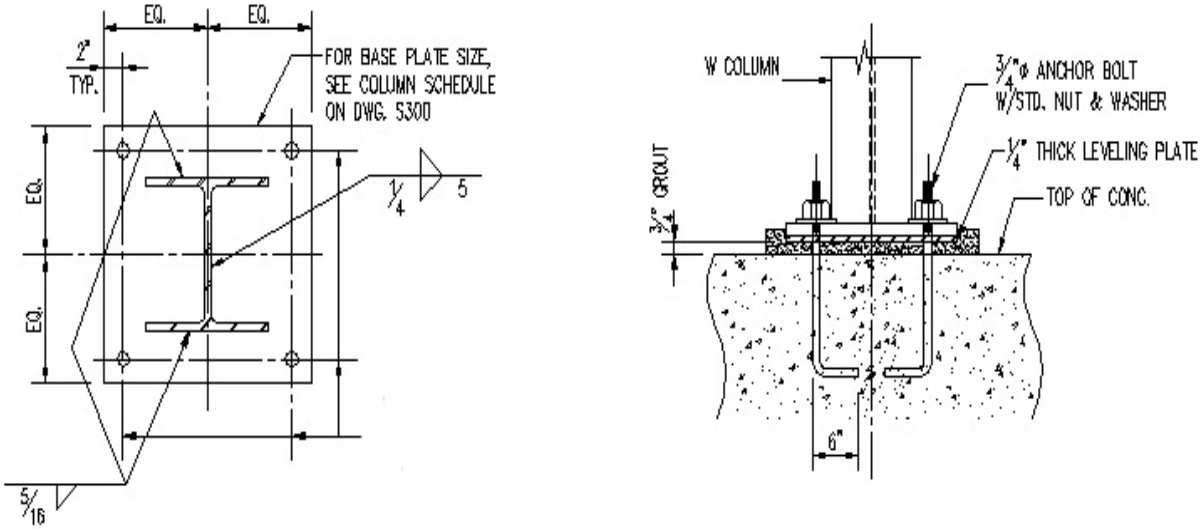
Roof

The roof consists of rolled structural steel W shapes supporting roof deck and a lightweight concrete slab. Structural steel members are grade 50 W16 shapes and typically span approximately 27' with spacing of 9'. Roof deck is 20 gage, 3" deep galvanized wide rib type NI and is continuous over 2 spans at the joints of the deck. The roof deck will span from beam to beam, 9ft., and the short direction of a typical roof bay. The roof deck will be connected to the structural steel with 5/8" puddle weld in a 12-6-12 in pattern. Compressive strength of concrete on the roof is f'c = 3500psi at a minimum. The top of the concrete slab is 3 ¼"above top of slab, totaling to a 6 ¼"concrete slab.

Foundations

The foundation system of Fordham Place is composed of 150 ton steel piles that extend approximately 45 – 50ft deep into bedrock. The piles are A992 grade 50 rolled W shapes and are capped with concrete caps that have a compressive strength of f'c = 3000psi. The pile caps will range in size depending on the number of piles it needs to contain, which is dependent on the load a given column transfers. The number of piles per pile cap

ranges from 4 (PC-4) to 13 (PC-13). Load is transferred from the columns to the pile caps via A36 1/4" steel base plates. The base plate is welded to the column using a 5/16" fillet weld on the exterior of the flanges and a ¼" fillet weld on the web and interior of the flanges. The base plate is connected to the pile cap with 4 - 3/4" Ø anchor bolts extending 12 inches into the pile cap before turning 180 degrees and extending 6 more inches. Flush with the pile cap will be a slab on grade with a compressive strength f'c = 4000psi.



Base Plate Details

Connections

Throughout Fordham Place, there are many different connections, of which I have already talked about two; base plates and column splices. Other connections to consider are shear, moment, bracing connections to both columns and beams. Typical shear connections consist of double angles with the required number of A325 3/4"Ø S.C. bolts. Moment connections will be the same as a typical shear connection but will also have the top and bottom flanges of the beam welded with a 5/16" full penetration field weld. Bracing connections from the braced frames will be to beams and columns at different elevations of the building (See pictures below). Bracing to a column connections will compose of a gusset plate being welded to the underside of a beam and bolted to the column. Bracing members will be bolted to the gusset plate. Bracing to beam connections will occur at the midspan of the beam and will consist of a gusset plate welded to the underside of the beam. Bracing members will then be bolted to the gusset plate.

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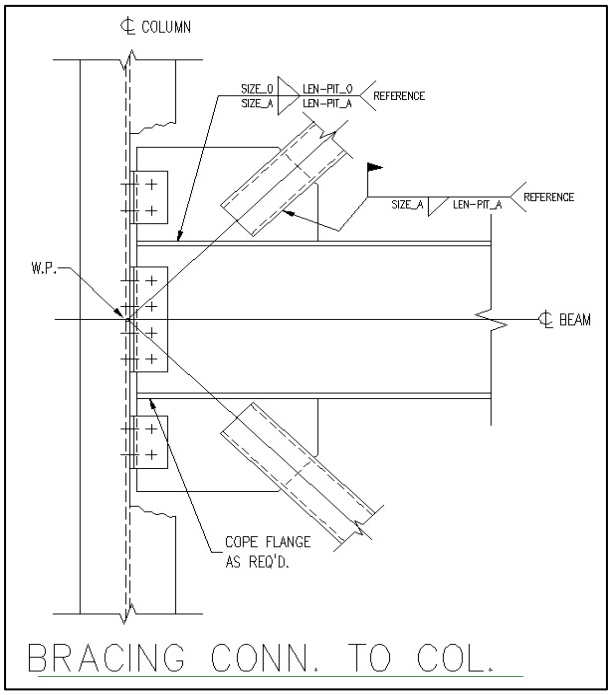
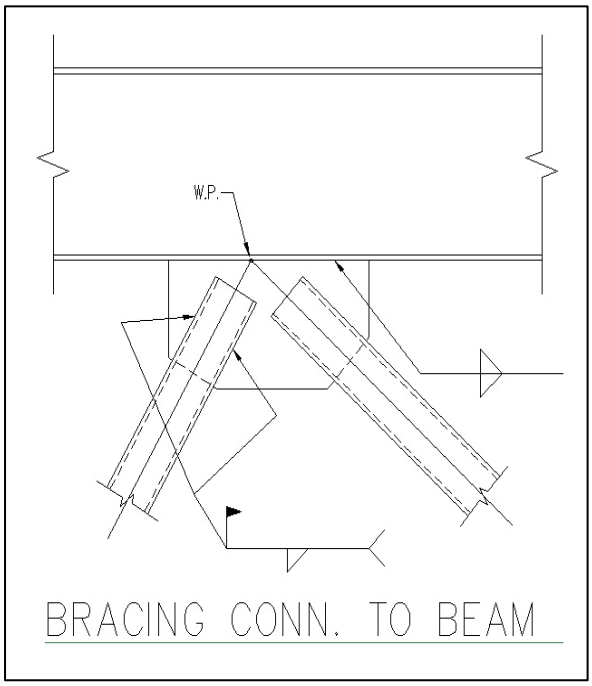




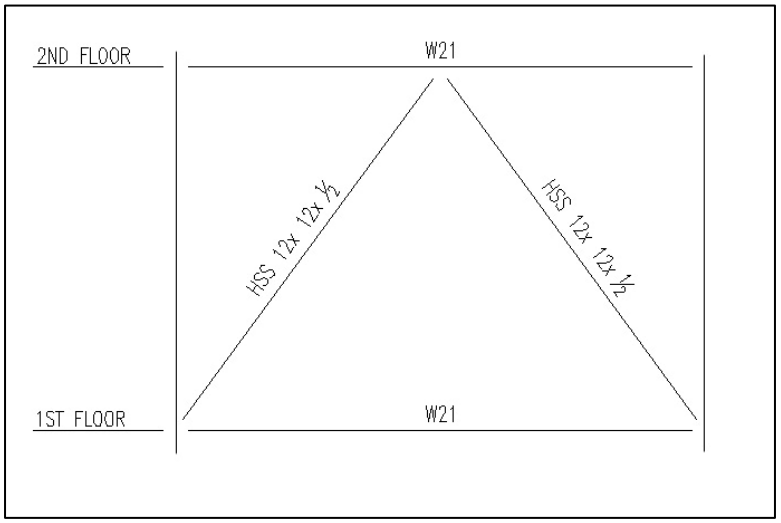
Enclosure

The building enclosure at Fordham Place consists of many different types. For the existing building, you will notice an older light brown brick wall with granite piers running the height of the building to interrupt the brick. At the base there currently is steel covering windows. But soon, when Fordham Place is finished with construction, it will return to display windows for retail stores. Playing off the older style building the existing structure brings, the new tower will match the light brown brick in the façade. The façade will also have sunlight

gleaming off the many blue tinted glass panes. Finally, on the lower 2 floors facing Fordham Road, the building will have a glass façade enclosing a two story lobby area.

Lateral System

The lateral system is composed of moment connections and braced frames. Moment connections are mostly located along the plane in which the existing building and new tower are connected. This is done so that each building can act independent of each other. The braced frames are "K" type braces utilizing A500 grade B HSS12x12x1/2" structural steel members. They are located in six different bents, all of which are centrally located near the core of the building and extend from the concourse floor to the roof. The bracing is located near the core of the building in order to avoid inducing any internal torsion. As discussed in the connections part of this report, there is bracing connections to beams and



columns. On each side of the bent, a bracing member will be framed from the bottom corner of the bent (column connection) to the midspan of the upper beam (beam connection). See picture to right.

Structural Design Code

The 2003 Building Code of New York City

Structural Design Specifications and Standards

Structural Concrete Design – American Concrete Institute, Building Code Requirements for Structural Concrete, ACI 318-02

Structural Steel Design – American Institute of Steel Construction, Steel Construction Manual, Allowable Stress Design Ninth Addition

Welding - American Welding Society, Structural Welding Code - Reinforcing Steel, AWS D1.4-79

Steel Deck - Design Manual for Floor Decks and Roof Decks, SDI

Masonry – American Concrete Institute, Specifications for masonry Structures, ACI 530.1

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Project Material Strength

Concrete (28 day minimum compressive strength)

Footings: 3000psi

Slab on Grade: 4000psi

Piers: 4000psi

Footings: 4000psi

Steel Deck Slabs (lightweight): 3500psi

Lightweight Concrete: 115pcf

Normal weight Concrete: 145pcf

Steel Reinforcement

Reinforcing Bars – ASTM A615 or A706 Grade 60
(Fy = 60,000psi min)

Welded Wire Fabric – ASTM 185

Metal Deck

Roof Deck: ASTM A653, Grade 33

Floor Deck: ASTM A661, Grade C, D or E.

Structural Steel members

Columns, Beams, Girders: ASTM A992 or ASTM A572, Grade 50.

Structural Steel Plates and miscellaneous steel: ASTM A36

Cold-Formed Steel Tubing: ASTM A500, Grade B.

Structural Steel Pipe: ASTM A53 or A500, Type E or S, Grade B.

Connectors

Headed shear stud: ASTM A108, Grade 1015 or 1020

Anchor Rods: ASTM F1554 Grade 36,

Bolts: ASTM A325

Welding

All Welds: AWS E70XX Electrodes, minimum tensile strength = 70,000psi

Masonry

Concrete Masonry Units: ASTM C90, f'c = 3750psi

Grout: ASTM C476 f'c = 2500psi

Design Gravity Loads (ASCE 7-02)

Load Type	Existing Retail	Stairs	New Building Retail	Existing Building Community Areas
Dead Load	122	50	60	122
Superimposed Dead Load	20	-	30	20
Live Load	100	100	100/75	50
Truck Load	-	-	250	-

Load Type	New Building Community Areas	Existing Roof	New Roof	Penthouse
Dead Load	60	117	60	20
Superimposed Dead Load	30	10	20	60
Live Load	80	30	30	30
Truck Load	-	-	-	-

Table: Designer's gravity loads.

*Note: See PDF on next page for my gravity loads

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GRAVITY

SNOW

TERRAIN CAT "B"
FULLY EXPOSED
$C_e = 0.9$
$C_t = 1.0$
$I = 1.0$
$P_g = 30$ psf
FLAT ROOF

$P_f = 0.7 C_e C_t I P_g$
$= 0.7 (0.9)(1.0)(1.0)(30 psf)$

$P_f = 18.9$ psf

LIVE

LOBBY = 100 PSF
CORRIDOORS = 100 PSF (80 PSF ABOVE FIRST FLOOR)
OFFICES = 50 PSF (USED 60PSF BASED ON CLIENTS REQUEST)
RETAIL=
FIRST FLOOR= 100 PSF
UPPER FLOORS= 75 PSF

ROOF LIVE LOAD

$L_r = 20 R_1 R_2$ $\quad R_2 = 1$ FLAT ROOF

$A_T = 258\ ft^2$

$R_1 = 1.2 - 0.001(258)$
$R_1 = 0.94$

$L_r = 20(0.94)(1.0)$

$L_r = 18.8$ PSF

DEAD LOAD

FOUND FOR EACH INDIVIDUAL CASE

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Wind Loads

North – South Direction

Height	K_z	q_h	q_v	$p_{leeward}$	$p_{windward}$	p_{net}
0-15	0.57	25.4592	12.4032	-9.8527104	7.680061	17.53277184
15-20	0.62	25.4592	13.4912	-9.8527104	8.353751	18.20646144
20-25	0.66	25.4592	14.3616	-9.8527104	8.892703	18.74541312
25-30	0.7	25.4592	15.232	-9.8527104	9.431654	19.2843648
30-40	0.76	25.4592	16.5376	-9.8527104	10.24008	20.09279232
40-50	0.81	25.4592	17.6256	-9.8527104	10.91377	20.76648192
50-60	0.85	25.4592	18.496	-9.8527104	11.45272	21.3054336
60-70	0.89	25.4592	19.3664	-9.8527104	11.99167	21.84438528
70-80	0.93	25.4592	20.2368	-9.8527104	12.53063	22.38333696
80-90	0.96	25.4592	20.8896	-9.8527104	12.93484	22.78755072
90-100	0.99	25.4592	21.5424	-9.8527104	13.33905	23.19176448
100-120	1.04	25.4592	22.6304	-9.8527104	14.01274	23.86545408
120-140	1.09	25.4592	23.7184	-9.8527104	14.68643	24.53914368
140-160	1.13	25.4592	24.5888	-9.8527104	15.22538	25.07809536
160-180	1.17	25.4592	25.4592	-9.8527104	15.76434	25.61704704
180-200	1.2	25.4592	26.112	-9.8527104	16.16855	26.0212608
200-250	1.28	25.4592	27.8528	-9.8527104	17.24645	27.09916416

Level	height range (ft)	Tributary Height (ft)	Tributary Width (ft)	Area Ave. Wind Pressure(psf)	F_x (k)
B		0.00	164	0.0	0
1	0-10	10.00	164	17.5	29
2	10-28	18.00	164	18.3	54
3	28-43	15.00	164	20.1	49
4	43-56.5	13.50	158	21.0	45
5	56.5-70	13.50	158	21.7	46
6	70-83.5	13.50	112	22.5	34
7	83.5-96.5	13.00	112	23.0	33
8	96.5-109	12.50	112	23.7	33
9	109-121.5	12.50	112	23.9	34
10	121.5-134	12.50	112	24.5	34
11	134-146.5	12.50	112	24.8	35
12	146.5-159	12.50	112	25.1	35
13	159-171.5	12.50	112	25.6	36
14	171.5-184	12.50	112	25.7	36
15	184-196.5	12.50	86	26.0	28
roof	196.5-203	6.50	86	26.5	15
	$\Sigma =$	203	$\Sigma =$	370	

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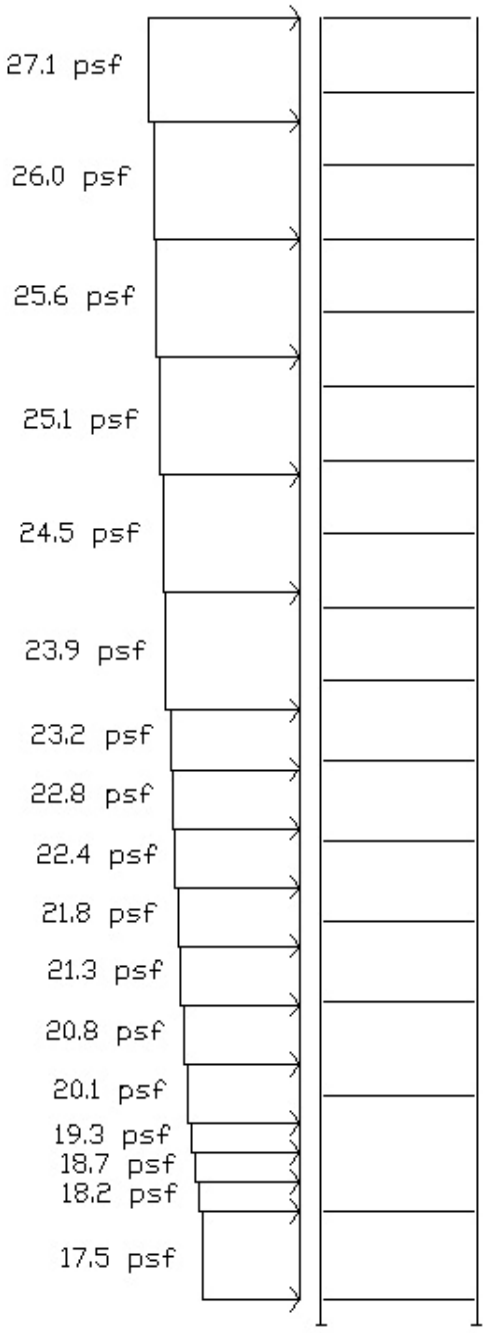
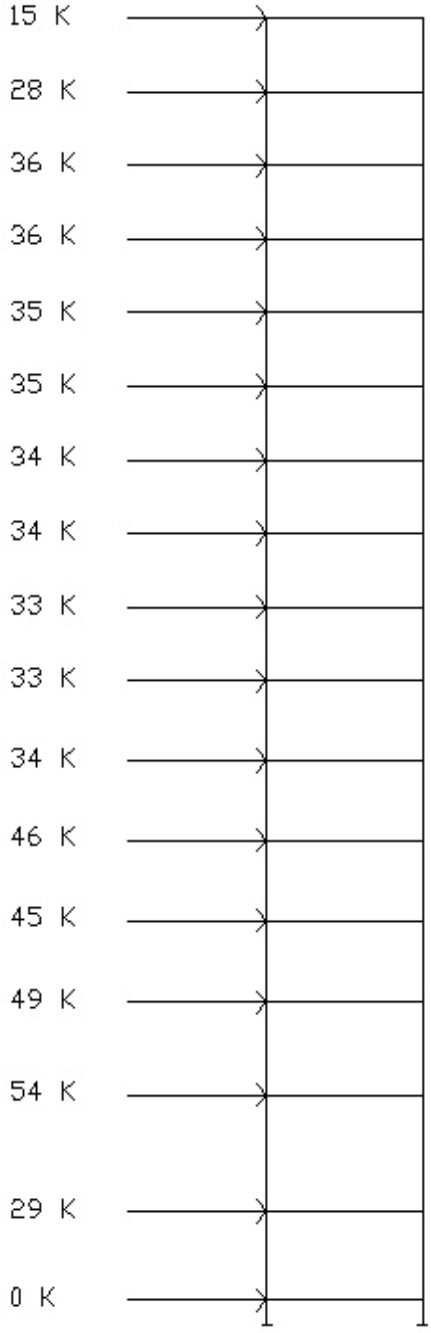


Wind Net Pressures (N-S)



Wind Story Forces (N-S)

East – West Direction

Height	K_z	q_h	q_v	$p_{leeward}$	$p_{windward}$	p_{net}
0-15	0.57	25.4592	12.4032	-5.94981504	7.729674	13.67948928
15-20	0.62	25.4592	13.4912	-5.94981504	8.407716	14.35753088
20-25	0.66	25.4592	14.3616	-5.94981504	8.950149	14.89996416
25-30	0.7	25.4592	15.232	-5.94981504	9.492582	15.44239744
30-40	0.76	25.4592	16.5376	-5.94981504	10.30623	16.25604736
40-50	0.81	25.4592	17.6256	-5.94981504	10.98427	16.93408896
50-60	0.85	25.4592	18.496	-5.94981504	11.52671	17.47652224
60-70	0.89	25.4592	19.3664	-5.94981504	12.06914	18.01895552
70-80	0.93	25.4592	20.2368	-5.94981504	12.61157	18.5613888
80-90	0.96	25.4592	20.8896	-5.94981504	13.0184	18.96821376
90-100	0.99	25.4592	21.5424	-5.94981504	13.42522	19.37503872
100-120	1.04	25.4592	22.6304	-5.94981504	14.10327	20.05308032
120-140	1.09	25.4592	23.7184	-5.94981504	14.78131	20.73112192
140-160	1.13	25.4592	24.5888	-5.94981504	15.32374	21.2735552
160-180	1.17	25.4592	25.4592	-5.94981504	15.86617	21.81598848
180-200	1.2	25.4592	26.112	-5.94981504	16.273	22.22281344
200-250	1.28	25.4592	27.8528	-5.94981504	17.35786	23.30768

Level	height range (ft)	Tributary Height (ft)	Tributary Width (ft)	Area Ave. Wind Pressure(psf)	F_x (k)
B		0.00	112	0.0	0
1	0-10	10.00	112	17.5	20
2	10-28	18.00	112	18.3	37
3	28-43	15.00	112	20.1	34
4	43-56.5	13.50	90	21.0	26
5	56.5-70	13.50	90	21.7	26
6	70-83.5	13.50	90	22.5	27
7	83.5-96.5	13.00	90	19.2	22
8	96.5-109	12.50	90	19.9	22
9	109-121.5	12.50	90	20.1	23
10	121.5-134	12.50	90	20.7	23
11	134-146.5	12.50	90	21.0	24
12	146.5-159	12.50	90	21.3	24
13	159-171.5	12.50	90	21.8	24
14	171.5-184	12.50	90	21.9	25
15	184-196.5	12.50	88	22.2	24
roof	196.5-203	6.50	88	22.7	13
	$\Sigma =$	203	$\Sigma =$	332	

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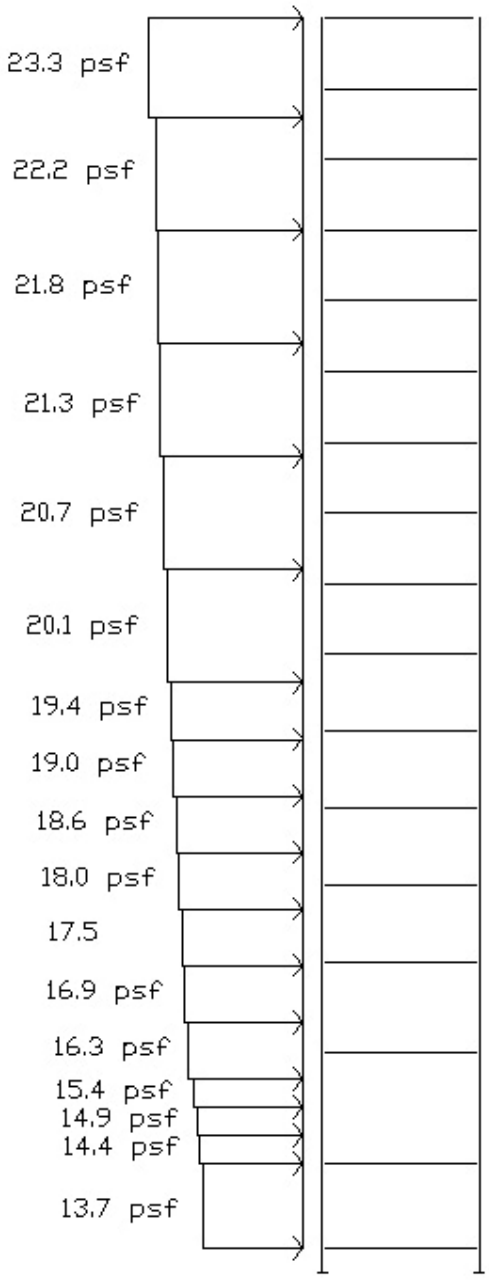
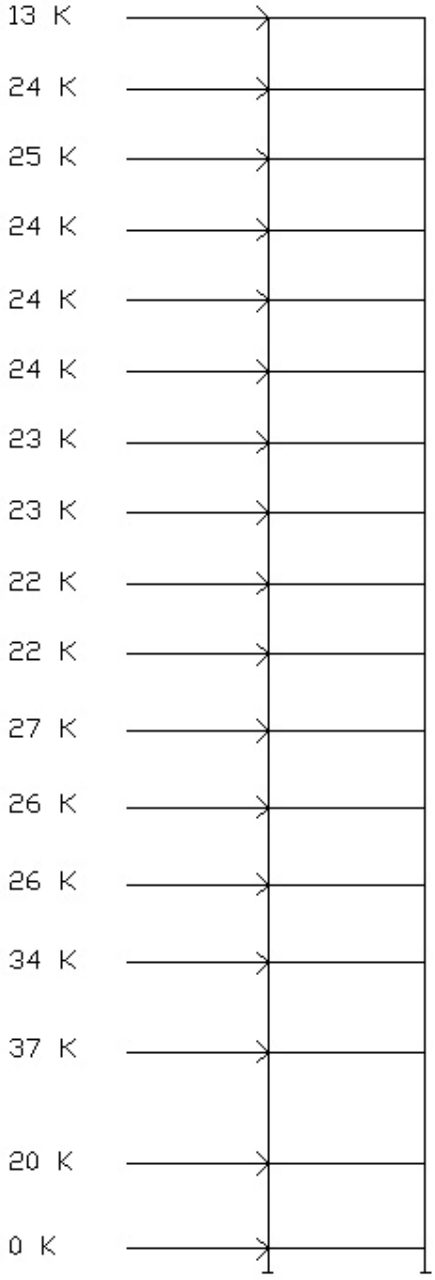


Wind Net Pressures (E-W)



Wind Story Forces (E-W)

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Seismic Loads

Assumptions:
Occupancy Category I (Table 1-1)
Seismic Use Group I (Table 9.1.3)
Importance Factor = 1.0 (Table 9.1.4)
Site Class D (Table 9.4.1.2)
Steel Concentrically Braced Frames

Ss = 0.43 (Figure 9.4.1.1a)
S1 = 0.095 (Figure 9.4.1.1b)

Sms = 0.626
Sm1 = 0.228

Sds = 0.417
Sd1 = 0.152

T = 1.725
Cs = 0.022

Seismic Design Category B

Effective Seismic Weight of Structure (9.5.3)

W_{TOTAL}= 9921 k

Seismic Base Shear (9.5.5.2)

$V = C_s W$

V = 218 k

Level	w_x (k)	h_x	$w_x h_x^k$	C_{vx}	F_x (k)
B	0	0	0	0	0
1	910	14.5	13195	0.012221	3
2	871	34.25	29831.75	0.027629	6
3	840	50	42000	0.038899	8
4	840	63.75	53550	0.049596	11
5	569	77.5	44097.5	0.040841	9
6	569	91	51779	0.047956	10
7	554	104.5	57893	0.053618	12
8	561	117	65637	0.06079	13
9	561	129.5	72649.5	0.067285	15
10	561	142	79662	0.07378	16
11	561	154.5	86674.5	0.080274	17
12	561	167	93687	0.086769	19
13	561	179.5	100699.5	0.093264	20
14	423	192	81216	0.075219	16
15	423	204.5	86503.5	0.080116	17
roof	556	217	120652	0.111743	24
Σ =	9921	Σ =	1079727		

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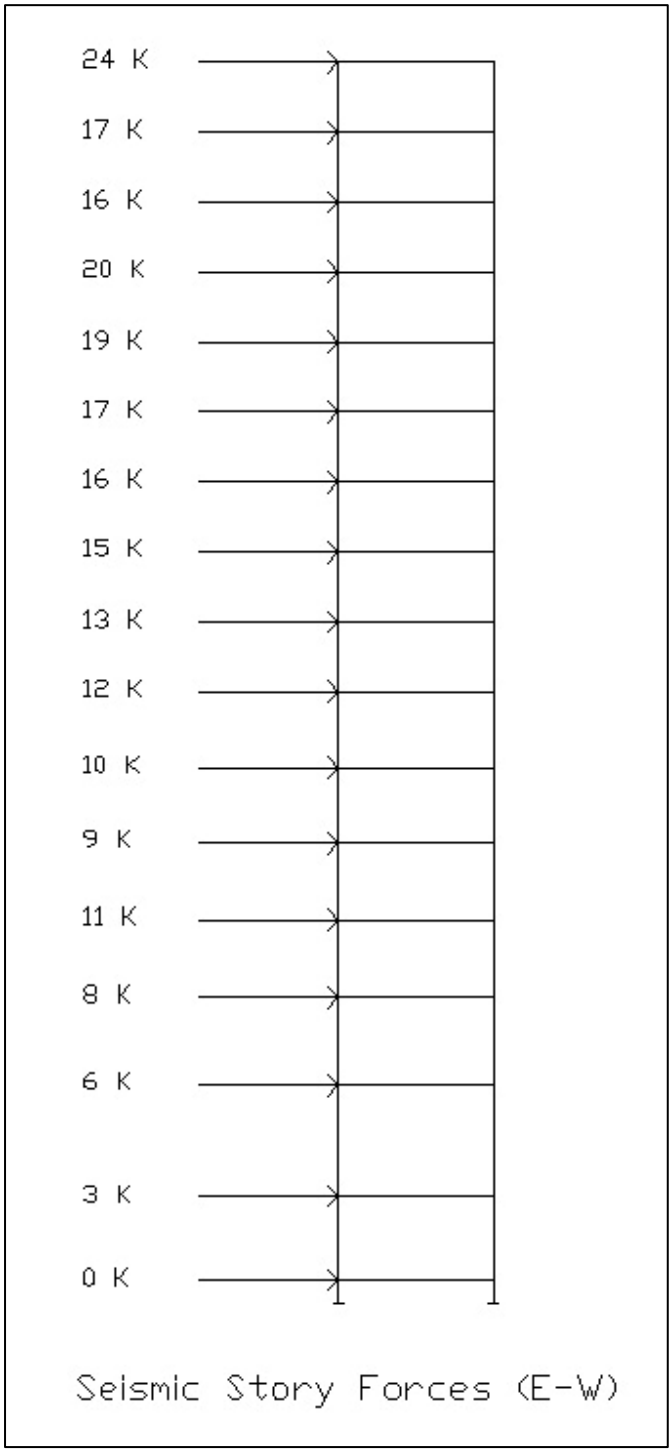

Seismic Story Forces (E-W)