APPENDIX

APPENDIX A

A.1 – WIND LOADS

Velocity Wind Pressure

Windward pressure

$$q_z = 0.00256K_zK_{zt}K_dV^2I$$

$$q_z = (0.00256)(1.03)(0.085)(1.0)(95\text{mph})^2(1.0)$$

$$q_z = 20.23\text{psf}$$

Height	kz	qz
0 - 15	1.03	20.23 psf
15 - 20	1.08	21.21 psf
20 - 25	1.12	22.00 psf
25 - 30	1.16	22.78 psf
30 - 40	1.22	23.96 psf
40 - 50	1.27	24.94 psf
50 - 60	1.31	25.73 psf
60 - 70	1.34	26.32 psf
70 - 80	1.38	27.10 psf
80 - 90	1.4	27.49 psf
90 - 100	1.43	28.08 psf
100 - 110	1.455	28.57 psf

Leeward pressure

$$q_h = 0.00256K_zK_{zt}K_dV^2I$$

$$q_h = (0.00256)(1.455)(0.085)(1.0)(95\text{mph})^2(1.0)$$

$$q_h = 28.57\text{psf}$$

Design Wind Pressure

Windward wall

$$p = q_zGCp - (GCpi)q_h$$

$$p = (20.23\text{psf})(0.85)(0.8) - (\pm 0.18)(28.57)$$

$$p = 13.75 \pm 5.14\text{psf}$$

Height	qz	p
0 - 15	20.23 psf	13.75 +/- 5.14 psf
15 - 20	21.21 psf	14.42 +/- 5.14 psf
20 - 25	22.00 psf	14.96 +/- 5.14 psf
25 - 30	22.78 psf	15.49 +/- 5.14 psf
30 - 40	23.96 psf	16.29 +/- 5.14 psf
40 - 50	24.94 psf	16.96 +/- 5.14 psf
50 - 60	25.73 psf	17.49 +/- 5.14 psf
60 - 70	26.32 psf	17.89 +/- 5.14 psf
70 - 80	27.10 psf	18.43 +/- 5.14 psf
80 - 90	27.49 psf	18.70 +/- 5.14 psf
90 - 100	28.08 psf	19.10 +/- 5.14 psf
100 - 110	28.57 psf	19.43 +/- 5.14 psf

Leeward wall with north-south wind

$$p = q_h GCp - (GCpi)q_h$$
$$p = (28.57psf)(0.85)(-0.3) - (\pm 0.18)(28.57)$$
$$p = -7.28 \pm 5.14psf$$

Roof with north south wind

$$\frac{h}{L} = \frac{110'}{294'-8''} = 0.373$$

$$p = q_h GCp - (GCpi)q_h$$
$$p = (28.57psf)(0.85)(-0.9) - (\pm 0.18)(28.57) \qquad 0 - 110'$$
$$p = -21.86 \pm 5.14psf$$

$$p = q_h GCp - (GCpi)q_h$$
$$p = (28.57psf)(0.85)(-0.5) - (\pm 0.18)(28.57) \qquad 110' - 220'$$
$$p = -12.14 \pm 5.14psf$$

$$p = q_h GCp - (GCpi)q_h$$
$$p = (28.57psf)(0.85)(-0.3) - (\pm 0.18)(28.57) \qquad 220' - 294'\text{-}8''$$
$$p = -7.28 \pm 5.14psf$$

Leeward wall east-west wind

$$p = q_h GCp - (GCpi)q_h$$
$$p = (28.57\,psf)(0.85)(-0.5) - (\pm 0.18)(28.57)$$
$$p = 12.14 \pm 5.14 psf$$

Roof with east-west wind

$$\frac{h}{L} = \frac{110'}{144'-4''} = 0.762$$

$$p = q_h GCp - (GCpi)q_h$$
$$p = (28.57\,psf)(0.85)(-0.9) - (\pm 0.18)(28.57) \qquad 0 - 110'$$
$$p = -21.86 \pm 5.14 psf$$

$$p = q_h GCp - (GCpi)q_h$$
$$p = (28.57\,psf)(0.85)(-0.5) - (\pm 0.18)(28.57) \qquad 110' - 220'$$
$$p = -12.14 \pm 5.14 psf$$

$$p = q_h GCp - (GCpi)q_h$$
$$p = (28.57\,psf)(0.85)(-0.3) - (\pm 0.18)(28.57) \qquad 220' - 294'\text{-}8''$$
$$p = -7.28 \pm 5.14 psf$$

A.2 – SEISMIC LOADS

Building Period

$$T = Ct(h_n)^{3/4}$$

$$T = (0.035)(110')^{3/4}$$

$$T = 1.189s$$

Design Base Shear

$$V = \frac{CvI}{RT}w = \frac{(0.12)(1.0)}{(6)(1.189s)}(20330k)$$

$$V = 342k$$

$$Ft = 0.07VT = (0.07)(342k)(1.189s)$$

$$Ft = 28.5k$$

$$Fi = \frac{(V - Ft)w_i h_i}{\Sigma w_i h_i}$$

Level	h_i	w_i	$w_i h_i$	F_i
1	10	2290	22900	6.72
2	20	2290	45800	13.46
3	30	2330	69900	20.54
4	40	2330	93200	27.38
5	50	2360	118000	34.67
6	60	1660	99600	29.26
7	70	1660	116200	34.14
8	80	1660	132800	39.02
9	90	1710	153900	45.22
10	100	970	97000	28.50
roof	110	1070	117700	34.58

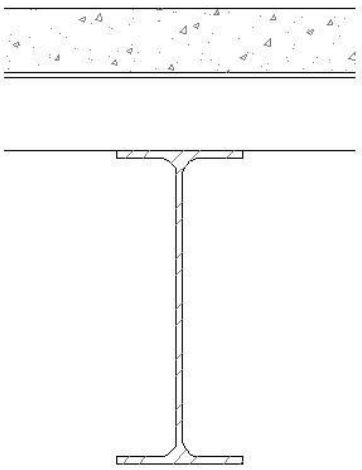
$\Sigma w_i h_i =$	1067000

APPENDIX B

B.1 – COMPOSITE BEAM CHECK

Loads:

Superimposed Dead = 25 psf
Superimposed Live = 40 psf
Construction Dead = 45 psf + self weight



Beam Length = 23′-0″
Beam Spacing = 8′-0″

f′c = 4 ksi
Fy = 50 ksi

$$w_D = (25psf + 45psf)(8') + 12plf$$
$$w_D = 572plf$$
$$w_L = (40psf)(8')$$
$$w_L = 320plf$$

$$w_U = 1.2w_D + 1.6w_L$$
$$w_U = 1.2(572plf) + 1.6(320plf)$$
$$w_U = 1.2klf$$

$$Vu = \frac{w_U L}{2} = \frac{(1.2klf)(23')}{2}$$
$$Vu = 13.8^{k}$$

$$Mu = \frac{w_U L^2}{8} = \frac{(1.2klf)(23')^2}{8}$$
$$Mu = 79.4'^{k}$$

$$b_{eff} = \underset{MIN}{\left| \begin{array}{l} \frac{23'(12''/1')}{4} = 69'' \\ (8')(12''/1') = 96'' \end{array} \right.}$$

Assume 1″ of concrete in compression:

$$y_2 = 4.5'' - 1''/2$$
$$y_2 = 4''$$

From LRFD 13th Edition Table 3-19:

Try W 10x12

PNA at location 6

$\phi Mn = 84.2'^{k} > Mu = 79.4'^{k}$

$\sum Qn = 68.9^{k}$

$$a = \frac{\sum Qn}{0.85f'cb_{eff}} = \frac{68.9^{k}}{(0.85)(4ksi)(69")}$$

$a = 0.29" < 1" \therefore$ ok

Use W 10x12 Beam

B.2 – GRAVITY COLUMN CHECK

Column K-3 at Level 3

Loads:

$Pu = 124.7^{k}$

$Mu_X = 3.4'^{k}$

$Mu_Y = 2.5'^{k}$

$kLx = kLy = 10'$

W 10x33:

$\phi Pn = 330^{k}$ LRFD 13th Edition Table 4-1

$\phi Mn_X = \phi Mn_Y = 134'^{k}$ LRFD 13th Edition Table 3-10

$$\frac{Pu}{\phi Pn} = \frac{124.7^{k}}{330^{k}} = 0.378 > 0.2 \therefore \text{Equation H1-1a}$$

$$\frac{Pu}{\phi Pn} + \frac{8}{9}\left(\frac{Mu_X}{\phi Mn_X} + \frac{Mu_Y}{\phi Mn_Y}\right) \le 1.0$$

$$\frac{124.7^{k}}{330^{k}} + \frac{8}{9}\left(\frac{3.4'^{k}}{134'^{k}} + \frac{2.5'^{k}}{134'^{k}}\right) = 0.42 < 1.0 \therefore \text{ok}$$

Check local buckling:

Use W 10x33 Column

B.3 – FOUNDATION CHECK

$P = 143.6^{k}$

$Pu = 184.4^{k}$

Bearing pressure = 40,000 psf

Footing Size:

$$40ksf = \frac{143.6^{k}}{B^2}$$

$B = 2'–6"$

$$q = \frac{184.4^{k}}{(2.5')^2}$$

$q = 29.5ksf$

Two Way Shear:

$$Vc = \phi 4\sqrt{f'c} = (0.75)(4)\left(\sqrt{4000psi}\right)$$

$Vc = 189.7psi$

$$d^2\left(Vc + \frac{q}{4}\right) + d\left(Vc + \frac{q}{2}\right)w = \left(\frac{q}{4}\right)\left(BL - w^2\right)$$

$$d^2\left(189.7psi + \frac{204.9psi}{4}\right) + d\left(189.7psi + \frac{204.9psi}{2}\right)(16") = \left(\frac{204.9psi}{4}\right)\left((30")^2 - (10")^2\right)$$

$d = 5.5"$

Punching Shear:

$$4d^2 + 2d(b + c) = \frac{Pu}{Vc}$$

$$4d^2 + 2d(16"+14") = \frac{184400lb}{189.7psi}$$

$d = 10"$

Punching Shear Controls

Use h = 14″

$$d = 14" - 3" - \frac{5}{8}"$$

$$d = 10.375"$$

Flexure:
Critical Section

$$l = 1.25' - \frac{8"}{12}$$

$$l = 0.583'$$

$$Mu = \frac{(29.5ksf)(0.583')^2}{2}$$

$$Mu = 5.02'^{k}$$

$$Mu = \phi Asfy\left(d - \frac{a}{2}\right)$$

$$a = \frac{Asfy}{0.85f'cb} = \frac{As(60ksi)}{(0.85)(4ksi)(12")}$$

$$a = 1.47As$$

$$(5.02')(12"/1') \le 0.9As(60ksi)\left(10.375" - \frac{1.47As}{2}\right)$$

$$As \ge 0.11in^2/ft$$

Use #5 @ 12″ o.c.

Check Minimum Steel:

$$\rho = \frac{0.31in^2/ft}{(14")(12")} = 0.00185 > \rho_{min} = 0.0018 \therefore ok$$

Check Tension Controlled Section:

$$\varepsilon = \frac{0.003}{c}(d - c)$$

$$c = \frac{a}{\beta_1} = \frac{(1.47)(0.31in^2)}{0.85}$$

$$c = 0.536"$$

$$\varepsilon = \frac{0.003}{0.536"}(10.375" - 0.536)$$

$$\varepsilon = 0.0551 > 0.005 \therefore \phi = 0.9$$

Check Bearing:

$$\phi Bn = \phi 0.85 f'c A_1 \sqrt{\frac{A_2}{A_1}} = (0.65)(0.85)(4ksi)(224in^2)\sqrt{\frac{900in^2}{224in^2}}$$

$$\phi Bn = 992.3^k > Pu = 184.4^k \therefore ok$$

Use 2′-6″ x 2′-6″ x 14″ thick spread footing reinforced with #5 bars at 12″ o.c.

B.4 – BRACING MEMBER CHECK

Brace at 3rd floor in the y-direction
2 L 6x6x½

Load Combination: 1.2D + 1.6W
$Tu = 46.5^{k}$

Tension Yield:
$\varphi Tn = \varphi FyAg = (0.9)(36ksi)(11.5in^2)$
$\varphi Tn = 372.6^{k} > Tu = 46.5^{k} \Rightarrow$ ok

Tension Fracture:
$\varphi Tn = \varphi FuAe$
$Ae = UAn$

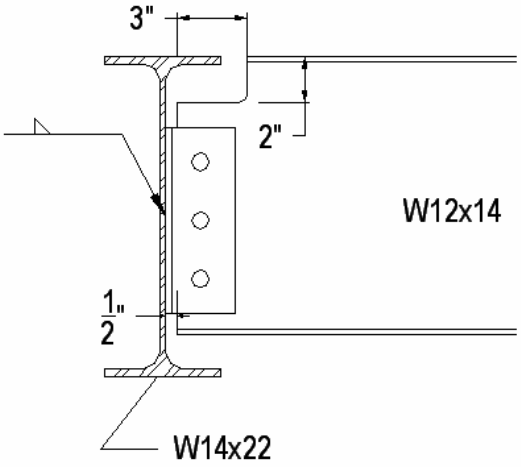
$U = 1 - \bar{x}/L = 1 - 1.67"/3"$
$U = 0.443$

$An = 11.5in^2 - 2(3/4" + 1/8")(1/2")$
$An = 10.625in^2$

$\varphi Tn = (0.75)(58ksi)(0.443)(10.635in^2)$
$\varphi Tn = 204.7^{k} > Tu = 46.5^{k} \Rightarrow$ ok

B.5 – TYPICAL SINGLE ANGLE CONNECTION

Vu = 13.8k



W12x14

$t_w = 0.255"$

$d = 11.9"$

$A = 4.16in^2$

$S_{net} = 4.71in^3$

Minimum weld size:

$t_w = 0.23"$ (W14x22 girder)

$t_{weld} = 1/8"$

Eccentric shear strength of the weld:

$Rn = CC_1Dl$

$kl = 3"$

$\therefore k = \frac{3"}{6"} = 0.5$

$x = 0.083$

$xl = (0.083)(6") = 0.489"$

$e_x = 3.1" - 0.498" = 2.602"$

$a = e_x/1 = 2.602"/6"$

$a = 0.434$

a	k=0.5
0.4	2.24
0.434	C
0.5	1.95

C=2.12

$Rn = (2.12)(1.0)(2)(6")$

$Rn = 25.44^k$

$\varphi Rn = (0.75)(25.44^k)$

$\varphi Rn = 19.1^k > Vu = 13.8^k \Rightarrow$ use 1/8″ weld

Check weld base metal:

$\varphi Rn = \varphi(0.6Fu)t_w l$

$\varphi Rn = (0.75)(0.6)(65ksi)(0.23")(6")$

$\varphi Rn = 40.4^k > Vu = 13.8^k \Rightarrow$ ok

Minimum angle thickness:

$d_b = 3/4"$

$\therefore t_{min} = 3/8" \Rightarrow$ use L 3x3x3/8 x 6″ angle

Bolt shear:

$\varphi Vn = \varphi Fv Ab$

$$\varphi Vn = (0.75)(48ksi)(2)\left(\frac{\pi(3/4")^2}{4}\right)$$

$\varphi Vn = 31.8^k > Vu = 13.8^k \Rightarrow$ ok

Angle Bearing and Tearout:

$Rn = 1.2L_c tFu \le 2.4d_b tFu$

Angle diameter $= 3/4" + 1/16" + 1/16" = 0.875"$

$1.2(3" - 0.875")(3/8")(58ksi) = 55.5^k$

$1.2(3" - 0.875"/2)(3/8")(58ksi) = 27.7^k$ Edge bolts control

$2.4(3/4")(3/8")(58ksi) = 39.2^k$ Tearout controls

$\varphi Rn = (0.75)(27.7^k + 39.2^k)$

$\varphi Rn = 50.2^k > Vu = 13.8^k \Rightarrow$ ok

Angle block shear:

$Rn = 0.6FuAnv + UbsFuAnt \leq 0.6FyAgv + UbsFuAnt$

$Agt = (1.5")(3/8") = 0.5625in^2$

$Agv = (4.5")(3/8") = 1.6875in^2$

$Ant = 0.5625in^2 - 0.5(0.875")(3/8") = 0.398in^2$

$Anv = 1.6875in^2 - 1.5(0.875")(3/8") = 1.195in^2$

$0.6(58ksi)(1.195in^2) + (1.0)(58ksi)(0.398in^2) = 64.7^k$

$0.6(36ksi)(1.6875in^2) + (1.0)(58ksi)(0.398in^2) = 59.5^k \Rightarrow$ controls

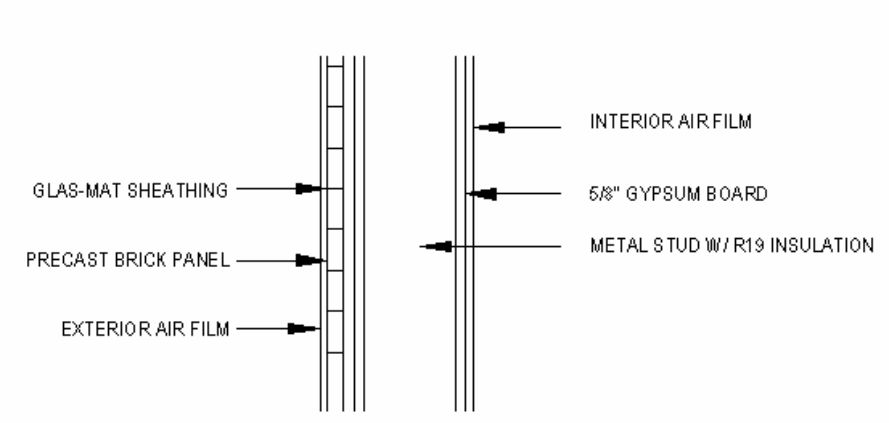
$\varphi Rn = (0.75)(59.5^k)$

$\varphi Rn = 44.6^k > Vu = 13.8^k \Rightarrow$ ok

APPENDIX C

C.1 – LEED CERTIFICATION – BUILDING ENVELOPE

Existing Wall System:



Material	R-Value
Outside Air Film	0.17
1 ¾″ Precast Thin Brick	0.14
5/8″ Glas-Mat Sheathing	3.0
6″ Metal Stud w/ Insulation	19
5/8″ Gypsum Board	0.56
Interior Air Film	0.68

Exterior air film: $h_o = 6\,^{BTU}/_{hr-ft^2-°F}$

Interior air film: $h_i = 1.46\,^{BTU}/_{hr-ft^2-°F}$

Wall system R value: $\Sigma R = 23.55$

$$Q = \frac{\Delta T}{{}^{1}/_{h_i} + \Sigma R + {}^{1}/_{h_o}} = \frac{72°F - 13°F}{{}^{1}/_{6} + 23.55 + {}^{1}/_{1.46}}$$

$$Q = 2.42\,^{BTU}/_{hr}$$

(Assuming 1 s.f. of wall area)

$$T_0 - T_1 = \frac{Q}{h_o}$$

$$13°F - T_1 = \frac{2.42}{6}$$

$$T_1 = 13.4°F$$

$$T_1 - T_2 = QR$$

$$13.4°F - T_2 = (2.42)(0.14)$$

$$T_2 = 13.7°F$$

$$T_2 - T_3 = QR$$

$$13.7°F - T_3 = (2.42)(3.0)$$

$$T_3 = 21.0°F$$

$$T_3 - T_4 = QR$$

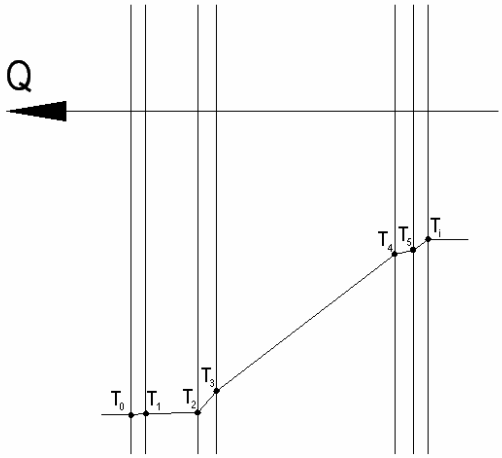
$$21.0°F - T_3 = (2.42)(19)$$

$$T_4 = 67°F$$

$$T_4 - T_5 = QR$$

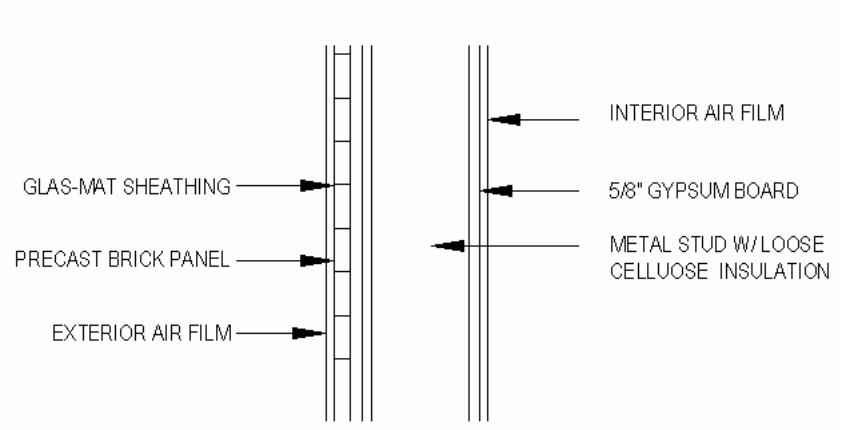
$$67.0°F - T_5 = (2.42)(0.56)$$

$$T_5 = 68.4°F$$



Heat Transfer, Q	2.42 BTU/hr
T_1	13.4
T_2	13.7
T_3	21.0
T_4	67.0
T_5	68.4

Alternative Wall System 1: Loose cellulose Insulation



Material	R-Value
Outside Air Film	0.17
1 ¾″ Precast Thin Brick	0.14
5/8″ Glas-Mat Sheathing	3.0
6″ Metal Stud w/ Insulation	22.8
5/8″ Gypsum Board	0.56
Interior Air Film	0.68

Exterior air film: $h_o = 6\,{}^{BTU}/_{hr-ft^2-°F}$

Interior air film: $h_i = 1.46\,{}^{BTU}/_{hr-ft^2-°F}$

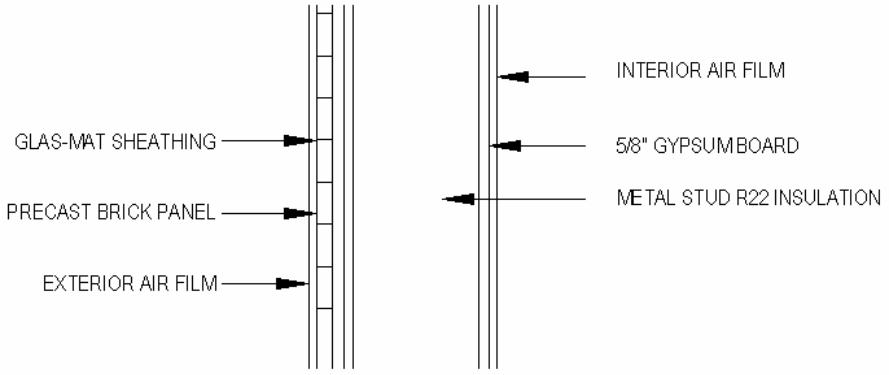
Wall system R value: $\Sigma R = 27.35$

$$Q = \frac{\Delta T}{{}^{1}/_{h_i} + \Sigma R + {}^{1}/_{h_o}} = \frac{72°F - 13°F}{{}^{1}/_{6} + 27.35 + {}^{1}/_{1.46}}$$

$$Q = 2.09\,{}^{BTU}/_{hr}$$

(Assuming 1 s.f. of wall area)

Alternative Wall System 2: Increase Insulation Thickness



Material	R-Value
Outside Air Film	0.17
1 ¾″ Precast Thin Brick	0.14
5/8″ Glas-Mat Sheathing	3.0
8″ Metal Stud w/ Insulation	22
5/8″ Gypsum Board	0.56
Interior Air Film	0.68

Exterior air film: $h_o = 6\,{}^{BTU}/_{hr-ft^2-°F}$

Interior air film: $h_i = 1.46\,{}^{BTU}/_{hr-ft^2-°F}$

Wall system R value: $\Sigma R = 26.55$

$$Q = \frac{\Delta T}{{}^{1}/_{h_i} + \Sigma R + {}^{1}/_{h_o}} = \frac{72°F - 13°F}{{}^{1}/_{6} + 26.55 + {}^{1}/_{1.46}}$$

$$Q = 2.15\,{}^{BTU}/_{hr}$$

(Assuming 1 s.f. of wall area)

C.2 – LEED CREDITS

Yes	?	No			
10			**Sustainable Sites**		**14** Points
Y			Prereq 1	**Construction Activity Pollution Prevention**	Required
1			Credit 1	**Site Selection**	1
1			Credit 2	**Development Density & Community Connectivity**	1
1			Credit 3	**Brownfield Redevelopment**	1
1			Credit 4.1	**Alternative Transportation**, Public Transportation Access	1
1			Credit 4.2	**Alternative Transportation**, Bicycle Storage & Changing Rooms	1
			Credit 4.3	**Alternative Transportation**, Low-Emitting & Fuel-Efficient Vehicles	1
1			Credit 4.4	**Alternative Transportation**, Parking Capacity	1
1			Credit 5.1	**Site Development,** Protect of Restore Habitat	1
1			Credit 5.2	**Site Development,** Maximize Open Space	1
1			Credit 6.1	**Stormwater Design,** Quantity Control	1
			Credit 6.2	**Stormwater Design,** Quality Control	1
			Credit 7.1	**Heat Island Effect,** Non-Roof	1
			Credit 7.2	**Heat Island Effect,** Roof	1
1			Credit 8	**Light Pollution Reduction**	1

Yes	?	No			
3			**Water Efficiency**		**5** Points
1			Credit 1.1	**Water Efficient Landscaping**, Reduce by 50%	1
			Credit 1.2	**Water Efficient Landscaping**, No Potable Use or No Irrigation	1
1			Credit 2	**Innovative Wastewater Technologies**	1
1			Credit 3.1	**Water Use Reduction**, 20% Reduction	1
			Credit 3.2	**Water Use Reduction**, 30% Reduction	1

2			**Energy & Atmosphere**		**17** Points
Y			Prereq 1	**Fundamental Commissioning of the Building Energy Systems**	Required
Y			Prereq 2	**Minimum Energy Performance**	Required
Y			Prereq 3	**Fundamental Refrigerant Management**	Required
2			Credit 1	**Optimize Energy Performance**	1 to 10
				10.5% New Buildings or 3.5% Existing Building Renovations	1
				2 14% New Buildings or 7% Existing Building Renovations	2
				17.5% New Buildings or 10.5% Existing Building Renovations	3

				21% New Buildings or 14% Existing Building Renovations	4
				24.5% New Buildings or 17.5% Existing Building Renovations	5
				28% New Buildings or 21% Existing Building Renovations	6
				31.5% New Buildings or 24.5% Existing Building Renovations	7
				35% New Buildings or 28% Existing Building Renovations	8
				38.5% New Buildings or 31.5% Existing Building Renovations	9
				42% New Buildings or 35% Existing Building Renovations	10
			Credit 2	**On-Site Renewable Energy**	1 to 3
				2.5% Renewable Energy	1
				7.5% Renewable Energy	2
				12.5% Renewable Energy	3
			Credit 3	**Enhanced Commissioning**	1
			Credit 4	**Enhanced Refrigerant Management**	1
			Credit 5	**Measurement & Verification**	1
			Credit 6	**Green Power**	1

continued…

Yes	?	No			
4			**Materials & Resources**		**13** Points
Y			Prereq 1	**Storage & Collection of Recyclables**	Required
			Credit 1.1	**Building Reuse**, Maintain 75% of Existing Walls, Floors & Roof	1
			Credit 1.2	**Building Reuse**, Maintain 100% of Existing Walls, Floors & Roof	1
			Credit 1.3	**Building Reuse**, Maintain 50% of Interior Non-Structural Elements	1
1			Credit 2.1	**Construction Waste Management**, Divert 50% from Disposal	1
			Credit 2.2	**Construction Waste Management**, Divert 75% from Disposal	1
1			Credit 3.1	**Materials Reuse**, 5%	1
1			Credit 3.2	**Materials Reuse**,10%	1
1			Credit 4.1	**Recycled Content**, 10% (post-consumer + ½ pre-consumer)	1
			Credit 4.2	**Recycled Content**, 20% (post-consumer + ½ pre-consumer)	1
			Credit 5.1	**Regional Materials**, 10% Extracted, Processed & Manufactured Regionally	1
			Credit 5.2	**Regional Materials**, 20% Extracted, Processed & Manufactured Regionally	1
			Credit 6	**Rapidly Renewable Materials**	1
			Credit 7	**Certified Wood**	1

Yes ? No

7				**Indoor Environmental Quality**	**15** Points
Y			Prereq 1	**Minimum IAQ Performance**	Required
Y			Prereq 2	**Environmental Tobacco Smoke** (ETS) **Control**	Required
			Credit 1	**Outdoor Air Delivery Monitoring**	1
			Credit 2	**Increased Ventilation**	1
			Credit 3.1	**Construction IAQ Management Plan**, During Construction	1
			Credit 3.2	**Construction IAQ Management Plan**, Before Occupancy	1
			Credit 4.1	**Low-Emitting Materials**, Adhesives & Sealants	1
1			Credit 4.2	**Low-Emitting Materials**, Paints & Coatings	1
1			Credit 4.3	**Low-Emitting Materials**, Carpet Systems	1
			Credit 4.4	**Low-Emitting Materials**, Composite Wood & Agrifiber Products	1
1			Credit 5	**Indoor Chemical & Pollutant Source Control**	1
1			Credit 6.1	**Controllability of Systems**, Lighting	1
1			Credit 6.2	**Controllability of Systems**, Thermal Comfort	1
1			Credit 7.1	**Thermal Comfort**, Design	1
			Credit 7.2	**Thermal Comfort**, Verification	1
1			Credit 8.1	**Daylight & Views**, Daylight 75% of Spaces	1
			Credit 8.2	**Daylight & Views**, Views for 90% of Spaces	1
Yes	?	No			
				Innovation & Design Process	**5** Points
			Credit 1.1	**Innovation in Design**: Provide Specific Title	1
			Credit 1.2	**Innovation in Design**: Provide Specific Title	1
			Credit 1.3	**Innovation in Design**: Provide Specific Title	1
			Credit 1.4	**Innovation in Design**: Provide Specific Title	1
			Credit 2	**LEED® Accredited Professional**	1
Yes	?	No			
26				**Project Totals (pre-certification estimates)**	**69** Points

C.3 – MATERIAL QUANTITY TAKEOFFS

Concrete Quantities

Formwork		
	Quantity	
Columns	44000	sf
Beams	3500	sf
Slab	185000	sf
Walls	46330	sf
Total	278830	sf

Concrete		
	Quantity	
Columns	900	cy
Beams	60	cy
Slab	4500	cy
Walls	1400	cy
Total	6860	cy

Reinforcing		
	Quantity	
Columns	2150	cwt
Beams	200	cwt
Slab	18100	cwt
Walls	2000	cwt
Total	22450	cwt

Miscellaneous		
	Quantity	
Formwork Hardware	35400	ea
Formwork Release	311500	sf
Chamfer Strips	27000	lf
Slab Finishing	181000	sf
Slab Screeds	21720	lf
Shoring	362000	sf

Steel:

Steel		
	Quantity	
Beams	6000	cwt
Columns	1900	cwt
Angles	200	cwt
Frames	36200	cwt
Total	44300	cwt

Composite Slab		
	Quantity	
Metal Deck	181000	sf
Shear Studs	17660	ea
Concrete	1960	cy
WWF Reinforcing	1990	lf
Slab Finishing	181000	sf
Slab Screeds	21720	lf

Miscellaneous		
	Quantity	
Anchor Bolts	228	ea
Baseplates	57	ea
Grout	89	sf
Red Oxide	16000	sf
Gypsum Board	20000	bdf

C.4 – CONSTRUCTION COST

Material Costs:

Concrete		
	Unit Cost	
5000 psi Concrete	$ 60.00	/cy
3000 psi Concrete	$ 55.00	/cy
Formwork	$ 1.00	/sf
Reinforcing	$ 27.00	/cwt
Shoring	$ 3.00	/sf
Formwork Hardware	$ 0.50	ea
Formwork Release	$ 0.50	/sf
Chamfer Strips	$ 0.50	/lf
Slab Screeds	$ 1.00	/lf

Steel		
	Unit Cost	
Structural Steel	$ 35.00	/cwt
Anchor Bolts	$ 2.00	ea
Baseplates	$ 25.00	ea
Grout	$ 6.00	/sf
Shear Studs	$ 10.00	ea
Shop Paint	$ 1.00	/sf
Gypsum Board	$ 2.00	/bdf
Metal Deck	$ 5.00	/sf
WWF Reinforcing	$ 8.20	/cwt

Labor Costs:

Concrete Crews		Rate / day
C235	Concrete Pump 6 Common Laborers 1 Common Laborer Foreman 1 Vibrator Operator	$ 1,512.00
C276	Concrete Finishing 1 Common Laborer 3 Concrete Finishers	$ 826.00
C311	Formwork 3 Carpenters 1 Carpenter Foreman 2 Common Laborers	$ 1,152.00
C321	Reinforcing Steel 6 Reinforcing Rodmen 1 Reinforcing Rodman Foreman	$ 1,780.00

Steel Crews		Rate / day
C235	Concrete Pump 6 Common Laborers 1 Common Laborer Foreman 1 Vibrator Operator	$ 1,512.00
C276	Concrete Finishing 1 Common Laborer 3 Concrete Finishers	$ 826.00
C311	Formwork 3 Carpenters 1 Carpenter Foreman 2 Common Laborers	$ 1,152.00
C321	Wiremesh 1 Reinforcing Rodmen 6 Common Laborers	$ 1,321.00
C360	Baseplate Grout Crew 1 Concrete Finisher	$ 216.00
C509	Miscellaneous Metals 3 Steelworkers	$ 760.00

C510	Structural Steel 8 Steelworkers 1 Steelworker Foreman	$ 3,000.00
C917	Fireproofing 1 Misc. Fireproofing Laborer 1 Fireproofing Laborer	$ 330.00
C990	Paint 1 Common Laborer 5 Painters	$ 1,188.00

Equipment Costs:

Equipment Costs		
Concrete Pump	$ 6.00	/cy
Crane	$ 300.00	/day

	Crews	# Crews	Crew Production	Total Production	# Days	Material Quantity	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Total Material Cost	Total Labor Cost	Total Equipment Cost	Total Cost
Column Formwork	C311	4	600 sf/day	2400 sf/day	18	44000 sf	$1.00 /sf	$1,152.00 /day		$44,000.00	$84,480.00		$128,480.00
Slab Formwork	C311	7	600 sf/day	4200 sf/day	44	185000 sf	$1.00 /sf	$1,152.00 /day		$185,000.00	$355,200.00		$540,200.00
Beam Formwork	C311	6	600 sf/day	3600 sf/day	1	3500 sf	$1.00 /sf	$1,152.00 /day		$3,500.00	$6,720.00		$10,220.00
Wall Formwork	C311	7	600 sf/day	4200 sf/day	11	46330 sf	$1.00 /sf	$1,152.00 /day		$46,330.00	$88,953.60		$135,283.60
Formwork Hardware						35400 sf	$0.50			$17,700.00			
Formwork Release	C311	7	500 sf/day	3500 sf/day	89	311500 sf	$0.50 /sf	$1,152.00 /day		$155,750.00	$717,696.00		$873,446.00
Chamfer Strips	C311	7	700 lf/day	4900 lf/day	6	27000 lf	$0.50 /lf	$1,152.00 /day		$13,500.00	$44,434.29		$57,934.29
Column Reinforcing	C321	7	50 cwt/day	350 cwt/day	6	2150 cwt	$27.00 /cwt	$1,780.00 /day		$58,050.00	$76,540.00		$134,590.00
Slab Reinforcing	C321	7	50 cwt/day	350 cwt/day	52	18100 cwt	$27.00 /cwt	$1,780.00 /day		$488,700.00	$644,360.00		$1,133,060.00
Beam Reinforcing	C321	3	50 cwt/day	150 cwt/day	1	200 cwt	$27.00 /cwt	$1,780.00 /day		$5,400.00	$7,120.00		$12,520.00
Wall Reinforcing	C321	7	50 cwt/day	350 cwt/day	6	2000 cwt	$27.00 /cwt	$1,780.00 /day		$54,000.00	$71,200.00		$125,200.00
Column Pour	C235	1	100 cy/day	100 cy/day	9	900 cy	$60.00 /cy	$1,512.00 /day	$6.00 /cy	$54,000.00	$13,608.00	$5,400.00	$73,008.00
Slab Pour	C235	3	100 cy/day	300 cy/day	15	4500 cy	$60.00 /cy	$1,512.00 /day	$6.00 /cy	$270,000.00	$68,040.00	$27,000.00	$365,040.00
Beam Pour	C235	1	100 cy/day	100 cy/day	1	60 cy	$60.00 /cy	$1,512.00 /day	$6.00 /cy	$3,600.00	$907.20	$360.00	$4,867.20
Wall Pour	C235	4	100 cy/day	400 cy/day	4	1400 cy	$60.00 /cy	$1,512.00 /day	$6.00 /cy	$84,000.00	$21,168.00	$8,400.00	$113,568.00
Slab Finishing	C276	7	500 sf/day	3500 sf/day	52	181000 sf		$826.00 /day			$299,012.00		$299,012.00
Slab Screeds	C311	3	250 lf/day	750 lf/day	29	21720 lf	$1.00 /lf	$1,152.00 /day		$21,720.00	$100,085.76		$121,805.76
Shoring	C235	3	600 sf/day	1800 sf/day	70	362000 sf	$3.00 /sf	$1,512.00 /day		$1,086,000.00	$105,840.00		$1,191,840.00
Crane					140		2		500 /day		$0.00	$140,000.00	$140,000.00
										$2,591,250.00	$2,705,364.85	$181,160.00	$5,460,074.85

Concrete Structure Estimate

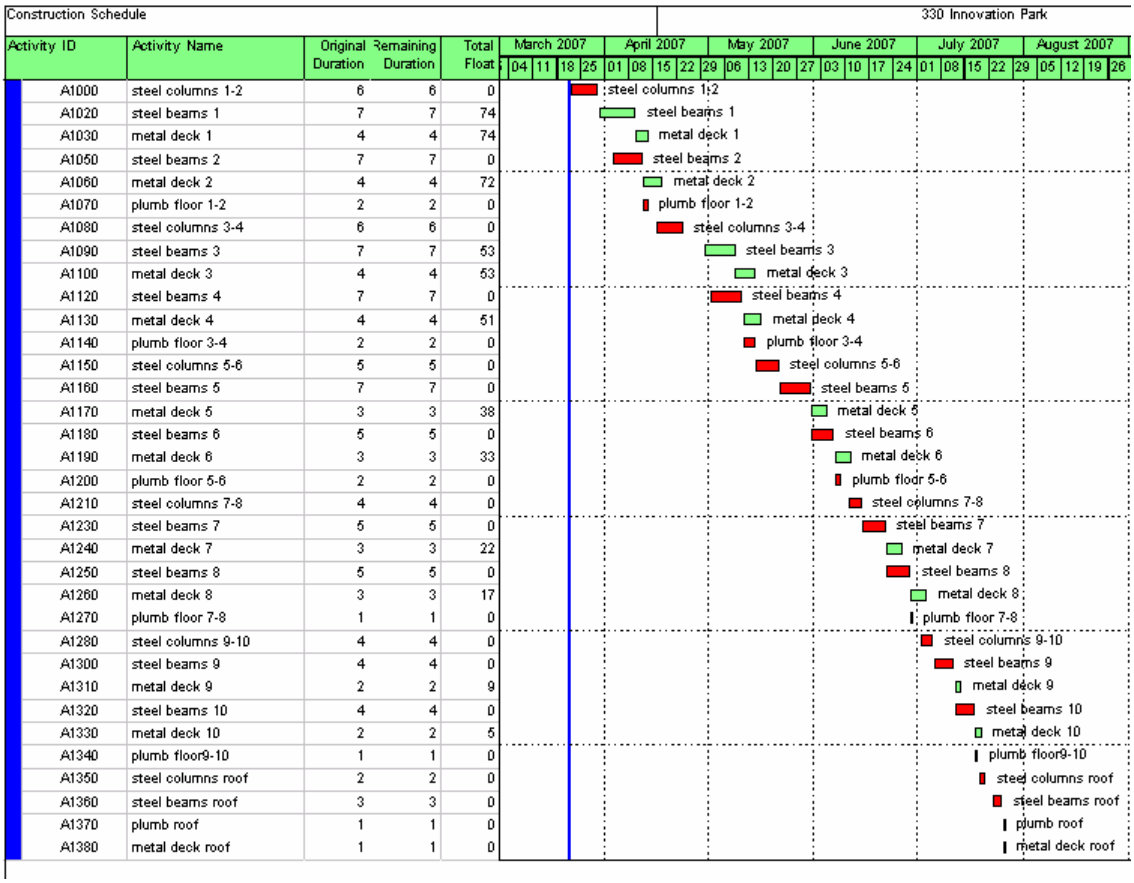
	Crews	# Crews	Crew Production	Total Production	# Days	Material Quantity	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Total Material Cost	Total Labor Cost	Total Equipment Cost	Total Cost
Steel Beams	C510	2	100 cwt/day	200 cwt/day	30	6000 cwt	$35.00 /cwt	$3,000.00 /day		$210,000.00	$180,000.00		$390,000.00
Steel Columns	C510	2	100 cwt/day	200 cwt/day	10	1900 cwt	$35.00 /cwt	$3,000.00 /day		$66,500.00	$57,000.00		$123,500.00
Steel Angles	C510	2	100 cwt/day	200 cwt/day	1	200 cwt	$35.00 /cwt	$3,000.00 /day		$7,000.00	$6,000.00		$13,000.00
Steel Frame	C510	3	100 cwt/day	300 cwt/day	121	36200 cwt	$35.00 /cwt	$3,000.00 /day		$1,267,000.00	$1,086,000.00		$2,353,000.00
Anchor Bolts	C509	1	100 /day	100	2	228	$2.00	$760.00		$456.00	$1,732.80		$2,188.80
Base Plates	C510	1	65 /day	65 /day	1	57	$25.00	$3,000.00 /day		$1,425.00	$2,630.77		$4,055.77
Grout	C360	2	35 sf/day	70 sf/day	1	89 sf	$6.00 /sf	$216.00		$534.00	$549.26		$1,083.26
Shear Studs	C509	3	400 /day	1200 /day	15	17659	$10.00	$760.00 /day		$176,590.00	$33,552.10		$210,142.10
Red Oxide	C990	2	400 sf/day	800 sf/day	20	16000 sf	$1.00 /sf	$1,188.00 /day		$16,000.00	$47,520.00		$63,520.00
Gypsum Board	C917	1	300 bdf/day	300 bdf/day	67	20000 bdf	$2.00 /bdf	$330.00 /day		$40,000.00	$22,000.00		$62,000.00
Metal Deck	C510	10	600 sf/day	6000 sf/day	30	181000 sf	$5.00 /cwt	$3,000.00 /day		$905,000.00	$905,000.00		$1,810,000.00
WWF Reinforcing	C320	2	100 sqs/day	200 sqs/day	10	1990 sqs	$8.20 /cwt	$1,321.00 /day		$16,318.00	$26,287.90		$42,605.90
Concrete Slab	C235	3	100 cy/day	300 cy/day	7	1960 cy	$55.00 /cy	$1,512.00 /day	$6.00 /cy	$107,800.00	$29,635.20	$11,760.00	$149,195.20
Slab Finishing	C276	6	500 sf/day	3000 sf/day	60	181000 sf		$826.00 /day			$299,012.00		$299,012.00
Slab Screeds	C311	6	250 lf/day	1500 lf/day	14	21720 lf	$1.00 /lf	$1,152.00 /day		$21,720.00	$100,085.76		$121,805.76
Crane					93	2			$300 /day		$0.00	$55,800.00	$55,800.00
										$2,836,343.00	$2,797,005.79	$67,560.00	$5,700,908.79

Steel Structure Estimate

C.4 – CONSTRUCTION SCHEDULE

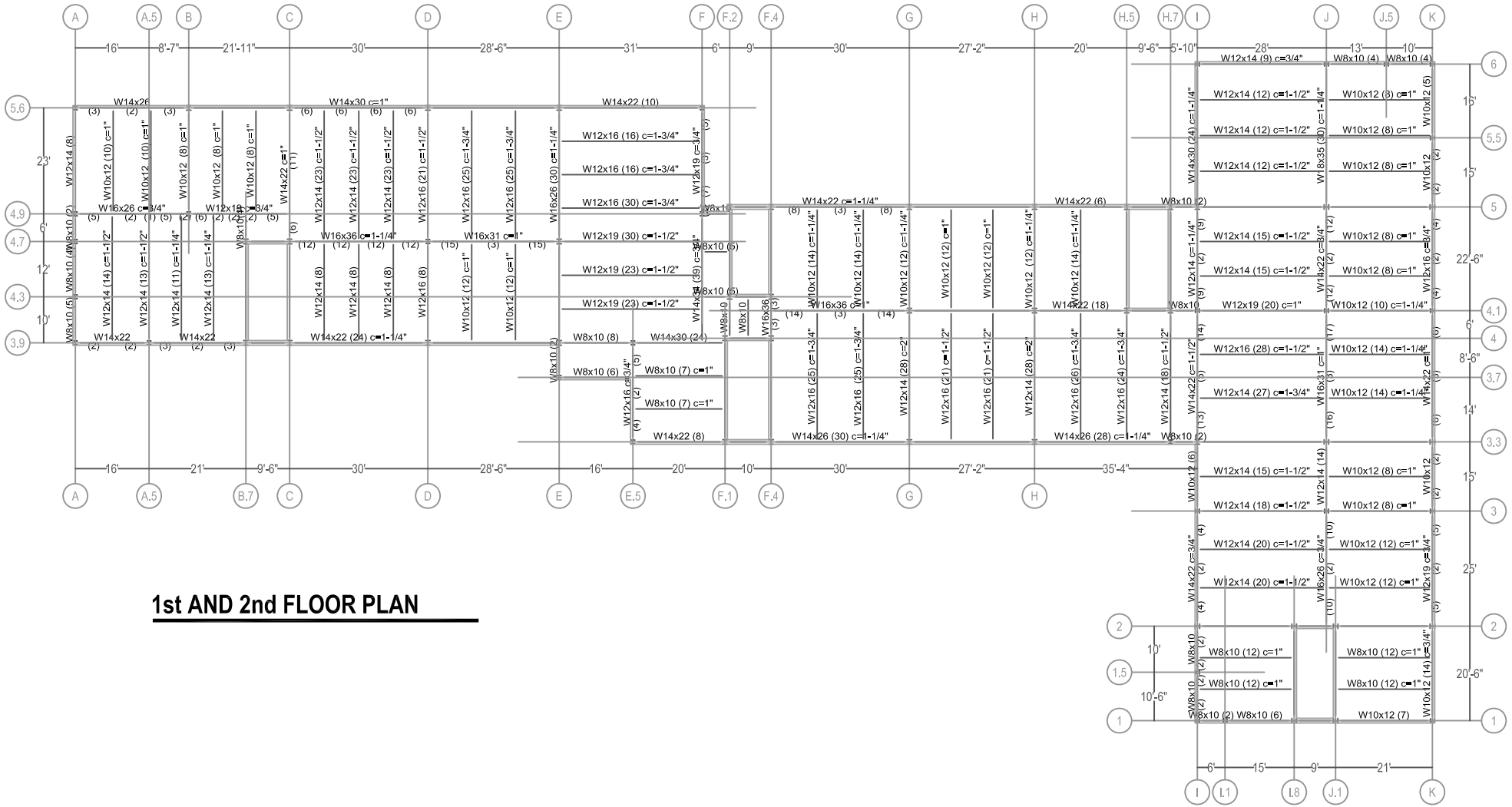
Crew Production:

Crew Production		
C235	100	ct/day
C276	155	sf/day
C311	250	lf/day
C320	100	sqs/day
C360	35	sf/day
C509	100	/day
C510	100	cwt/day
	600	sf/day
C917	300	bdf/day
C990	400	sf/day



Activity ID	Activity Name	Original Duration	Remaining Duration	Total Float
A1000	steel columns 1-2	6	6	0
A1020	steel beams 1	7	7	74
A1030	metal deck 1	4	4	74
A1050	steel beams 2	7	7	0
A1060	metal deck 2	4	4	72
A1070	plumb floor 1-2	2	2	0
A1080	steel columns 3-4	6	6	0
A1090	steel beams 3	7	7	53
A1100	metal deck 3	4	4	53
A1120	steel beams 4	7	7	0
A1130	metal deck 4	4	4	51
A1140	plumb floor 3-4	2	2	0
A1150	steel columns 5-6	5	5	0
A1160	steel beams 5	7	7	0
A1170	metal deck 5	3	3	38
A1180	steel beams 6	5	5	0
A1190	metal deck 6	3	3	33
A1200	plumb floor 5-6	2	2	0
A1210	steel columns 7-8	4	4	0
A1230	steel beams 7	5	5	0
A1240	metal deck 7	3	3	22
A1250	steel beams 8	5	5	0
A1260	metal deck 8	3	3	17
A1270	plumb floor 7-8	1	1	0
A1280	steel columns 9-10	4	4	0
A1300	steel beams 9	4	4	0
A1310	metal deck 9	2	2	9
A1320	steel beams 10	4	4	0
A1330	metal deck 10	2	2	5
A1340	plumb floor9-10	1	1	0
A1350	steel columns roof	2	2	0
A1360	steel beams roof	3	3	0
A1370	plumb roof	1	1	0
A1380	metal deck roof	1	1	0

APPENDIX D



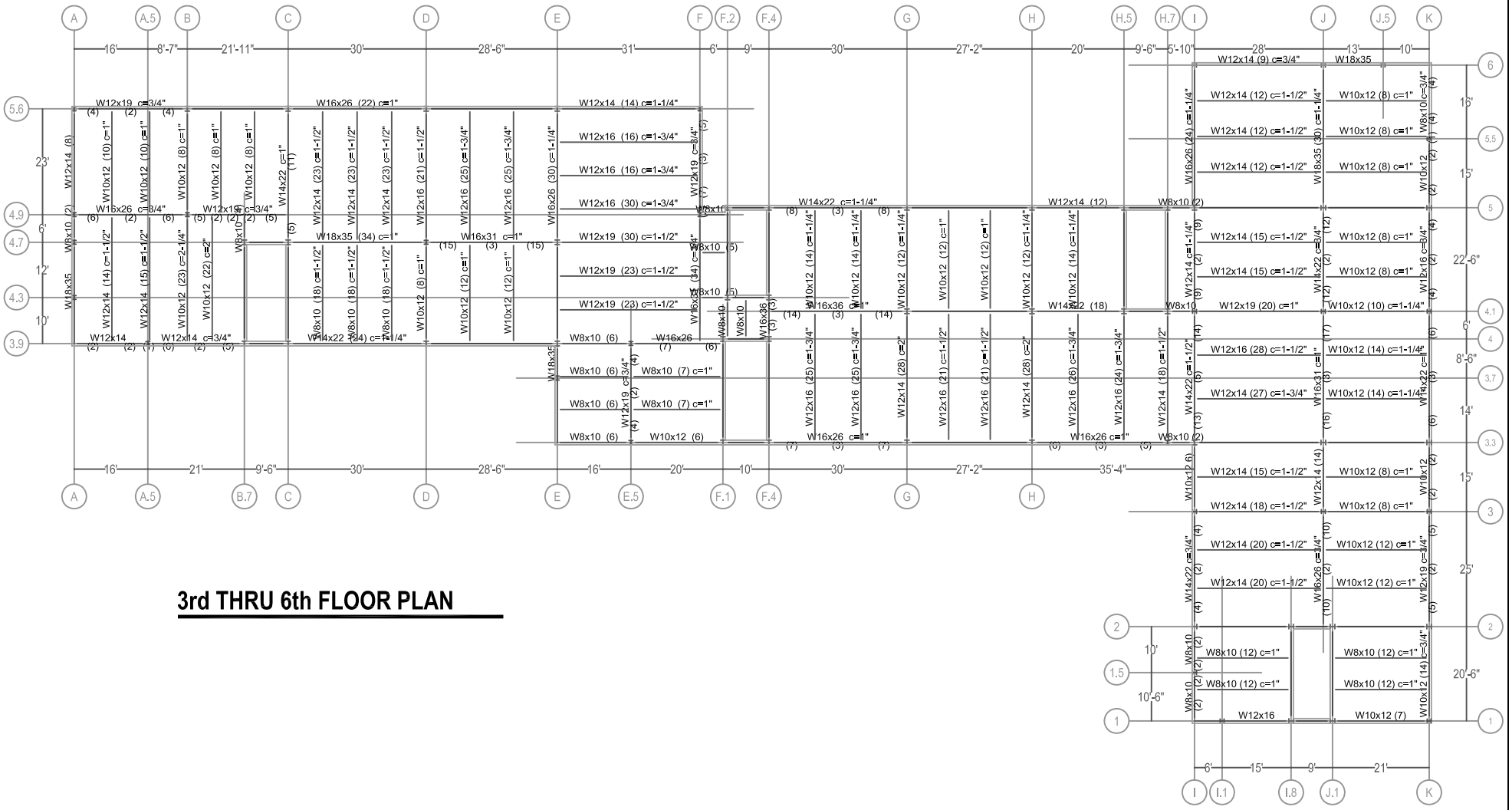
1st AND 2nd FLOOR PLAN

The Towers at The City College of New York

STRUCTURAL PLAN - FLOOR 1 - 2

SCALE: $\frac{1}{32}$" = 1'-0"

S1.1



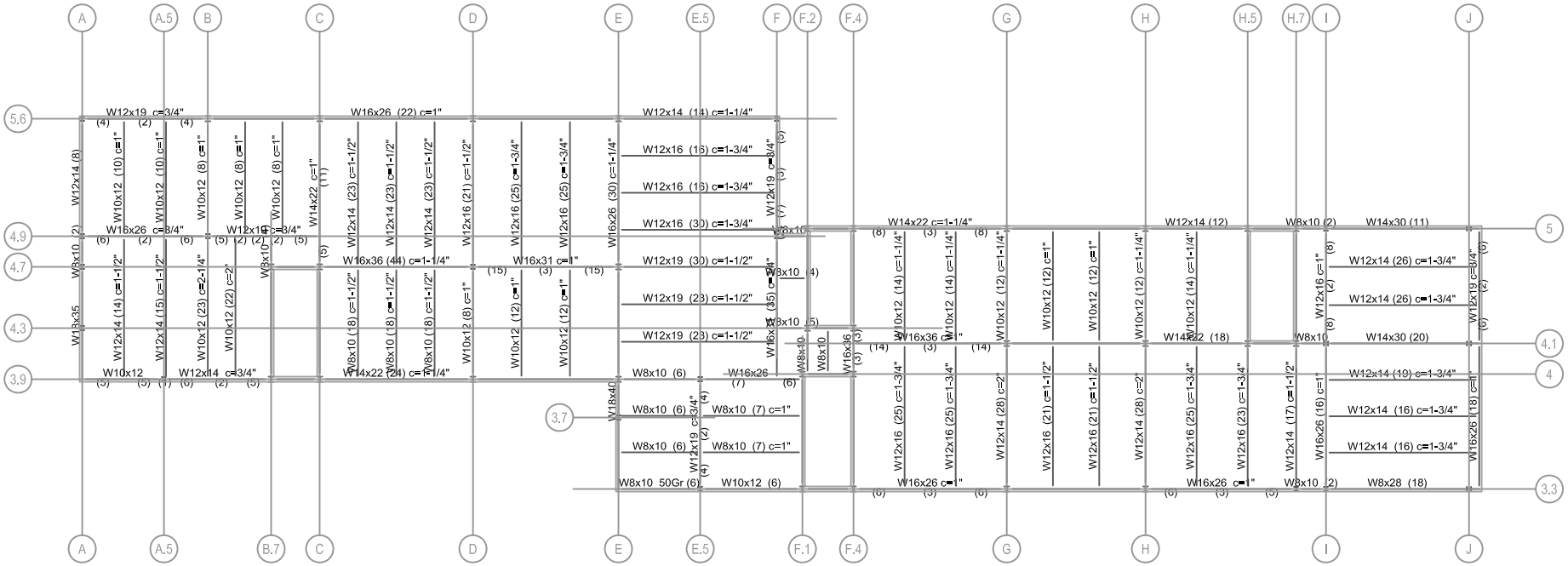
3rd THRU 6th FLOOR PLAN

The Towers at The City College of New York

STRUCTURAL PLAN - FLOOR 3 - 6

SCALE: $\frac{1}{32}$" = 1'-0"

S1.2



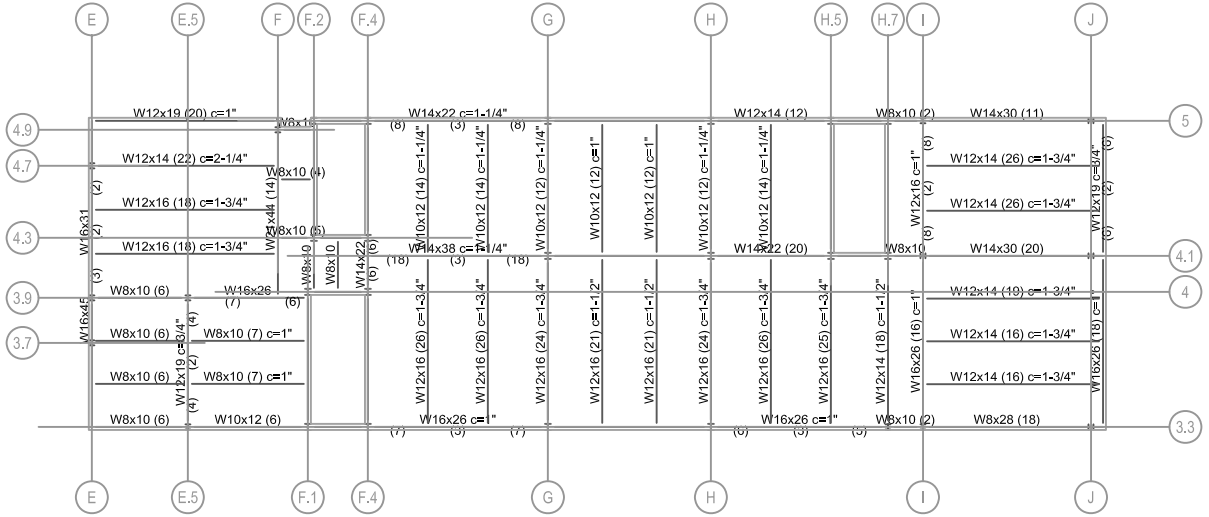
7th THRU 9th FLOOR PLAN

The Towers at The City College of New York

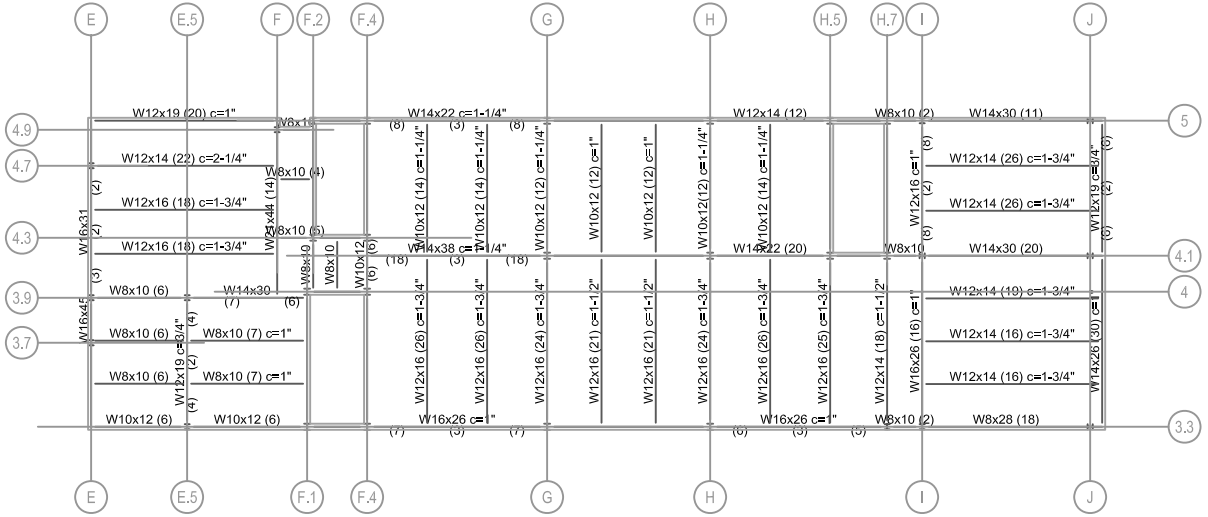
STRUCTURAL PLAN - FLOOR 7 - 9

SCALE: $\frac{1}{32}$" = 1'-0"

S1.3



10th FLOOR PLAN



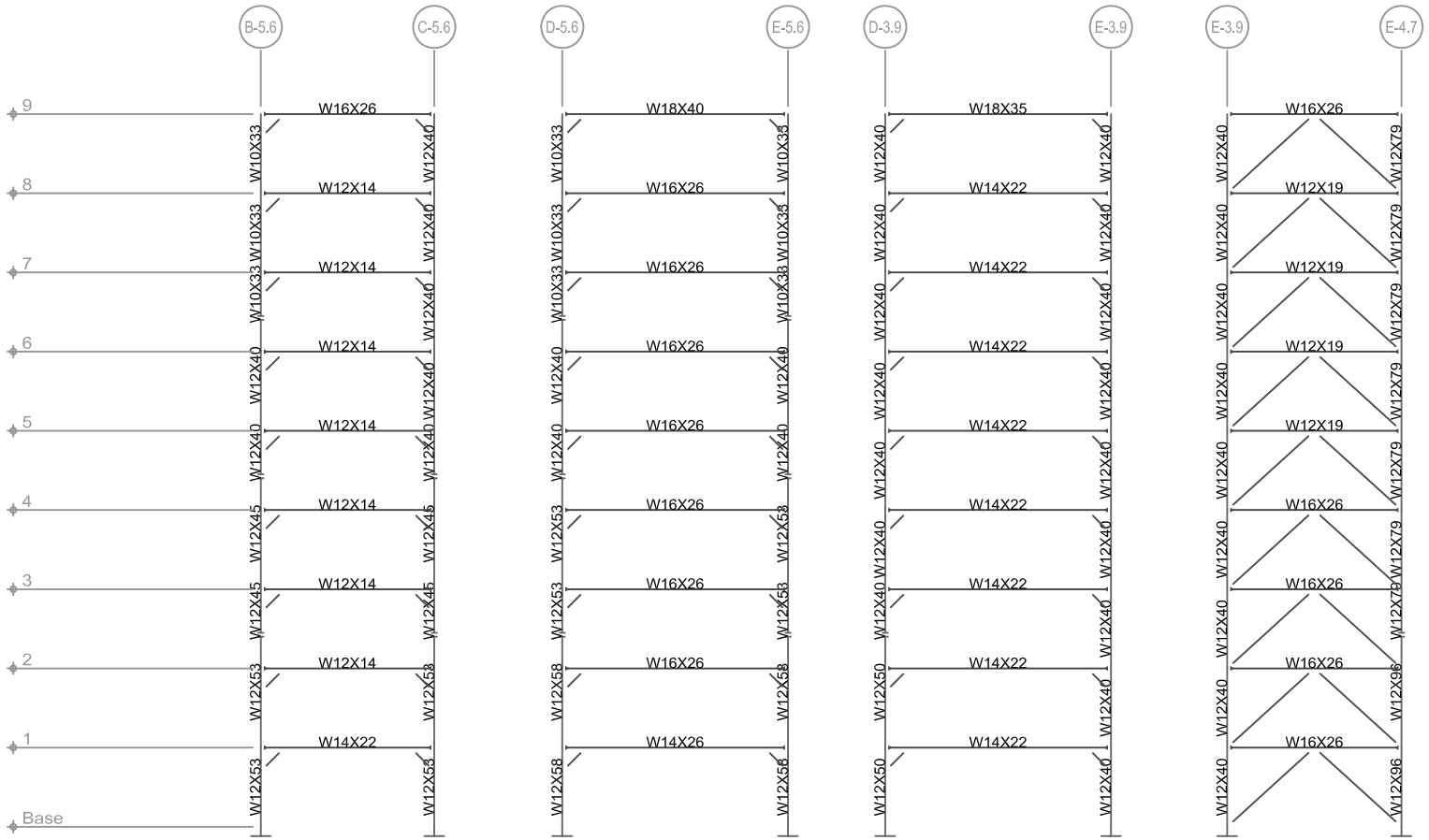
ROOF PLAN

The Towers at The City College of New York

STRUCTURAL PLAN - FLOOR 10 - ROOF

SCALE: $\frac{1}{32}$" = 1'-0"

S1.4

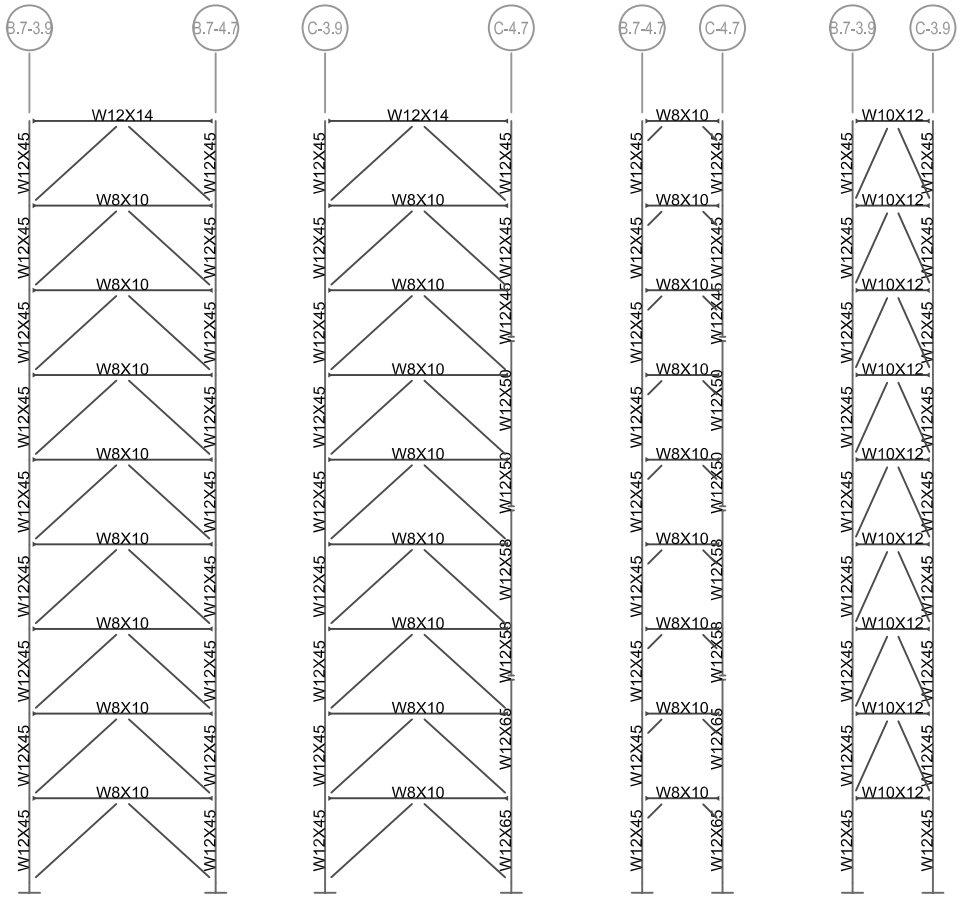


The Towers at The City College of New York

FRAME ELEVATIONS

SCALE: $\frac{1}{32}$" = 1'-0"

S2.1



The Towers at The City College of New York

FRAME ELEVATIONS

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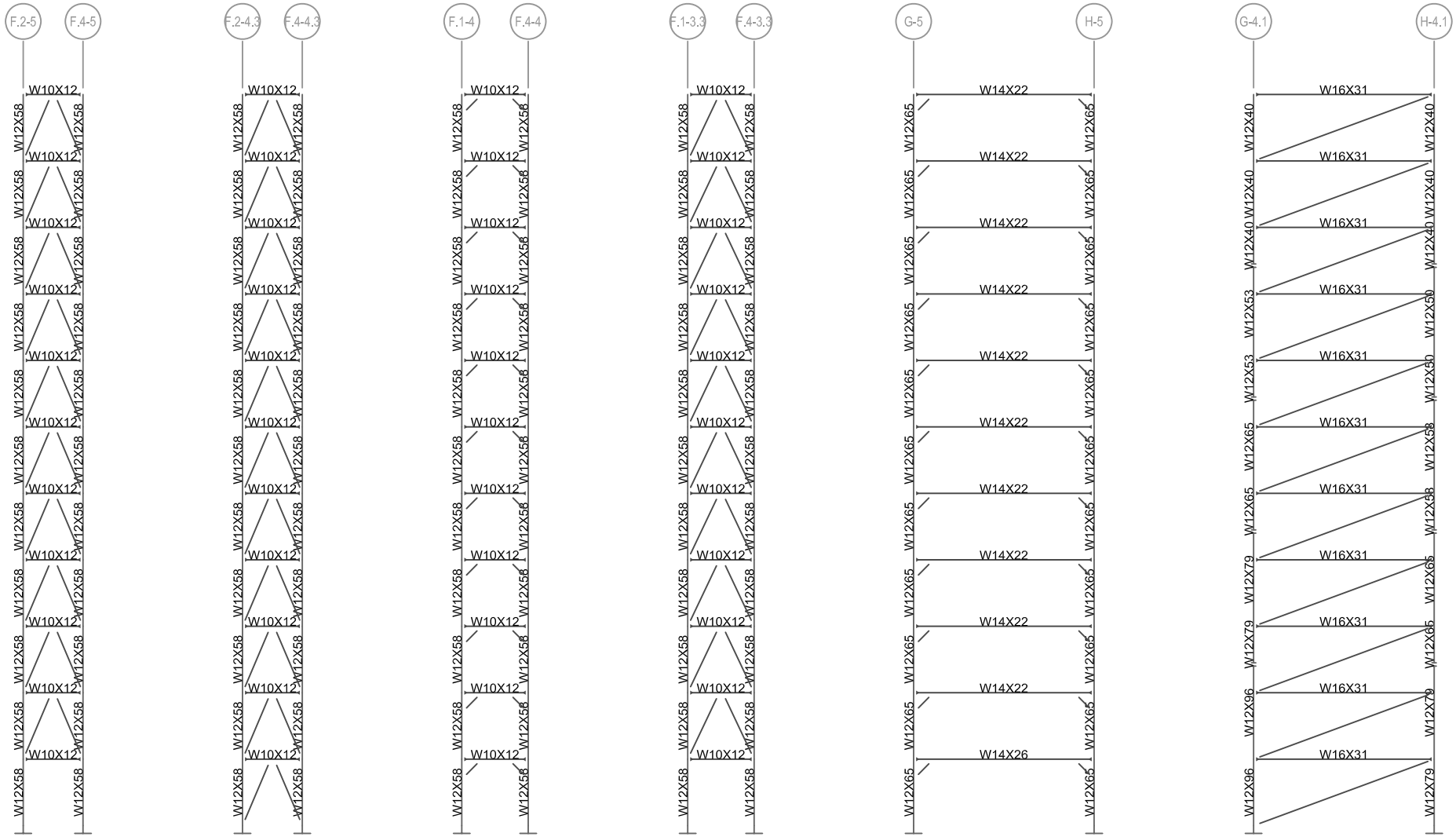
S2.2

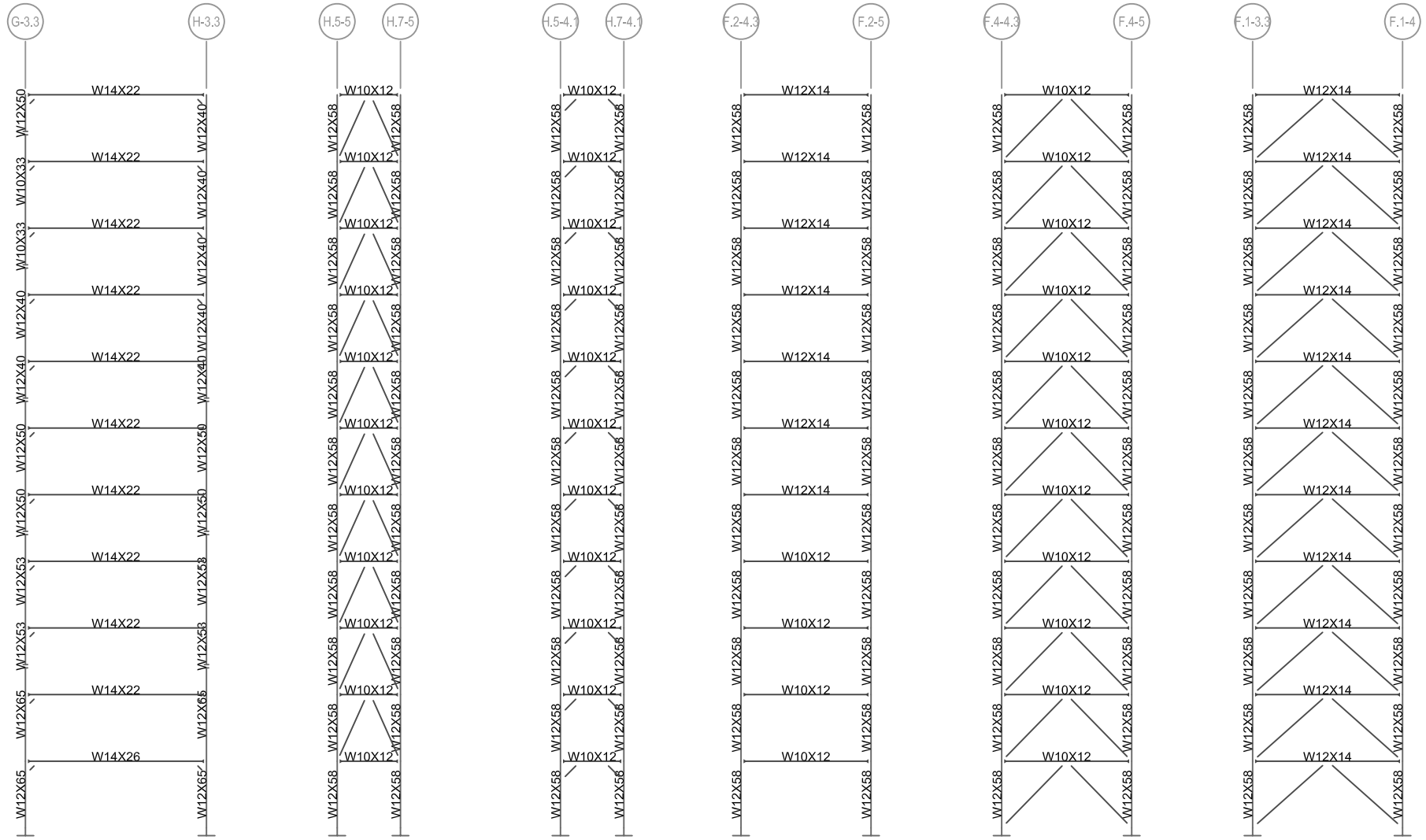


The Towers at The City College of New York

FRAME ELEVATIONS

SCALE: $\frac{1}{32}$" = 1'-0"

S2.3



The Towers at The City College of New York

FRAME ELEVATIONS

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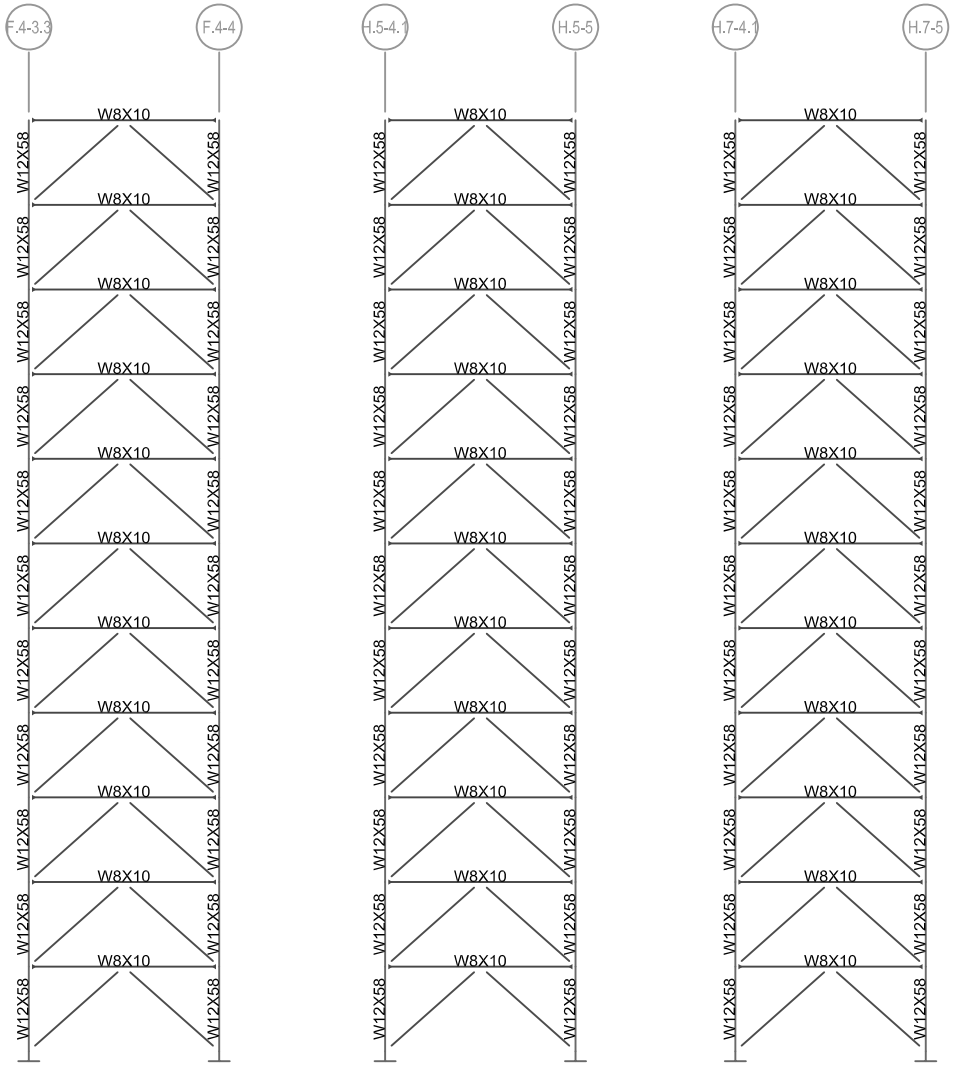
S2.4



The Towers at The City College of New York

FRAME ELEVATIONS

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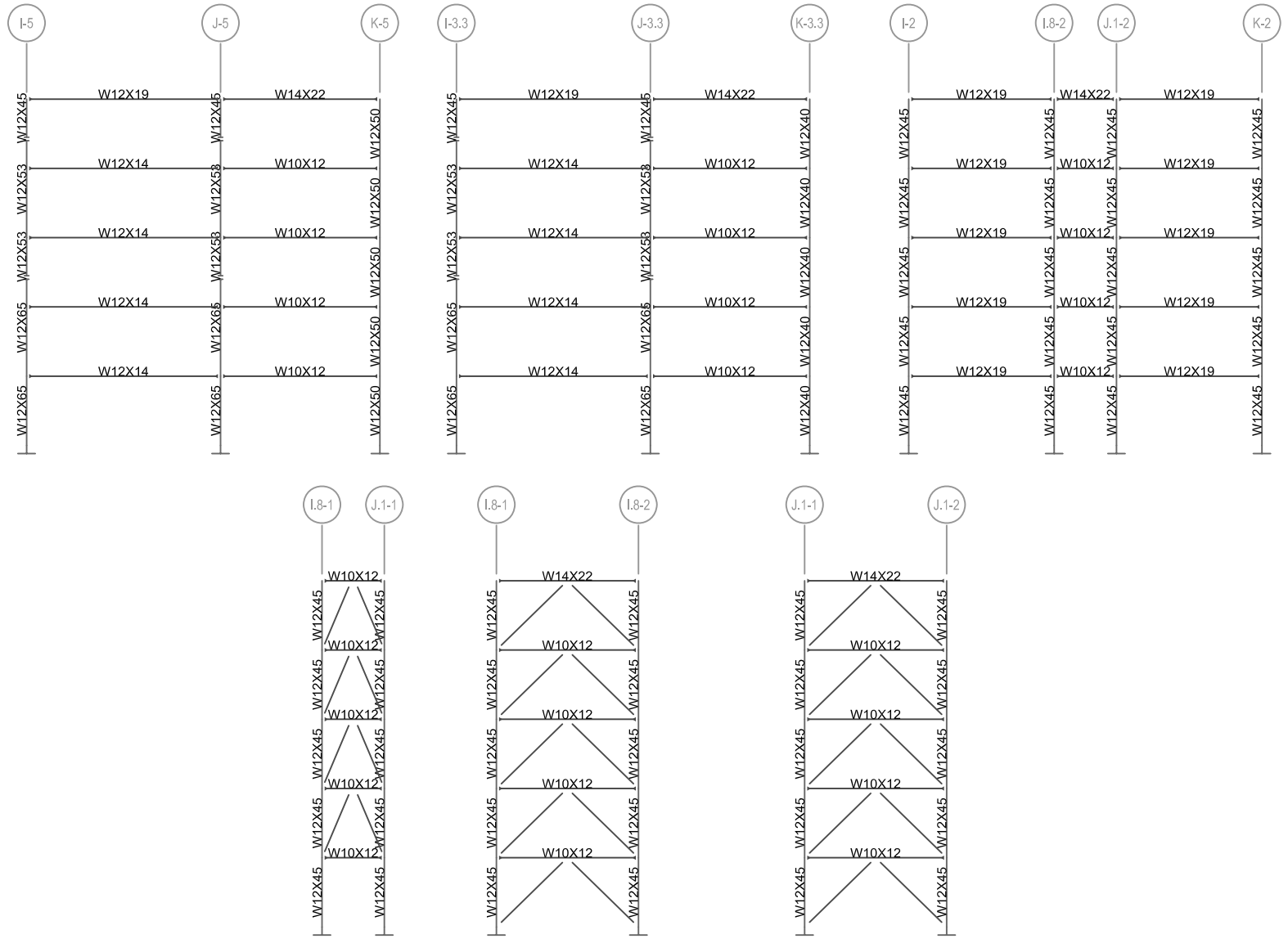
S2.5



The Towers at The City College of New York

FRAME ELEVATIONS

SCALE: $\frac{1}{32}$" = 1'-0"

S2.6