Structural Concepts/ Structural Existing Conditions Report

St. Joseph Hospital of Orange Patient Care Center & Facility Service Building

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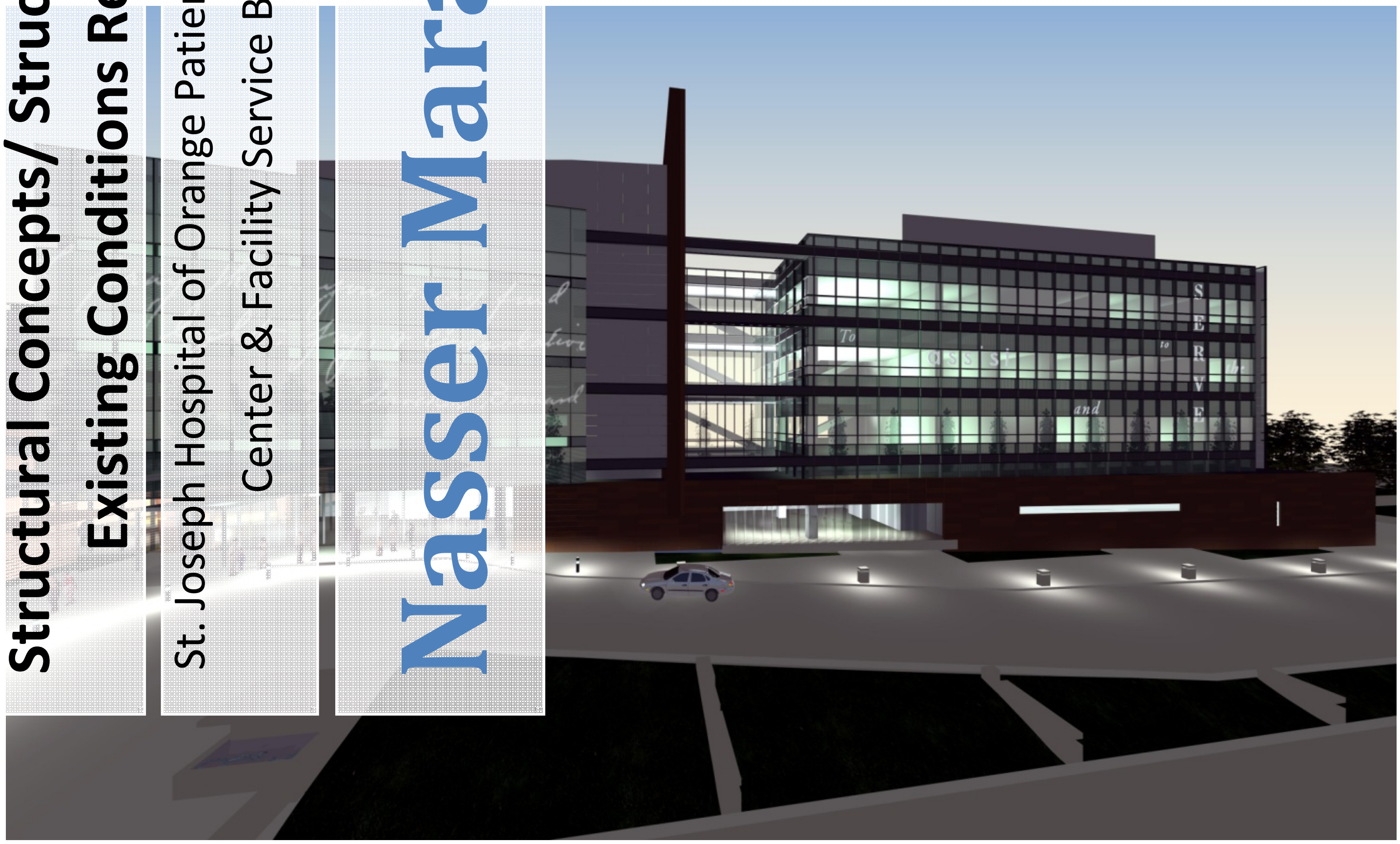

Technical Report 1

Professor Andres Lepage
STRUCTURAL OPTION
October 5th
2007

Executive Summary

This is an existing condition report of the structural system in St. Joseph Hospital of Orange Patient Care Center & Facility Service Building. The report first describes the structural systems used throughout the building. The report then talks about the occupant use throughout the building and design assumptions made. Further on the report goes and lists the codes that were used and material strength requirements. A series of load computations are then made for dead, live, wind and seismic. Snow load computations were not done due its insignificance at the building's location.

Spot checks for the gravity beams and girders are sized accordingly with the dead and live load computations. Seismic forces were found to control against wind forces; an ETABS lateral system model was made to check the lateral system against computed seismic forces. The Lateral system is sized accordingly and any discrepancies are justified.

Refer to the appendix for backup calculation and assumptions made. Additional backup calculations are available upon request.

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Introduction

St. Joseph Hospital of Orange Patient Care Center & Facility Service Building is to be built within Saint Joseph Hospital Campus serving the healthcare needs of the Orange county community in Orange, CA. The Patient Care Center is linked to the main hospital through an underground tunnel and through a lobby to further serve the patients' needs. The building consists of four stories with basement that gives 252,712 square foot of additional hospital space. The buildings is approximately 285'-0" by 198'-0" on Level 1 and 2 and then the floor plan is reduced to 240'-0" by 198'-0" on Level 3, 4 and the roof.

The main entrance to the lobby is connected to the adjacent hospital reception area. The Patient Care Center consists of operating rooms to expand the surgical capacity of the main hospital. Operating rooms are equipped with latest innovative technology and medical equipment. To help further serve the main hospital, the Patient Care Center also has additional room for incoming patients and rooms for patients requiring intensive care.

The Patient Care Center has a central sterile plant located on the basement level with MEP equipment. The first level of the hospital consists of surgical rooms, administrative rooms and the lobby. The upper floors are separated by the central courtyard locate don level 2. The west side consists of patient rooms and the east side consists of intensive care units. The remaining mechanical equipment is located on the roof level.

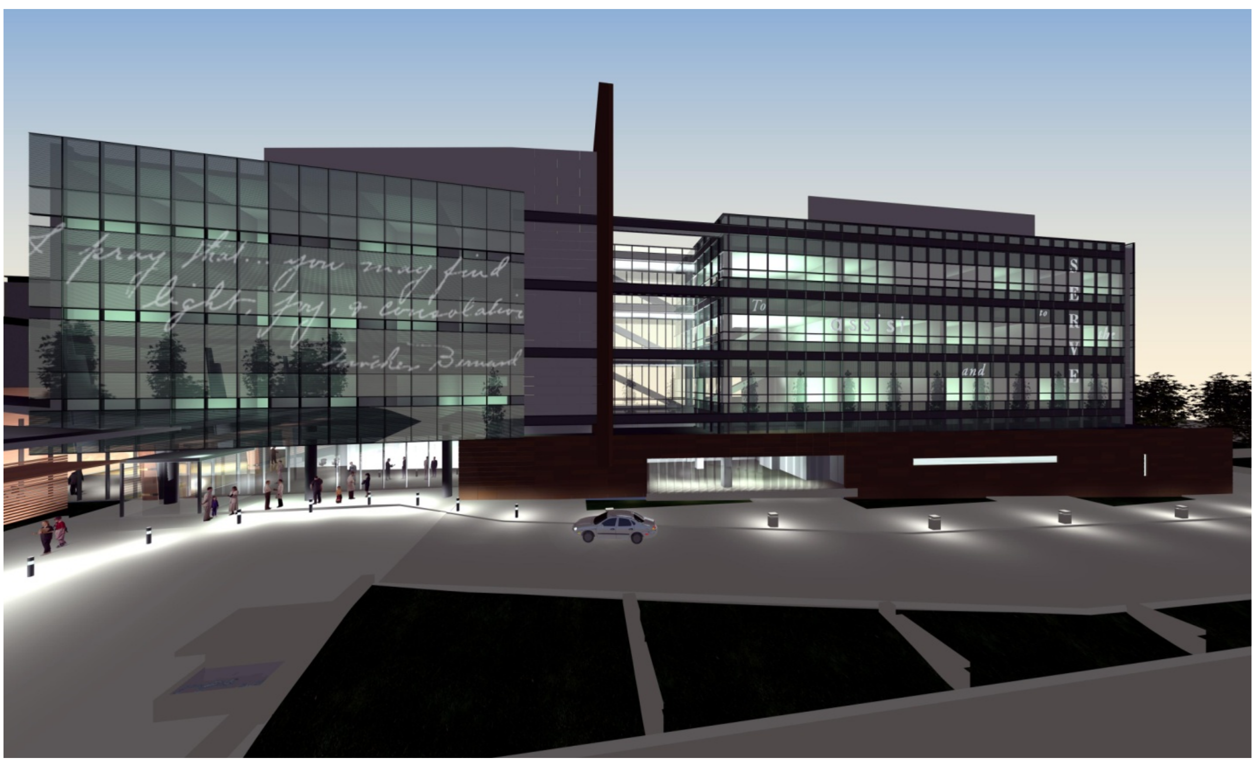

Figure 1. Computer rendering of Patient Care Center's North elevation.

Structural Systems

Floor Framing

There are minor variations to the floor framing through the Patient Care Center. The typical floor system is a composite steel framing using lightweight concrete and a total thickness of 6¼", 3" composite deck is used with 5" long, ¾"diameter shear studs for composite action. The typical infill beam is a W16x31, 30'-0" long spaced at 10'-0" on center, which frame onto a W24x68 30'-0" long. Variations from the typical floor system are based on the use of the space. Light weight concrete was used in the typical steel deck configuration to reduce shear and overturning moment during seismic events.

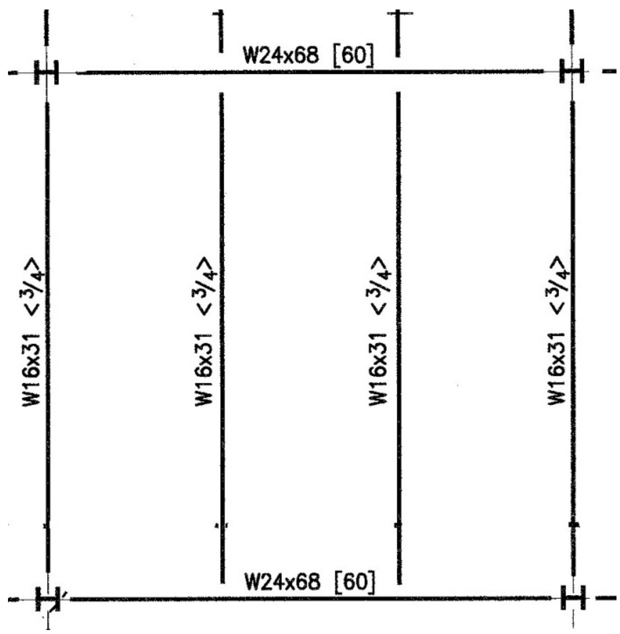

Fig2. Typical 30'-0"x30'-0" bay located on Levels 2, 3 and 4

First floor

The floor framing plan on the first floor differs from the rest due to different loading criterion used. Typical infill members used are W18x35 framing into W24x68 girders. Composite steel framing is used with normal weight concrete and a total thickness of 7½", 3" composite deck with 5" long, ¾" diameter shear studs.

Second floor

There is a central courtyard which is supported by the second floor framing system. Due to the high loading W21x111 infill beams are used which frame into W30x148. A composite steel framing system is also used with normal weight concrete and a total thickness of 9", 3" composite deck with 5" long, ¾" diameter shear studs.

Roof

Due to the location of air handling units on the roof, members with a higher loading capacity are required. Therefore the member sizes change to a W18x40 for beams and W24x84 for girders. A 9" composite steel system exists similar to the second floor courtyard but covered with rigid insulation.

Lateral Resisting System

The lateral system consists of 6 sets of braced frames located both along the N-S and E-W planes. It ranges from 2 bays to as long as 6 bays framing vertically to the roof of the structure. These braces are supported by shear walls at basement level. The braced frames are typically V-bracing while a whole set running E-W is diagonally braced. Both configurations are considered concentrically braced frames. X-Braced frames are a TS shaped with a gusset plate slipped in and welded. The gusset plate is then welded onto the column and beam, allowing the brace to buckle out of plane to dissipate energy at time of an earthquake. While diagonally braced member consists of a W Shape section which has its web and flanges welded to a plate which are all then welded onto the gusset plate. The plates attached to the flange are slipped in the gusset plate and welded.

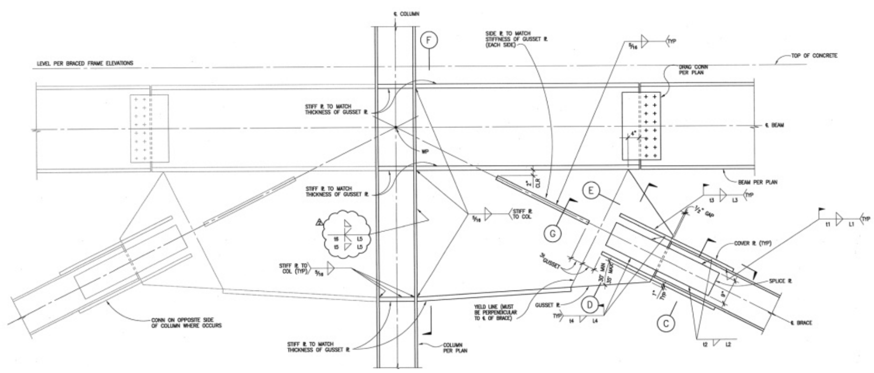

Fig3. Diagonal Brace Connection Detail

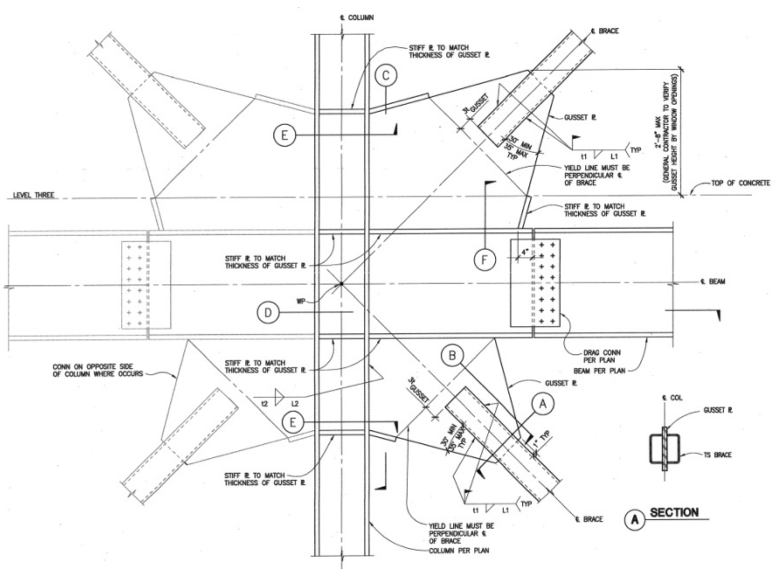

Fig4. X Brace Connection Detail

Foundation system

Gravity columns at the basement level are supported by concrete footings. These footings range depth from 1'-6" to 3'-6" and their size ranges from 2'-0"x2'-0" to 16'-0"x16'-0". While the shear walls are supported by continuous deep footings typically 5'-0" deep and 7'-0" wide from each face of the wall. The majority of the foundation is considered shallow as advised by the geotechnical engineer. While the main entrance canopy is supported by piles capes each connected to 4 piles.

Columns

There are two columns sets per gridline intersection which are usually spliced at 5'-0" from the Level 2. Typical columns sizes are W14x99 on the upper levels (Level 2 to Roof); while the lower columns are W14x145 or W14x132 depending on location and there loadings. Columns existing in the brace frame are usually W14x145 except the end columns which are W14x211 on the top and W14x311 at the bottom. These columns have greater strength capacities due to the excess tension and compression they carry from the bracing system induced moment.

Connections

Beams and Girders are typically connected to each other using bolted connections on the beams with steel plates and welded on the girder. The gravity girders have similar connections to the columns, where a shear plate is welded on the column flange.

Identification of other structural elements

There are several areas in the building that were not discussed in depth in this report. These include the underground tunnel connecting to the adjacent hospital, the canopy at the building's main entrance, and the elevator machine rooms located at the roof. Other structural elements like checking the braced system connections and the foundation system where not discussed in this report but will be analyzed and justified in later reports.

Codes and Material Properties

Codes and Referenced Standards

The following table shows the codes that were adopted in this report and codes that were implemented by the designer.

Codes adopted by this report	Codes adopted by the designer
2007 California Building Code	Title 24, Part 1 2001 California Building Code
ASCE 7-05	1997 Uniform Building Code with California amendments
ACI 318-05	
13th Edition of the AISC Manual of Steel Construction	

Material Strength Requirements

These requirements correspond to the general structural notes on the plans.

Concrete	Strength	Density
Footings	4000 psi	150 pcf
Basement Walls	4000 psi	150 pcf
Composite Concrete Light Weight	3000 psi	110 pcf
Composite Concrete Normal Weight	4000 psi	150 pcf
Slab on Grade	4000 psi	150 pcf
Drilled Concrete Piles	4000 psi	150 pcf
Reinforcing (Steel)	ASTM706 Grade 60	

Steel Deck	I (in^4)	S (in^3)
3" x 18 GA Deck	1.203	.767

Structural Steel	ASTM	Fu (ksi)	Fy (ksi)
Wide-Flange Shapes (WF Shapes, W14 and larger)	A992	65	50
WF Shapes, W12x14, W10x12, W8x12 and smaller	A992	65	50
Plates	A572, Gr50	65	50
Connection Plates	A36	58	36
Pipe Columns	A53 Grade B	80	40
Tube Sections	A500 Grade B	58	46
Bolts	A325N, A490SC		
Bolts in Concrete	A307, A3548C		
Angles, Channel and WT Shapes	A36	58	36

Foundation	
Allowable Bearing (Gravity Loads)	4000 psf (Basement Footings) 2500 psf (Ground Floor Footings)
Equivalent Fluid Pressure	30 pcf (unrestrained walls) 23 pcf (unrestrained walls)
Passive Earth Pressure	300 pcf

Framing Plans and Elevations

1st Floor plans

The following figure represents the first floor plan labeled with occupant use. The designer assumed a live load of 80 psf throughout the first floor. This is a design time efficient assumption, since the corridor space is dominant throughout the operating and patient rooms. Assuming 60 psf and 40 psf respectively would have caused minimal differences in the final design, while reducing the capability of the hospital being equipped with heavier loads later on in the future.

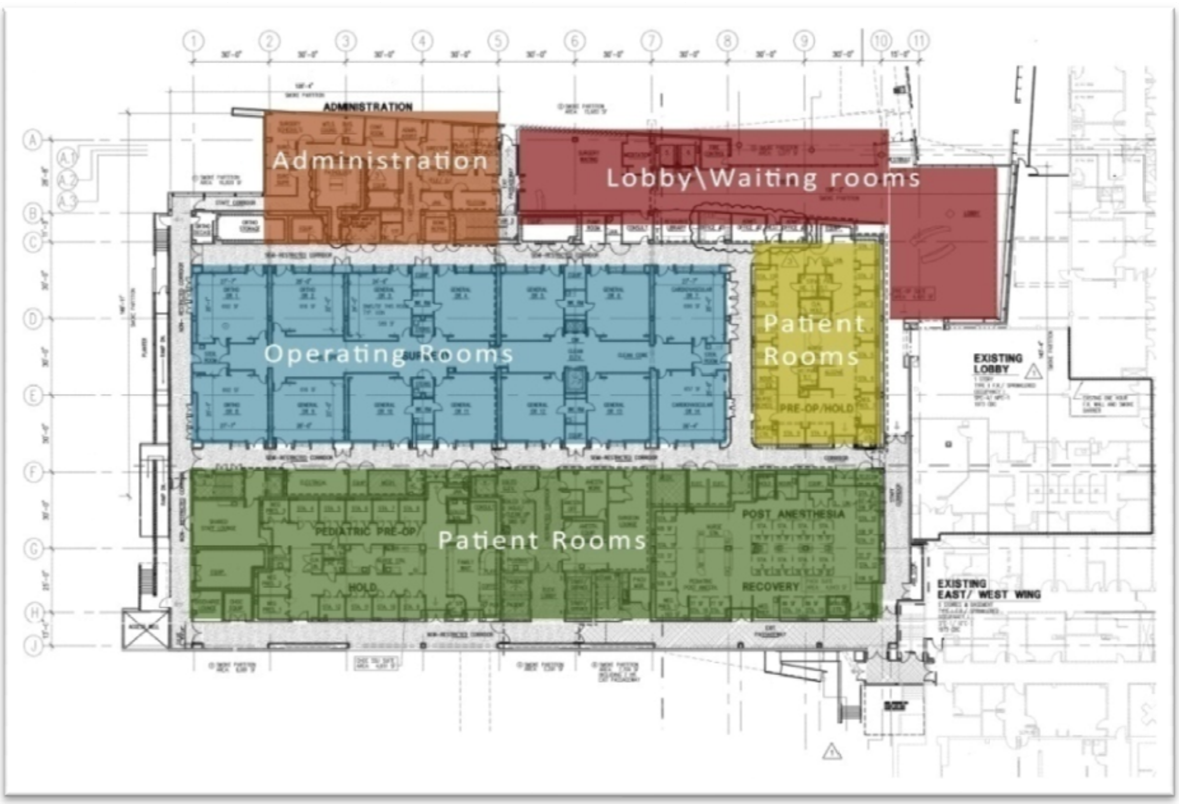

Fig5. First floor plan showing occupant use.

The figure below represents the framing system on the first floor. A typical 30'-0"x30'x0" bay was maintained through the center part of the structure for simplicity. While a 10'-0" span joist was maintained throughout the structure.

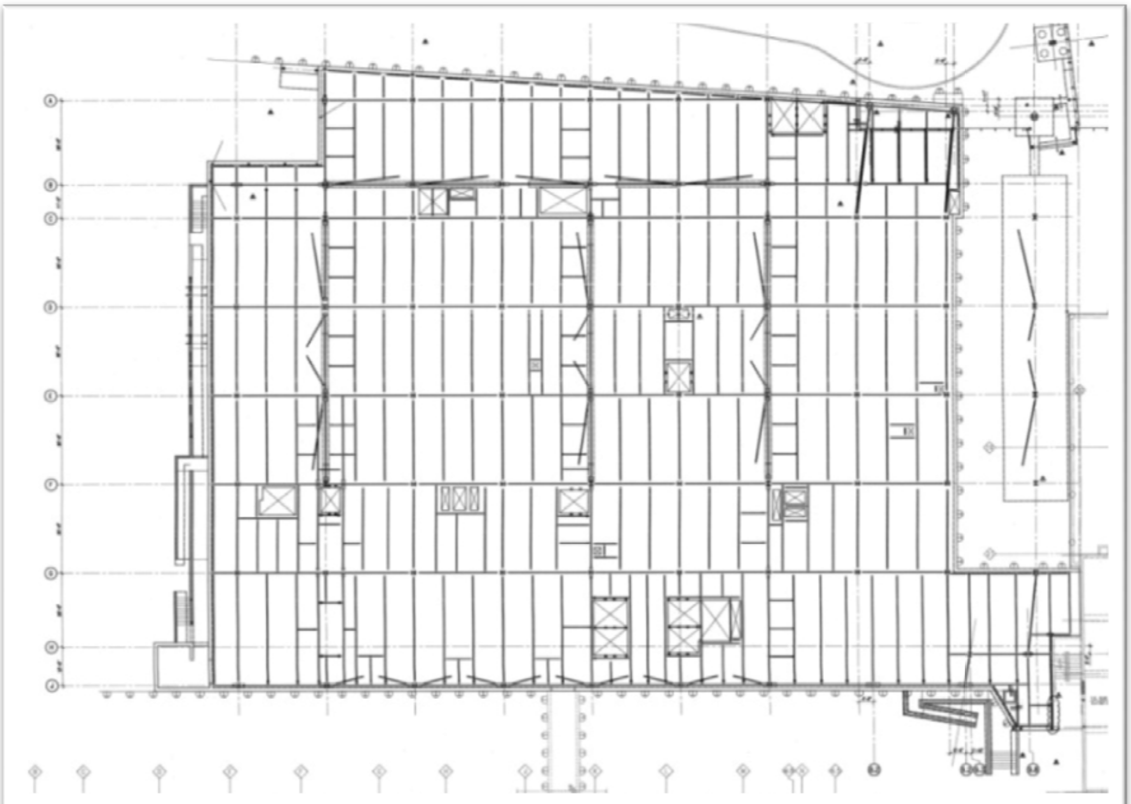

Fig6. First floor framing plan.

2nd Floor Plan

The figure below represents the 2nd floor plan occupant use. Loadings here are assumed to be 80 psf where patient rooms and the Intensive care units exist. While at the court yard a super imposed dead load is added counting for pavements, planters and trees. The roof on the west side is designed for future planters.

Fig7. 2nd floor plan showing occupant use.

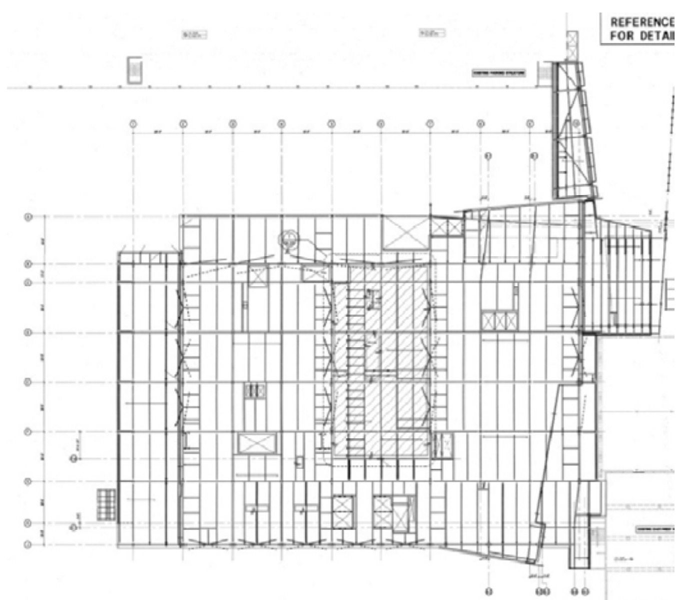

Fig8. 2nd floor plan showing framing plan.

3rd Floor plan.

On the third floor of the patient care center, the occupant usage is similar to the second floor without the courtyard. The live loads here are assumed to be 80 psf by the designer. The 4th and third floor is similar in loading and occupant layout.

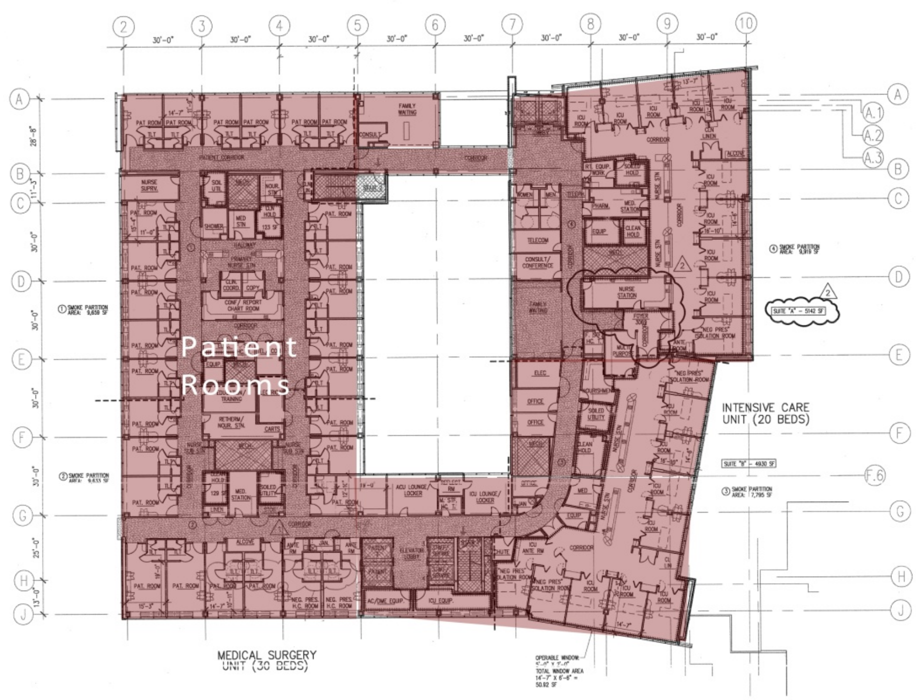

Fig9. 3rd Floor Plan showing occupant use.

Building Sections

The figures below represent the building sections through the building taken at the courtyard. This report does not take into consideration wind pressures that might arise inside the courtyard space.

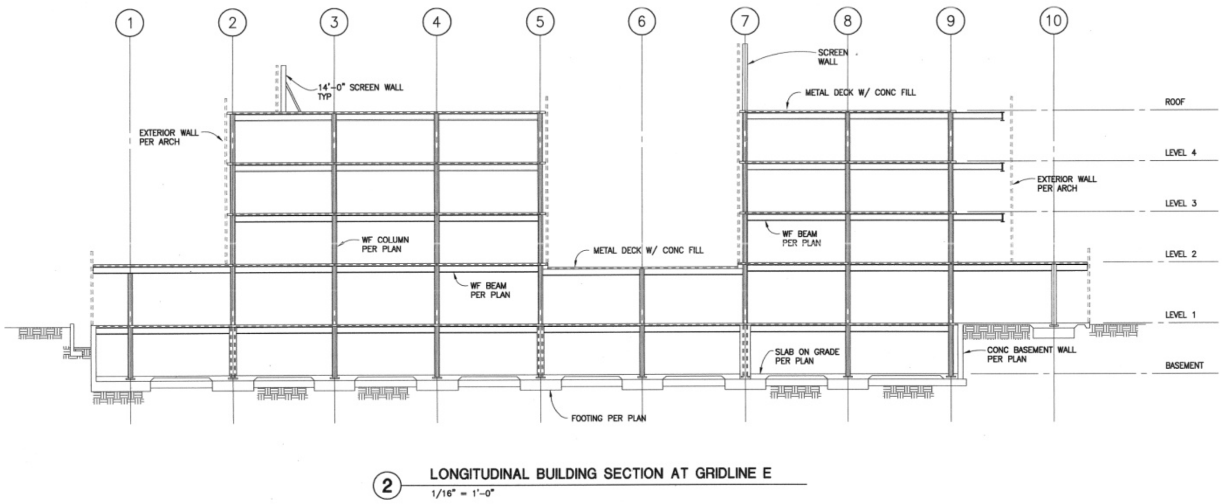

Fig10. Longitudinal Section at gridline E.

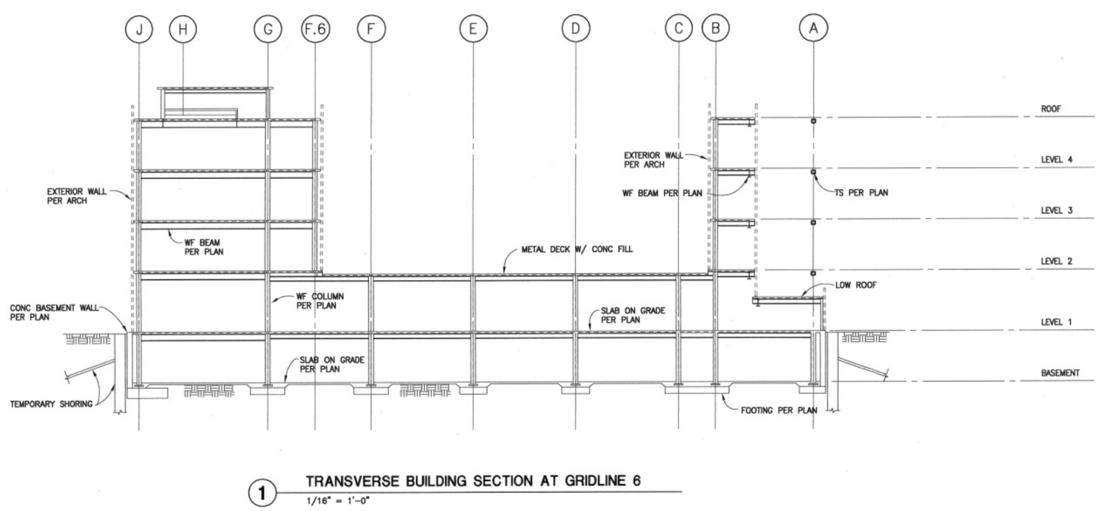

Fig11. Transverse Building Section at gridline 6.

Lateral Resisting system

The following figure represents the lateral system labeled on level 1. The lateral system consists of concentrically braced frames. There are 6 groups of braced frames altogether, and two types, one consists of diagonal bracing while the others are all V braced frames.

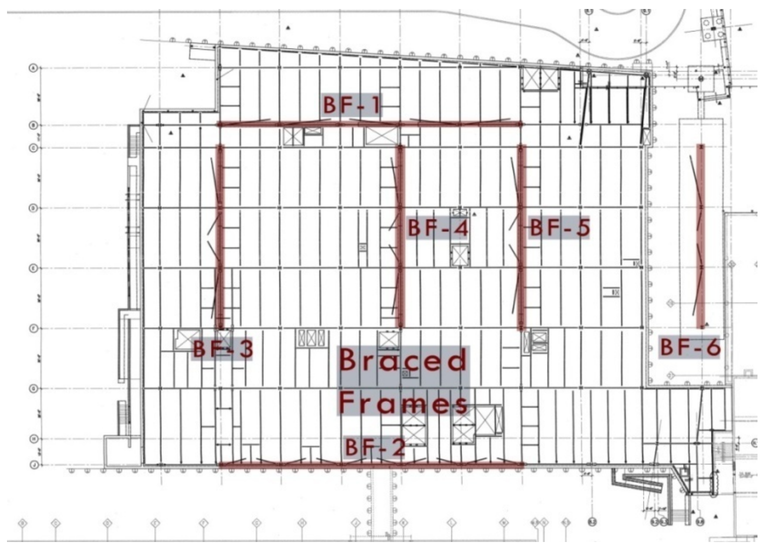

Fig12. 1st Floor plan labeling all braced frames

BF-1 Diagonally Braced Members

Consist of diagonal members, member's sizes range from W14x90 on level 4, to W14x211 on level 1. Braced frames are supported by shear walls located on the basement floor and tied into a 5'-0" continuous footing. The entire brace frame is 150'-0" wide.

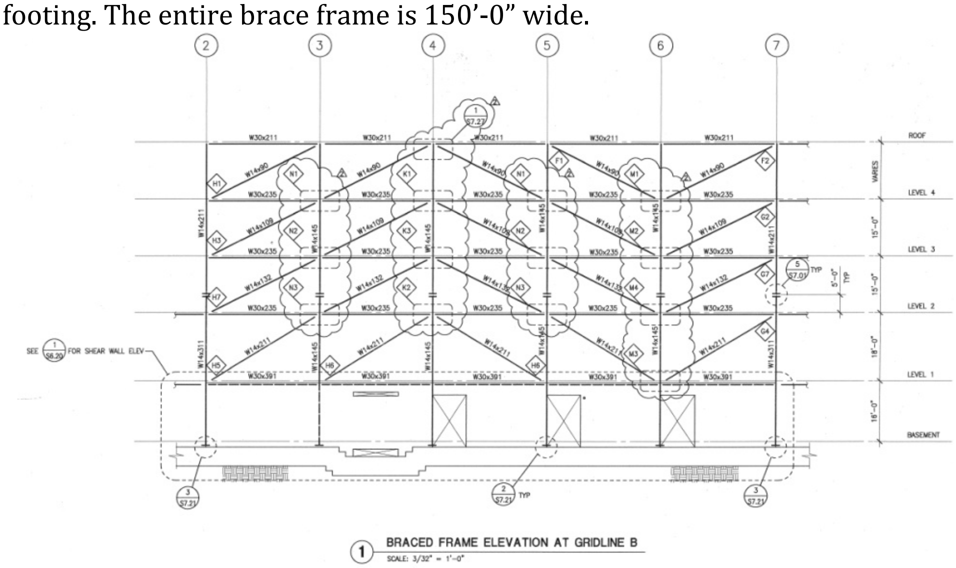

Fig13. BF-1 Braced Frame Elevation

BF-3 X-Braced Members

Consist of X-braced members; members are usually steel tubes. There are two W14x145 running as diagonal members on each end bay on level 1. Braced frames are supported by shear walls located on the basement floor and tied into a 5'-0" continuous footing. The entire braced frame is 90'-0" wide.

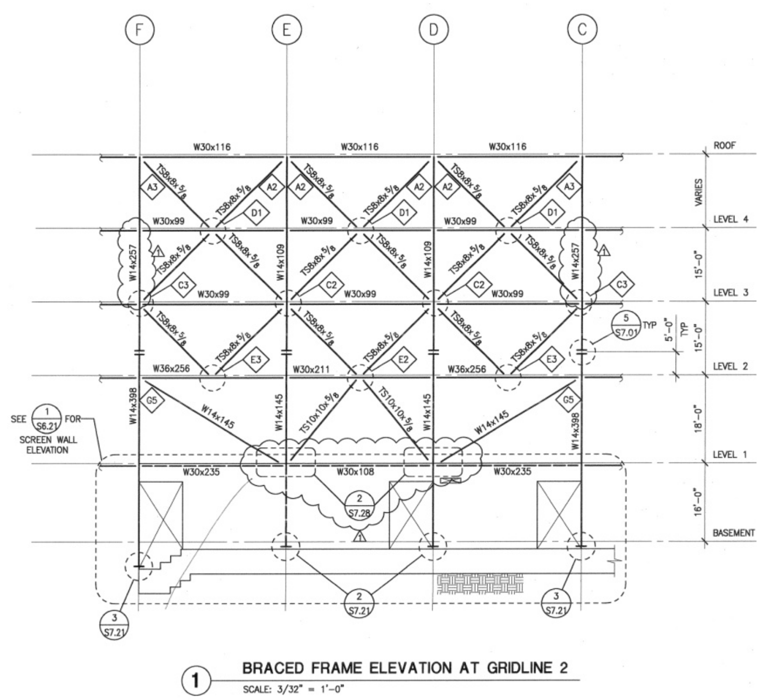

Fig14. BF-3 Braced Frame Elevation

Building Loads and Loading Diagrams

Live Loads

Live loads are determined in accordance with ASCE 7-05.

Occupancy	Designer's Uniform Live load (psf)	2007 CBC Uniform Live loads (psf)
Roof	20	20
Patient Rooms	80[1]	40
Operating Rooms, Laboratories	80[1]	60
Corridors	80[1]	100
Storage	120	125
Computer Rooms	100	100
Elevator Machines Rooms	125[1]	
Public Areas, Assemblies	100	100
Mechanical Rooms	150[1]	50
Roof Gardens	100	100
Office	80[1]	50

[1] Designer's value used for simplicity reasons.

Dead Loads

Refer to Appendix for dead load calculations. Material weights are taken from the ASCE 7-05 Chapter C3.

	LVL1	LVL2	LVL3	LVL4	ROOF
Concrete Topping	75	44	44	44	94
Steel Deck (18 Gage)	3	3	3	3	3
Super Imposed	12	12	12	12	25
Partitions	20	20	20	20	
Total Dead Load	**110**	**79**	**79**	**79**	**122**

*Units in pounds per square foot

Level 2 Courtyard	PAVER	PLANTER W/ TREES	PLANTER
Concrete Topping	94	94	94
Steel Deck (18 Gage)	3	3	3
Super Imposed	22	552	342
Topping	80		
Total Dead Load	**200**	**649**	**439**

Wind Loads

Below is a list of assumption made for determining wind load calculations based on ASCE 7-05. Refer to appendix for calculations.

Basic Wind Speed	85 mph
Wind Directionality Factor	.85
Importance Factor (I)	1.15
Exposure	C
Topographic Factor (K_{zt})	1
Gust Effect Factor (G)	N-S (.621) E-W (.645)
Internal Pressure Coefficient (GC_{pi})	±.18

The tables below summarize the pressures, loads and shears from the wind load calculations. Refer to Appendix for additional information.

Pressures (psf)

	N-S						E-W					
Level	**Windward**		**Leeward**		**Sideward**		**Windward**		**Leeward**		**Sideward**	
Level 2	7.92	±3.88	-6.69	±3.88	-9.36	±3.88	8.23	±3.88	-6.94	±3.88	-9.72	±3.88
Level 3	9.00	±3.88	-6.69	±3.88	-9.36	±3.88	9.35	±3.88	-6.94	±3.88	-9.72	±3.88
Level 4	9.74	±3.88	-6.69	±3.88	-9.36	±3.88	10.12	±3.88	-6.94	±3.88	-9.72	±3.88
Roof	10.31	±3.88	-6.69	±3.88	-9.36	±3.88	10.71	±3.88	-6.94	±3.88	-9.72	±3.88
Mech. Room	10.70	±3.88	-6.69	±3.88	-9.36	±3.88	11.11	±3.88	-6.94	±3.88	-9.72	±3.88

Load (plf)

	N-S			E-W		
Level	**Windward**	**Leeward**	**Sideward**	**Windward**	**Leeward**	**Sideward**
Level 2	194.65	-174.27	-218.39	199.73	-178.56	-224.39
Level 3	193.13	-158.43	-198.54	198.37	-162.32	-203.99
Level 4	204.21	-158.43	-198.54	209.88	-162.32	-203.99
Roof	191.53	-142.58	-178.68	196.94	-146.09	-183.59
Mech. Room	87.44	-63.37	-79.42	89.93	-64.93	-81.60

	Shear (kips)			
	N-S		E-W	
Level	N-S dir	E-W Dir	N-S Dir	E-W Dir
Level 2	105.14	-62.24	79.44	-47.12
Level 3	100.19	-56.58	75.75	-42.84
Level 4	103.35	-56.58	78.16	-42.84
Roof	95.22	-50.92	72.04	-38.55
Mech. Room	42.98	-22.63	32.52	-17.14
Total Base Shear	446.9	-249.0	337.9	-188.5

In comparison with seismic base shear on page 23, the base shear for wind does not control.

Roof			
x < Horiz. Dist < y		Final Pressure (psf)	
x	y	N-S	E-W
0.00	37.50	1.47	1.38
37.50	75.00	1.47	1.38
75.00	150.00	1.47	1.38
150.00		1.47	1.38

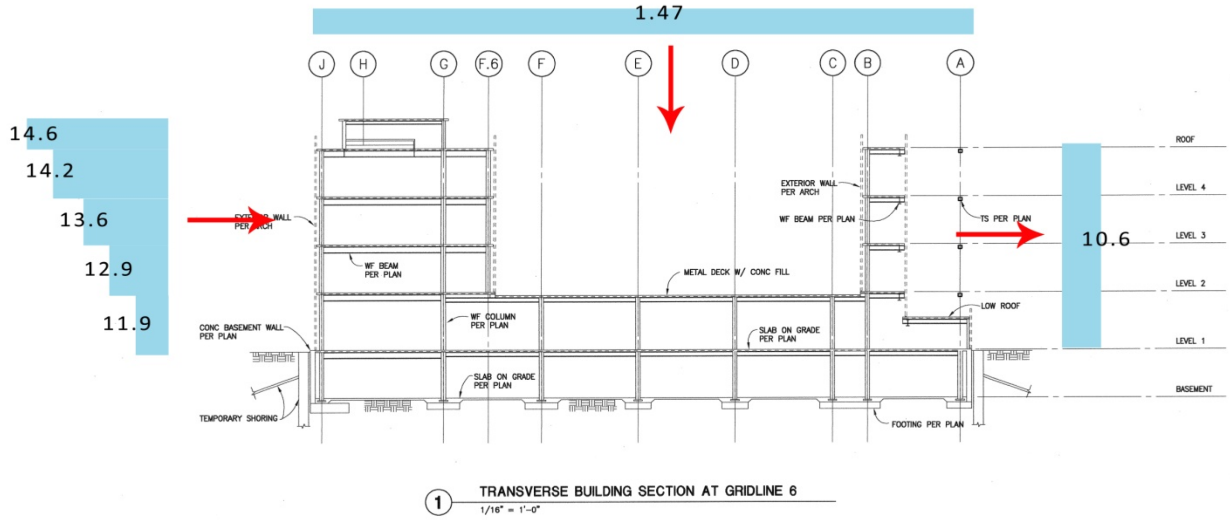

Fig15. Transverse Section with the N-S Wind Load Pressures (psf)

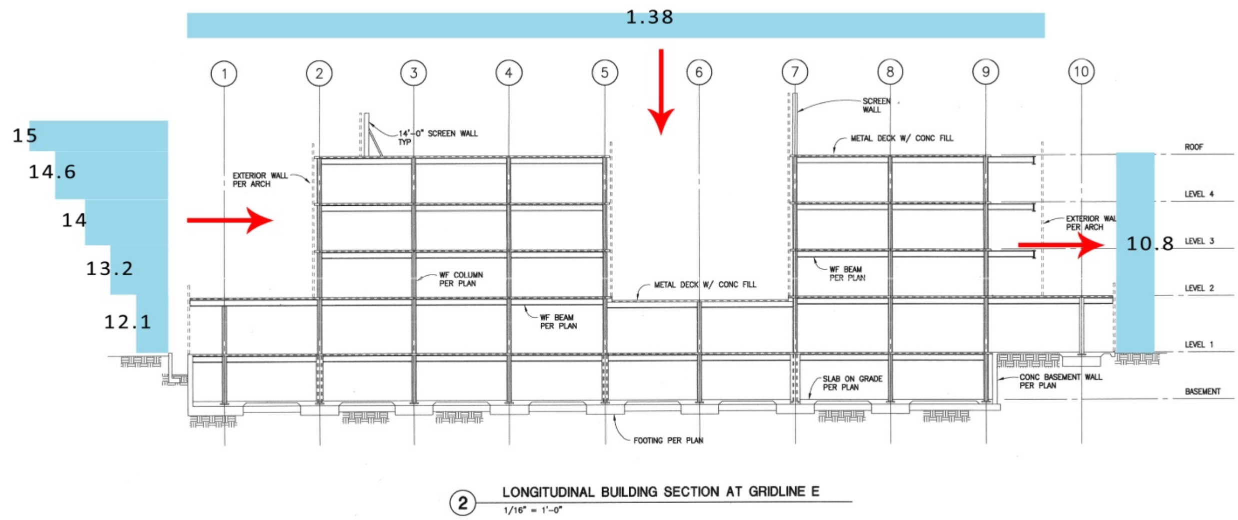

Fig16. Longitudinal Section with the E-W Wind Load Pressures (psf)

Seismic Loads

Below is a list of assumptions made for determining the buildings seismic loads based on ASCE7-05. Site class informational comes from the geotechnical report. Although the geotechnical report includes response spectrums for maximum capable earthquakes; the spectrums were not used since they were intended to be used with UBC 1997 and assumed a 10% probability of exceedence in 50 years for the 1000 year earthquake. While ASCE 7-05 uses 2% exceedence in 50 years for the 2500 year earthquake. Therefore the building's longitude and latitude coordinates where used to determine the seismic design values with the USGS website.

Occupancy Category	IV
Importance Factor (I_E)	1.5
Mapped Spectral Response Accelerations	S_s = 1.378 S_1 = .497
Site Class	D
Site Class Factors	F_a = 1 F_v = 1.5
$S_{MS} = F_a(S_s)$	1.378
$S_{M1} = F_v(S_1)$	.7455
$S_{DS} = 2/3(S_{MS})$	.92
$S_{D1} = 2/3(S_{M1})$	.746
Seismic Response Coefficient (C_t)	.02
Period Coefficient (x)	.75
Building Height (h_x)	63'-0"
Coefficient for upper limit (C_u)	1.4
Period $T = (C_u)(C_t)(h_x)^x$	.626
Seismic Design Category	D
Response Modification Factor (R)	6 (Special Steel Concentrically Braced Frames)
Seismic Response Coefficient (C_s)	.23
Deflection Amplification (C_d)	5
Allowable Deflection	Δ_a= 0.0015h_{sx}
Story Drift	Δ = (Story Drift Ratio)(h_{sx})(C_d)/(I_E)

Refer to the lateral resisting system check for vertical distribution of seismic forces and base shear calculations on page 23.

Spot Checks of typical framing elements

Gravity Beam check (W16x31)

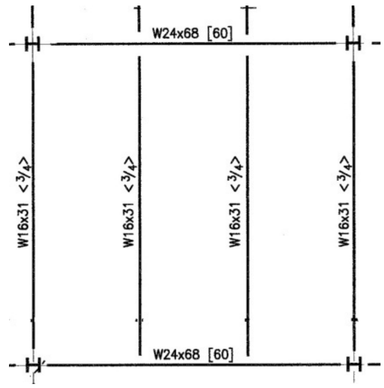

Fig17. Typical 30'-0"x30'-0" bay located on Levels 2, 3 and 4

Computer Loadings	
Live Loads	80 psf
Dead Loads	79 psf
Beams with composite action, deck running perpendicular to beams	f'c = 3000 psi
	¾" Shear Studs @ 12" OC
w_u	2.22 Klf
M_u	250 ft-Kips
V_u	33.3 Kips
Compute Moment Strength Capacity	
Σ Qn from studs	30*17.1=516k
Σ Qn required	456K
beff = min(0.5*span, spacing)	10'
a	1.49"
Y2	5.5"
ΦMp	460 ft-K > Mu **OK**
Check Deflection	
I_{LB}	1200 in^4
Δmax = l/360	1"
Δ	.42" **OK**
Check Deflection before composite action	
w_u (Dead load of Concrete Deck)	.59 klf
I	384 in^4
Δ	.99" -.75" Camber = .24" **OK**

Gravity Girder Check (W24x68)

Computer Loadings	
Beams with composite action, deck running perpendicular to beams	f'c = 3000 psi
	(60) ¾" Shear Studs
Pu (@ 1/3 Points)	66.6 Kips
M_u	666 ft-Kips
V_u	66.6 Kips
Compute Moment Strength Capacity	
Σ Qn from studs	60*17.1=1026k
Σ Qn required	1000K
beff = min(0.5*span, spacing)	15'
a	2.18"
Y2	5.16"
ΦMp	1270 ft-K > Mu **OK**
Check Deflection	
I_{LB}	4680
Δmax = l/360	1"
Δ	.29" **OK**
Check Deflection before composite action	
P_u (Dead load of Concrete Deck)	.16.7 Kips
I	1830 in^4
Δ	.52" **OK but overdesigned**

This analysis does not take floor vibrations into account, the girder might be increased in size for this reason.

Lateral resisting system check

The vertical diagonal brace BF-1 and BF-2 was checked with the listed load combinations below. Wind loads are too low to have controlled compared to seismic loads therefore load combination with wind loads where not checked. Other load combinations with dead and live load were not checked since the members are oversized compared to the gravity beam and columns therefore load combinations with seismic forces would control.

Load Combinations:

$(1.2 + .2S_{DS})D + \rho\ Qe$

$(.9 - .2S_{DS})D + \rho\ Qe$

Vertical Distribution of Seismic Forces

Floor	hx (ft)	W (kips)	hxkWx	Cvx	Fx (kips)	Vx (kips)	Mx (ft-K)
Roof	63.00	5393.40	1896398	0.51	1883.94		118688
Level 4	48.00	3566.00	853371	0.23	847.77	1883.94	40692.77
Level 3	33.00	3566.00	502202	0.13	498.90	2731.71	16463.83
Level 2	18.00	8089.20	483188	0.13	480.01	3230.61	8640.27
Level 1						3710.63	0.00
	Total	**20615**	**3735159**	**Base Shear**	**3711**	**Overturning Moment**	**184485**

There are two braced frame sets running in the E-W Direction, BF-1 and BF-2. Therefore seismic forces where distributed through a rigid diaphragm on each level in the computer model. Allowable story drift was computed based on ASCE7-05. Refer to calculations in the appendix for detail. A redundancy factor (ρ) of 1.3 was applied in this analysis for conservative purposes. Since torsion was not considered in the computer model a factor of 1.2 was applied to all earthquake loads. The two braced frames were modeled using ETABS, and printouts are available upon request.

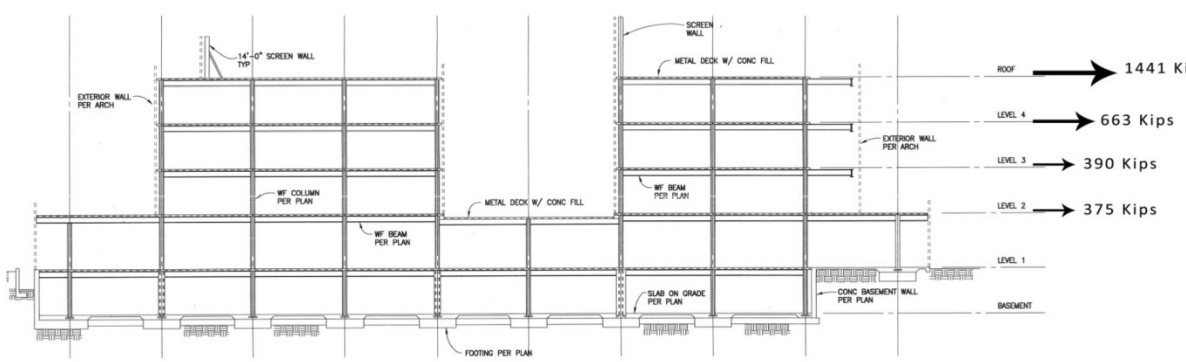

Fig18. Longitudinal Section showing earthquake forces assigned to the diaphragm.

Story Drift

Story	hx (ft)	Allowable Drift (in)	Story Drift (in)
Roof	15.00	2.70	0.667
Level 4	15.00	2.70	0.838
Level 3	15.00	2.70	0.955
Level 2	18.00	3.24	0.882

Importance Factor	1.5
Cd	5

The allowable story drift was met based on the analysis results from ETABS.

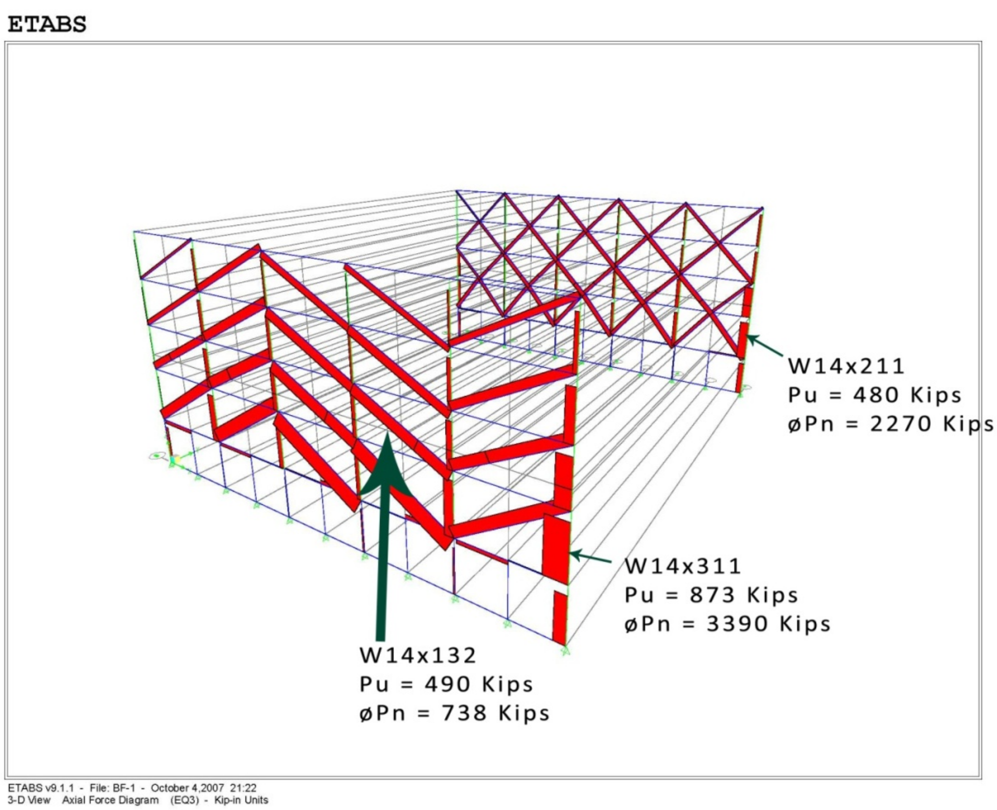

Fig18. Axial force diagrams of BF-1(front) and BF-2(back). Spot check where performed in accordance with the 13th Edition of the AISC Steel Manual. Refer to Appendix for calculations.

Fig18. Represents spot checks performed based on the axial force computed in ETABS. The results show oversized members even with conservative factors applied which might be due to an inaccurate computation of the buildings self weight. Further analysis will be required to justify my reason.

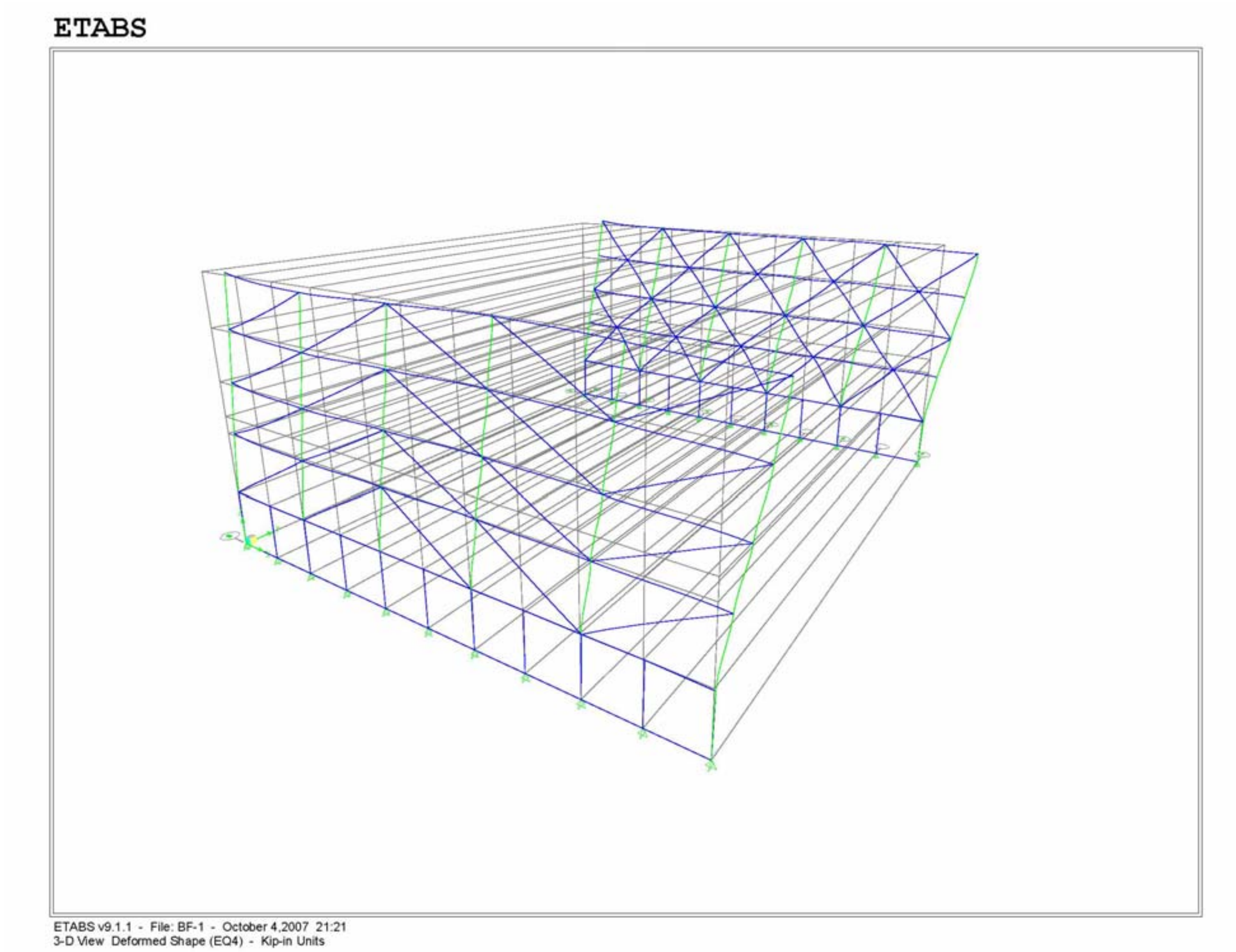

Fig19. Deflected shape of BF-1(front) and BF-2(back).

Appendix

Dead load Calculations

Lightweight Concrete (3.25" top, 3" Deck)	44 psf
Normal Weight Concrete (6" top, 3" Deck)	94 psf
Normal Weight Concrete (4.5" top, 3" Deck)	75 psf
Steel Deck (18 Gage)	3 psf
Glazing	12 psf
Partitions	20 psf
Metal Panels	14 sf
Precast Panels	68 psf
Super Imposed:	
Indoors	12 psf
Roof	25 psf
Courtyard Planter	350 psf*
Courtyard Tree+Planter	350 psf*

*Designer's value used instead.

Wind Calculations

Wind Load Calculation Spread Sheet

Locality Factors and Building Description

Basic Wind Speed	V	85	*h*	75	*Bldg. Height*
wind directionality factor	Kd	0.85	*N-S*		
Importance Factor	I	1.15	*B*	285	
Windward Wall	Cp	0.8	*L*	210	
Leeward Wall	Cp	-0.5	*h/L*	**0.3571**	
Side Wall	Cp	-0.7	*E-W*		
Topographic Factor	Kzt	1	*B*	210	
Period	T	1.33	*L*	285	
Internal pressure coeff.	GCpi ±	0.18	*h/L*	**0.2632**	

B Horiz. Dim. normal to wind dir.
L Parallel Dim. normal to wind dir.

Gust Effect Factor - Flexible Structure

Table 6-2

Exposure C	alpha	9.5		
	Zg	900		
	â	0.10526		
	Bhat	1		
	alpha line	0.15385		
	b line	0.65		
	c	0.2		
	l	500		
	Є line	0.2		
	Zmin	15	**45**	or .6h *Calc. assumes .6h always controls

Gust Effect Factor Calculations

Vz	**84.99366595**
Lz	**531.9976564**
n1	**0.751879699**
N1	**4.706212321**

N-S				E-W			
Rh	**0.2741**	n	**3.051974**	Rh	**0.2741**	n	**3.052**
RB	**0.08251**	n	**11.5975**	RB	**0.1102**	n	**8.5455**
RL	**0.03434**	n	**28.60894**	RL	**0.0254**	n	**38.826**

Beta	0.01		
Rn	0.052303194		
R	0.254165767	R	0.292572889
gr	4.120932232		
Iz	0.189924168		
Q	0.207688013	Q	0.227608027
gq &gv	3.4		
Gf	0.620786688	**Gf**	0.644912391

Roof Calculations

qh	21.54	
h/L < 0.5	Cp1	Cp2
0 to h/2	-0.9	-0.18
h/2 to h	-0.9	-0.18
h to 2h	-0.5	-0.18
> 2h	-0.3	-0.18

**Applicable for h/L < 0.5 only*

Roof

x < Horiz. Dist < y		N-S				E-W				Final Pressure (psf)	
x	y	P w/Cp1		P w/Cp2		P w/Cp1		P w/Cp2		N-S	E-W
0.00	37.50	-12.03	±3.88	-2.41	±3.88	-12.50	±3.88	-2.50	±3.88	1.47	1.38
37.50	75.00	-12.03	±3.88	-2.41	±3.88	-12.50	±3.88	-2.50	±3.88	1.47	1.38
75.00	150.00	-6.69	±3.88	-2.41	±3.88	-6.94	±3.88	-2.50	±3.88	1.47	1.38
150.00		-4.01	±3.88	-2.41	±3.88	-4.17	±3.88	-2.50	±3.88	1.47	1.38

Level	Elevation	Trib. Height	Height	Kz	qz	qh
Level 2	181.5	16.5	18	0.88	15.95	21.54
Level 3	196.5	15	33	1.00	18.12	21.54
Level 4	211.5	15	48	1.08	19.61	21.54
Roof	226.5	13.5	63	1.15	20.76	21.54
Mech. Room	238.5	6	75	1.19	21.54	21.54

*Refer to Wind Calculation on Page 15 for output.

Seismic Calculations

Building weight calculations.

Please note that additional weight calculations are available upon request.

Weight of Building

Floor	Component	Weight (psf)	Area	Weight (Kips)
		LVL 2		
	Beams			231
	Girders			168
	Columns			132
	Curtain Wall			218
	Composite Deck	47	37000	1739
	Partitions	20	37000	740
	Super Imposed	12	37000	444
Courtyard	*Composite Deck*	94	7200	676.8
	Super Imposed	22	6500	143
	SI Tree	552	110	60.72
	SI Planters	342	271	92.682
Lvl 2 Roof	*Composite Deck*	47	12000	564
	Super Imposed	222	12000	2664
	Topping	18	12000	216
			Total Weight	8089
		LVL 3		
	Beams			151
	Girders			94
	Columns			180
	Curtain Wall			218
	Composite Deck	47	37000	1739
	Partitions	20	37000	740
	Super Imposed	12	37000	444
			Total Weight	3566

LVL 4

Beams			151
Girders			94
Columns			180
Curtain Wall			218
Composite Deck	47	37000	1739
Partitions	20	37000	740
Super Imposed	12	37000	444
		Total Weight	3566

ROOF

	Beams			234
	Girders			116
	Composite Deck	94	39000	3666
	Super Imposed	25	39000	975
	AHU	25	7200	180
				0
Pent House	*Pent House*	170	620	105.4
			Total Weight	5276.4

Vertical Distribution of Seismic Forces

Floor	hx (ft)	W (kips)	hxkWx	Cvx	Fx (kips)	Vx (kips)	Mx (ft-K)
Roof	63.00	5393.40	1896398	0.51	1883.94		118688.44
Level 4	48.00	3566.00	853371	0.23	847.77	1883.94	40692.77
Level 3	33.00	3566.00	502202	0.13	498.90	2731.71	16463.83
Level 2	18.00	8089.20	483188	0.13	480.01	3230.61	8640.27
Level 1						3710.63	0.00
Total		20615	3735159	**Base Shear**	3711	**Overturning Moment**	184485

k	1.415
Cs	0.18
*V = Cs*W*	3710.628