3.0 - PROBLEM STATEMENT

Upon a site visit to The Towers, it was discovered that large, round concrete columns were placed in the corner windows of the apartments, obstructing any views of Saint Nicholas Park or downtown Manhattan. There are also many large, concrete columns placed throughout the building on an irregular grid, which may have impacted the ease of construction of The Towers. Some of these columns are obstructions in corridors and open spaces, which detract from the architecture of the building.

Figure 5: Photograph illustrating the concrete column obstructing the window (Photo courtesy of Robert Chin)

4.0 - PROPOSAL

A steel structure on a regular grid is proposed to eliminate the corner columns in the windows and make construction of the building more efficient. A composite steel deck will replace the flat plate concrete slab and steel braced frames and moment frames will replace the concrete shear walls. Using a steel frame will also cut down on the foundation loads which can decrease the required sizes for the spread footings. Although using steel will increase floor to floor height of the building, the zoning requirements per the Building Code of the City of New York allows for an increase of 3′ per floor.

The corner columns will be eliminated by cantilevering the beams supporting the portion of the building where the corner windows are located. By keeping a ceiling plenum depth of 2′, the floor to floor height will only be increased by 1′-4″ which only increases the total building height by approximately 13′.

5.0 - DESIGN CRITERIA

5.1 - DESIGN PROCEDURE

To determine the most appropriate layout for the proposed steel structure, trace paper will be placed over the existing architectural plans and several schematic layouts will be sketched. This is done to ensure that column lines will be in line with partition walls and do not interfere with any door or window openings and open spaces. The grid will be input into RAM Structural System and then the columns and beams will be laid out. Deflections for members will be limited to:

Dead: $\frac{L}{360}$

Total: $\frac{L}{240}$

$\frac{L}{400}$ (Cantilevers)

After the gravity framing system is in place, the lateral force resisting system will be laid out. Braced frames will used primarily around the stair and elevator cores where the frame was aligned with the interior wall. Moment frames with bracing kickers were used where door and window openings were located so that the architecture will not be impacted. Due to the plan irregularity of the building, the frames will be laid out to try to reduce the eccentricity between the center of rigidity and the center of mass of the building, thus reducing the torsional

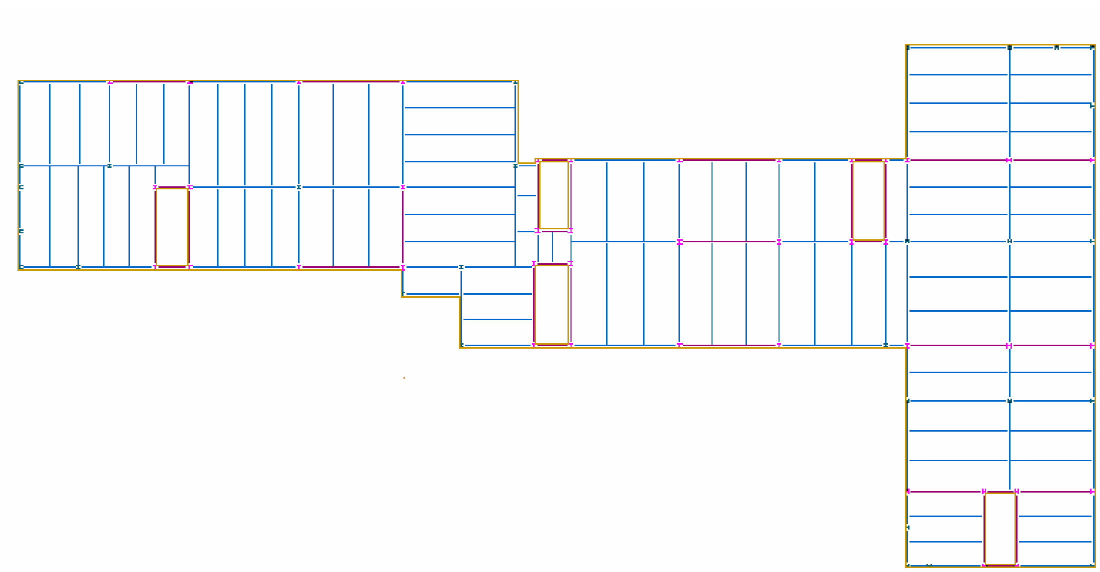

Figure 6: Typical plan showing structural layout, Levels 1 and 2

moment caused by the lateral loads.

An analysis of the gravity beams and columns will then be performed in RAM Structural System for the various dead and live loading conditions. RAM Frame will be used to evaluate the effects of wind and seismic loads imposed on the building. From RAM Frame, story displacements and story forces can be obtained to determine feasibility of the system.

All designs will be compliant with provisions set forth in the Building Code of the City of New York, which further references UBC 97 for seismic loads and ASCE 7-05 for wind loads.

5.2 - LOADING CONDITIONS

5.2.1 - GRAVITY LOADS

The following is the list of gravity dead and live loads for each of the building occupancies used in the proposed design of The Towers. These loads are in accordance with the Building Code of the City of New York. Dead loads include self weight of the members, finishes, MEP piping and sprinklers, and partitions. The loads listed below do not include the weight of the structural members; however they will be included in the RAM analysis. The live loads are reducible per section 27-566 of the building code.

DORMITORY	PSF
Construction Dead Load	
- 2" deck w/ 2 ½" N.W. concrete	45
Superimposed Dead Load	
- ceiling	4
- floor finish	2
- mechanical/electrical	5
- partitions (100-200 plf)	12
- misc.	2
Total Dead Load	70
Live Load	
- for partitioned dormitories	40

LOBBY/CORRIDOR	PSF
Construction Dead Load	
- 2" deck w/ 2 ½" N.W. concrete	45

Superimposed Dead Load		
- ceiling		2
- floor finish		2
- mechanical/electrical		5
	Total Dead Load	60
Live Load		100

ROOF (MECHANICAL)		PSF
Construction Dead Load		
- 2" deck w/ 2 ½" N.W. concrete		45
Superimposed Dead Load		
- ceiling		2
- mechanical/electrical		6
- roofing and insulation		5
- misc		2
	Total Dead Load	70
Live Load		
- weight of equipment and ponding water		150

EXTERIOR WALL LOADS	PSF
Dead Load	
- prefabricated thin brick panels with metal stud back-up wall	24
- curtain wall system	15

5.2.2 - LATERAL LOADS

Lateral loads imposed on The Towers are the result of wind and seismic forces. Per the City Building Code of the City of New York, the wind loads are calculated based on the methods provided in ASCE 7-05 and the seismic loads are calculated based on the UBC Section 2312-1990 with modifications provided in the New York City building code.

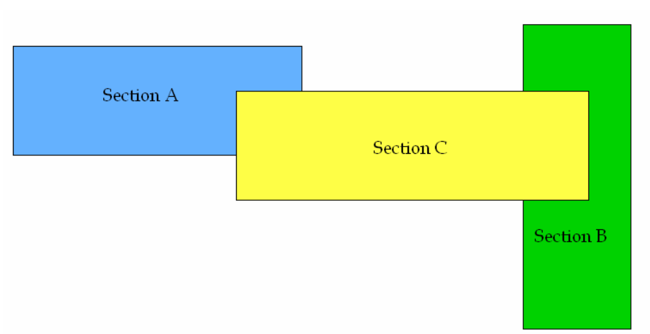

Figure 7: Building components used for lateral load calculations

To simplify the loading for wind, the building will be broken up into three components as shown in Figure 2. Section A, B and C consist of 8, 6, and 11 stories consecutively. It was determined that wind loading will control in the east-west directions because of the much greater loading area. The seismic loading will control in the north-south direction because large braces could not be implemented in this direction.

The following is a summary of the wind and seismic loads, as well as diagrams to illustrate the loading patterns on the building. See Appendix A for complete lateral loading calculations.

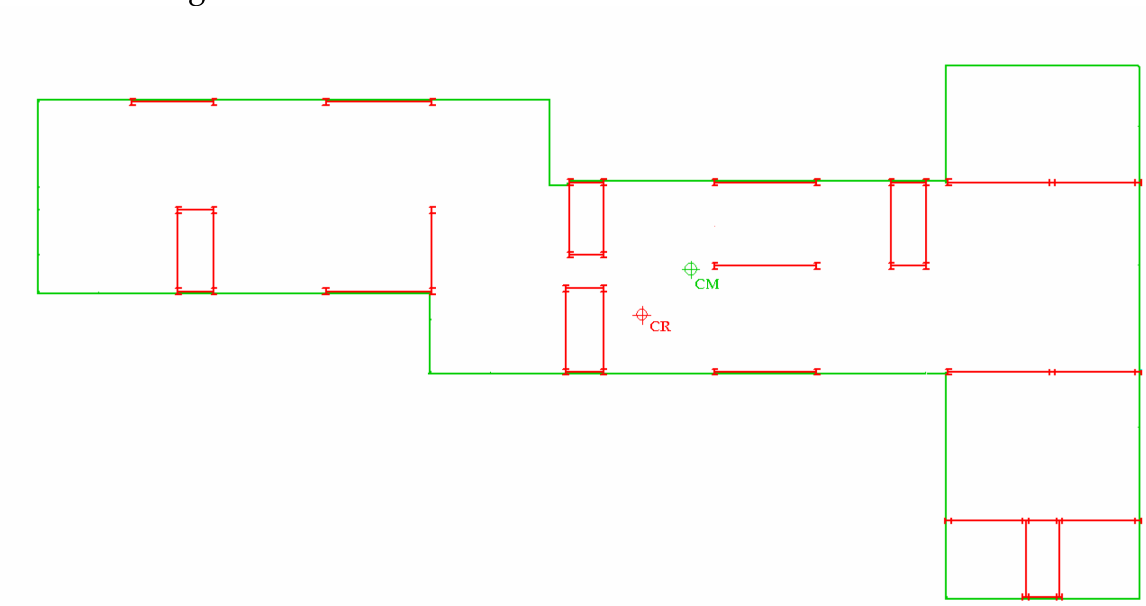

Figure 8: Center of rigidity and center of mass for the 3rd floor

WIND LOADS

- Basic Wind Speed	V = 95 mph	
- Importance Factor	I_w = 1.0	
	Category 4	
- Building Exposure	D	
- Mean Roof Height	110′-0″	
- Gust Factor (Rigid Structure)	G = 0.85	
- Topographic Factor	Kzt = 1.0	
- Wind Directionality Factor	Kd = 0.85	
- Velocity Pressure Coefficients	Kh = 1.455	
	Kz = 1.03	0 – 15′
	Kz = 1.08	15 – 20′
	Kz = 1.12	20 – 25′
	Kz = 1.16	25 – 30′
	Kz = 1.22	30 – 40′
	Kz = 1.27	40 – 50′

	Kz = 1.31	50 – 60′
	Kz = 1.34	60 – 70′
	Kz = 1.38	70 – 80′
	Kz = 1.40	80 – 90′
	Kz = 1.43	90 – 100′
	Kz = 1.455	100 – 110′
- Internal Pressure Coefficient	GCpi = +/- 0.18	
- Wall Pressure Coefficients	Cp = 0.8 (windward)	
	Cp = -0.5 (leeward ⊥ 294’-8”)	
	Cp = -0.3 (leeward ⊥ 144’-4”)	
	Cp = -0.7 (sidewall)	
- Roof Pressure Coefficients	Cp = -0.9 (0 – h)	
	Cp = -0.5 (h – 2h)	
	Cp = -0.3 (>2h)	

<u>East – West Wind</u>
Loading Diagrams

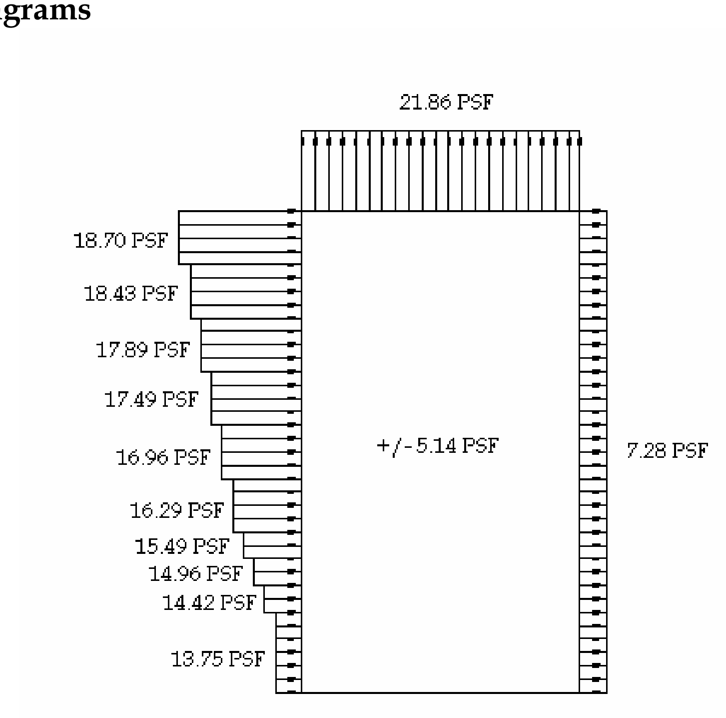

Figure 9: Wind pressure on Section A

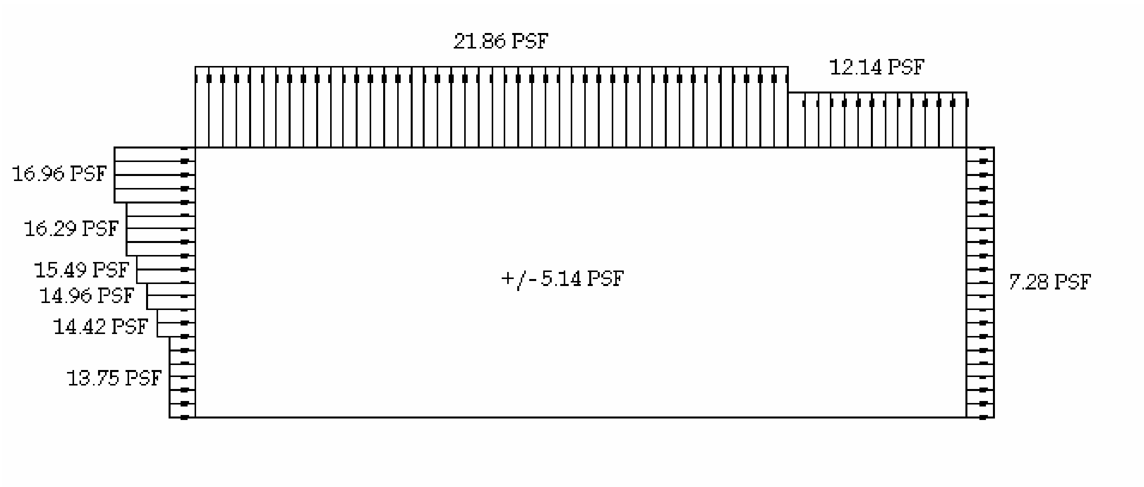

Figure 10: Wind pressure on Section B

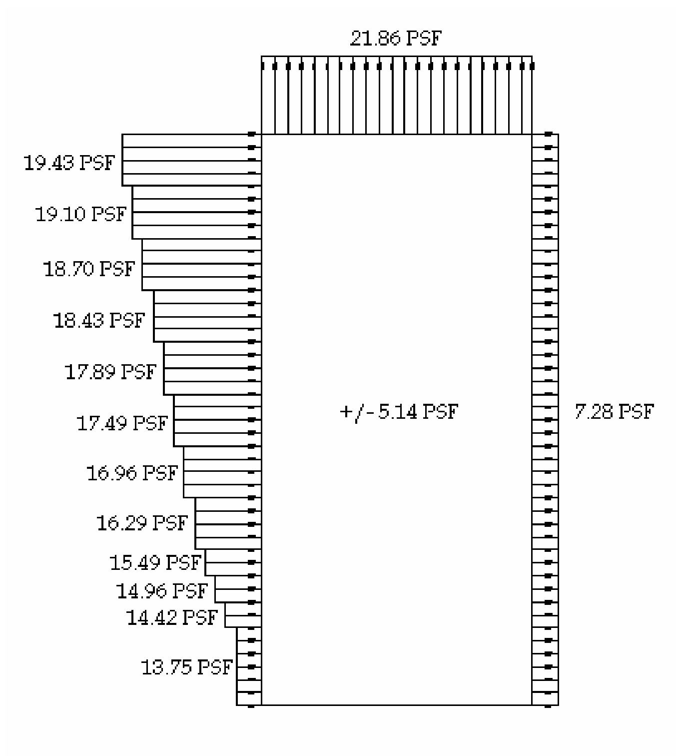

Figure 11: Wind pressure on Section C