7.0 - STRUCTURAL DEPTH SUMMARY

GRAVITY SYSTEM

A composite steel frame was proposed for the gravity system of The Towers. The beams were W10 or W12 shapes and the girders were kept to a maximum depth of 21″ to keep a 2′ plenum depth. A 2″ composite metal deck with 2 ½″ of normal weight concrete was used as the floor system. This is capable of spanning the maximum beam spacing of 11′-0″ without needing shoring. The columns for the gravity loads are W10 shapes.

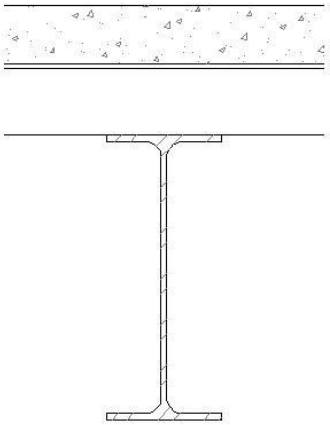

Figure 23: Section of composite floor slab and beam

The use of steel imposes less dead load on the foundations, which results in a decrease in foundation size and less reinforcing required for the gravity system. The beam to girder connections are single angles shop welded to the girder and bolted to the beam. The beam to column connections are shear tabs shop welded to the column flange and bolted to the beam.

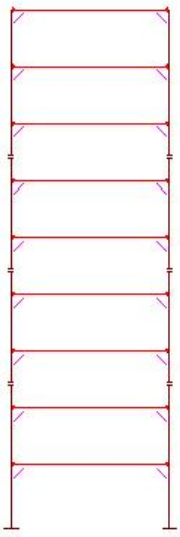

Figure 24: Typical moment frame

LATERAL SYSTEM

The lateral forces imposed on the building are resisted by a dual system of eccentric braced frames with ordinary moment resisting frames. Braced frames are used where they line up within a wall. Moment frames with kickers are used where the wall has window or door openings.

For the lateral system, light bracing connections consisting of L6x6x½″ angles are used to connect the double angle braces to the beams and columns. All lateral columns are W12 shapes for added stiffness. The lateral beams range in size from W10′s to W14′s. Fully restrained moment connections are required at the beam to column connections to resist wind and seismic loads.

8.0 - BREADTH TOPICS

8.1 – LEED CERTIFICATION

Designing a building to be LEED certified has become a growing trend in today's construction industry. With the trend in the rising earth's temperature and the fear of depleting fossil fuels, there are many people looking for ways to reduce the consumption of energy and become more efficient in building designs. The Unites States Green Building Council (USGBC) is a group dedicated to making buildings more environmentally efficient and healthier places to be in. The USGBC developed the LEED rating system as a set of guidelines to follow to create a sustainable building. Today, there are many incentives for buildings to go green. The benefits of LEED certification include tax rebates, operating cost reduction, conservation of energy and an overall healthier living environment.

For a building to become LEED certified, five aspects of design and construction of the building are analyzed to determine if it meets the requirements for energy and water efficiency. These aspects are:

- Sustainable Sites
- Water Efficiency
- Energy and Atmosphere
- Materials and Resources
- Indoor Environmental Quality

It was determined if there was a possibility for The Towers to become a LEED certified building. After analyzing the criteria provided by the USGBC for new building construction, it is possible for the building to gain the 26 points which will qualify it for LEED certification. Points can be earned from site selection because previously the site consisted of old buildings. The location of the building is close to four subway stops and many other bus stops. Also, the use of recycled steel and incorporating low VOC emitting paints and finishes can add points to the LEED rating. Appendix C contains a LEED checklist of possible rating points that The Towers can attain.

One specific point that was investigated was the thermal efficiency of the building envelope. The existing exterior wall consists of a 1 ¾" precast thin brick panel, 5/8" glas-mat sheathing, 6" cold formed metal stud with R19 insulation, and 5/8" gypsum board. Two options that were chosen to increase thermal efficiency of the wall system was to increase the thickness of the insulation and to use loose fill cellulose insulation.

Wall Insulation	Wall R-Value	Heat Transfer Through Wall (BTU/hr)
6″ R19 Batt Insulation	23.55	2.42
6″ Loose Fill Cellulose Insulation	27.35	2.09
8″ Batt Insulation	26.55	2.15

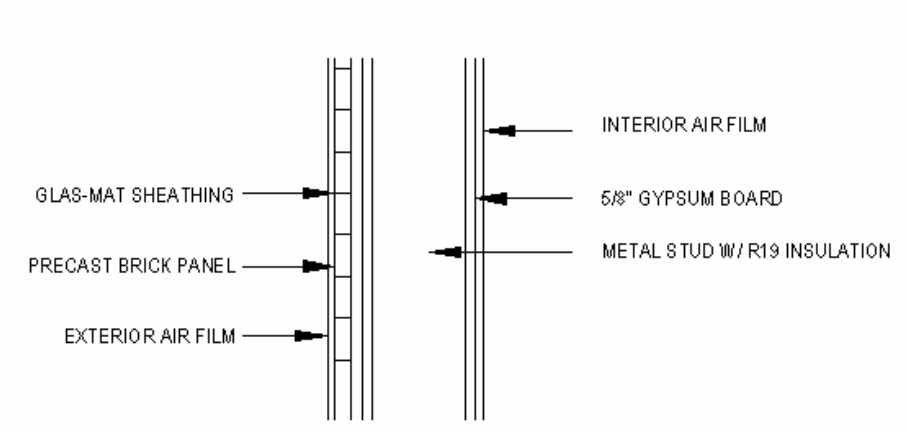

Figure 25: Existing building envelope

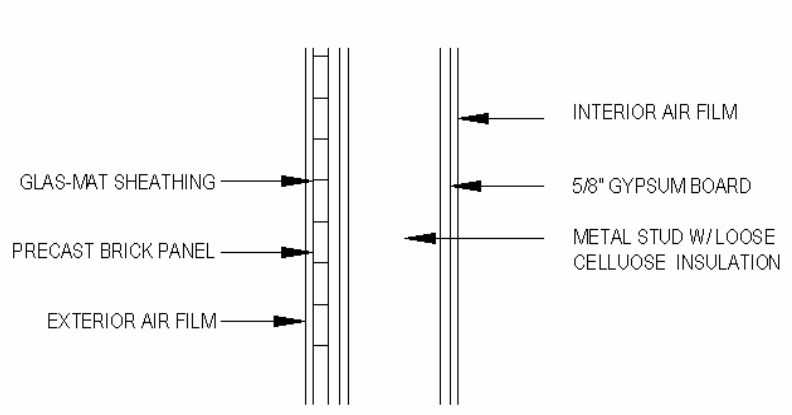

Figure 26: Proposed building envelope

Cellulose loose fill insulation will be proposed to insulate the wall. This will provide a higher R-value and less heat transfer without increasing the thickness of the wall. Cellulose loose fill insulation is made from recycled newspaper, which provides a higher R-Value than conventional fiberglass batting and earns points for the LEED rating.

8.2 – COST ANALYSIS

Changing a building's structural frame will impact the construction cost and schedule of the project. For the proposed steel structure, production costs from MC^2 software, RSMeans and Primavera scheduling software were used to perform a cost and schedule analysis. The cost and schedule for the steel structure was then compared to the existing concrete structure.

For The Towers, the exact cost of the concrete frame was unable to be obtained. A concrete estimate was done taking into consideration the material quantity and labor costs of formwork, reinforcing, 5000 psi concrete, shoring and required equipment. It was determined that the concrete structure cost approximately $5.5 million. All material takeoffs and labor rates are located in Appendix C. The following is a breakdown of the cost for the elements used in the steel structure. It was determined that the total cost for the steel structure will be approximately $6.0 million.

COMPOSITE DECK	
- Concrete	$149,200
- Wire Mesh Reinforcing	$42,600
- 2" Deck	$1,810,000
- Screeds for Slab	$121,800
- Slab Finish	$229,000
- Protect and Cure	$23,400
	$2,376,000
STEEL FRAMING	
- W Shapes	$2,870,000
- Angles	$150,000
- Shear Studs	$42,400
- Red Oxide	$63,500
- Base plates	$4,000
- Grout	$1,000
- Anchor Bolts	$2,800
- Gypsum Board Fireproofing	$62,000
	$3,621,000
TOTAL COST	$5,997,000