Wisconsin Place Residential

Chevy Chase, Maryland

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The Pennsylvania State University

Final Report

Structural Option

Faculty Advisor: Dr. Memari

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Wisconsin Place Residential

Chevy Chase, Maryland

Architecture

Wisconsin Place Residential is a 15-story, U-shaped residential tower consisting of 432 units within a world-class urban development called Wisconsin Place. The rental apartments at Wisconsin Place include studio, one, and two-bedroom units, with an exclusive selection of penthouses.

Building Information

Building Name:
- *Wisconsin Place Residential*

Location:
- *Chevy Chase, Maryland*

Size:
- *479,000 SF*

Construction Dates:
- *May 2006 to February 2009*

Building Cost:
- *$75 Million*

Delivery method:
- *GMP*

Project Team

Owner/Developer:
- *Archstone-Smith*

Architect:
- *SK&I Architectural Design Group*

Landscape Architect:
- *Carol R. Johnson Associates*

Structural Engineer:
- *Smislova, Kehnemui & Associates*

MEP Engineer:
- *G H T Limited*

Civil Engineer:
- *Loiederman Soltesz Associates*

Interior Designers:
- *Handel Architects*

General Contractor:
- *Turner Construction*

Structural System

- Wisconsin Place Residential consists of 15 levels of flat plate construction with 2 underground levels for parking.
- Seismic force-resisting system consists of a shear wall-frame interactive system with ordinary reinforced concrete moment frames and ordinary reinforced concrete shear walls.
- Typical floors are 7-1/2" thick unbonded post-tensioned slabs, with a two-way bottom reinforcement mat.
- The 15-story building shall be supported on spread footings. Columns and wall footings supported by rock shall be designed for a bearing pressure of 40,000 PSF.

Mechanical System

- 24 Heat pumps ranging from 1-1/2 to 6 tons
- 5 rooftop units ranging from 2600 to 5100 CFM
- 2 Cooling Towers consisting of 1450 GPM
- 1 40 MBH Gas fired unit

Electrical/Lighting System

- 4000A busways, 120/208V, 3 phase, 4 wire system
- Emergency generator shall be a Four-Cycle, diesel power unit producing 350kw of continuous standby power at 265/460V, 3 Phase, 4 wire.
- General, Apartment, Exterior, and Public areas contain 120V and 265V luminaires.

Kurt Krasavage — Structural Option

HTTP://WWW.ARCHE.PSU.EDU/THESIS/PORTFOLIOS/2008/KSK165

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Executive Summary

The controlling factor of this thesis project is the architecture of the building. The existing building was structurally designed to accommodate the architecture, which resulted in the two-way flat plate post-tensioned system. There is currently a height restriction on the building which limits the alternative choices for a redesign let alone a chance to save money. In a previous technical report it was found that the precast girder-slab system would be the best alternative solution if the column layout could be altered.

A breadth study of architecture was conducted and a completely new column layout was generated. This new layout consisted of typical bays of 17' X 28' and was consistent to the shape of the existing residential tower. All of the apartments in the proposed building had to be redesigned to accommodate the column layout. The architecture of the individual units not only complied with the square footages of the existing building, but maintained the same style, shape, and overall quality. On top of maintaining the quality, the proposed layout provided a floor plan with more variety, i.e. non-typical apartments and an option of a 3 bedroom.

An in depth study of the structural system was performed for the proposed building. The gravity system consisted of precast 8" X 4' 7- ½ " strands hollow core planks with a 2" topping. The planks were supported by D-Beams on all of the levels except the main roof which was supported by convential steel framing due to the high live load of the mechanical equipment. Rolled W12 shaped columns supported the girders and beams and were redesigned and spliced every four levels throughout the building. The lateral system changed from shear walls to braced frames. The building period increased in both directions and the North-South wind continued to be the controlling factor of base shear and the seismic loads controlled the maximum moment as in the existing structure.

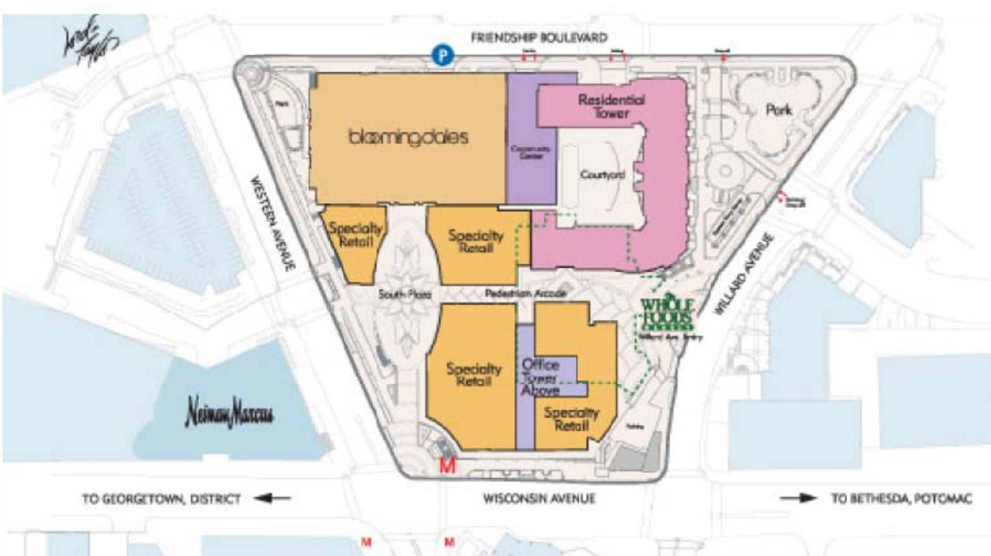
A breath study of the construction of the two buildings was investigated. The proposed system was found to be approximetly 25% more expensive than the existing post-tensioned system. However when the schedules were investigated it was found that the girder-slab system would result a reduction of four months of construction. The average revenue per month generated from rent of the tenants offset the 25% cost of the girder-slab system and actually resulted in a savings of approximately $750,000 not including future income based on the additional apartments added to the building within the proposed layout.

Background

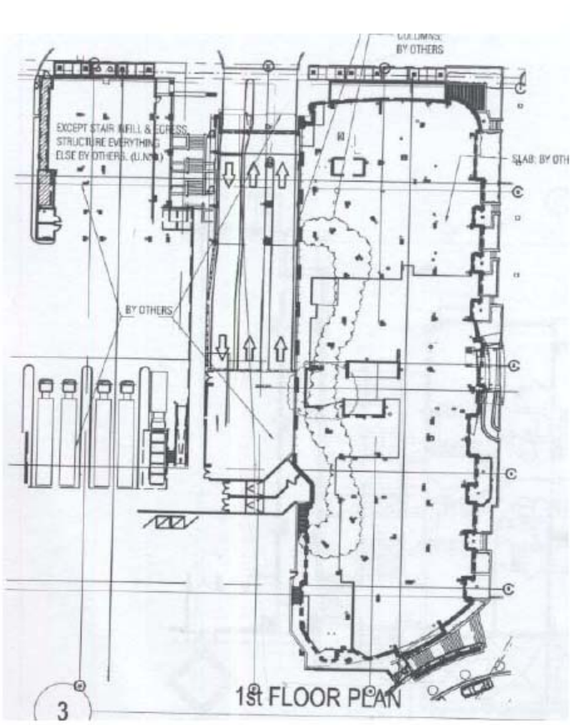
<u>Architecture</u>

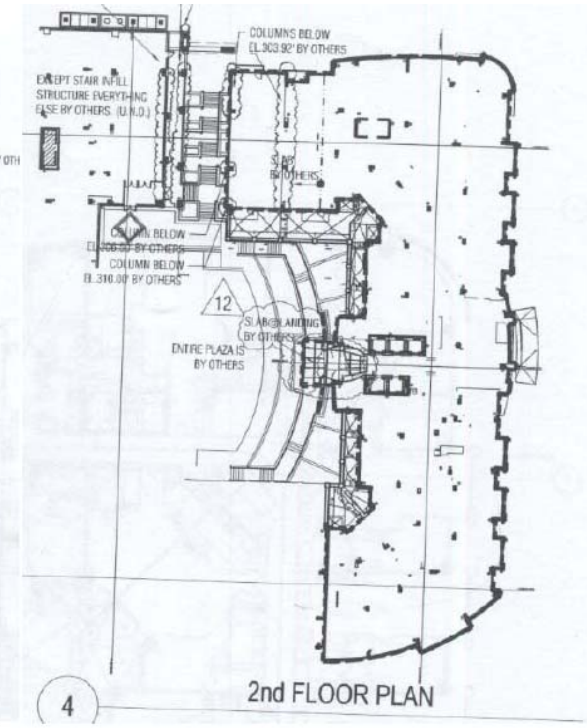
Wisconsin Place Residential consists of 15 above stories and 2 below grade stories. The building is approximately 479,000 S.F., stretching from 25 feet below grade to 142 feet above grade. The building consists of 432 units spread out over the 15 floors. The 13th floor contains a 1,000 S.F. pool for all tenants of the building. The two levels below grade are set aside for residential parking and are integrated with the parking for the mixed-use development. Please note that there is currently a height restriction of the building set at 143 feet.

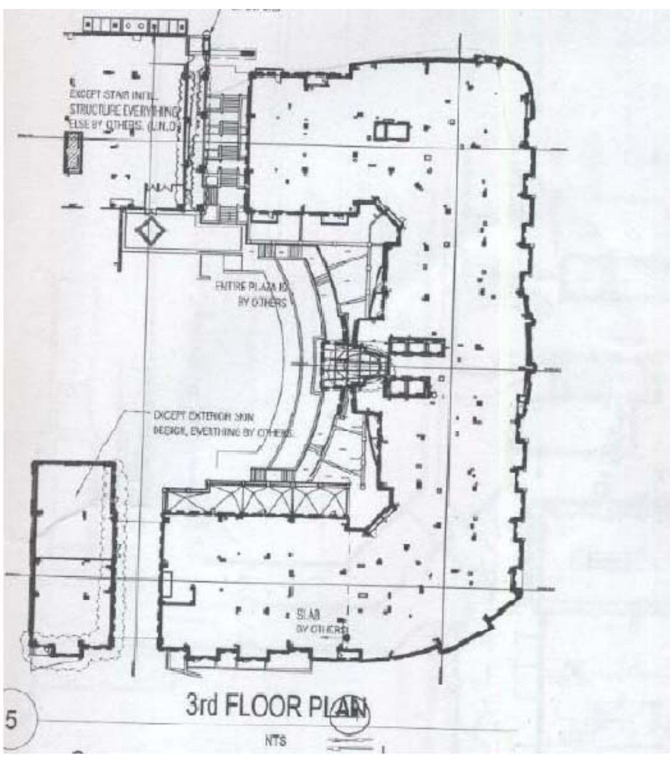
The rental apartments at Wisconsin Place include studio, one, and two bedroom units, with an exclusive selection of penthouses. The building envelope is primarily a glass curtain wall with masonry. On-site amenities include a private exercise facility, a resident library, and a fully equipped business center.

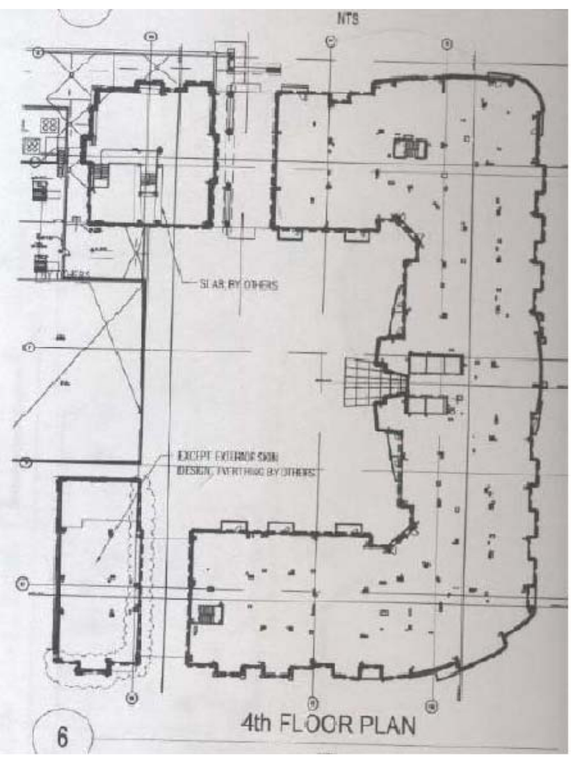


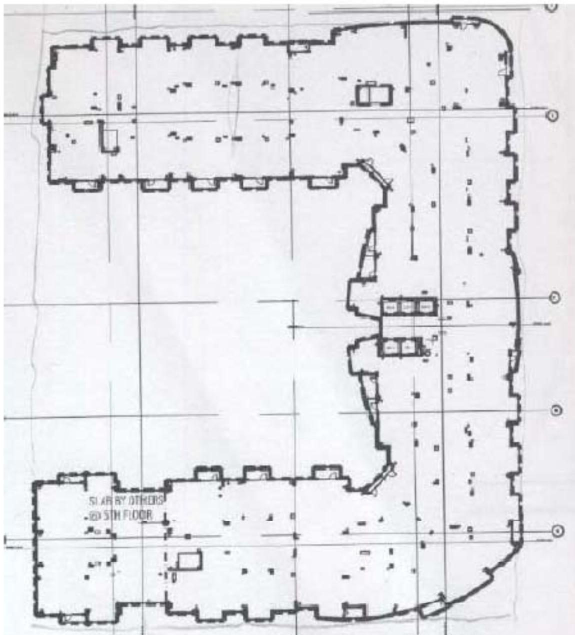
Existing Building Floor Plans



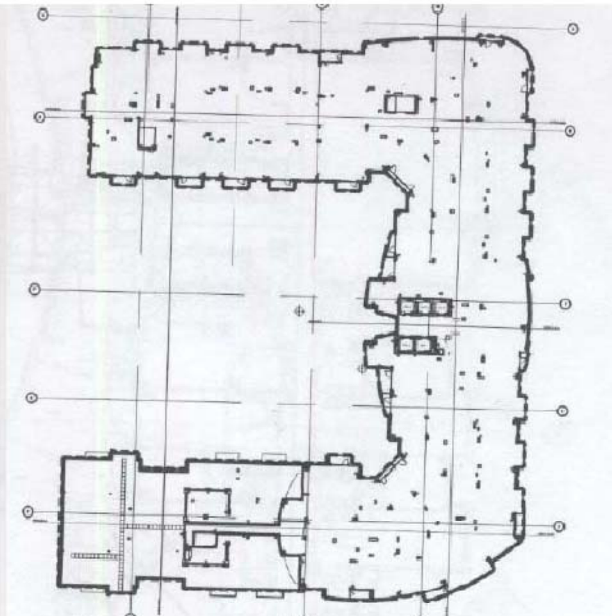




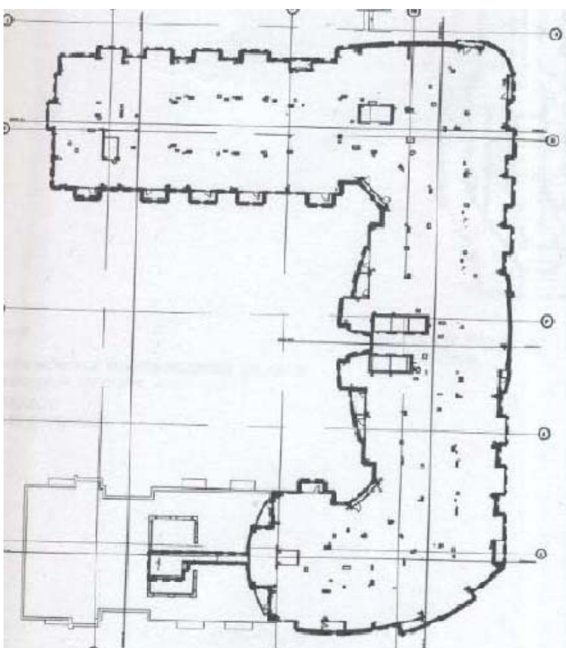




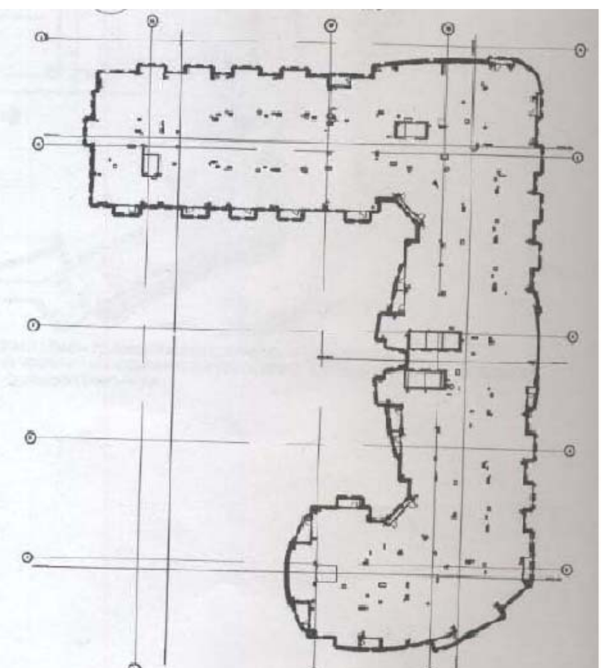
7 5th THRU 7th FLOOR PLAN



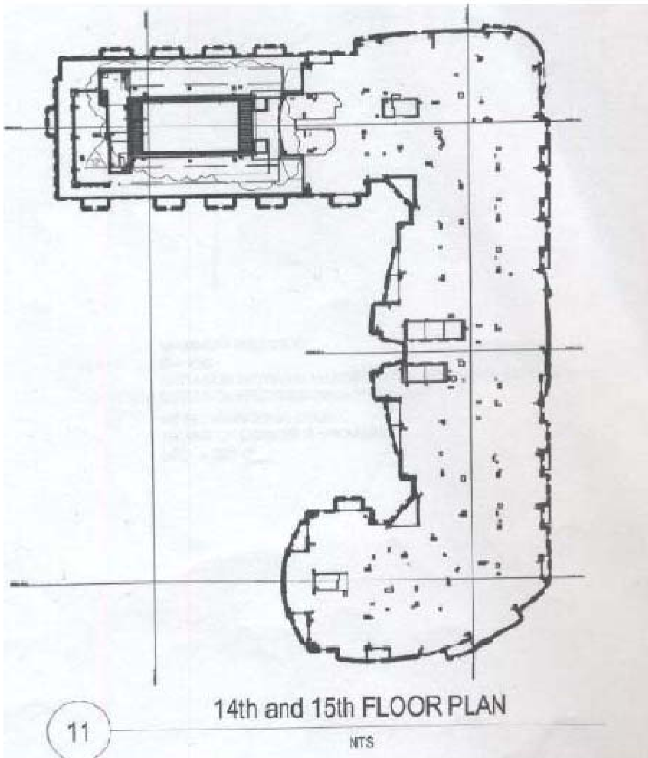
8 8th FLOOR PLAN
NTS

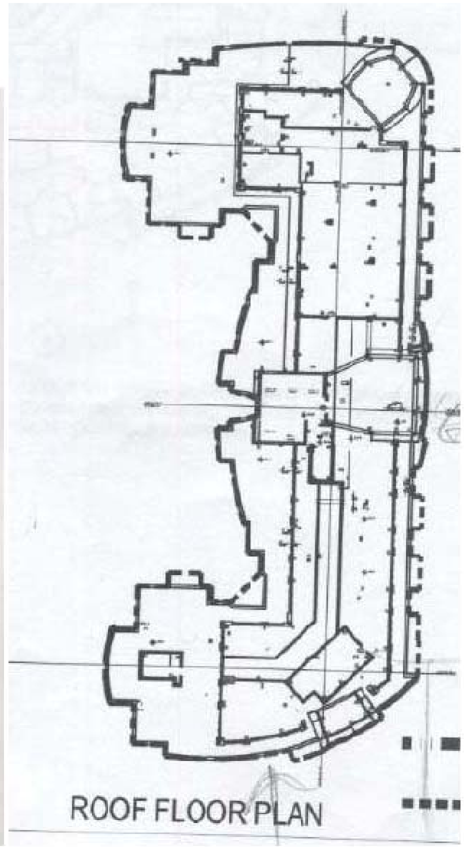


9 9th THRU 12th FLOOR PLAN
NTS



10 13th FLOOR PLAN





Codes and Code Requirements

Codes Used for the Existing Building

The structural design of Wisconsin Place Residential used various codes for gravity and lateral load conditions. Some of the codes used are the "ACI 318-02 Building Code Requirements for Structural Concrete", "ASCE 7-02", and the 2003 International Building Code.

Codes Used for this Report

All of the information computed throughout this report took in consideration the most up-to-date codes. ACI 318-05, ASCE 7-05, and The 2006 IBC.

Deflection Criteria

Maximum displacements of story drifts due to wind are controlled by H/400 and .0125H for Seismic loads. For other materials, maximum deflection shall be L/360 or L/240. Floor deck deflection shall not exceed L/360 under full live and superimposed loads. Dead load and a 20 PSF construction live load, shall not exceed L/180.

Gravity and Lateral Loads

The gravity and lateral loads were determined in accordance with ASCE 7-05. Live Loads were established using section 4 of ASCE 7-05. General assumptions for dead loads were made based on unit weights from ASCE 7-05.

Dead Loads:

<u>Construction Dead Loads:</u>

Concrete	150 PCF

<u>Superimposed Dead Loads:</u>

Partitions	20PSF
Finishes & Miscellaneous	5 PSF
MEP	10 PSF
Columns & Walls	10 PSF
Shear Walls	(SEE APPENDIX A)

Live Loads:

Floors Including Partition Load	60 PSF
Canopy	75 PSF
Slab-On-Grade	100 PSF
Storage	125 PSF

Public Rooms and Corridors	100 PSF
Balconies	100 PSF
Lobby, Corridors, Stairs and Pool Areas	100 PSF
Penthouse, Mechanical Room	150 PSF
Elevator Machine Room	125 PSF
Roof	30 PSF
Roof Snow Load	27 PSF

Load Combinations

1) 1.4(D + F)
2) 1.2(D + F + T) +1.6(L + H) + 0.5(Lr or S or R)
3) 1.2D + 1.6(Lr or S or R) + (L or 0.8W)
4) 1.2D + 1.6W + L + 0.5(Lr or S or R)
5) 1.2D + 1.0E + L + 0.2S
6) 0.9D + 1.6W + 1.6H
7) 0.9D + 1.0E + 1.6H
8.) 1.0D + 1.0L + 1.0E

Existing Structural System

Foundations

The foundation shall be supported on spread and combined footings. These footings are typically 12’ X 12’ by 24” thick. Column and wall footings supported by rock shall be designed for a bearing pressure of 40,000 PSF. A 4-inch gravel base shall be provided below floor slabs as a moisture barrier. Also, under-floor sub-drainage system shall be installed. All exterior footings shall be a minimum of 2’-6” below grade. All controlled compacted fill shall be compacted to not less than 95% of the maximum dry density determined in accordance with ASTM D-698.

Floor Systems

1st Floor:

Slab on grade.

2nd - 12th Floor:

Flat plate 7 ½" thick unbounded post-tension slabs, with a two-way bottom reinforcement mat of #4@24" continuous bars each way. Hooked bars at discontinuous ends are provided along with 2 #5 top and bottom additional bars along free slab edges. Concrete for slabs shall be normal weight concrete at 5000 psi. The post-tension cables consist of uniform tendons being pulled in the S-N direction and the banded tendons are in the pulled in the W-E direction of the building. The typical uniform cables are 15.0 klf and the banded cables range from approximately 50 - 400 kips.

13th Floor:

Floors are typically post-tensioned the same as the 2nd - 12th except in the pool area. The 12" and 15" slab areas require #5@24" O.C. each way continuous on top and bottom. The 23" slab area requires #6@12" O.C. each way continuous on top and bottom.

Pool House Roof:

7" slab with normal weight concrete and 60,000 psi reinforcing steel. A top and bottom mat of #4@12" O.C. continuous each way is required. Additional top reinforcing for column and middle strips is 6#5 top bars.

14th and 15th Floors:

Floors are typically post-tensioned the same as the 2nd - 12th.

Main Roof:

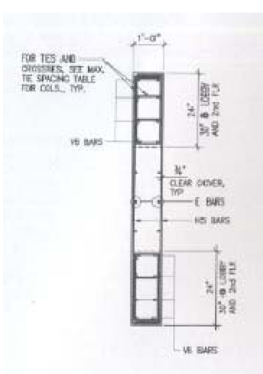
Slab is 8" thick unbounded post tensioned with a two-way bottom reinforcement of #4@24" continuous each way. For the 10" and 12" thick areas, #5@24" continuous mats are required as well as 2 #6 top and bottom additional bars along free slab edges.

Columns

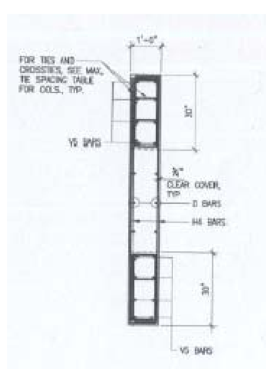
The columns in Wisconsin Place Residential are primarily standard reinforced concrete with varying sizes, shape, and reinforcement depending on their location and loads that are applied throughout the building. The most typical shapes are 16”x28” and 16”x32”. The reinforcement for the columns varies from floor to floor. The typical reinforcement is 8 #7 or 8 #8 bars, but varies throughout typical levels. The 12th – 13th floor reinforcement is typically #10 or #11 bars, due to the fact that they are supporting the pool. The loads vary greatly from column to column and are as large as 1380k and as small as 122k for dead loads and 293k to 17k for live loads at the top of the pad.

Lateral System

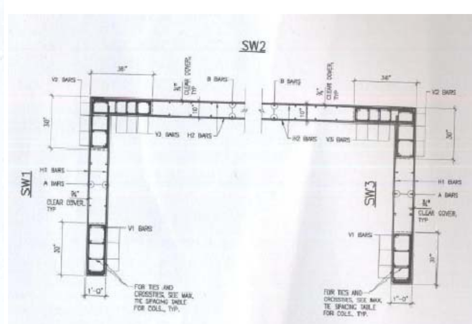
Concrete shear walls make up the buildings lateral load resisting system. Two elevator cores serve as the main components of these elements and are connected from the 1st Floor to the roof. There are also three other shear walls spread out on the west side of the building. Typically the shear wall reinforcement is #4@12” for horizontal reinforcement and #6 or #7 bars for vertical reinforcement. The typical reinforcement for ties and crossties cooresponds to the maximum spacing for columns.



SHEAR WALL @ COLUMN 110

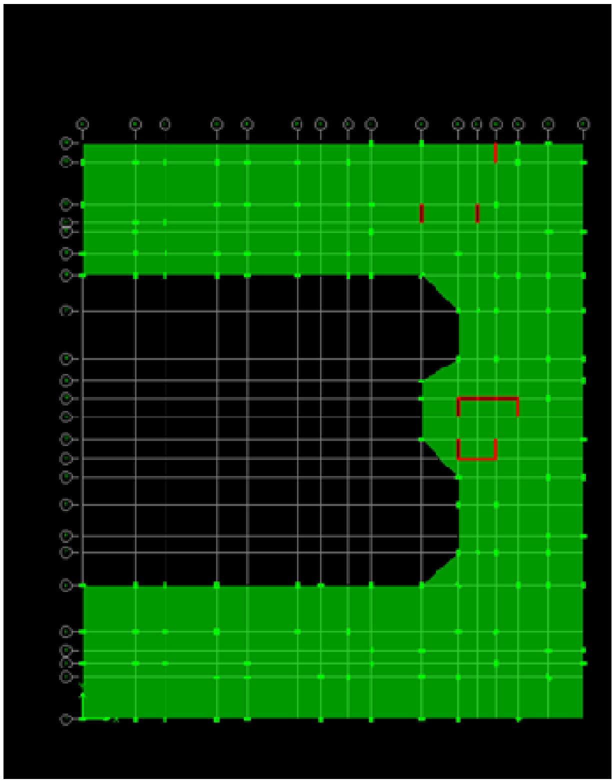


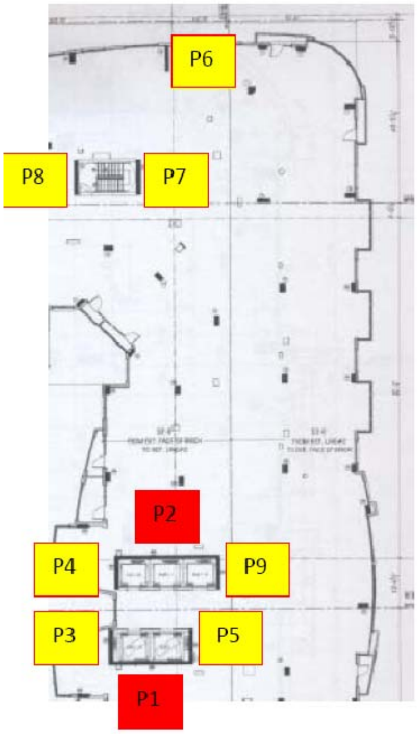
SHEAR WALL @ COLUMNS 124 AND 125



SHEAR WALL 1, 2 & 3

Location and Distribution of Shear Walls





The red walls in the figure to the left are the shear walls that provide lateral resistance against seisimic and wind loads. After completeing the seismic and wind analysis, it was found that the maximum base shear of the building to be controlled by the wind in the North-South direction (770 kips) and the maximum moment due to the seismic loads to control (65,627 ft-kips).

Pier	Direction of Wind	Load at the Top of the Wall (kips)	Relative Displacement (inches)	Relative Stiffness	% Distributions
1	North-South	8.13	1.17	0.609	32
2	North-South	27.34	0.709	1.27	68
			Σ	1.879	100
3	East-West	10.93	5.58	0.21	22
4	East-West	10.03	5.58	0.208	22
5	East-West	0.09	3.81	0.018	2
6	East-West	1.73	3.81	0.147	15
7	East-West	1.15	4.7	0.11	12
8	East-West	0.57	7.32	0.051	5
9	East-West	5.76	2.83	0.211	22
			Σ	0.955	100

Thesis Objective

Architectural Breadth Study

The controlling factor of this thesis project is the architecture of the building. The existing building was structurally designed to accommodate the architecture, which resulted in the two-way flat plate post-tensioned system. In this report an investigation is done to see wheter or not a new typical column layout will integrate with the existing building's architecture. The new layout is required due to the the necessity of a small floor-to-floor height which complies with the height restriction of the building and with the irregular column layout. It is nearly impossible to achieve this without using the girder slab system. This architectural study will try to accommodate the shape, style, and size of the existing apartments and at the same time improve the overall quality of a typical floor within the building.

Structural Depth Study

The first step in the redesign of Wisconsin Place Residential will be finding a typical bay size that will accommodate all gravity loads and serviceability requirements for a precast girder-slab system. The floor system will be designed in accordance with ACI-318-05, referencing all applicable sections. After the building is completely redesigned for gravitational loads and maintains full functionality that integrates with the architecture, the lateral system will be re-designed based upon ASCE7-05 using an ETABS model.

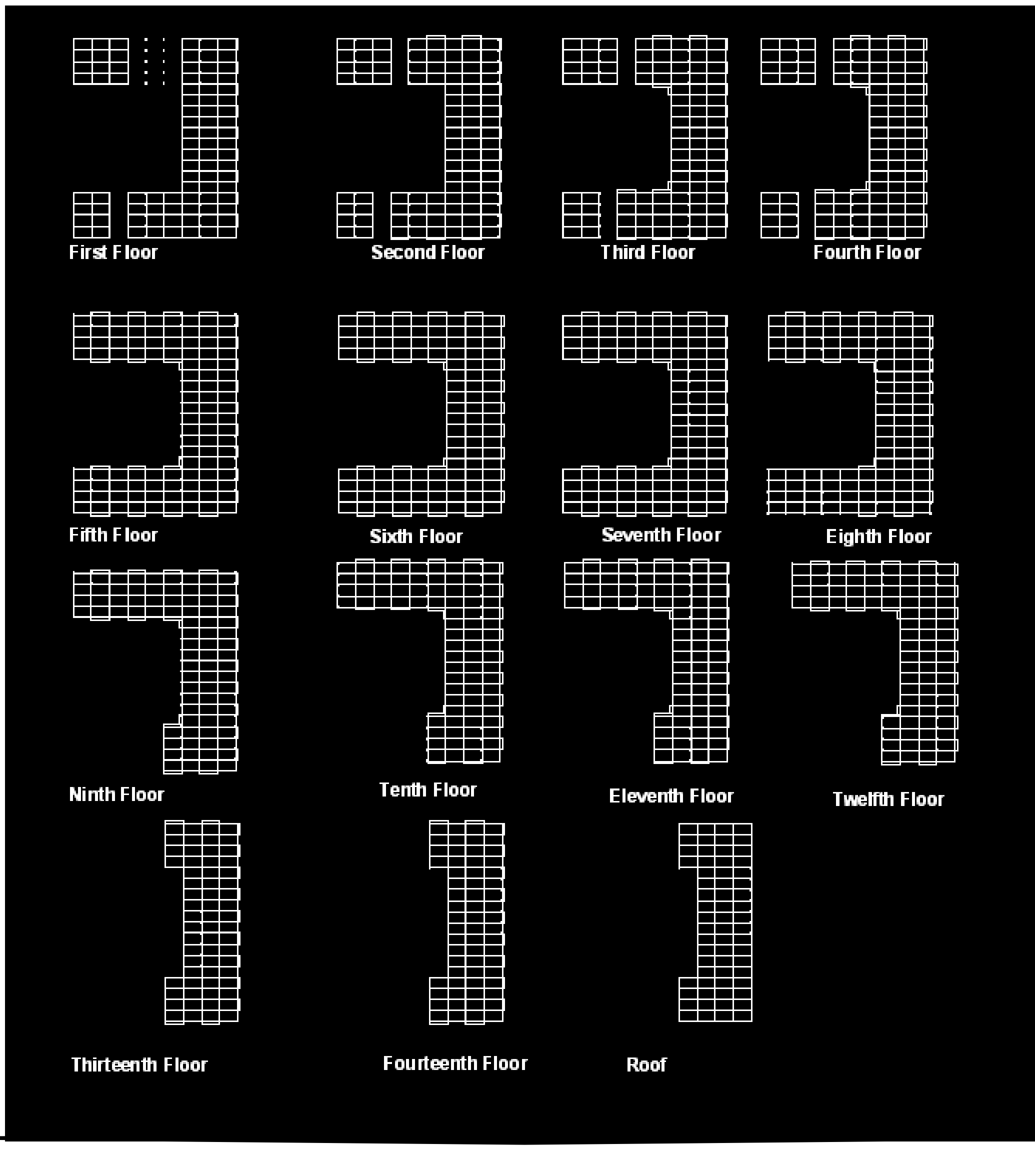
Construction Breadth Study

After the building is completely re-designed to accommodate the architecure and structure, a cost analysis will be performed on the existing building and new building to determine how much money could be potentially saved or spent. The analysis will take in consideration architectural changes as well as the total duration to erect the building.

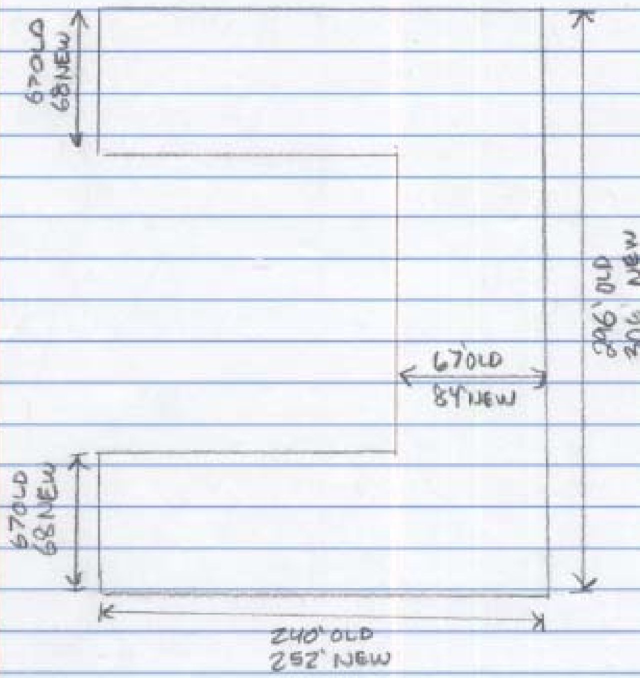
Architectural Breadth Study

Please note that due to the time-frame of this thesis study, I am assuming the parking gargage beneath the residential tower will be fully able to integrate with the column layout of the proposed building. This however may not be the case and may require a transfer slab, which can potentially change the results of this thesis. Also, the pool on the 13th floor will be relocated to the community center which is part of the mixed-use development to significantly reduce the weight of the building and ease the design of the structural system.

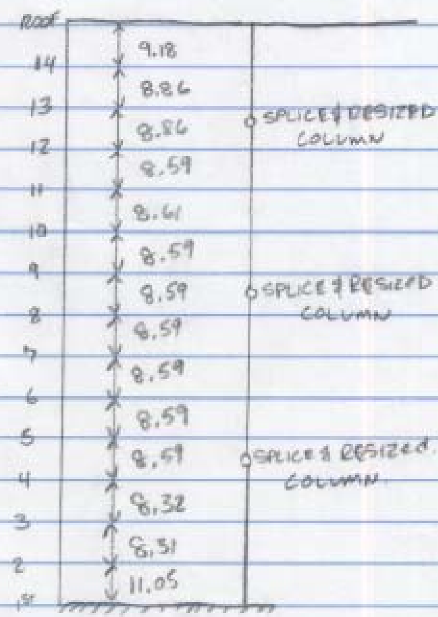
Proposed Layout Using Typical Bay



BUILDING DIMENSIONS



FL-FL HEIGHT & COLUMN SPLICING LOCATION



TOTAL HT OF NEW BUILDING

13FLOORS (10") + 123.32' + (24" BEAM + 10" SLAB)

10.83' + 123.32' + 2.83'

TOTAL HT ALLOWED = 143'

$\boxed{\text{TOTAL HT PROVIDED} = 136.98'}$

Square Footage

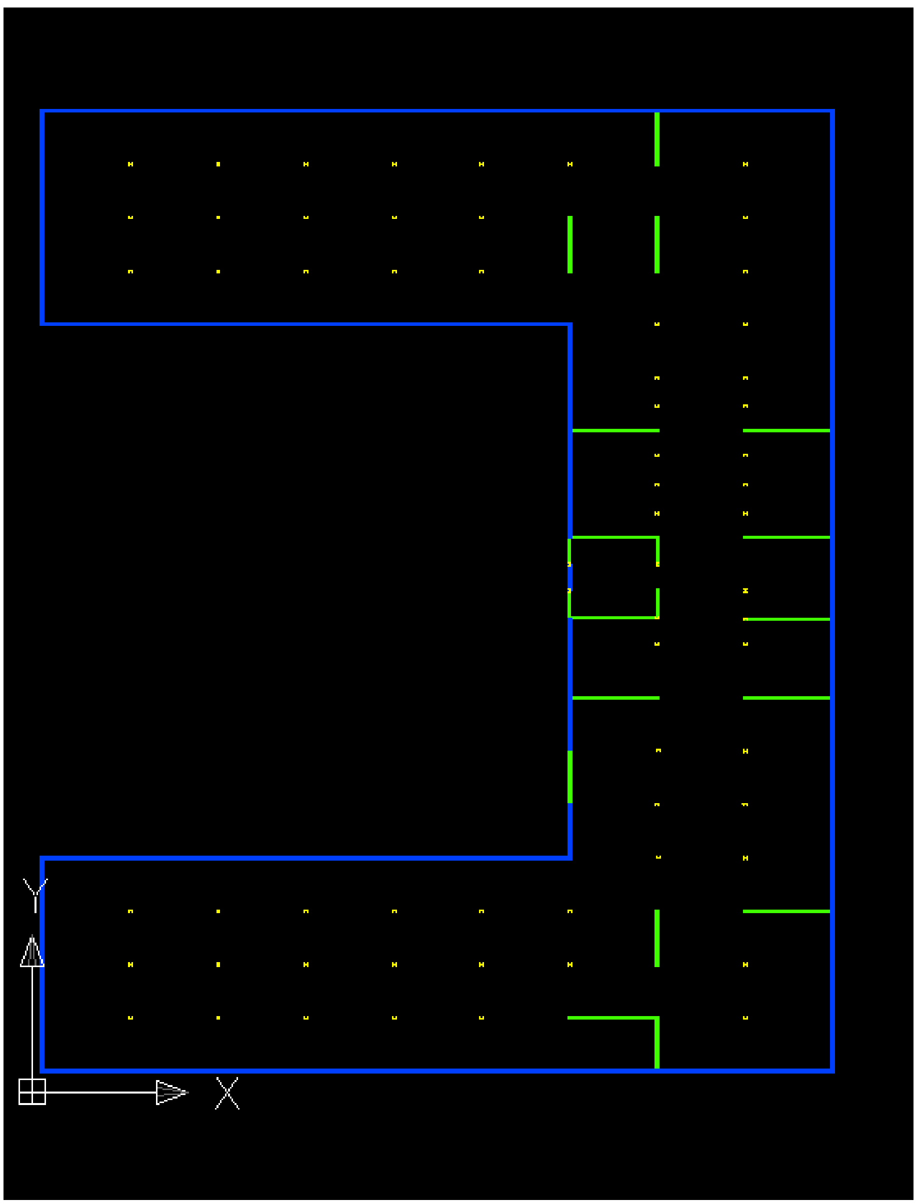
After finding a typical bay size that would integrate with the architecture of the existing building, a comparative analysis of total square footage was required to determine if the building lost or gained square footage. The spreadsheet below is a summary of that information.

Floors	Existing Total Floor Area	Estimated Total Area for Proposed Tower	Difference
1	19,103	25,064	5,961
2	22,988	28,708	5,720
3	30,510	34,368	3,858
4	30,507	34,380	3,873
5	40,789	47,518	6,729
6	40,789	47,518	6,729
7	40,789	47,518	6,729
8	40,970	47,699	6,729
9	32,974	38,179	5,205
10	32,980	38,185	5,205
11	32,980	38,185	5,205
12	32,980	38,185	5,205
13	33,158	28,843	-4,315
14	25,373	28,843	3,470
15	25,373	28,843	3,470
Roof	25,373	0	-25,373
Sum	507,636	552,036	44,400

This spreadsheet concludes that the proposed layout of the building using typical bays will result in an additional 44,400 S.F. This is a significant amount of extra square footage that will provide additional apartment units on each floor, which in turn will produce revenue for the owner.

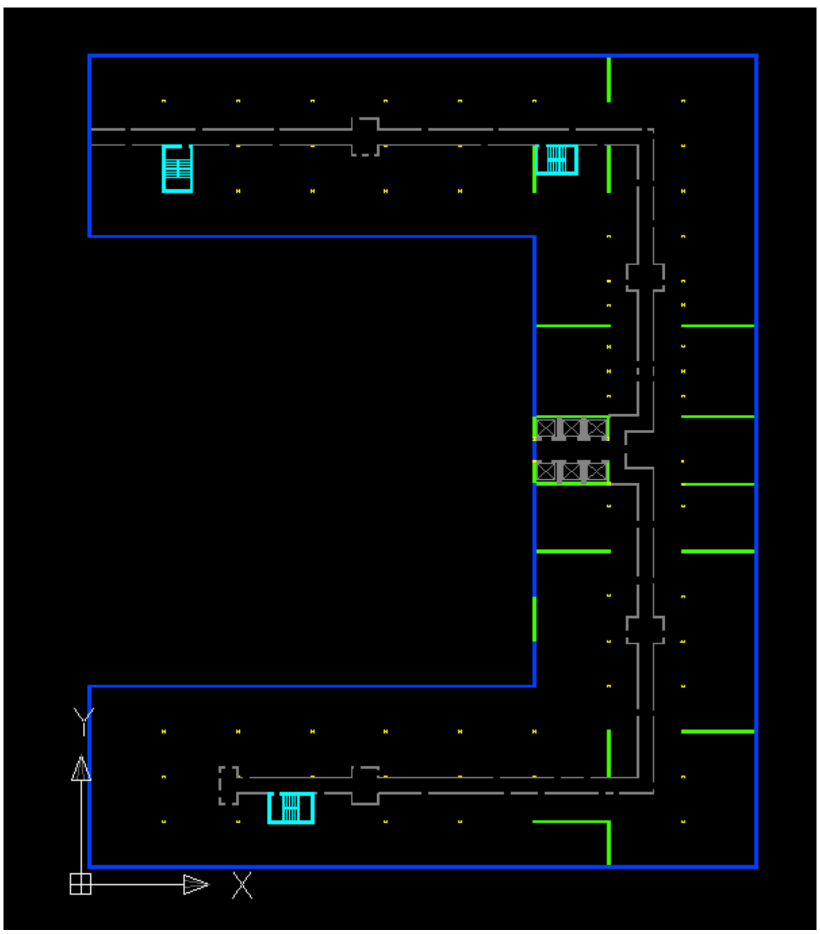
Location of Lateral Resisting Elements

After laying out the typical bays for gravity loading, lateral members are needed to resist the seismic and wind loads. The locations of the frames were chosen based upon the location of the existing shear walls and center of mass and rigidity of the previous system. Along with the latter, architectural requirements limited the orientation and location of the frames based upon the concept of keeping the same number of apartments with approximately the same square footage. Below is a typical floor plan of the building. The green represents the location length of the braced frames.



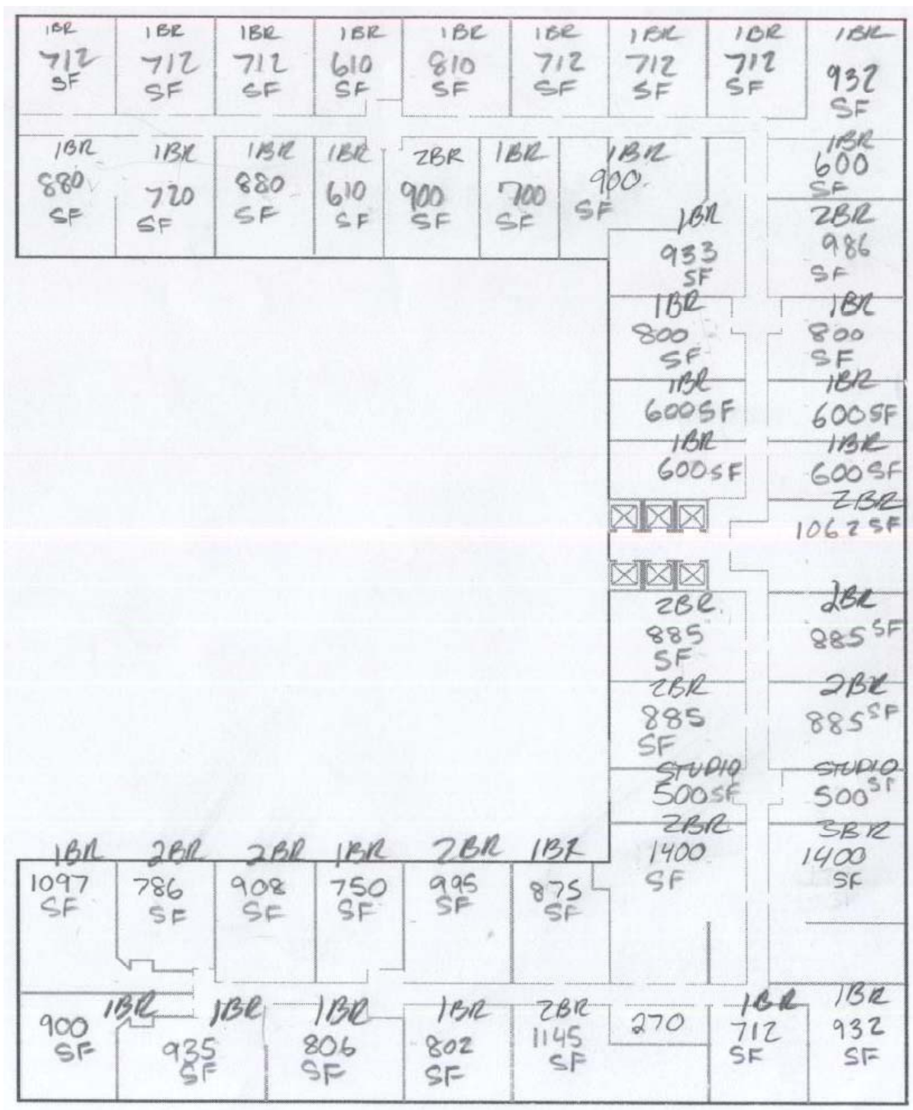
Functionalism

Please note that the corridors are in relatively the same location to the existing system and are approximately 6' wide. In the existing building the corridors pose as a major architectural fault, because they are over 200' in length and have no cut backs or other means to create a non tunnel experience as the tenant walks through the building. This problem is corrected by opening up the hall way an additional 8' at mid-points of the North-South corridors. Also, the East-West corridor is now cut in half due to the undulation about the elevator core. The existing floor plan had 5 elevators and in the new layout it was possible to add an additional elevator for the tenants of the building. The means of egress remained unchanged and there are 3 stairwells in the same locations throughout the building.



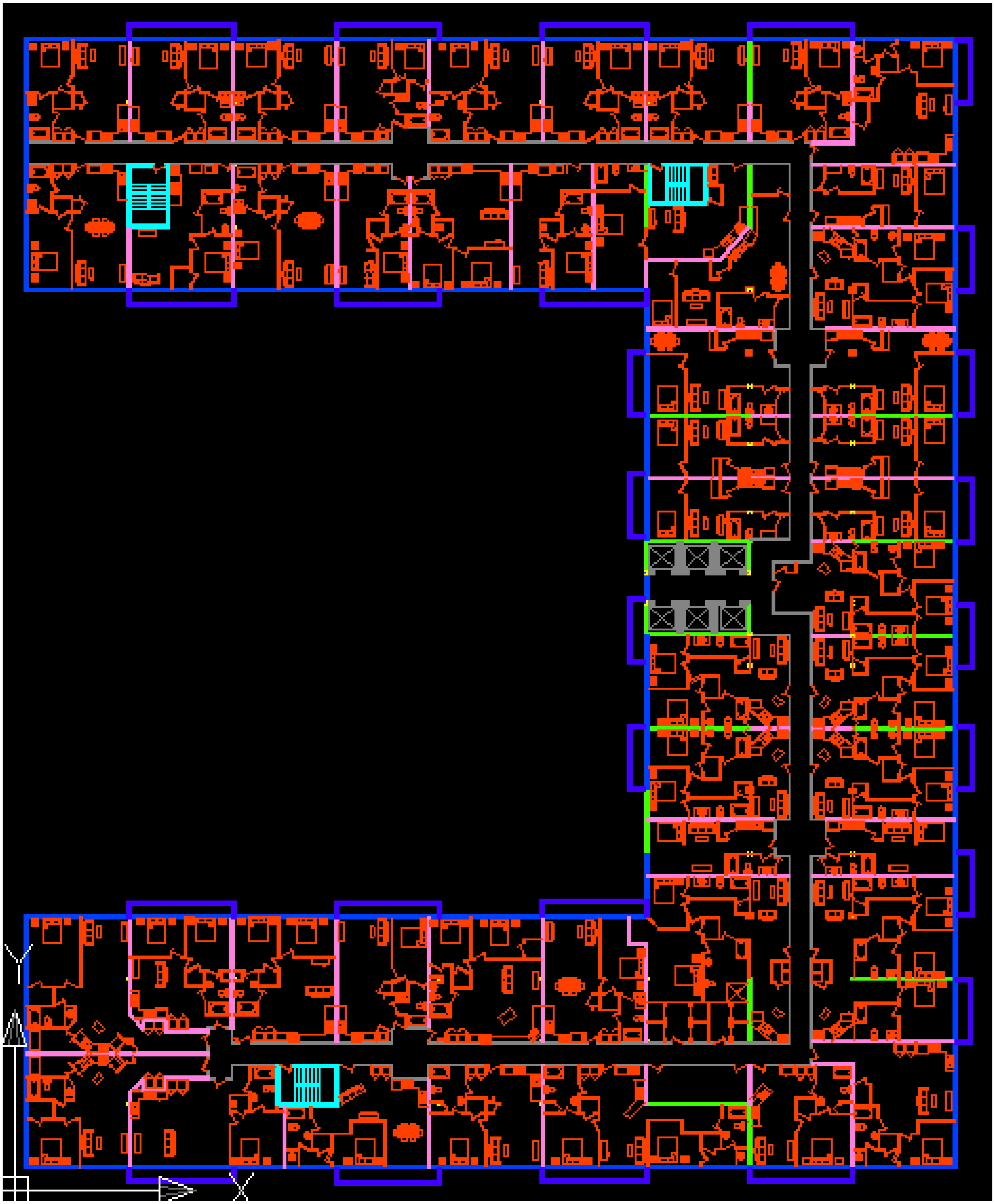
Apartments

The proposed layouts of the apartments were designed to correlate with the approximate square footages of the existing building. This layout allotted 47 apartments consisting of 32-1 Bed Room, 12-2 Bed Room, 1- 3 Bedroom, and 2 studio apartments. The existing floor plan contained 40 apartments consisting of 22-1 Bed Room, 16-2 Bed Room, and 2 studio apartments per typical floor.



Inclusive Floor Plan

Please note that most of the apartments are significantly different from each other and may viewed in more detail when referencing Appendix B.



Architectural Breadth Conclusions

After completing the architectural study it was found that by implementing the proposed column layout on a typical grid of 17’ X 28’, the building gained an additional 45,000 square feet of area. This extra area resulted in approximetly 7 more apartments per floor, which is about 70 more units for the entire building. The corridors were shortened and opened up to prevent the feeling of walking through a tunnel, which will provide a better living/walking experience for the tenant. Not only was the corridor re-designed to prevent the problem mentioned in the latter, but it also allowed another elevator to be incorportated. The architecture of the individual units not only complied with the square footages of the existing building, but maintained the same style, shape, and overall quality. On top of maintaining the quality, the proposed layout provided a floor plan with more variety, i.e. non-typical apartments and an option of a 3 bedroom. Also, the proposed layout was designed with the concept of mirroring apartments for a more econonmical construction.

Structural Depth

Design Goals and Procedures

The overall goal of this thesis project is to investigate whether or not an alternative structural system could be a more economical option for the design of Wisconsin Place Residential. In a previous report labeled as Technical Assignment 2, a comparative analysis of four different alternative floor framing systems were investigated. To remain consistent with typical design practices of achieving the smallest floor sanwich dimension, the following systems were researched:

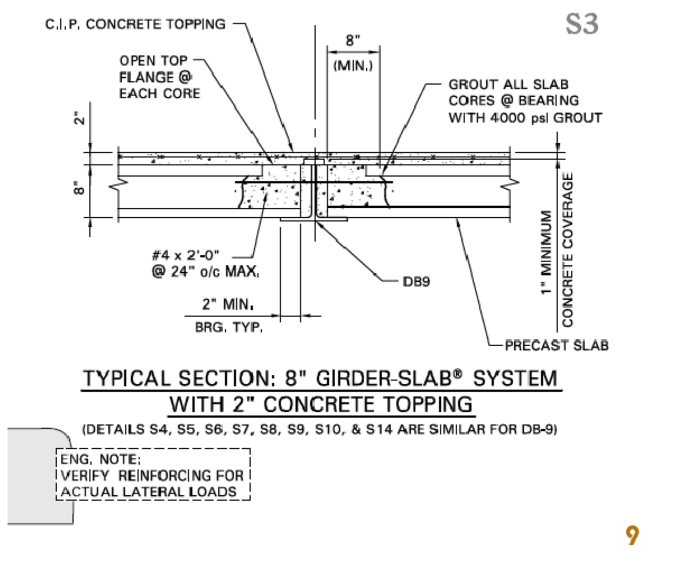
- Redesigned Two-Way Post-Tensioned Flat Plate w/ Lightweight Concrete
- Precast Girder-Slab
- Two-Way Flat Plate with Normal and Lightweight Concrete
- Composite Deck with Non-Composite Steel Framing

After completing the analysis of the four alternate systems, each system had unique advantages and disadvantages as shown in the figure on the next page. All of the systems with the exception of the Two-Way Post-Tensioned Flat Plate w/ Lightweight Concrete require the floor plan to be significantly changed into a typical grid, which will limit the architecture of the building. Also, all of the lateral elements will have to be completely redesigned and the building will lose at least one floor. The irregularity of the column layout and the height restriction are two major limiting factors for a structural re-design of Wisconsin Place Residential. An architectural redesign of the building is required in order to make a structural redesign feasible.

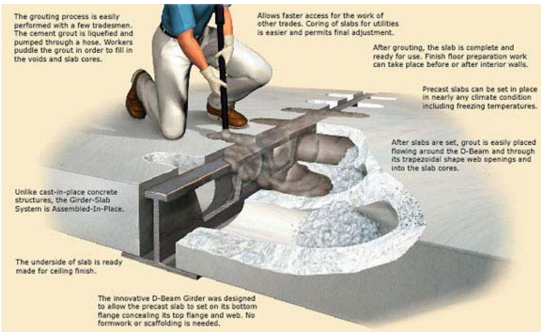
System	Two-Way Post-Tensioned Flat Plate w/ Normal Weight Concrete (EXISTING)	Two-Way Post-Tensioned Flat Plate w/ Lightweight Concrete	Precast Girder-Slab	Two-Way Flat Plate w/ Normal Weight Concrete	Two-Way Flat Plate w/ Lightweight Concrete	Composite Deck with Non-Composite Steel Framing
Weight (psf)	94	74	74	138	101	45
Slab Depth (in)	7.5	8	6	11	11	3.5
Largest Depth	7.5	8	8	11	11	17.5
Construction Difficulty	Hard	Hard	Easy	Easy	Easy	Easy
Lead Time	Short	Short	Long	Short	Short	Long
Formwork	Yes	Yes	Little	Little	Little	Little
Additional Fireproofing	No	No	Yes	No	No	Yes
Lateral System Effects	N/A	Medium	Medium	High	Medium	High
Relative Vibration	Low	Low	Medium	Low	Low	High
Foundation Impact	N/A	Medium	Medium	High	Medium	High
Cost/SF						
Materials	$10.62	$10.75	$10.72	$7.64	$7.77	$16.61
Labor	$8.01	$8.01	$3.15	$8.10	$8.10	$7.73
Total ($)	$18.63	$18.76	$13.87	$15.74	$15.87	$24.34

The chart above concludes that the Girder-Slab system is the cheapest viable option for a floor system in Wisconsin Place Residential and below are some of the advantages the Girder-Slab system offers.

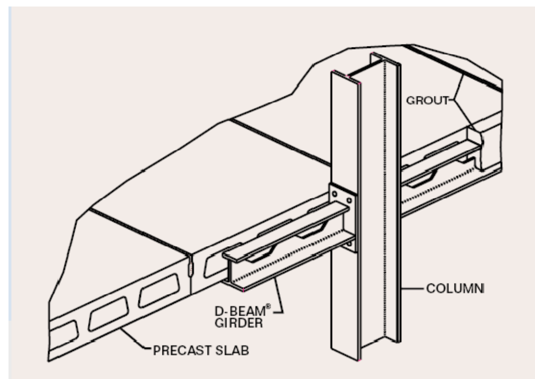
- Low floor-to-floor heights, minimize building height
- Super-fast structure and building completion
- Reduced building structure weight
- Limited weather impact
- Structure assembly is one process, one source
- Integrates well with mixed use spaces below
- Limited on-site labor
- Reduced on-site overhead costs



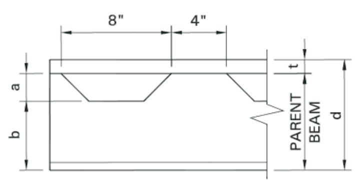
Precast Girder-Slab System



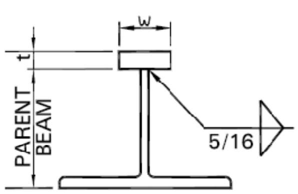
A Precast Girder-Slab system is a steel and precast hybrid system that forms a monolithic structural slab assembly. A special steel beam is used as an interior girder supporting the precast slab on its bottom flange. The flat structural slab permits minimum and variable floor-to-floor heights. When designing the hollow-core floor planks, Nitterhouse Concrete tables were used. The typical planks resulted in being 8"X 4'-0" with a 2" topping spanning a distance of 28'-0" with a 2hr fire resistance. The topping strength required was 6,000 psi. Supporting these hollow-core planks are the special DB beams, properties of the beams are shown below.



Designation	Web Included		Depth	Web	Parent Beam			Top Bar
	Weight	Avg. Area	d	Thickness t_w	Size	a	b	w x t
	lb/ft	in²	in	in		in	in	in x in
DB 8 x 35	34.7	10.2	8	.340	W10 x 49	4	3	3 x 1
DB 8 x 37	36.7	10.8	8	.345	W12 x 53	2	5	3 x 1
DB 8 x 40	39.8	11.7	8	.340	W10 x 49	3	3.5	3 x 1.5
DB 8 x 42	41.8	12.3	8	.345	W12 x 53	1	5.5	3 x 1.5
DB 9 x 41	40.7	11.9	9.645	.375	W14 x 61	3.375	5.25	3 x 1
DB 9 x 46	45.8	13.4	9.645	.375	W14 x 61	2.375	5.75	3 x 1.5



D-Beam® Reference Calculator is Available on Website. www.girder-slab.com



Designation	Steel Only / Web Ignored						Transformed Section / Web Ignored				
	Ix	C bot	C top	S bot	S top	Allowable Moment Fy=50 KSI f_b=0.6 Fy	Ix	C bot	C top	S bot	S top
	in⁴	in	in	in³	in³	kft	in⁴	in	in	in³	in³
DB 8 x 35	102	2.80	5.20	36.5	19.7	49	279	4.16	4.40	67.1	63.5
DB 8 x 37	103	2.76	5.24	37.3	19.7	49	282	4.16	4.42	67.7	63.8
DB 8 x 40	122	3.39	4.61	36.1	26.5	66	289	4.26	4.30	67.9	67.2
DB 8 x 42	123	3.35	4.65	36.9	26.5	66	291	4.26	4.32	68.4	67.5
DB 9 x 41	159	3.12	6.51	51.0	24.4	61	332	4.27	5.35	77.7	62.1
DB 9 x 46	195	3.84	5.79	50.8	33.7	84	356	4.43	5.20	80.6	68.6

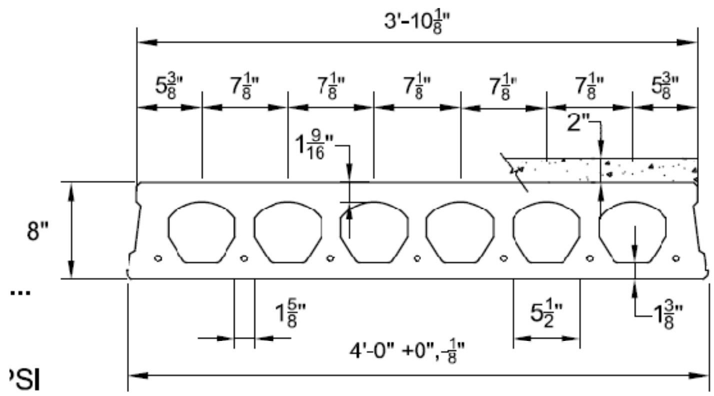
Proposed Building Structural System

Foundations

The foundations were not re-designed because the loading on the columns did not significantly change and there was approximately the same amount in both buildings. This will not create a significant savings in the total cost, so the foundations were not investigated into further detail. The typical factored gravity load transferred into the footings ranged from 166 kips to 1300 kips. The total weight of the proposed building is 65,172 kips which is a reduction when compared to the existing weight of 67,790 kips.

Floor Systems

Hollow Core Floor Planks



The use of hollowcore planks as the main floor element has significant advantages as compared to the Two-way Flat Plate Post Tensioned slab. These advantages include faster erection time, due to the fact that minimal formwork is required and onsite labor costs are low. High span-to-depth ratios are easily achieved with the use of prestressed concrete and the planks perform well in vibrations, acoustics and fire-ratings. The planks used for the proposed building are referenced from Nitterhouse Concrete and Masonry Products and were designed primarily to integrate with the architecture. The typical planks used for the 2nd through 14th floor span 28’ in the North-South direction of the building and are supported by D-Beams that span 17’ in the East-West direction of the building. The roof differed from the latter due to the high live load. A live load of 150PSF was imposed on the structure due to the mechanical equipment of the building. The resulting sytem for the roof uses convential steel framing of W24X68 Girders spanning 28’ in the North-South direction and and W16X31

Beams spanning 17’ in the East-West direction instead of the D-Beams as mentioned above.

Supporting D-Beams

Using D-Beams compared to convential steel framing results in a much smaller floor-to-floor height, because the plank sits on the bottom flange. Using this beam to support typical floors was imperitive due to the height restriction of the building. There are two basic D-Beam Girder sections available for use with an 8” thick precast slab. The DB-8 provides an 8” thick slab assembly, while the DB-9 is designed for use with a 2” concrete topping resulting in a 10” thick slab. Since the slab is now increased from 7 ½ “ to 10”, Wisconsin Place Residential will have to reduce to 14 floors instead of 15 as per existing building. The D-Beams were designed by hand calculations and also the Girder-Slab calculator for initial load and total load moment and deflections. Also the superimposed compressive stress on the concrete as well as the bottom flange tension stress were checked.

Due to the step in the building architecture, there was potential for snow drifting on the roofs at levels 8 and 12. The snow drift resulted in an 87PSF surcharge load. The D-Beams were checked and are acceptable for use to support the 8th and 12th floor. Please see calculation in Appendix H for further detail.

Columns

The columns supporting the first floor through the roof are rolled W12 shapes with a yield strength of 50ksi. The column sizes range from W12X40's to W12X120. The columns were designed using the tributary area method and Microsoft Excel for gravity loading. The columns were designed to be spliced and resized every 4 levels throughout the building. The following spread sheets show the column sizes for each column at every level. Loading on individual columns can be seen in Appendix G.

Column	A1	A2	A3	A4	A5	A15	A16	A17	A18	A19	B1	B2	B3	B4	B5	B15	B16	B17	B18	B19
Roof																				
14																				
13																				
12																				
11						W12X40	W12X40	W12X40	W12X40	W12X40						W12X40	W12X40	W12X40	W12X40	W12X40
10						W12X40	W12X40	W12X40	W12X40	W12X40						W12X40	W12X40	W12X40	W12X40	W12X40
9						W12X40	W12X40	W12X40	W12X40	W12X40						W12X40	W12X40	W12X40	W12X40	W12X40
8						W12X40	W12X40	W12X40	W12X40	W12X40						W12X40	W12X40	W12X40	W12X40	W12X40
7	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X65	W12X65	W12X65	W12X40
6	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X65	W12X65	W12X65	W12X40
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2	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X53	W12X53	W12X53	W12X40	W12X40	W12X65	W12X65	W12X65	W12X40	W12X53	W12X87	W12X87	W12X87	W12X53
1	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X53	W12X53	W12X53	W12X40	W12X40	W12X65	W12X65	W12X65	W12X40	W12X53	W12X87	W12X87	W12X87	W12X53

Column	C1	C2	C3	C4	C5	C15	C16	C17	C18	C19	D1	D2	D3	D4	D5	D15	D16	D17	D18	D19
Roof																				
14																				
13																				
12																				
11						W12X40	W12X40	W12X40	W12X40	W12X40						W12X40	W12X40	W12X40	W12X40	W12X40
10						W12X40	W12X40	W12X40	W12X40	W12X40						W12X40	W12X40	W12X40	W12X40	W12X40
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Column	E1	E2	E3	E4	E5	E15	E16	E17	E18	E19	F1	F2	F3	F4	F5	F15	F16	F17	F18	F19
Roof																				
14											W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40
13											W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40
12											W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40
11						W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X53	W12X53	W12X53	W12X40
10						W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X53	W12X53	W12X53	W12X40
9						W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X53	W12X53	W12X53	W12X40
8						W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X53	W12X53	W12X53	W12X40
7	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X65	W12X65	W12X65	W12X40	W12X40	W12X65	W12X65	W12X65	W12X40	W12X45	W12X79	W12X79	W12X79	W12X45
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Column	G1	G2	G3	G4	G5	G6	G7	G8	G9	G10	G11	G12	G13	G14	G15	G16	G17	G18	G19
Roof																			
14	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40
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Column	H1	H2	H3	H4	H5	H6	H7	H8	H9	H10	H11	H12	H13	H14	H15	H16	H17	H18	H19
Roof																			
14	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40
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5	W12X53	W12X87	W12X87	W12X87	W12X87	W12X87	W12X87	W12X87	W12X87	W12X87	W12X87	W12X87	W12X87	W12X87	W12X87	W12X87	W12X87	W12X87	W12X53
4	W12X53	W12X87	W12X87	W12X87	W12X87	W12X87	W12X87	W12X87	W12X87	W12X87	W12X87	W12X87	W12X87	W12X87	W12X87	W12X87	W12X87	W12X87	W12X53
3	W12X65	W12X120	W12X120	W12X120	W12X120	W12X120	W12X120	W12X120	W12X120	W12X120	W12X120	W12X120	W12X120	W12X120	W12X120	W12X120	W12X120	W12X120	W12X65
2	W12X65	W12X120	W12X120	W12X120	W12X120	W12X120	W12X120	W12X120	W12X120	W12X120	W12X120	W12X120	W12X120	W12X120	W12X120	W12X120	W12X120	W12X120	W12X65
1	W12X65	W12X120	W12X120	W12X120	W12X120	W12X120	W12X120	W12X120	W12X120	W12X120	W12X120	W12X120	W12X120	W12X120	W12X120	W12X120	W12X120	W12X120	W12X65

Column	I1	I2	I3	I4	I5	I6	I7	I8	I9	I10	I11	I12	I13	I14	I15	I16	I17	I18	I19
Roof																			
14	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40
13	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40
12	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40
11	W12X40	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X40
10	W12X40	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X40
9	W12X40	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X40
8	W12X40	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X40
7	W12X53	W12X87	W12X87	W12X87	W12X87	W12X87	W12X87	W12X87	W12X87	W12X87	W12X87	W12X87	W12X87	W12X87	W12X87	W12X87	W12X87	W12X87	W12X53
6	W12X53	W12X87	W12X87	W12X87	W12X87	W12X87	W12X87	W12X87	W12X87	W12X87	W12X87	W12X87	W12X87	W12X87	W12X87	W12X87	W12X87	W12X87	W12X53
5	W12X53	W12X87	W12X87	W12X87	W12X87	W12X87	W12X87	W12X87	W12X87	W12X87	W12X87	W12X87	W12X87	W12X87	W12X87	W12X87	W12X87	W12X87	W12X53
4	W12X53	W12X87	W12X87	W12X87	W12X87	W12X87	W12X87	W12X87	W12X87	W12X87	W12X87	W12X87	W12X87	W12X87	W12X87	W12X87	W12X87	W12X87	W12X53
3	W12X65	W12X120	W12X120	W12X120	W12X120	W12X120	W12X120	W12X120	W12X120	W12X120	W12X120	W12X120	W12X120	W12X120	W12X120	W12X120	W12X120	W12X120	W12X65
2	W12X65	W12X120	W12X120	W12X120	W12X120	W12X120	W12X120	W12X120	W12X120	W12X120	W12X120	W12X120	W12X120	W12X120	W12X120	W12X120	W12X120	W12X120	W12X65
1	W12X65	W12X120	W12X120	W12X120	W12X120	W12X120	W12X120	W12X120	W12X120	W12X120	W12X120	W12X120	W12X120	W12X120	W12X120	W12X120	W12X120	W12X120	W12X65

Column	J1	J2	J3	J4	J5	J6	J7	J8	J9	J10	J11	J12	J13	J14	J15	J16	J17	J18	J19
Roof																			
14	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40
13	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40
12	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40
11	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40
10	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40
9	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40
8	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40	W12X40
7	W12X40	W12X53	W12X53	W12X53	W12X53	W12X53	W12X53	W12X53	W12X53	W12X53	W12X53	W12X53	W12X53	W12X53	W12X53	W12X53	W12X53	W12X53	W12X40
6	W12X40	W12X53	W12X53	W12X53	W12X53	W12X53	W12X53	W12X53	W12X53	W12X53	W12X53	W12X53	W12X53	W12X53	W12X53	W12X53	W12X53	W12X53	W12X40
5	W12X40	W12X53	W12X53	W12X53	W12X53	W12X53	W12X53	W12X53	W12X53	W12X53	W12X53	W12X53	W12X53	W12X53	W12X53	W12X53	W12X53	W12X53	W12X40
4	W12X40	W12X53	W12X53	W12X53	W12X53	W12X53	W12X53	W12X53	W12X53	W12X53	W12X53	W12X53	W12X53	W12X53	W12X53	W12X53	W12X53	W12X53	W12X40
3	W12X53	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X53
2	W12X53	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X53
1	W12X53	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X65	W12X53

Lateral System

<u>Wind</u>

Wind loads were analyzed using section 6 of ASCE 7-05. Please note that this is not the most accurate way to measure wind pressure at each story. If a wind tunnel test was performed the cladding report would most likely show higher wind pressures on the south elevation of the building because the legs of the "U" would act like a funnel, thus causing higher wind speeds which would increase pressures.

Exposure Class	B			
Importance Factor I	1			
Wind Design Method	2			
Approximate Fundamental Period	0.801			
Topographic Factor K_{zt}	1			
Wind Directionality Factor K_d	0.85			
Basic Wind Speed V (mph)	90			
N-S Length of Building	252			
E-W Length of Building	306			
No. of Stories	14			
Typ. Story Height (ft)	9.42			
Building Height (ft)	136.98			
L/B in N-S Direction	0.82			
L/B in E-W Direction	1.21			
h/L in N-S Direction	0.544			
h/L in E-W Direction	0.448			
	$C_{p,\ windward}$	$C_{p,\ leeward}$	$C_{p,\ side\ wall}$	Gust Factor
N-S Direction	0.8	-0.5	-0.7	0.8
E-W Direction	0.8	-0.454	-0.7	0.81

Wind Distribution

Level	FL-FL Height	h_x	K_z	q_z	Pressures (PSF)						Load (kips)		Shear (kips)		Moment (ft-k)		Internal Pressure (PSF)	
					N/S Wind			E/W Wind			N/S	E/W	N/S	E/W	N/S	E/W	+	-
					Windward	Leeward	Sidewall	Windward	Leeward	Sidewall								
Roof	12.01	136.98	1.09	19.21	12.30	-7.68	-10.76	12.45	-7.06	-10.89	37	13	0	0	5,033	1,799	25	-25
14	9.7	124.97	1.09	19.21	12.30	-7.68	-10.76	12.45	-7.06	-10.89	66	24	36	13	8,290	2,964	22	-22
13	9.7	115.27	1.04	18.33	11.73	-7.68	-10.76	11.88	-7.06	-10.89	58	21	103	37	6,636	2,370	21	-21
12	9.43	105.57	1.04	18.33	11.73	-7.68	-10.76	11.88	-7.06	-10.89	57	46	160	57	5,990	4,813	19	-19
11	9.44	96.14	0.99	17.45	11.17	-7.68	-10.76	11.31	-7.06	-10.89	54	44	217	103	5,230	4,197	17	-17
10	9.42	86.7	0.96	16.92	10.83	-7.68	-10.76	10.96	-7.06	-10.89	53	43	272	146	4,632	3,715	16	-16
9	9.42	77.28	0.96	16.92	10.83	-7.68	-10.76	10.96	-7.06	-10.89	53	43	325	189	4,124	3,308	14	-14
8	9.42	67.86	0.93	16.39	10.49	-7.68	-10.76	10.62	-7.06	-10.89	52	42	378	232	3,555	2,849	12	-12
7	9.42	58.44	0.89	15.69	10.04	-7.68	-10.76	10.17	-7.06	-10.89	51	41	431	274	2,986	2,390	11	-11
6	9.42	49.02	0.85	14.98	9.59	-7.68	-10.76	9.71	-7.06	-10.89	50	40	482	315	2,441	1,952	9	-9
5	9.42	39.6	0.81	14.28	9.14	-7.68	-10.76	9.25	-7.06	-10.89	48	39	532	355	1,920	1,534	7	-7
4	9.15	30.18	0.76	13.40	8.57	-7.68	-10.76	8.68	-7.06	-10.89	46	37	580	394	1,393	1,111	5	-5
3	9.15	21.03	0.66	11.63	7.45	-7.68	-10.76	7.54	-7.06	-10.89	42	34	626	430	891	708	4	-4
2	11.88	11.88	0.57	10.05	6.43	-7.68	-10.76	6.51	-7.06	-10.89	45	36	669	464	539	427	2	-2
Totals											714	500	714	500	53,661	34,136	184	-184

Weight of Proposed Building

Floors	Existing Gross Area for Tower	Existing Total Floor Area	Difference	Estimated New Gross Area for New Tower Not the whole floor	Estimated Total Area for Proposed Tower Not the whole floor	Gross Area for Whole Building	Total Area for Whole Building	Weight of Balconies	Weight of Columns	Weight of Beams	Weight of slab, topping, partitions,finishes, and/or MEP	Weight of Floors for Proposed Building	Weight of Tower not whole building	Mass/Area
1	19,743	19,103	640	25,704	25,064	40,936	40,296	0	0	0	0.00	0	0	
2	23,792	22,988	804	29,512	28,708	44,744	43,940	10	104	93	121.25	5,535	3,688	3.91211406
3	31,366	30,510	856	35,224	34,368	44,744	43,888	10	91	93	121.25	5,516	4,362	3.90308872
4	31,351	30,507	844	35,224	34,380	44,744	43,900	10	91	93	121.25	5,517	4,363	3.90305112
5	41,823	40,789	1,034	48,552	47,518	48,552	47,518	10	73	93	121.25	5,938	5,938	3.88106442
6	41,823	40,789	1,034	48,552	47,518	48,552	47,518	10	73	93	121.25	5,938	5,938	3.88106442
7	41,823	40,789	1,034	48,552	47,518	48,552	47,518	10	73	93	121.25	5,938	5,938	3.88106442
8	33,827	32,974	853	39,032	38,179	39,032	38,179	10	73	93	121.25	4,806	4,806	3.9093259
Roof @ 8	7,996	7,996	0	9,520	9,520	9,520	9,520	10	73	93	101.25	1,140	1,140	3.71985751
9	33,827	32,974	853	39,032	38,179	39,032	38,179	10	50	78	121.25	4,767	4,767	3.87766725
10	33,827	32,980	847	39,032	38,185	39,032	38,185	10	50	78	121.25	4,768	4,768	3.87764963
11	33,827	32,980	847	39,032	38,185	39,032	38,185	10	50	78	121.25	4,768	4,768	3.87764963
12	33,827	32,980	847	29,512	28,665	29,512	28,665	10	50	78	121.25	3,613	3,613	3.91488663
Roof @ 12				9,520	9,520	9,520	9,520	10	50	78	101.25	1,102	1,102	3.59413331
13	26,042	25,373	669	29,512	28,843	29,512	28,843	10	62	62	121.25	3,632	3,632	3.91045477
14	26,042	25,373	669	29,512	28,843	29,512	28,843	10	62	62	121.25	3,632	3,632	3.91045477
15	26,042	25,373	669	29,512	28,843	29,512	28,843	10	16	203	86.25	2,717	2,717	2.92514083
Total	486,978	474,478	12,500	564,536	552,036	614,040	601,540	160	1,043	1,464		69,328	65,172	

Factors Used in Seismic Distribution

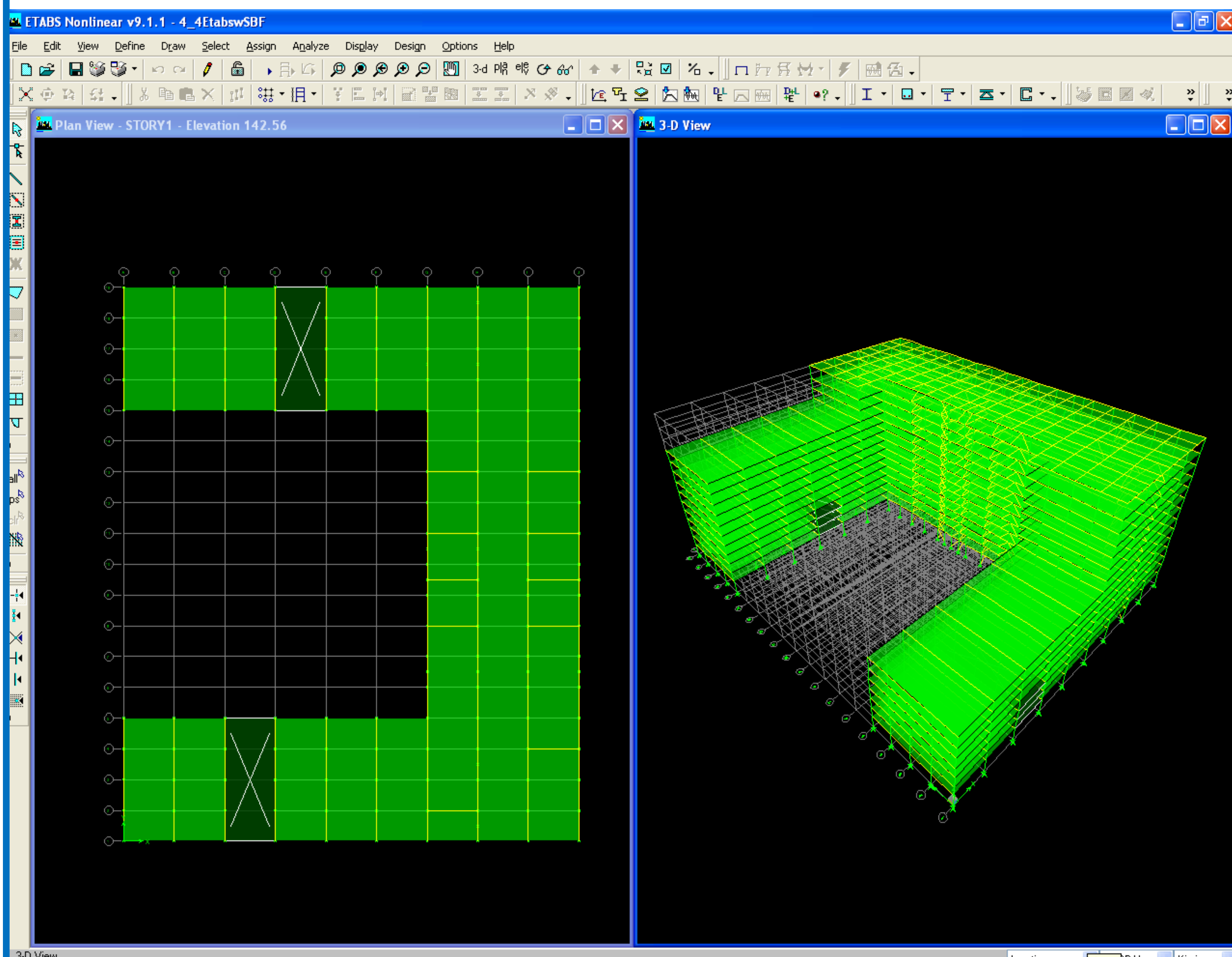
Site Classification	B
$S_{s\ (g)}$	0.154
$S_{1\ (g)}$	0.05
F_a	1
F_v	1
$S_{ms\ (g)}$	0.154
$S_{m1\ (g)}$	0.05
$S_{DS\ (g)}$	0.103
$S_{D1\ (g)}$	0.034
R	6.0
Seismic Importance factor	1
Occupancy Category	II
Seismic Design Category	A
T (s)	1.36
$T_{L\ (s)}$	8
C_S	0.01
$h_{n\ (ft)}$	136.98
k	1.23
V (k)	694
M (ft-kips)	62,061

Seismic Distribution

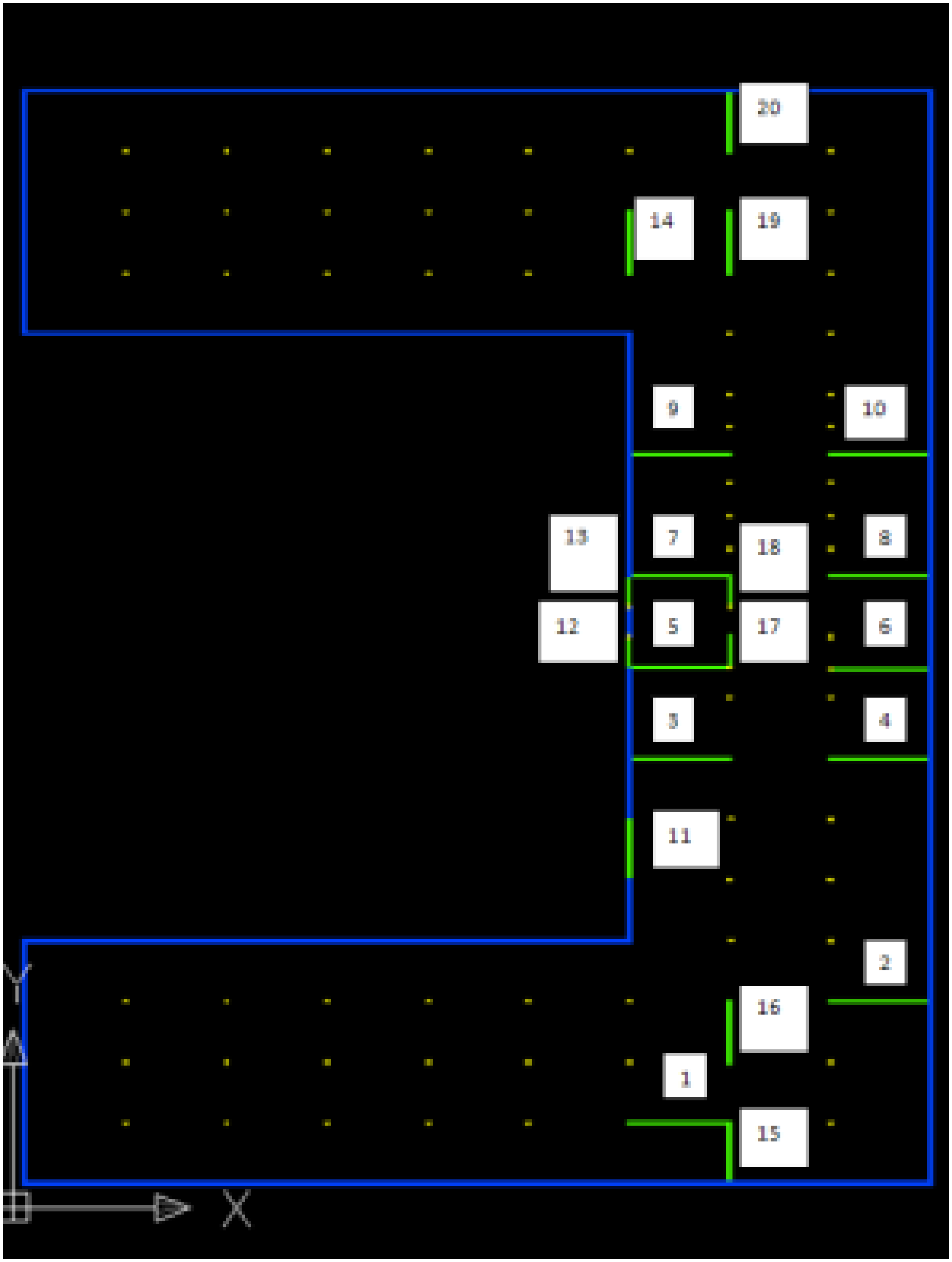
						Load	Shear	Moment
Level	**w_x**	**FL-FL Height**	**h_x**	**$w_x h_x^k$**	**C_{vx}**	**F_x**	**V_x**	**M_x**
	(kips)	(ft)	(ft)			(kips)	(kips)	(ft-kips)
Roof	2,717	12.01	136.98	1,153,926	0.091	63	0	8,691
14	3,632	9.70	124.97	1,377,898	0.109	76	63	9,468
13	3,632	9.70	115.27	1,247,547	0.099	69	139	7,907
12	4,715	9.43	105.57	1,453,572	0.115	80	208	8,437
11	4,768	9.44	96.14	1,310,112	0.104	72	288	6,925
10	4,768	9.42	86.70	1,153,718	0.091	63	360	5,500
9	4,767	9.42	77.28	1,001,308	0.079	55	423	4,255
8	5,946	9.42	67.86	1,064,412	0.084	59	478	3,972
7	5,938	9.42	58.44	884,492	0.070	49	537	2,842
6	5,938	9.42	49.02	712,524	0.056	39	585	1,920
5	5,938	9.42	39.60	548,031	0.043	30	625	1,193
4	5,517	9.15	30.18	364,550	0.029	20	655	605
3	5,516	9.15	21.03	233,731	0.019	13	675	270
2	5,535	11.88	11.88	116,183	0.009	6	688	76
Totals				12,622,004	1.00	694	**694**	**62,061**

After completing the seismic and wind analysis it was found that the maximum base shear of the building was still controlled by the wind in the North-South direction (714 kips) as compared to the existing system with shear walls (770 kips). Seismic also continued to control the maximum moment (62,061 ft-kips) as compared to the existing building of (65,627ft-kips). Even though the seismic produced the largest forces overall, the wind produced much higher forces in the lower levels and gradually increased to the top of the structure, whereas the seismic forces were low at the lower levels.

ETABS Model



Location and Reference Number for Special Concentric Braced Frames



The S.C.B.F.'s that are designed by ETABS in the proposed building are in the Chevron shapes shown in the figures to the left and right of the page. The typical frames occupy either a 28' or 17' bay. Sizes of the HSS shapes range from HSS4X.237 to HSS6X.250. Please see Appendix A for elevations and sizes of individual frames

When using ETABS, all of the columns were modeled as having a pinned connection at the base and were continuous through all 14 floors and pinned at the roof of the structure. Since D-Beams are not an option for input while using ETABS, the parent beams from which they were made are used. This should not significantly affect the results, because the beams are only providing support for gravity loading and are modeled as shear connections to the columns. To allow all the braced frames to act as one system the members were connected to a rigid diaphragm at each floor. This analysis technique permits a more direct analysis and interpretation of the results. The wind and seismic loads were applied manually as user defined loads calculated from the wind and seismic analysis in accordance with ASCE-7 05 chapters 6 and 12.

After entering the mass/area of the building into ETABS, 12 different failure modes were evaluated in showing how the proposed structural system fundamentally behaves. Failure mode 2 calculated the period of the building to be 5.35s in the East-West direction and Failure mode 3 calculated 3.09s in the North-South direction. These periods are significantly bigger than the existing periods of 1.76s in the East-West direction and .70s in the North-South direction. This makes sense because the proposed building is not as stiff as the existing building with concrete shear walls.

Using the shear forces per floor and inputting the data into the ETABS model acting at the center of gravity of each floor, it was found that the maximum displacements of the building due to seismic and wind are acceptable as per H/400 for wind loadings and .0125H for seismic as shown in the tables on the next page.

Below is a table of the location of the center of mass and rigidity of each floor for the proposed building. These eccentricities were used by ETABS, when designing the braced frames for torsion.

Floor	Xcm (ft)	Ycm (ft)	Xcr (ft)	Ycr (ft)	ex (ft)	ey (ft)
2	151.189	153.052	187.876	131.711	36.687	21.341
3	151.138	153.044	188.441	131.279	37.303	21.765
4	151.112	153.029	188.601	131.371	37.489	21.658
5	151.088	153.01	188.551	131.411	37.463	21.599
6	151.086	153.011	188.41	131.469	37.324	21.542
7	151.084	153.012	188.256	131.701	37.172	21.311
8	151.115	153.072	188.064	131.708	36.949	21.364
9	170.642	181.669	187.809	131.659	17.167	50.01
10	170.641	181.674	187.551	131.626	16.91	50.048
11	170.639	181.676	187.402	131.681	16.763	49.995
12	170.717	181.615	187.223	131.808	16.506	49.807
13	202.768	152.928	187.035	131.906	15.733	21.022
14	202.765	152.925	186.869	131.979	15.896	20.946
Roof	202.713	152.988	186.348	132.293	16.365	20.695

Floor	Fl-FL height (ft)	hx	H/400	Wind Displacement N-S	Drift (in)	Check	Wind Displacement E-W	Drift (in)	Check
Roof	12.01	136.98	0.3603	2.85	0.27	**OK**	3.37	0.360	**OK**
14	9.7	124.97	0.291	2.58	0.25	**OK**	3.01	0.190	**OK**
13	9.7	115.27	0.291	2.33	0.25	**OK**	2.82	0.210	**OK**
12	9.43	105.57	0.2829	2.08	0.25	**OK**	2.61	0.210	**OK**
11	9.44	96.14	0.2832	1.83	0.25	**OK**	2.4	0.280	**OK**
10	9.42	86.7	0.2826	1.58	0.23	**OK**	2.12	0.280	**OK**
9	9.42	77.28	0.2826	1.35	0.22	**OK**	1.84	0.280	**OK**
8	9.42	67.86	0.2826	1.13	0.21	**OK**	1.56	0.280	**OK**
7	9.42	58.44	0.2826	0.92	0.2	**OK**	1.28	0.270	**OK**
6	9.42	49.02	0.2826	0.72	0.18	**OK**	1.01	0.259	**OK**
5	9.42	39.6	0.2826	0.54	0.16	**OK**	0.751	0.230	**OK**
4	9.15	30.18	0.2745	0.38	0.12	**OK**	0.521	0.197	**OK**
3	9.15	21.03	0.2745	0.26	0.12	**OK**	0.324	0.165	**OK**
2	11.88	11.88	0.3564	0.14	0.14	**OK**	0.159	0.159	**OK**

Floor	Fl-FL height (ft)	hx	0.015H	ETABS Displacement N-S	Actual Displacement (N-S)	Drift (in)	Check	ETABS Displacements E-W	Actual Displacements (E-W)	Drift (in)	Check	Cd
Roof	12.01	136.98	2.1618	4.2	21	2.00	**OK**	**4.3**	**21.5**	**2.00**	**OK**	5
14	9.7	124.97	1.746	3.8	19	1.50	**OK**	**3.9**	**19.5**	**1.50**	**OK**	5
13	9.7	115.27	1.746	3.5	17.5	1.50	**OK**	**3.6**	**18**	**1.00**	**OK**	5
12	9.43	105.57	1.6974	3.2	16	1.50	**OK**	**3.4**	**17**	**1.50**	**OK**	5
11	9.44	96.14	1.6992	2.9	14.5	1.50	**OK**	**3.1**	**15.5**	**1.50**	**OK**	5
10	9.42	86.7	1.6956	2.6	13	1.50	**OK**	**2.8**	**14**	**0.75**	**OK**	5
9	9.42	77.28	1.6956	2.3	11.5	1.00	**OK**	**2.65**	**13.25**	**1.25**	**OK**	5
8	9.42	67.86	1.6956	2.1	10.5	1.50	**OK**	**2.4**	**12**	**1.50**	**OK**	5
7	9.42	58.44	1.6956	1.8	9	1.50	**OK**	**2.1**	**10.5**	**1.50**	**OK**	5
6	9.42	49.02	1.6956	1.5	7.5	1.50	**OK**	**1.8**	**9**	**1.50**	**OK**	5
5	9.42	39.6	1.6956	1.2	6	1.50	**OK**	**1.5**	**7.5**	**1.50**	**OK**	5
4	9.15	30.18	1.647	0.9	4.5	1.05	**OK**	**1.2**	**6**	**1.50**	**OK**	5
3	9.15	21.03	1.647	0.69	3.45	1.45	**OK**	**0.9**	**4.5**	**1.50**	**OK**	5
2	11.88	11.88	2.1384	0.4	2	0.00	**OK**	**0.6**	**3**	**0.00**	**OK**	5

Structural Depth Conclusions

After completing the structural depth of the proposed building it was found that the foundations would not need to be re-designed because they will not significantly change or reduce the cost of the overall structure. The columns for the proposed system are rolled W12 shapes ranging from W12X40 to W12X160. These columns were designed using a K factor of 1.0 being conservative. The columns are spliced and redesigned every 4 floors throughout the building. The hollow core planks were designed as 8” X 4’, 7 – ½ diameter strands with a 2” topping. These planks will be supported on the special D-Beams. The framing is typical all the way up the building until the main roof. The main roof uses conventional steel framing to support the planks due to the high live load of mechanical equipment.

The lateral system analysis concluded that the wind in the N-S direction controlled the base shear of the building as in the prior existing system and the seismic forces controlled the maximum moment. Due to the lateral loads, 20 chevron special concentric braced frames are required to satisfy the serviceability requirements. ETABS designed the brace frames for P-delta effects and also took in consideration torsion for the design of the frames.

Overall this system is acceptable for gravity and lateral loads and is completely compatible with the proposed architectural floor plans discussed earlier in this report. A cost analysis of each structure is required in order to conclude which system is actually cheaper.

Construction Breadth

The purpose of this thesis project is to determine whether or not an alternative structural system can be a more economical option for Wisconsin Place Residential. This building did not have many options to work with, due to the irregularity of the column layout and the height restrictions.

Cost Analysis

Since only the maximum budget was given for the existing building, actual material, labor, and equipment costs of the existing building structure were not available. Therefore, a unit cost analysis was done for both the existing structure and the proposed redesign structure using data from RS Means Construction Cost 2006. Takeoffs can be referenced in Appendices C & D. Please note that the unit prices in the appendix and total costs listed in tables below are before overhead and profit and are multiplied by the city cost index numbers of Baltimore, Maryland.

Scheduling

This entire report is centered on the fact that a prefabricated structure will save a significant amount of erection time. Therefore it is critical to be able to determine the actual construction time of the existing building vs. the proposed redesign.

As in the cost analysis, original scheduling information was not available. Similar estimation methods as described in the cost analysis were used. Reasonable assumptions were made as to the number of crews that could be used to complete a given task. Photographs of the building were used to compare actual duration of the project to the estimated projection. Please refer to Appendices E & F for more detailed information.

Existing Structure

Description	Crew	Daily Output	Lab Hrs	Unit	Mat	Lab	EQ	Total /Unit	Adjustment	Total	Adjusted Total
Column Form	C1	235	0.136	S.F.C.A.	0.73	4.56	0	5.29	0.786	544,461	427,946
Slab Forms	C2	560	0.086	S.F.	1.4	2.96	0	4.36	0.786	2,178,561	1,712,349
Shear Wall Forms	C2	395	0.122	S.F.C.A.	0.7	4.2	0	4.9	0.786	163,318	128367.948
Column Reinforcement	4Rodm	5400	0.006	lbs	0.44	0.23	0	0.67	0.906	296,727	268,835
Slab Reinforcement	4Rodm	5800	0.006	lbs	0.47	0.22	0	0.69	0.906	89,276	80,884
PT Strands	C3	1200	0.053	lbs	1.44	1.93	0.09	3.46	0.906	514,640	466,264
Shear Wall Reinforcement	4Rodm	8000	0.004	lbs	0.44	0.16	0	0.6	0.906	79,118	71,681
Spread Footings F.W, Concrete, Reinforcing	C-14C	38.07	2.942	C.Y.	175	99.5	0.56	275.06	0.903	349,142	315,275
Concrete for Columns	0	0	0	C.Y.	100	11.55	4.32	115.87	0.908	220,846	200,528
Concrete for Slab	0	0	0	C.Y.	100	11.55	4.32	115.87	0.908	1,340,203	1,216,904
Concrete for Shear Walls	0	0	0	C.Y.	100	11.55	4.32	115.87	0.908	68,488	62,187
Machine Trowel Finishing	1Cefi	550	0.15	S.F.	0	0.5	0	0.5	0.908	249,835	226,850
Shoring/Reshoring	C17D	1400	0.011	S.F.	0.42	0.41	0	0.83	0.786	414,726	325,975
Concrete Placement for Columns	C20	92	0.696	C.Y.	0	20.5	8.1	28.6	0.908	54,511	49,496
Concrete Placement for Slabs	C20	160	0.4	C.Y.	0	11.9	4.65	16.55	0.908	191,425	173,814
Concrete Placement for Shear Walls	C20	110	0.582	C.Y.	0	17.25	6.75	24	0.908	14,186	12,881
TOTAL											**5,740,237**
										Cost/S.F	11.48

Formwork %	39.52
Concrete %	25.78
Rebar %	15.46
Placement and Finishes %	8.07
Shoring and Reshoring	5.68
Total Footing %	5.49
Totals	100.00

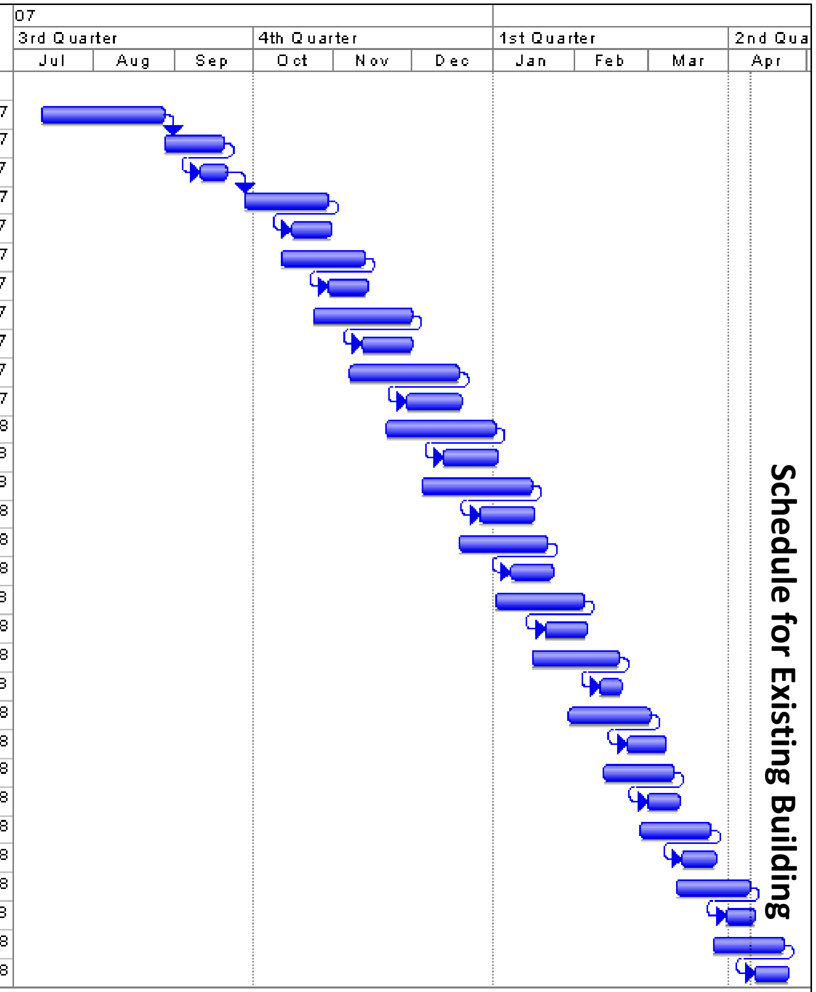
Proposed Structure

Description	Crew	Daily Output	Lab Hrs	Unit	Mat	Lab	EQ	Total /Unit	Adjustment	Total	Adjusted Total
Formwork for Edge of Topping	C1	500.0	0.064	L.F.	0.190	2.140	0.000	2.330	0.786	40,001.0	31,441
Hollowcore 8" Planks	C11	3,200.0	0.023	S.F.	5.750	0.880	0.480	7.110	0.903	3,923,689.0	3,543,091
Finishing of the Topping	1Cefi	900.0	0.009	S.F.	0.000	0.310	0.000	0.310	0.908	171,075.0	155,336
Concrete Topping	0.0	0.0	0.000	C.Y.	100.000	11.550	4.320	115.870	0.908	395,502.0	359,116
Averaged W-Shapes for Columns	E-2	972.0	0.058	L.F.	91.000	2.210	1.450	94.660	1.005	1,033,650.0	1,038,818
D-Beams	0.0	0.0	0.000	lbs	1.250	0.000	0.000	1.250	1.005	1,533,490.0	1,541,157
D-Beam Erection	E-2	972.0	0.058	L.F.	0.000	2.250	1.470	3.720	1.005	101,035.0	101,540
W-Shapes for Girders and Beams	E-2	984.0	0.057	L.F.	77.500	2.210	1.450	81.160	1.005	348,176.0	349,917
Braces in Frames	E-2	1,080.0	0.052	L.F.	32.500	2.020	1.320	35.840	1.005	368,794.0	370,638
Fireproofing for Roof Beams	G-2	1,500.0	0.016	S.F.	0.430	0.470	0.080	0.980	0.904	28,267.0	25,553
Spread Footings F.W, Concrete, Reinforcing	C-14C	38.1	2.942	C.Y.	175.000	99.500	0.560	275.060	0.903	399,020.0	360,315
TOTAL											**7,876,923**
										Cost/S.F.	14.27

Floor Assembly (Plank, Toping)	49.5
Steel Framing D-Beam, Girders, Beams	41.9
Erection and Finishing Costs	3.3
Total Foundation %	4.6
Formwork & Fire Proofing	0.7
Totals	100.0

Schedule for Existing Building

ID	Task Name	Duration	Start	Finish
1				
2	Form/Place Footings	33 days	Thu 7/12/07	Mon 8/27/07
3	Form/Pour 2nd Floor Slabs/Columns/S.W.	17 days	Tue 8/28/07	Wed 9/19/07
4	Stress/Strip/Reshore 2nd Floor	8 days	Tue 9/11/07	Thu 9/20/07
5	Form/Pour 3rd Floor Slabs/Columns/S.W.	22 days	Fri 9/28/07	Mon 10/29/07
6	Stress/Strip/Reshore 3rd Floor	11 days	Tue 10/16/07	Tue 10/30/07
7	Form/Pour 4th Floor Slabs/Columns/S.W.	22 days	Fri 10/12/07	Mon 11/12/07
8	Stress/Strip/Reshore 4th Floor	11 days	Tue 10/30/07	Tue 11/13/07
9	Form/Pour 5th Floor Slabs/Columns/S.W.	28 days	Wed 10/24/07	Fri 11/30/07
10	Stress/Strip/Reshore 5th Floor	15 days	Mon 11/12/07	Fri 11/30/07
11	Form/Pour 6th Floor Slabs/Columns/S.W.	30 days	Wed 11/7/07	Tue 12/18/07
12	Stress/Strip/Reshore 6th Floor	15 days	Thu 11/29/07	Wed 12/19/07
13	Form/Pour 7th Floor Slabs/Columns/S.W.	30 days	Wed 11/21/07	Tue 1/1/08
14	Stress/Strip/Reshore 7th Floor	15 days	Thu 12/13/07	Wed 1/2/08
15	Form/Pour 8th Floor Slabs/Columns/S.W.	30 days	Wed 12/5/07	Tue 1/15/08
16	Stress/Strip/Reshore 8th Floor	15 days	Thu 12/27/07	Wed 1/16/08
17	Form/Pour 9th Floor Slabs/Columns/S.W.	24 days	Wed 12/19/07	Mon 1/21/08
18	Stress/Strip/Reshore 9th Floor	12 days	Tue 1/8/08	Wed 1/23/08
19	Form/Pour 10th Floor Slabs/Columns/S.W.	24 days	Wed 1/2/08	Mon 2/4/08
20	Stress/Strip/Reshore 10th	12 days	Mon 1/21/08	Tue 2/5/08
21	Form/Pour 11th Floor Slabs/Columns/S.W.	24 days	Wed 1/16/08	Mon 2/18/08
22	Stress/Strip/Reshore 11th Floor	7 days	Mon 2/11/08	Tue 2/19/08
23	Form/Pour 12th Floor Slabs/Columns/S.W.	24 days	Wed 1/30/08	Sat 3/1/08
24	Stress/Strip/Reshore 12th Floor	12 days	Fri 2/22/08	Fri 3/7/08
25	Form/Pour 13th Floor Slabs/Columns/S.W.	20 days	Wed 2/13/08	Mon 3/10/08
26	Stress/Strip/Reshore 13th Floor	9 days	Sat 3/1/08	Wed 3/12/08
27	Form/Pour 14th Floor Slabs/Columns/S.W.	20 days	Wed 2/27/08	Mon 3/24/08
28	Stress/Strip/Reshore 14th Floor	9 days	Fri 3/14/08	Wed 3/26/08
29	Form/Pour 15th Floor Slabs/Columns/S.W.	20 days	Wed 3/12/08	Tue 4/8/08
30	Stress/Strip/Reshore 15th Floor	9 days	Mon 3/31/08	Thu 4/10/08
31	Form/Pour Roof Slab/Columns/S.W.	19 days	Wed 3/26/08	Mon 4/21/08
32	Stress/Strip/Reshore Roof	9 days	Fri 4/11/08	Wed 4/23/08



Project: Scheduling for Construction B
Date: Wed 4/9/08

Task | Split | Progress | Milestone | Summary | Project Summary | External Tasks | External Milestone | Deadline

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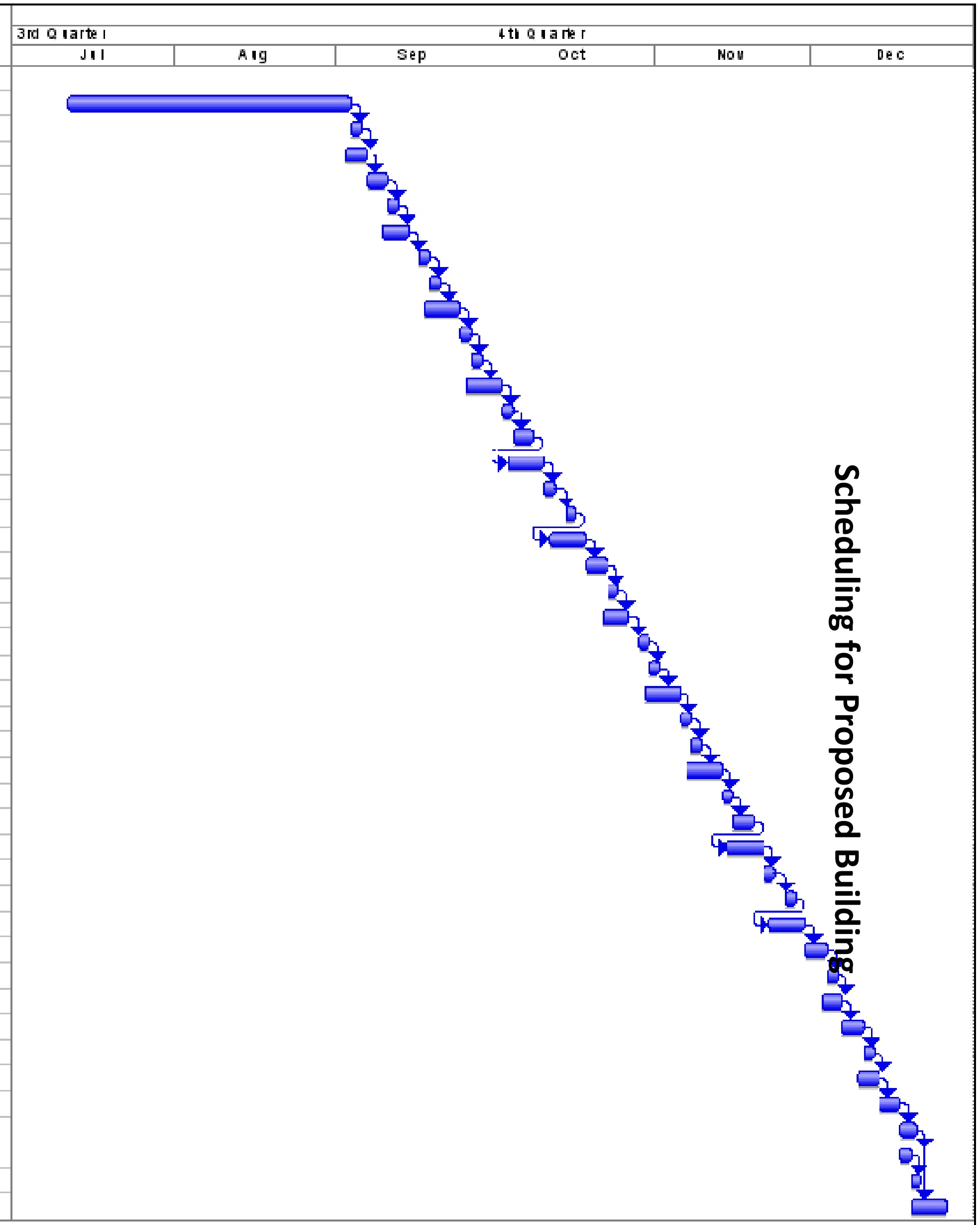
Scheduling for Proposed Building

ID		Task Name	Duration	Start	Finish	Predecessors
1						
2		Form/Place Footings	38 days	Thu 7/12/07	Mon 9/3/07	
3		Steel Framing of Floor 2	2 days	Tue 9/4/07	Wed 9/5/07	2
4		Erection of Planks	4 days	Mon 9/3/07	Thu 9/6/07	3FS-3 days
5		Form/Pour/Finish Topping	2 days	Fri 9/7/07	Mon 9/10/07	4
6		Steel Framing of Floor 3	2 days	Tue 9/11/07	Wed 9/12/07	5
7		Erection of Planks	5 days	Mon 9/10/07	Fri 9/14/07	6FS-3 days
8		Form/Pour/Finish Topping	2 days	Mon 9/17/07	Tue 9/18/07	7
9		Steel Framing of Floor 4	2 days	Wed 9/19/07	Thu 9/20/07	8
10		Erection of Planks	5 days	Tue 9/18/07	Mon 9/24/07	9FS-3 days
11		Form/Pour/Finish Topping	2 days	Tue 9/25/07	Wed 9/26/07	10
12		Steel Framing of Floor 5	2 days	Thu 9/27/07	Fri 9/28/07	11
13		Erection of Planks	5 days	Wed 9/26/07	Tue 10/2/07	12FS-3 days
14		Form/Pour/Finish Topping	2 days	Wed 10/3/07	Thu 10/4/07	13
15		Steel Framing of Floor 6	2 days	Fri 10/5/07	Mon 10/8/07	14
16		Erection of Planks	5 days	Thu 10/4/07	Wed 10/10/07	15FS-3 days
17		Form/Pour/Finish Topping	2 days	Thu 10/11/07	Fri 10/12/07	16
18		Steel Framing of Floor 7	2 days	Mon 10/15/07	Tue 10/16/07	17
19		Erection of Planks	5 days	Fri 10/12/07	Thu 10/18/07	18FS-3 days
20		Form/Pour/Finish Topping	2 days	Fri 10/19/07	Mon 10/22/07	19
21		Steel Framing of Floor 8	2 days	Tue 10/23/07	Wed 10/24/07	20
22		Erection of Planks	5 days	Mon 10/22/07	Fri 10/26/07	21FS-3 days
23		Form/Pour/Finish Topping	2 days	Mon 10/29/07	Tue 10/30/07	22
24		Steel Framing of Floor 9	2 days	Wed 10/31/07	Thu 11/1/07	23
25		Erection of Planks	5 days	Tue 10/30/07	Mon 11/5/07	24FS-3 days
26		Form/Pour/Finish Topping	2 days	Tue 11/6/07	Wed 11/7/07	25
27		Steel Framing of Floor 10	2 days	Thu 11/8/07	Fri 11/9/07	26
28		Erection of Planks	5 days	Wed 11/7/07	Tue 11/13/07	27FS-3 days
29		Form/Pour/Finish Topping	2 days	Wed 11/14/07	Thu 11/15/07	28
30		Steel Framing of Floor 11	2 days	Fri 11/16/07	Mon 11/19/07	29
31		Erection of Planks	5 days	Thu 11/15/07	Wed 11/21/07	30FS-3 days
32		Form/Pour/Finish Topping	2 days	Thu 11/22/07	Fri 11/23/07	31
33		Steel Framing of Floor 12	2 days	Mon 11/26/07	Tue 11/27/07	32
34		Erection of Planks	5 days	Fri 11/23/07	Thu 11/29/07	33FS-3 days
35		Form/Pour/Finish Topping	2 days	Fri 11/30/07	Mon 12/3/07	34
36		Steel Framing of Floor 13	2 days	Tue 12/4/07	Wed 12/5/07	35
37		Erection of Planks	4 days	Mon 12/3/07	Thu 12/6/07	36FS-3 days
38		Form/Pour/Finish Topping	2 days	Fri 12/7/07	Mon 12/10/07	37
39		Steel Framing of Floor 14	2 days	Tue 12/11/07	Wed 12/12/07	38
40		Erection of Planks	4 days	Mon 12/10/07	Thu 12/13/07	39FS-3 days
41		Form/Pour/Finish Topping	2 days	Fri 12/14/07	Mon 12/17/07	40
42		Steel Framing of Roof	3 days	Tue 12/18/07	Thu 12/20/07	41
43		Erection of Planks	2 days	Tue 12/18/07	Wed 12/19/07	42FS-3 days
44		Form/Pour/Finish Topping	2 days	Thu 12/20/07	Fri 12/21/07	43
45		Fire Proofing	5 days	Thu 12/20/07	Wed 12/26/07	42FS-3 days



Project: Scheduling for Construction B
Date: Wed 4/9/08

Task | Split | Progress | Milestone | Summary | Project Summary | External Tasks | External Milestone | Deadline

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Total Rent Generated/Month

Existing Building	# of Apartments	Total S.F.	Cost/S.F.	Total Rent
Floor				
15	22	25,373	1.50	38059.5
14	22	25,373	1.50	38059.5
13	22	25,373	1.50	38059.5
12	32	32,980	1.50	49470
11	32	32,980	1.50	49470
10	32	32,980	1.50	49470
9	32	32,974	1.50	49461
8	32	40,789	1.50	61183.5
7	40	40,789	1.50	61183.5
6	40	40,789	1.50	61183.5
5	40	40,789	1.50	61183.5
4	30	30,507	1.50	45760.5
3	30	30,510	1.50	45765
2	21	22,988	1.50	34482
1	5	19,103	1.50	28654.5
Total	432	474,297	1.50	711,446

New Building		Total S.F.	Cost/S.F.	Total Rent
Floor				
14	29	28,843	1.40	40380.2
13	29	28,843	1.40	40380.2
12	29	38,185	1.40	53459
11	38	38,185	1.40	53459
10	38	38,185	1.40	53459
9	38	38,179	1.40	53450.6
8	38	47,518	1.40	66525.2
7	47	47,518	1.40	66525.2
6	47	47,518	1.40	66525.2
5	47	47,518	1.40	66525.2
4	39	34,380	1.40	48132
3	39	34,368	1.40	48115.2
2	39	28,708	1.40	40191.2
1	5	25,064	1.40	35089.6
Total	502	523,012	1.40	732,217

New Building		Total S.F.	Cost/S.F.	Total Rent
Floor				
14	29	28,843	1.50	43264.5
13	29	28,843	1.50	43264.5
12	29	38,185	1.50	57277.5
11	38	38,185	1.50	57277.5
10	38	38,185	1.50	57277.5
9	38	38,179	1.50	57268.5
8	38	47,518	1.50	71277
7	47	47,518	1.50	71277
6	47	47,518	1.50	71277
5	47	47,518	1.50	71277
4	39	34,380	1.50	51570
3	39	34,368	1.50	51552
2	39	28,708	1.50	43062
1	5	25,064	1.50	37596
Total	502	523,012	1.50	784,518

New Building		Total S.F.	Cost/S.F.	Total Rent
Floor				
14	29	28,843	1.25	36053.75
13	29	28,843	1.25	36053.75
12	29	38,185	1.25	47731.25
11	38	38,185	1.25	47731.25
10	38	38,185	1.25	47731.25
9	38	38,179	1.25	47723.75
8	38	47,518	1.25	59397.5
7	47	47,518	1.25	59397.5
6	47	47,518	1.25	59397.5
5	47	47,518	1.25	59397.5
4	39	34,380	1.25	42975
3	39	34,368	1.25	42960
2	39	28,708	1.25	35885
1	5	25,064	1.25	31330
Total	502	523,012	1.25	653,765

Approximate Revenue from Rent	
At $1.40/S.F.	
4 months early	2,928,867
2 months early	1,464,434
At $1.50/S.F.	
4 months early	3,138,072
2 months early	1,569,036
At $1.25/S.F.	
4 months early	2,615,060
2 months early	1,307,530

Early Income for Faster Construction			
7,928,217	Total Expected Cost of New Structure	Total Cost of Existing Building	
	7928217.00	5,740,237	
At $1.40/S.F.		Saving	Extra Spending
4 months early	4999349.80	740,887	723,546
2 months early	6463783.40		
At $1.50/S.F.			
4 months early	4790145.00	950,092	618,944
2 months early	6359181.00		
At $1.25/S.F.			
4 months early	5313157.00	427,080	880,450
2 months early	6620687.00		

Construction Breadth Conclusions

After completing the cost analysis of the existing building vs. the proposed system it was found that the proposed girder-slab system is approximately 25% more expensive than the two-way flat plate post-tensioned system. This analysis took into consideration formwork, reinforcement, concrete placing and finishing, as well as shoring and re-shoring. The total cost of the existing system was found to be $5,740,237. 40% of the total cost was composed of formwork, 25% for concrete material, 16% for reinforcing, 8% for placement of the concrete, 6% for shoring, and 5% for the spread footings.

The proposed system total cost was estimated at $7,876,923. This analysis took into consideration the formwork for the 2” topping, the hollow core planks, the cost of placing/finishing the concrete, the steel framing i.e. all D-Beams and rolled W-shapes, fireproofing for the roof, and the spread footings. 50% of the total cost was for the floor assembly, 41% of the cost was steel framing, 3% was the erection, 5% for the spread footings and 1% was for formwork and fire protection.

Though the upfront cost of the proposed structural system is more expensive than the existing building, there is a great possibility that the structure will actually be cheaper based upon the fact that duration of construction is 4 months less. The fact that there is approximately 50,000 S.F. added to the existing structure in the proposed building will generate a significant amount of extra revenue over the life of the building.

A call made to Archstone-Smith confirmed that the approximate rate of an apartment in the Chevy Chase area is approximately $1.50/S.F. With that being said an expected amount of $711,446 can be expected each month from the tenants paying rent in the existing building. Due to the fact that the exterior architecture of the proposed building is lacking in aesthetics and the pool was removed from the 12th floor, I assumed potential scenarios for the cost of rent. The first scenario would be receiving the same $1.50/S.F, which would produce

$784,518 in revenue each month. The next scenario would be $1.40/S.F. that would produce $732,217. Last but not least, a worst case scenario of $1.25/S.F. was investigated and confirmed that there would be $653,765 generated.

In the above paragraph it was mentioned that the proposed building will be erected four months earlier than the existing building. I assumed that just because the structure topped out early, didn't necessarily mean that the building would be completed four months early. I chose 2 scenarios, both of which would still have the proposed building being built faster, which is a certainty. I investigated the total duration of the project ending four months early and also two months early for each S.F. estimate scenario mentioned in the paragraph above. It was concluded that if the rent of the proposed building was completed four months earlier for $1.40/S.F., the total savings of the building would total approximately $740,887. For two months early, the building will still cost more than the existing system by $723,546. For four months early, at 1.50/S.F. the proposed building will save approximately $950,000. If the building were completed two months early, the owner would spend an additional $619,000. The worst case scenario showed that if the building was completed four months earlier than the owner would save approximately $427,000. If the building was only completed 2 months earlier than an addition $880,450 would need to be spent. Since there is an uncertainty of which scenarios would actually occur, a source at girder-slab needed to be contacted. Dan Fisher Sr. Managing Partner of Girder-Slab Technologies replied to a post on the conference board of the CPEP website and stated that "…erection of steel and precast floor/roof slabs can be as fast as 8,000 S.F./day. If this is the case for the proposed building, then the structure would top out in approximately 13 weeks. When using RS Means, it was found that the duration of construction dealing with the structure be approximately 24 weeks, which is almost double that of what the girder-slab manufacturer stated. This provides enough information to make a reasonable assumption that the building will be completed at least four months in advance and an assumed rate of $1.40/S.F. will be maintained based upon the inside quality of the apartments and interior aesthetics. In conclusion using the girder-slab system should eliminate four months of erection time and during that period, the overall cost of the system will be countered by the revenue generated by the tenants paying rent. This is not taking into consideration the 70 extra apartments the building contains and the revenue generated over the life of the building.

Conclusion and Recommendation

After an extensive investigation of the existing building and proposed redesigned building, it was found that changing the current structural system of a two-way flat plate post-tensioned floor with shear walls to a precast-girder slab floor utilizing braced frames would save the owner approximately $750,000. This number is not including future revenue that will be generated due to the additional rent of 70 apartments throughout the life-time of the building and is neglecting the fact that the parking garage below the building may not integrate with the column layout. The proposed system will not only save the owner a great deal of money, but will also improve the overall architectural interior.

Acknowledgements

This thesis investigation would not have been possible without the help of many people. I would like to thank the following people for their technical, financial, and emotional support:

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- All industry professionals who helped myself and other students on the e-Studio discussion boards, for their technical assistance
- Fellow 5th year Architectural Engineering students, for help on numerous issues throughout my project

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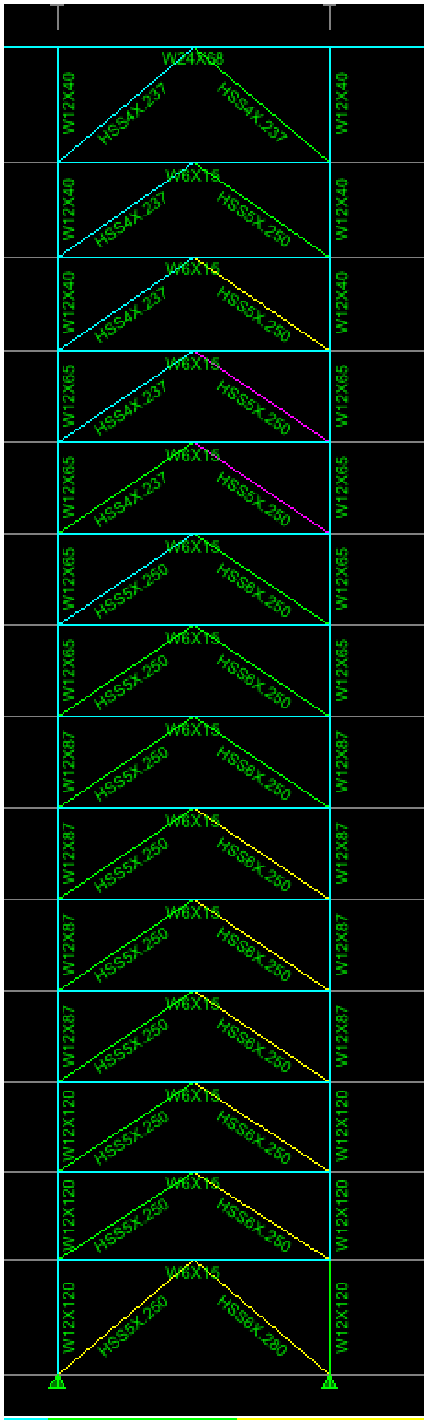
http://girder-slab.com

Appendix A

Braced Frame #1



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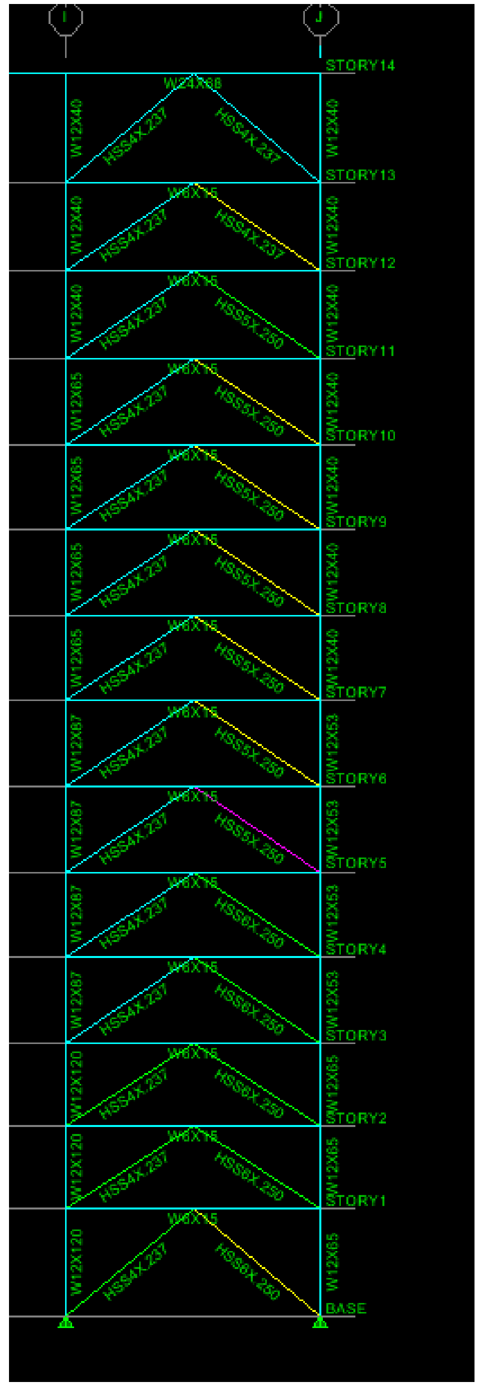

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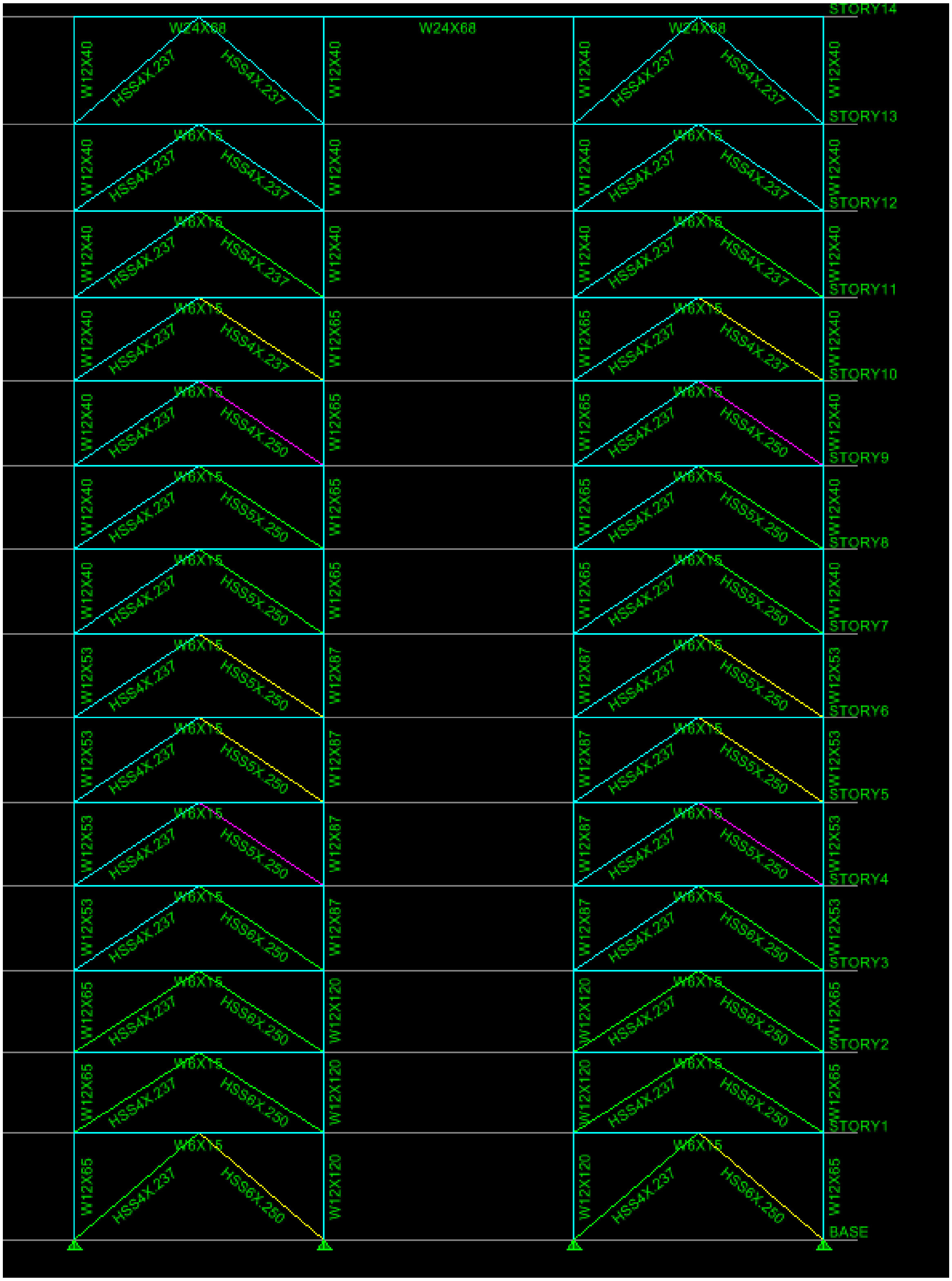
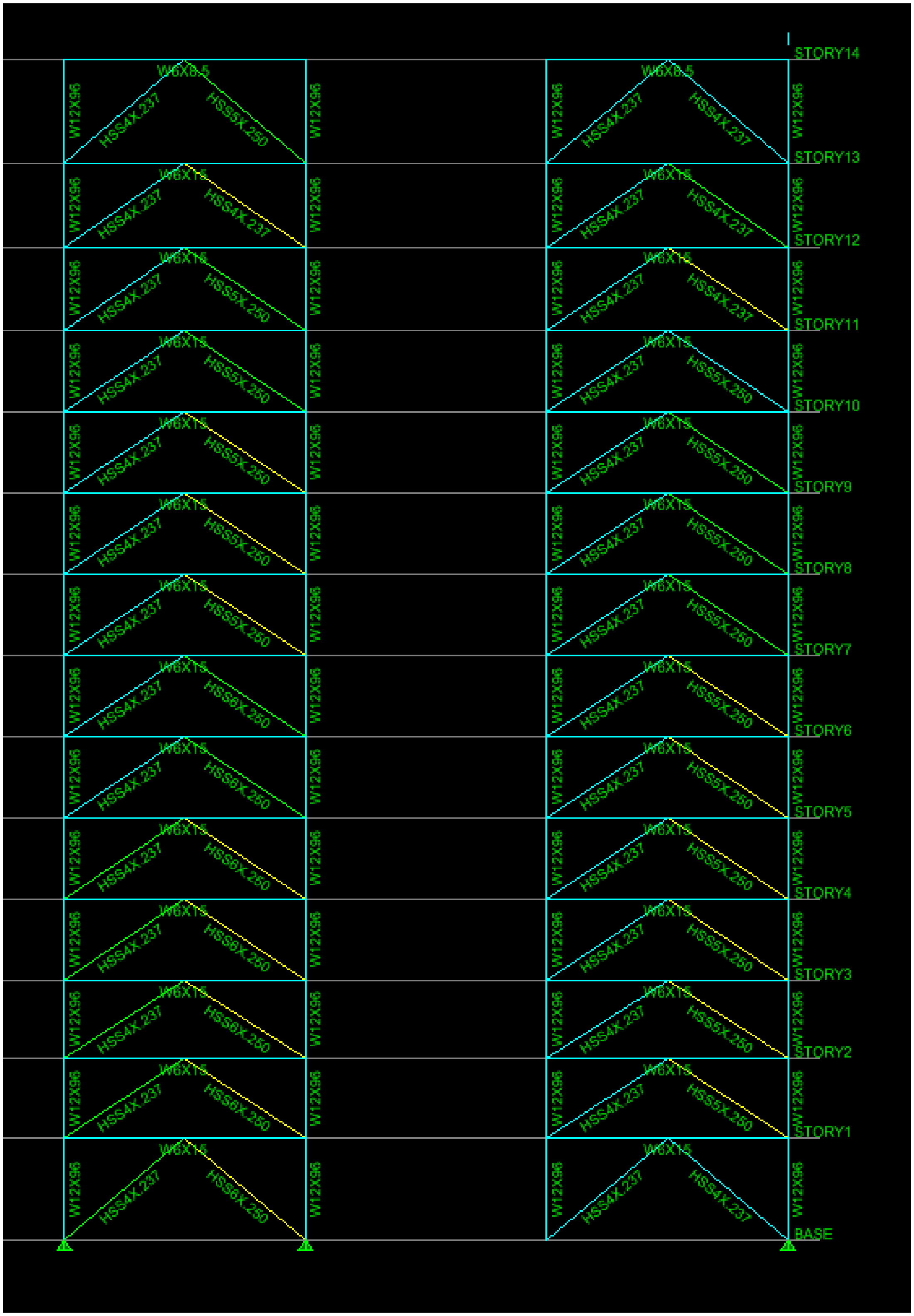


Braced Frame #5 Braced Frame #6



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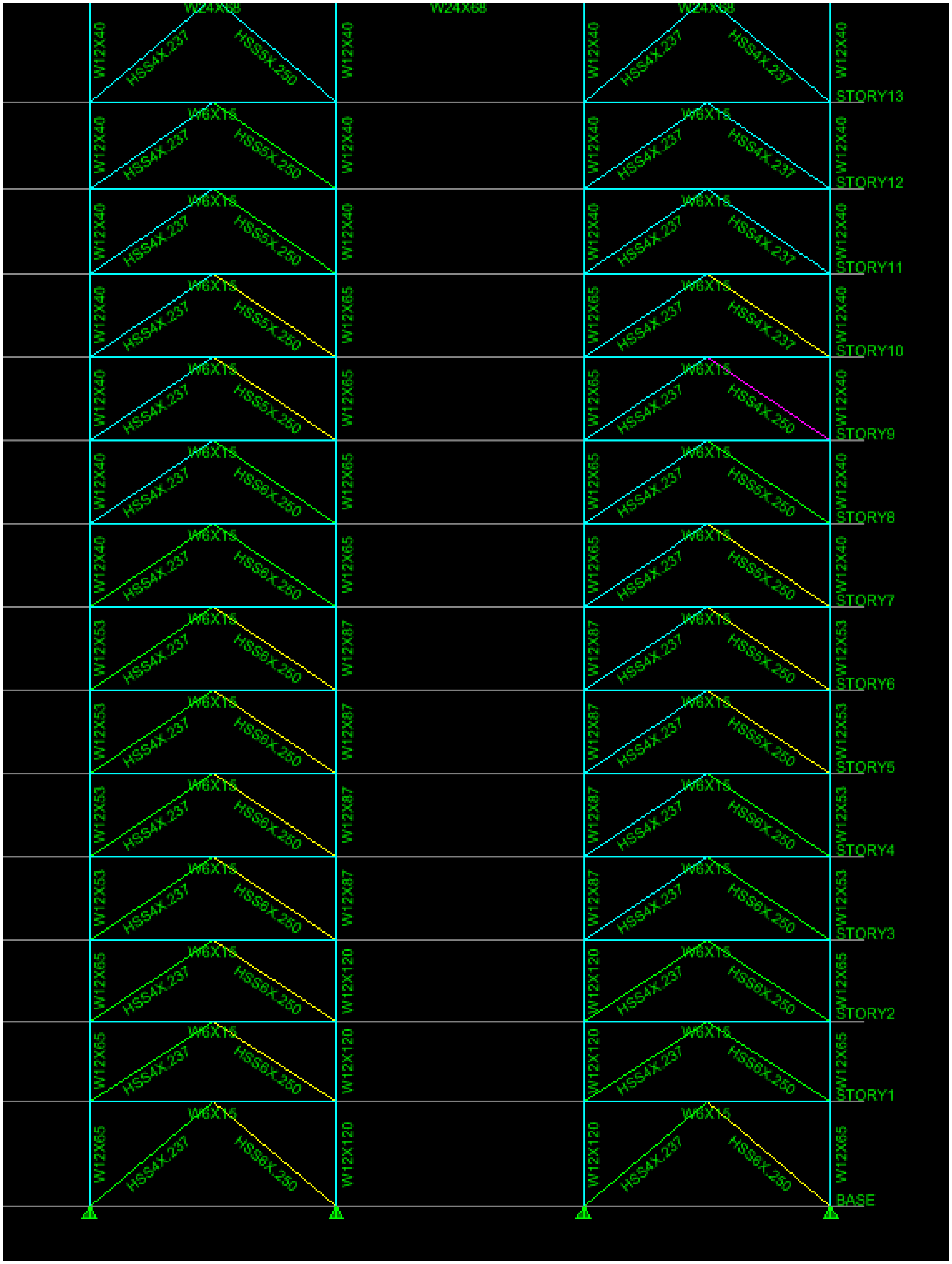

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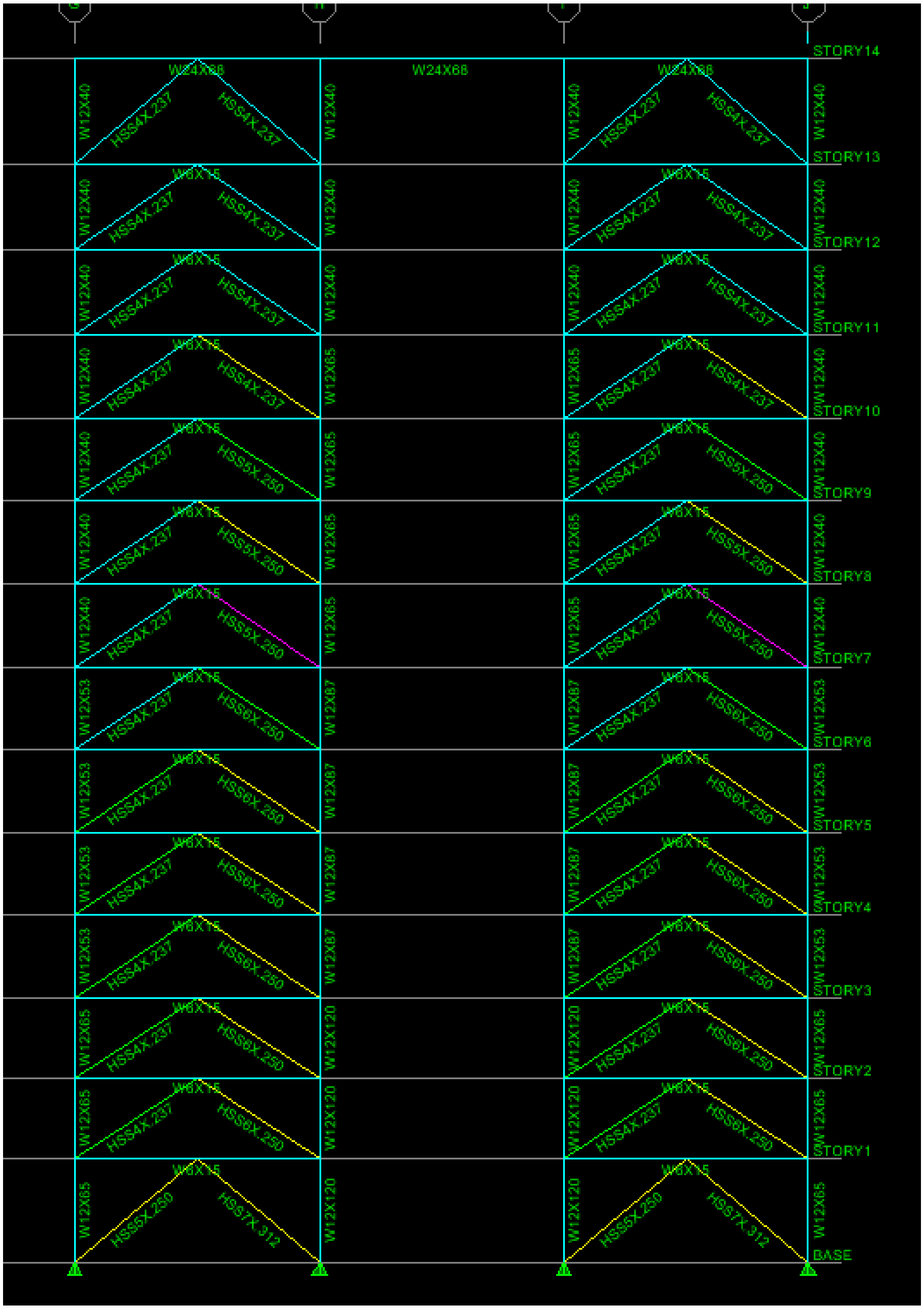

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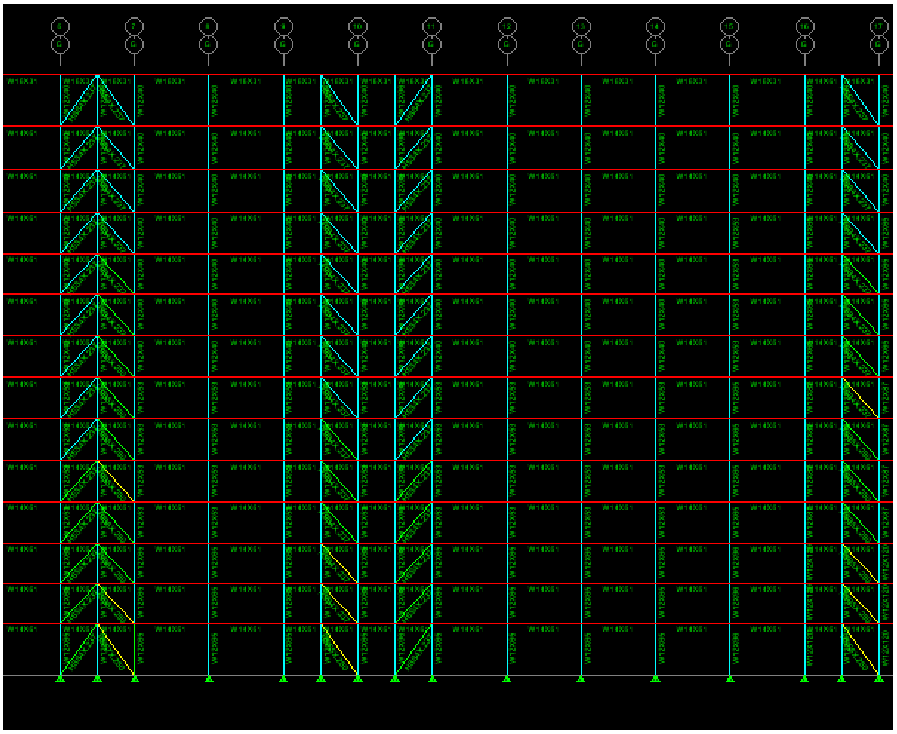

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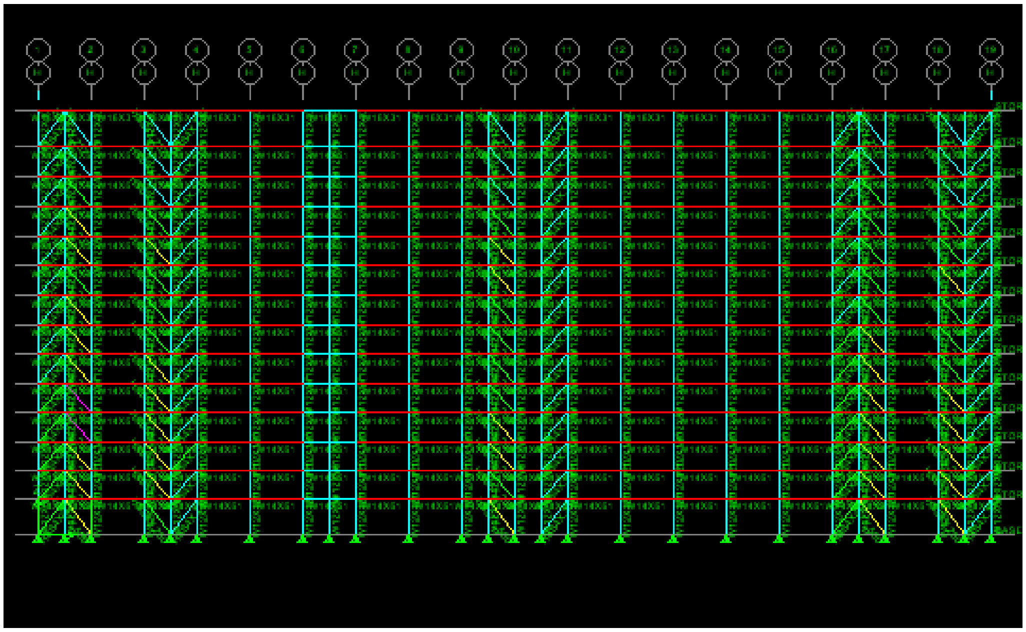
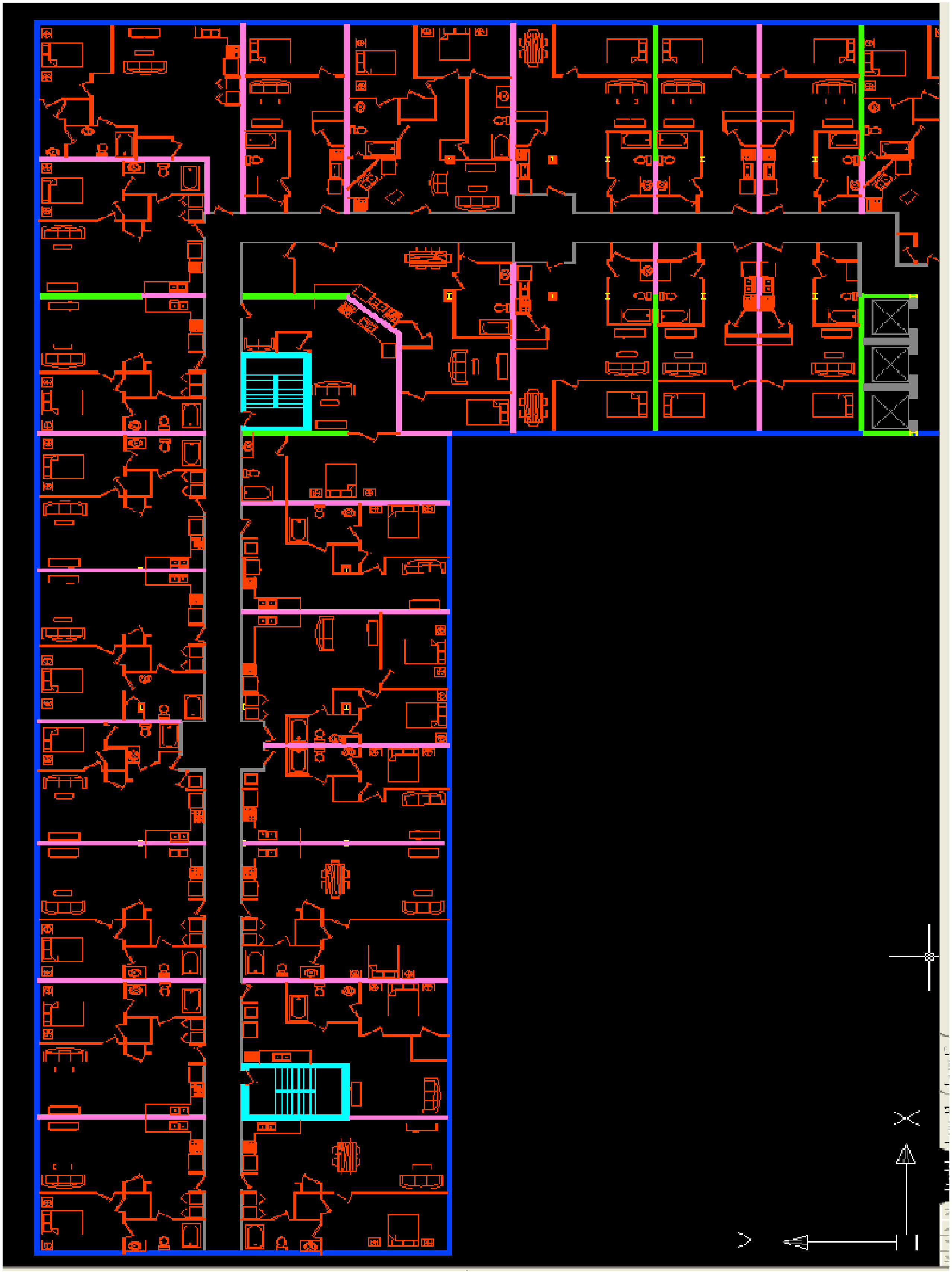
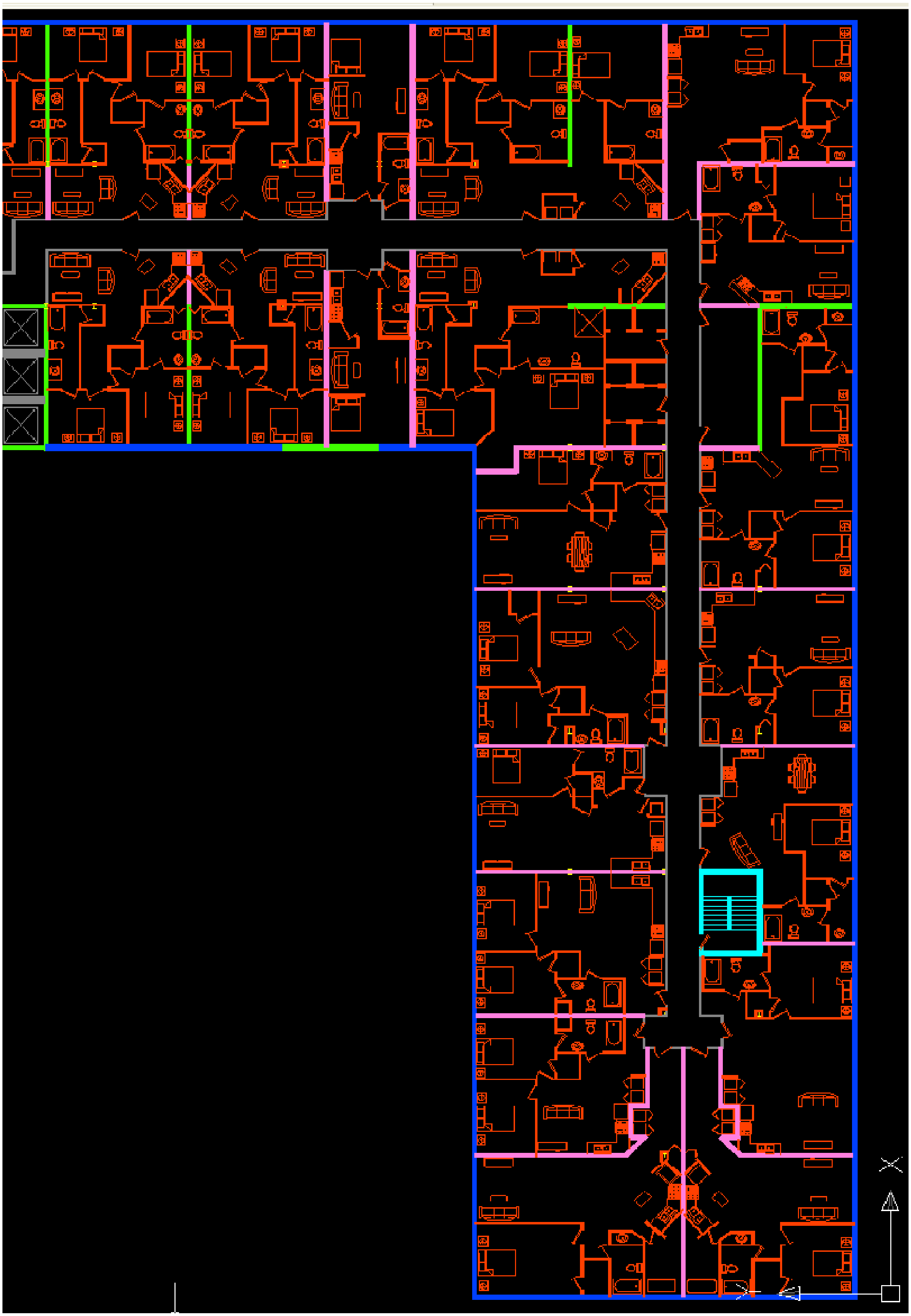


Appendix B





Appendix C

Slab Formwork			
Level			
	SQFT	Cost/S.F.	Total
Roof	25,373	4.36	110,626.3
15	25,373	4.36	110,626.3
14	25,373	4.36	110,626.3
13	25,373	4.36	110,626.3
12	32,980	4.36	143,792.8
11	32,980	4.36	143,792.8
10	32,980	4.36	143,792.8
9	32,974	4.36	143,766.6
8	40,789	4.36	177,840.0
7	40,789	4.36	177,840.0
6	40,789	4.36	177,840.0
5	40,789	4.36	177,840.0
4	30,507	4.36	133,010.5
3	30,510	4.36	133,023.6
2	22,988	4.36	100,227.7
1	19,103	4.36	83,289.1
	499,670.0		2,178,561.2

Column Reinforcement								
Level	# of Cols	Average Size of Bar	# of bars/column	length of bar	Weight/ft	Total Weight	Cost/lb	Total
Roof	76	10	8	9.9	4.303	25769.8064	0.67	17265.77029
15	95	10	8	9.5	4.303	31002.2544	0.67	20771.51045
14	95	10	8	9.5	4.303	31002.2544	0.67	20771.51045
13	95	10	8	9.2	4.303	30119.2788	0.67	20179.9168
12	95	10	8	9.2	4.303	30119.2788	0.67	20179.9168
11	95	10	8	9.2	4.303	30119.2788	0.67	20179.9168
10	95	10	8	9.2	4.303	30119.2788	0.67	20179.9168
9	95	10	8	9.2	4.303	30119.2788	0.67	20179.9168
8	119	10	8	9.2	4.303	37728.35976	0.67	25278.00104
7	119	10	8	9.2	4.303	37728.35976	0.67	25278.00104
6	119	10	8	9.2	4.303	37728.35976	0.67	25278.00104
5	87	10	8	9.2	4.303	27582.91848	0.67	18480.55538
4	71	10	8	8.9	4.303	21825.84872	0.67	14623.31864
3	71	10	8	8.9	4.303	21825.84872	0.67	14623.31864
2	50	10	8	11.7	4.303	20086.404	0.67	13457.89068
								296727.4616

Slab Reinforcement											
Level	Edge Bar Size	Bar Size Around Cols	# of edge	# of bars cols	length of edge bar	length of col bar	Weight/ft edge	Weight/ft col	Total Weight	Cost/lb	Total
Roof	4	6	1418	200	6	8	0.668	1.502	8086.544	0.69	5579.71536
15	4	6	1418	200	6	8	0.668	1.502	8086.544	0.69	5579.71536
14	4	6	1418	200	6	8	0.668	1.502	8086.544	0.69	5579.71536
13	4	6	1418	200	6	8	0.668	1.502	8086.544	0.69	5579.71536
12	4	6	1418	200	6	8	0.668	1.502	8086.544	0.69	5579.71536
11	4	6	1418	200	6	8	0.668	1.502	8086.544	0.69	5579.71536
10	4	6	1418	200	6	8	0.668	1.502	8086.544	0.69	5579.71536
9	4	6	1418	200	6	8	0.668	1.502	8086.544	0.69	5579.71536
8	4	6	1418	200	6	8	0.668	1.502	8086.544	0.69	5579.71536
7	4	6	1418	200	6	8	0.668	1.502	8086.544	0.69	5579.71536
6	4	6	1418	200	6	8	0.668	1.502	8086.544	0.69	5579.71536
5	4	6	1418	200	6	8	0.668	1.502	8086.544	0.69	5579.71536
4	4	6	1418	200	6	8	0.668	1.502	8086.544	0.69	5579.71536
3	4	6	1418	200	6	8	0.668	1.502	8086.544	0.69	5579.71536
2	4	6	1418	200	6	8	0.668	1.502	8086.544	0.69	5579.71536
1	4	6	1418	200	6	8	0.668	1.502	8086.544	0.69	5579.71536
											89275.44576

PT Strands						
Level	Average # of PT S	Average Length of Stra	Weight of Strand/ft	Total Weight	Cost/lb	Total
Roof	200	67	0.74	9916	3.46	34309.36
15	200	67	0.74	9916	3.46	34309.36
14	200	67	0.74	9916	3.46	34309.36
13	200	67	0.74	9916	3.46	34309.36
12	200	67	0.74	9916	3.46	34309.36
11	200	67	0.74	9916	3.46	34309.36
10	200	67	0.74	9916	3.46	34309.36
9	200	67	0.74	9916	3.46	34309.36
8	200	67	0.74	9916	3.46	34309.36
7	200	67	0.74	9916	3.46	34309.36
6	200	67	0.74	9916	3.46	34309.36
5	200	67	0.74	9916	3.46	34309.36
4	200	67	0.74	9916	3.46	34309.36
3	200	67	0.74	9916	3.46	34309.36
2	200	67	0.74	9916	3.46	34309.36
						514640.4

Foundations						
# of Footings	Average Size of F	Average Thickness of I	Cubic Yards	Total C.Y.	Cost/C.Y.	Total
119	12'X12'	24"	10.66666667	1269.333333	275.06	349142.8267

Concrete for Columns							
Level	# of Cols	hx	Average Size of Colum	Cubic Yards	Total C.Y.	Cost/C.Y.	Total
Roof	76.0	9.9	24"x24"	1.459259259	110.9037037	115.87	12,850.4
15	95.0	9.5	24"x24"	1.404444444	133.4222222	115.87	15,459.6
14	95.0	9.5	24"x24"	1.404444444	133.4222222	115.87	15,459.6
13	95.0	9.2	24"x24"	1.364444444	129.6222222	115.87	15,019.3
12	95.0	9.2	24"x24"	1.364444444	129.6222222	115.87	15,019.3
11	95.0	9.2	24"x24"	1.364444444	129.6222222	115.87	15,019.3
10	95.0	9.2	24"x24"	1.364444444	129.6222222	115.87	15,019.3
9	95.0	9.2	24"x24"	1.364444444	129.6222222	115.87	15,019.3
8	119.0	9.2	24"x24"	1.364444444	162.3688889	115.87	18,813.7
7	119.0	9.2	24"x24"	1.364444444	162.3688889	115.87	18,813.7
6	119.0	9.2	24"x24"	1.364444444	162.3688889	115.87	18,813.7
5	87.0	9.2	24"x24"	1.364444444	118.7066667	115.87	13,754.5
4	71.0	8.9	24"x24"	1.322962963	93.93037037	115.87	10,883.7
3	71.0	8.9	24"x24"	1.322962963	93.93037037	115.87	10,883.7
2	50.0	11.7	24"x24"	1.728888889	86.44444444	115.87	10,016.3
							220,845.6

Concrete for Slab					
Level	SqFt of Floor	Thickness of Floor	Total C.Y.	Cost/C.Y.	Total
		(ft)			
Roof	25,373	0.625	587.3	115.87	68,054.8
15	25,373	0.625	587.3	115.87	68,054.8
14	25,373	0.625	587.3	115.87	68,054.8
13	25,373	0.625	587.3	115.87	68,054.8
12	32,980	0.625	763.4	115.87	88,458.2
11	32,980	0.625	763.4	115.87	88,458.2
10	32,980	0.625	763.4	115.87	88,458.2
9	32,974	0.625	763.3	115.87	88,442.1
8	40,789	0.625	944.2	115.87	109,403.3
7	40,789	0.625	944.2	115.87	109,403.3
6	40,789	0.625	944.2	115.87	109,403.3
5	40,789	0.625	944.2	115.87	109,403.3
4	30,507	0.625	706.2	115.87	81,825.1
3	30,510	0.625	706.3	115.87	81,833.2
2	22,988	0.625	532.1	115.87	61,657.9
1	19,103	0.625	442.2	115.87	51,237.6
					1,340,202.8

Finishing			
Level	SqFt of Floor	Cost/S.F.	Total
Roof	25,373.0	0.5	12,686.5
15.0	25,373.0	0.5	12,686.5
14.0	25,373.0	0.5	12,686.5
13.0	25,373.0	0.5	12,686.5
12.0	32,980.0	0.5	16,490.0
11.0	32,980.0	0.5	16,490.0
10.0	32,980.0	0.5	16,490.0
9.0	32,974.0	0.5	16,487.0
8.0	40,789.0	0.5	20,394.5
7.0	40,789.0	0.5	20,394.5
6.0	40,789.0	0.5	20,394.5
5.0	40,789.0	0.5	20,394.5
4.0	30,507.0	0.5	15,253.5
3.0	30,510.0	0.5	15,255.0
2.0	22,988.0	0.5	11,494.0
1.0	19,103.0	0.5	9,551.5
			249,835.0

Shoring/Reshoring			
Level	SqFt of Floor	Cost/S.F.	Total
Roof	25,373.0	0.8	21,059.6
15.0	25,373.0	0.8	21,059.6
14.0	25,373.0	0.8	21,059.6
13.0	25,373.0	0.8	21,059.6
12.0	32,980.0	0.8	27,373.4
11.0	32,980.0	0.8	27,373.4
10.0	32,980.0	0.8	27,373.4
9.0	32,974.0	0.8	27,368.4
8.0	40,789.0	0.8	33,854.9
7.0	40,789.0	0.8	33,854.9
6.0	40,789.0	0.8	33,854.9
5.0	40,789.0	0.8	33,854.9
4.0	30,507.0	0.8	25,320.8
3.0	30,510.0	0.8	25,323.3
2.0	22,988.0	0.8	19,080.0
1.0	19,103.0	0.8	15,855.5
			414,726.1

Shear Walls Forming					
Level	hx	Perimeter of all Walls	S.F.C.A.	Cost/S.F.C.A.	Total
Roof	9.9	236	2324.6	4.9	11390.54
15.0	9.5	236	2237.28	4.9	10962.672
14.0	9.5	236	2237.28	4.9	10962.672
13.0	9.2	236	2173.56	4.9	10650.444
12.0	9.2	236	2173.56	4.9	10650.444
11.0	9.2	236	2173.56	4.9	10650.444
10.0	9.2	236	2173.56	4.9	10650.444
9.0	9.2	236	2173.56	4.9	10650.444
8.0	9.2	236	2173.56	4.9	10650.444
7.0	9.2	236	2173.56	4.9	10650.444
6.0	9.2	236	2173.56	4.9	10650.444
5.0	9.2	236	2173.56	4.9	10650.444
4.0	8.9	236	2107.48	4.9	10326.652
3.0	8.9	236	2107.48	4.9	10326.652
2.0	11.7	236	2754.12	4.9	13495.188
					163318.372

Shear Walls Concrete				
Level	hx	C.Y.	Cost/C.Y.	Total
Roof	9.9	41.22407407	115.87	4776.633463
15.0	9.5	39.67555556	115.87	4597.206622
14.0	9.5	39.67555556	115.87	4597.206622
13.0	9.2	38.54555556	115.87	4466.273522
12.0	9.2	38.54555556	115.87	4466.273522
11.0	9.2	38.54555556	115.87	4466.273522
10.0	9.2	38.54555556	115.87	4466.273522
9.0	9.2	38.54555556	115.87	4466.273522
8.0	9.2	38.54555556	115.87	4466.273522
7.0	9.2	38.54555556	115.87	4466.273522
6.0	9.2	38.54555556	115.87	4466.273522
5.0	9.2	38.54555556	115.87	4466.273522
4.0	8.9	37.3737037	115.87	4330.491048
3.0	8.9	37.3737037	115.87	4330.491048
2.0	11.7	48.84111111	115.87	5659.219544
				68487.71005

Shear Wall Reinforcement													
Level	hx	Bar Size	Bar Size	Wt/ft of bar	Wt/ft of bar	# of 8 Bars	# of 4 Bars	Weight of # 8Bars	Weight of # 4Bars	Horizontal Bar Weight	Total Weight	Cost/lb	Total
Roof	9.9	8	4	2.67	0.67	256	134	6732.672	884.333	1510	9127.005	0.6	5476.203
15.0	9.5	8	4	2.67	0.67	256	134	6479.7696	851.1144	1510	8840.884	0.6	5304.53
14.0	9.5	8	4	2.67	0.67	256	134	6479.7696	851.1144	1510	8840.884	0.6	5304.53
13.0	9.2	8	4	2.67	0.67	256	134	6295.2192	826.8738	1510	8632.093	0.6	5179.256
12.0	9.2	8	4	2.67	0.67	256	134	6295.2192	826.8738	1510	8632.093	0.6	5179.256
11.0	9.2	8	4	2.67	0.67	256	134	6295.2192	826.8738	1510	8632.093	0.6	5179.256
10.0	9.2	8	4	2.67	0.67	256	134	6295.2192	826.8738	1510	8632.093	0.6	5179.256
9.0	9.2	8	4	2.67	0.67	256	134	6295.2192	826.8738	1510	8632.093	0.6	5179.256
8.0	9.2	8	4	2.67	0.67	256	134	6295.2192	826.8738	1510	8632.093	0.6	5179.256
7.0	9.2	8	4	2.67	0.67	256	134	6295.2192	826.8738	1510	8632.093	0.6	5179.256
6.0	9.2	8	4	2.67	0.67	256	134	6295.2192	826.8738	1510	8632.093	0.6	5179.256
5.0	9.2	8	4	2.67	0.67	256	134	6295.2192	826.8738	1510	8632.093	0.6	5179.256
4.0	8.9	8	4	2.67	0.67	256	134	6103.8336	801.7354	1510	8415.569	0.6	5049.341
3.0	8.9	8	4	2.67	0.67	256	134	6103.8336	801.7354	1510	8415.569	0.6	5049.341
2.0	11.7	8	4	2.67	0.67	256	134	7976.6784	1047.7326	1510	10534.411	0.6	6320.647
													79117.9

Concrete for Slab					
Level	SqFt of Floor	Thickness of Floor	Total C.Y.	Cost/C.Y.	Total
		(ft)			
Roof	25,373	0.625	587.3	16.55	9,720.4
15	25,373	0.625	587.3	16.55	9,720.4
14	25,373	0.625	587.3	16.55	9,720.4
13	25,373	0.625	587.3	16.55	9,720.4
12	32,980	0.625	763.4	16.55	12,634.7
11	32,980	0.625	763.4	16.55	12,634.7
10	32,980	0.625	763.4	16.55	12,634.7
9	32,974	0.625	763.3	16.55	12,632.4
8	40,789	0.625	944.2	16.55	15,626.3
7	40,789	0.625	944.2	16.55	15,626.3
6	40,789	0.625	944.2	16.55	15,626.3
5	40,789	0.625	944.2	16.55	15,626.3
4	30,507	0.625	706.2	16.55	11,687.3
3	30,510	0.625	706.3	16.55	11,688.4
2	22,988	0.625	532.1	16.55	8,806.7
1	19,103	0.625	442.2	16.55	7,318.4
					191,424.5

Column Placement							
Level	# of Cols	hx	Average Size of Columr	Cubic Yards	Total C.Y.	Cost/C.Y.	Total
Roof	76.00	9.85	24"x24"	1.46	110.90	28.60	3,171.85
15.00	95.00	9.48	24"x24"	1.40	133.42	28.60	3,815.88
14.00	95.00	9.48	24"x24"	1.40	133.42	28.60	3,815.88
13.00	95.00	9.21	24"x24"	1.36	129.62	28.60	3,707.20
12.00	95.00	9.21	24"x24"	1.36	129.62	28.60	3,707.20
11.00	95.00	9.21	24"x24"	1.36	129.62	28.60	3,707.20
10.00	95.00	9.21	24"x24"	1.36	129.62	28.60	3,707.20
9.00	95.00	9.21	24"x24"	1.36	129.62	28.60	3,707.20
8.00	119.00	9.21	24"x24"	1.36	162.37	28.60	4,643.75
7.00	119.00	9.21	24"x24"	1.36	162.37	28.60	4,643.75
6.00	119.00	9.21	24"x24"	1.36	162.37	28.60	4,643.75
5.00	87.00	9.21	24"x24"	1.36	118.71	28.60	3,395.01
4.00	71.00	8.93	24"x24"	1.32	93.93	28.60	2,686.41
3.00	71.00	8.93	24"x24"	1.32	93.93	28.60	2,686.41
2.00	50.00	11.67	24"x24"	1.73	86.44	28.60	2,472.31
1.00							54,510.96

Shear Walls Concrete				
Level	hx	C.Y.	Cost/C.Y.	Total
Roof	9.85	41.22	24.00	989.38
15.00	9.48	39.68	24.00	952.21
14.00	9.48	39.68	24.00	952.21
13.00	9.21	38.55	24.00	925.09
12.00	9.21	38.55	24.00	925.09
11.00	9.21	38.55	24.00	925.09
10.00	9.21	38.55	24.00	925.09
9.00	9.21	38.55	24.00	925.09
8.00	9.21	38.55	24.00	925.09
7.00	9.21	38.55	24.00	925.09
6.00	9.21	38.55	24.00	925.09
5.00	9.21	38.55	24.00	925.09
4.00	8.93	37.37	24.00	896.97
3.00	8.93	37.37	24.00	896.97
2.00	11.67	48.84	24.00	1,172.19
				14,185.77

Appendix D

Columns From 1-2	Ht	# of Columns	Cost/Linear Ft	Total
W12X40	11	15	55.99	9238.35
W12X53	11	21	55.99	12933.69
W12X65	11	38	55.99	23403.82
W12X87	11	15	94.66	15618.9
W12X106	11	3	128.76	4249.08
W12X120	11	40	128.76	56654.4
				122098.2
Columns From 2-3	Ht	# of Columns	Cost/Linear Ft	Total
W12X40	8.5	15	55.99	7138.725
W12X53	8.5	21	55.99	9994.215
W12X65	8.5	38	55.99	18084.77
W12X87	8.5	15	94.66	12069.15
W12X106	8.5	3	128.76	3283.38
W12X120	8.5	40	128.76	43778.4
				94348.64
Columns From 3-4	Ht	# of Columns	Cost/Linear Ft	Total
W12X40	8.5	15	55.99	7138.725
W12X53	8.5	21	55.99	9994.215
W12X65	8.5	38	55.99	18084.77
W12X87	8.5	15	94.66	12069.15
W12X106	8.5	3	128.76	3283.38
W12X120	8.5	40	128.76	43778.4
				94348.64

Columns From 7-8	Ht	# of Columns	Cost/Linear Ft	Total
W12X40	9	42	55.99	21164.22
W12X45	9	2	55.99	1007.82
W12X53	9	32	55.99	16125.12
W12X65	9	15	55.99	7558.65
W12X79	9	3	94.66	2555.82
W12X87	9	40	94.66	34077.6
				82489.23
Columns From 8-9	Ht	# of Columns	Cost/Linear Ft	Total
W12X40	9	42	55.99	21164.22
W12X45	9	2	55.99	1007.82
W12X53	9	32	55.99	16125.12
W12X65	9	15	55.99	7558.65
W12X79	9	3	94.66	2555.82
W12X87	9	40	94.66	34077.6
				82489.23
Columns From 9-10	Ht	# of Columns	Cost/Linear Ft	Total
W12X40	9	66	55.99	33258.06
W12X53	9	5	55.99	2519.55
W12X65	9	40	55.99	20156.4
				55934.01

Columns From 10-11	Ht	# of Columns	Cost/Linear Ft	Total
W12X40	9	66	55.99	33258.06
W12X53	9	5	55.99	2519.55
W12X65	9	40	55.99	20156.4
				55934.01
Columns From 11-12	Ht	# of Columns	Cost/Linear Ft	Total
W12X40	9	66	55.99	33258.06
W12X53	9	5	55.99	2519.55
W12X65	9	40	55.99	20156.4
				55934.01
Columns From 12-13	Ht	# of Columns	Cost/Linear Ft	Total
W12X40	9	66	55.99	33258.06
W12X53	9	5	55.99	2519.55
W12X65	9	40	55.99	20156.4
				55934.01

Columns From 13-14	Ht	# of Columns	Cost/Linear Ft	Total
W12X40	9	86	55.99	43336.26
				43336.26
Columns From 14-Roof	Ht	# of Columns	Cost/Linear Ft	Total
W12X40	9	86	55.99	43336.26
				43336.26
Total Cost of Columns	**1,033,650.2**			

Supporting Floors 2-8					
D-Beams	Length	# of Beams	Weight of Beam	Cost/lb	Total
DB 9X46	17	120	45.8	1.25	116790
Total for Floors 2-8	**817,530**				
Supporting Floors 9-12					
D-Beams	Length	# of Beams	Weight of Beam	Cost/lb	Total
DB 9X46	17	100	45.8	1.25	97325
Total for Floors 9-12	**389,300**				
Supporting Floors 13-14					
D-Beams	Length	# of Beams	Weight of Beam	Cost/lb	Total
DB 9X46	17	80	45.8	1.25	77860
Total for Floors 13-14	**155,720**				
Balconies (All Stories)					
D-Beams	Length	# of Beams	Weight of Beam	Cost/lb	Total
DB 9X41	4	60	40.7	1.25	12210
Total for Floors 9-12	**170,940**				
Roof Beams and Girders	Length	# of Beams	Cost/Linear ft	Total	
W16X31	17	142	81.16	195920.2	
W24X68	28	67	81.16	152256.2	
Total Cost of B & G	**348,176**				
Total Cost of All Beams	**1,881,666**				

Hollow-core Planks			
Level	Sq.Ft.	Cost/Sq.Ft.	Total
Roof	28,843	7.11	205,074
14	28,843	7.11	205,074
13	28,843	7.11	205,074
12	38,185	7.11	271,495
11	38,185	7.11	271,495
10	38,185	7.11	271,495
9	38,179	7.11	271,453
8	47,518	7.11	337,853
7	47,518	7.11	337,853
6	47,518	7.11	337,853
5	47,518	7.11	337,853
4	34,380	7.11	244,442
3	34,368	7.11	244,356
2	28,708	7.11	204,114
1	25,064	7.11	178,205
			3,923,689

Finishing			
Level	**Sq.Ft.**	**Cost/Sq.Ft.**	**Total**
Roof	**28,843**	**0.31**	**8,941**
14	**28,843**	**0.31**	**8,941**
13	**28,843**	**0.31**	**8,941**
12	**38,185**	**0.31**	**11,837**
11	**38,185**	**0.31**	**11,837**
10	**38,185**	**0.31**	**11,837**
9	**38,179**	**0.31**	**11,835**
8	**47,518**	**0.31**	**14,731**
7	**47,518**	**0.31**	**14,731**
6	**47,518**	**0.31**	**14,731**
5	**47,518**	**0.31**	**14,731**
4	**34,380**	**0.31**	**10,658**
3	**34,368**	**0.31**	**10,654**
2	**28,708**	**0.31**	**8,899**
1	**25,064**	**0.31**	**7,770**
			171,075

Formwork			
Level	Perimeter	Cost/L.F.	Total
Roof	836.00	2.33	1947.88
14.00	836.00	2.33	1947.88
13.00	836.00	2.33	1947.88
12.00	1172.00	2.33	2730.76
11.00	1172.00	2.33	2730.76
10.00	1172.00	2.33	2730.76
9.00	1172.00	2.33	2730.76
8.00	1308.00	2.33	3047.64
7.00	1308.00	2.33	3047.64
6.00	1308.00	2.33	3047.64
5.00	1308.00	2.33	3047.64
4.00	1580.00	2.33	3681.40
3.00	1580.00	2.33	3681.40
2.00	1580.00	2.33	3681.40
			40001.44

Erection Costs					
Supporting Floors 2-8					
D-Beams	Length	# of Beams	Weight of Beam	Cost/ft	Total
DB 9X46	17	120	45.8	3.72	7588.8
Total for Floors 2-8	**53,122**				
Supporting Floors 9-12					
D-Beams	Length	# of Beams	Weight of Beam	Cost/ft	Total
DB 9X46	17	100	45.8	3.72	6324
Total for Floors 9-12	**25,296**				
Supporting Floors 13-14					
D-Beams	Length	# of Beams	Weight of Beam	Cost/ft	Total
DB 9X46	17	80	45.8	3.72	5059.2
Total for Floors 13-14	**10,118**				
Balconies (All Stories)					
D-Beams	Length	# of Beams	Weight of Beam	Cost/ft	Total
DB 9X41	4	60	40.7	3.72	892.8
Total for Floors 9-12	**12,499**				
Total Cost of Erection	**101,035**				

Concrete Topping					
Level	Sq.Ft.	Thickness of Flo	Total C.Y.	Cost/C.Y.	Total
		(ft)			
Roof	28,843	0.167	178.4	115.87	20,671.1
14	28,843	0.167	178.4	115.87	20,671.1
13	28,843	0.167	178.4	115.87	20,671.1
12	38,185	0.167	236.2	115.87	27,366.3
11	38,185	0.167	236.2	115.87	27,366.3
10	38,185	0.167	236.2	115.87	27,366.3
9	38,179	0.167	236.1	115.87	27,362.0
8	47,518	0.167	293.9	115.87	34,055.1
7	47,518	0.167	293.9	115.87	34,055.1
6	47,518	0.167	293.9	115.87	34,055.1
5	47,518	0.167	293.9	115.87	34,055.1
4	34,380	0.167	212.6	115.87	24,639.4
3	34,368	0.167	212.6	115.87	24,630.8
2	28,708	0.167	177.6	115.87	20,574.4
1	25,064	0.167	155.0	115.87	17,962.8
					395,502.0

Foundations						
# of Footings	Average Size	Average Thickn	Cubic Yards	Total C.Y.	Cost/C.Y.	Total
136	12'X12'	24"	10.66666667	1450.667	275.06	399020.4

Braced Frames			
	L.F.	Cost/L.F.	Total
W8X31 Smallest Size	10290	35.84	**368793.6**

Fire Protection			
	S.F.	Cost/S.F.	Total
Roof	28,843	0.98	28266.14

Appendix E

Column Formwork								
Level	# of Cols	width of form	# sides of form	hx	S.F.C.A.	S.F.C.A/day	# of Crews	Total Amount of Days
Roof	76.0	2.0	4.0	9.9	5,988.8	235.0	5.0	5
15	95.0	2.0	4.0	9.5	7,204.8	235.0	5.0	6
14	95.0	2.0	4.0	9.5	7,204.8	235.0	5.0	6
13	95.0	2.0	4.0	9.2	6,999.6	235.0	5.0	6
12	95.0	2.0	4.0	9.2	6,999.6	235.0	5.0	6
11	95.0	2.0	4.0	9.2	6,999.6	235.0	5.0	6
10	95.0	2.0	4.0	9.2	6,999.6	235.0	5.0	6
9	95.0	2.0	4.0	9.2	6,999.6	235.0	5.0	6
8	119.0	2.0	4.0	9.2	8,767.9	235.0	5.0	7
7	119.0	2.0	4.0	9.2	8,767.9	235.0	5.0	7
6	119.0	2.0	4.0	9.2	8,767.9	235.0	5.0	7
5	87.0	2.0	4.0	9.2	6,410.2	235.0	5.0	5
4	71.0	2.0	4.0	8.9	5,072.2	235.0	5.0	4
3	71.0	2.0	4.0	8.9	5,072.2	235.0	5.0	4
2	50.0	2.0	4.0	11.7	4,668.0	235.0	5.0	4
					102,922.8			

Slab Formwork				
Level				
	SQFT	S.F./day	# of Crews	Total Days
Roof	25,373	560	5.0	9
15	25,373	560	5.0	9
14	25,373	560	5.0	9
13	25,373	560	5.0	9
12	32,980	560	5.0	12
11	32,980	560	5.0	12
10	32,980	560	5.0	12
9	32,974	560	5.0	12
8	40,789	560	5.0	15
7	40,789	560	5.0	15
6	40,789	560	5.0	15
5	40,789	560	5.0	15
4	30,507	560	5.0	11
3	30,510	560	5.0	11
2	22,988	560	5.0	8
1	19,103	560	5.0	7

Shear Walls Forming						
Level	hx	Perimeter of all Walls	S.F.C.A.	S.F.C.A./day	# of Crews	Total Days
Roof	9.9	236	2324.6	395	5.0	1
15.0	9.5	236	2237.28	395	5.0	1
14.0	9.5	236	2237.28	395	5.0	1
13.0	9.2	236	2173.56	395	5.0	1
12.0	9.2	236	2173.56	395	5.0	1
11.0	9.2	236	2173.56	395	5.0	1
10.0	9.2	236	2173.56	395	5.0	1
9.0	9.2	236	2173.56	395	5.0	1
8.0	9.2	236	2173.56	395	5.0	1
7.0	9.2	236	2173.56	395	5.0	1
6.0	9.2	236	2173.56	395	5.0	1
5.0	9.2	236	2173.56	395	5.0	1
4.0	8.9	236	2107.48	395	5.0	1
3.0	8.9	236	2107.48	395	5.0	1
2.0	11.7	236	2754.12	395	5.0	1

Column Reinforcement									
Level	# of Cols	Average Size of Bar	# of bars/column	length of bar	Weight/ft	Total Weight	lb/day	# of Crews	Total Days
Roof	76	10	8	9.9	4.303	25769.8064	5400	2	2
15	95	10	8	9.5	4.303	31002.2544	5400	2	3
14	95	10	8	9.5	4.303	31002.2544	5400	2	3
13	95	10	8	9.2	4.303	30119.2788	5400	2	3
12	95	10	8	9.2	4.303	30119.2788	5400	2	3
11	95	10	8	9.2	4.303	30119.2788	5400	2	3
10	95	10	8	9.2	4.303	30119.2788	5400	2	3
9	95	10	8	9.2	4.303	30119.2788	5400	2	3
8	119	10	8	9.2	4.303	37728.35976	5400	2	3
7	119	10	8	9.2	4.303	37728.35976	5400	2	3
6	119	10	8	9.2	4.303	37728.35976	5400	2	3
5	87	10	8	9.2	4.303	27582.91848	5400	2	3
4	71	10	8	8.9	4.303	21825.84872	5400	2	2
3	71	10	8	8.9	4.303	21825.84872	5400	2	2
2	50	10	8	11.7	4.303	20086.404	5400	2	2

Slab Reinforcement												
Level	Edge Bar Size	Bar Size Around Cols	# of edge	# of bars cols	length of edg	length of col bar	Weight/ft edge	Weight/ft col	Total Weight	lb/day	# of Crews	Total Days
Roof	4	6	1418	200	6	8	0.668	1.502	8086.544	5800	1	1
15	4	6	1418	200	6	8	0.668	1.502	8086.544	5800	1	1
14	4	6	1418	200	6	8	0.668	1.502	8086.544	5800	1	1
13	4	6	1418	200	6	8	0.668	1.502	8086.544	5800	1	1
12	4	6	1418	200	6	8	0.668	1.502	8086.544	5800	1	1
11	4	6	1418	200	6	8	0.668	1.502	8086.544	5800	1	1
10	4	6	1418	200	6	8	0.668	1.502	8086.544	5800	1	1
9	4	6	1418	200	6	8	0.668	1.502	8086.544	5800	1	1
8	4	6	1418	200	6	8	0.668	1.502	8086.544	5800	1	1
7	4	6	1418	200	6	8	0.668	1.502	8086.544	5800	1	1
6	4	6	1418	200	6	8	0.668	1.502	8086.544	5800	1	1
5	4	6	1418	200	6	8	0.668	1.502	8086.544	5800	1	1
4	4	6	1418	200	6	8	0.668	1.502	8086.544	5800	1	1
3	4	6	1418	200	6	8	0.668	1.502	8086.544	5800	1	1
2	4	6	1418	200	6	8	0.668	1.502	8086.544	5800	1	1
1	4	6	1418	200	6	8	0.668	1.502	8086.544	5800		

PT Strands							
Level	Average # of PT Str	Average Length of Strand	Weight of Strand/ft	Total Weight	lb/day	# of Crews	Total Days
Roof	200	67	0.74	9916	1200	4	2
15	200	67	0.74	9916	1200	4	2
14	200	67	0.74	9916	1200	4	2
13	200	67	0.74	9916	1200	4	2
12	200	67	0.74	9916	1200	4	2
11	200	67	0.74	9916	1200	4	2
10	200	67	0.74	9916	1200	4	2
9	200	67	0.74	9916	1200	4	2
8	200	67	0.74	9916	1200	4	2
7	200	67	0.74	9916	1200	4	2
6	200	67	0.74	9916	1200	4	2
5	200	67	0.74	9916	1200	4	2
4	200	67	0.74	9916	1200	4	2
3	200	67	0.74	9916	1200	4	2
2	200	67	0.74	9916	1200	4	2

Foundations							
# of Footings	Average Size of Foo	Average Thickness of Footing	Cubic Yards	Total C.Y.	C.Y./day	# of Crews	Total Days
119	12'X12'	24"	10.66666667	1269.333333	38.07	1	33

Finishing				
Level	SqFt of Floor	S.F./day	# of Crews	Total Days
Roof	25,373.0	550.0	15	3
15.0	25,373.0	550.0	15	3
14.0	25,373.0	550.0	15	3
13.0	25,373.0	550.0	15	3
12.0	32,980.0	550.0	15	4
11.0	32,980.0	550.0	15	4
10.0	32,980.0	550.0	15	4
9.0	32,974.0	550.0	15	4
8.0	40,789.0	550.0	15	5
7.0	40,789.0	550.0	15	5
6.0	40,789.0	550.0	15	5
5.0	40,789.0	550.0	15	5
4.0	30,507.0	550.0	15	4
3.0	30,510.0	550.0	15	4
2.0	22,988.0	550.0	15	3
1.0	19,103.0	550.0	15	2

Shear Wall Reinforcement														
Level	hx	Bar Size	Bar Size	Wt/ft of bar	Wt/ft of bar	# of 8 Bars	# of 4 Bars	Weight of # 8Bars	Weight of # 4Bars	Horizontal Bar Weight	Total Weight	lb/day	# of Crews	Total Days
Roof	9.9	8	4	2.67	0.67	256	134	6732.672	884.333	1510	9127.005	8000	1	1
15.0	9.5	8	4	2.67	0.67	256	134	6479.7696	851.1144	1510	8840.884	8000	2	1
14.0	9.5	8	4	2.67	0.67	256	134	6479.7696	851.1144	1510	8840.884	8000	2	1
13.0	9.2	8	4	2.67	0.67	256	134	6295.2192	826.8738	1510	8632.093	8000	2	1
12.0	9.2	8	4	2.67	0.67	256	134	6295.2192	826.8738	1510	8632.093	8000	2	1
11.0	9.2	8	4	2.67	0.67	256	134	6295.2192	826.8738	1510	8632.093	8000	2	1
10.0	9.2	8	4	2.67	0.67	256	134	6295.2192	826.8738	1510	8632.093	8000	2	1
9.0	9.2	8	4	2.67	0.67	256	134	6295.2192	826.8738	1510	8632.093	8000	2	1
8.0	9.2	8	4	2.67	0.67	256	134	6295.2192	826.8738	1510	8632.093	8000	2	1
7.0	9.2	8	4	2.67	0.67	256	134	6295.2192	826.8738	1510	8632.093	8000	2	1
6.0	9.2	8	4	2.67	0.67	256	134	6295.2192	826.8738	1510	8632.093	8000	2	1
5.0	9.2	8	4	2.67	0.67	256	134	6295.2192	826.8738	1510	8632.093	8000	2	1
4.0	8.9	8	4	2.67	0.67	256	134	6103.8336	801.7354	1510	8415.569	8000	2	1
3.0	8.9	8	4	2.67	0.67	256	134	6103.8336	801.7354	1510	8415.569	8000	2	1
2.0	11.7	8	4	2.67	0.67	256	134	7976.6784	1047.7326	1510	10534.411	8000	2	1

Column Placement								
Level	# of Cols	hx	Average Size of Column	Cubic Yards	Total C.Y.	C.Y./day	# of Crews	Total Days
Roof	76.00	9.85	24"x24"	1.46	110.90	92.00	1	1
15.00	95.00	9.48	24"x24"	1.40	133.42	92.00	1	1
14.00	95.00	9.48	24"x24"	1.40	133.42	92.00	1	1
13.00	95.00	9.21	24"x24"	1.36	129.62	92.00	1	1
12.00	95.00	9.21	24"x24"	1.36	129.62	92.00	1	1
11.00	95.00	9.21	24"x24"	1.36	129.62	92.00	1	1
10.00	95.00	9.21	24"x24"	1.36	129.62	92.00	1	1
9.00	95.00	9.21	24"x24"	1.36	129.62	92.00	1	1
8.00	119.00	9.21	24"x24"	1.36	162.37	92.00	1	2
7.00	119.00	9.21	24"x24"	1.36	162.37	92.00	1	2
6.00	119.00	9.21	24"x24"	1.36	162.37	92.00	1	2
5.00	87.00	9.21	24"x24"	1.36	118.71	92.00	1	1
4.00	71.00	8.93	24"x24"	1.32	93.93	92.00	1	1
3.00	71.00	8.93	24"x24"	1.32	93.93	92.00	1	1
2.00	50.00	11.67	24"x24"	1.73	86.44	92.00	1	1

Placement for Slab						
Level	SqFt of Floor	Thickness of Floor	Total C.Y.	C.Y./day	# of Crews	Total Days
		(ft)				
Roof	25,373	0.625	587.3	160.00	1.5	2
15	25,373	0.625	587.3	160.00	1.5	2
14	25,373	0.625	587.3	160.00	1.5	2
13	25,373	0.625	587.3	160.00	1.5	2
12	32,980	0.625	763.4	160.00	1.5	3
11	32,980	0.625	763.4	160.00	1.5	3
10	32,980	0.625	763.4	160.00	1.5	3
9	32,974	0.625	763.3	160.00	1.5	3
8	40,789	0.625	944.2	160.00	1.5	4
7	40,789	0.625	944.2	160.00	1.5	4
6	40,789	0.625	944.2	160.00	1.5	4
5	40,789	0.625	944.2	160.00	1.5	4
4	30,507	0.625	706.2	160.00	1.5	3
3	30,510	0.625	706.3	160.00	1.5	3
2	22,988	0.625	532.1	160.00	1.5	2
1	19,103	0.625	442.2	160.00	1.5	2

Placement for S.W.					
Level	hx	C.Y.	Cy./day	# of Crews	Total Days
Roof	9.85	41.22	110.00	1	1
15.00	9.48	39.68	110.00	1	1
14.00	9.48	39.68	110.00	1	1
13.00	9.21	38.55	110.00	1	1
12.00	9.21	38.55	110.00	1	1
11.00	9.21	38.55	110.00	1	1
10.00	9.21	38.55	110.00	1	1
9.00	9.21	38.55	110.00	1	1
8.00	9.21	38.55	110.00	1	1
7.00	9.21	38.55	110.00	1	1
6.00	9.21	38.55	110.00	1	1
5.00	9.21	38.55	110.00	1	1
4.00	8.93	37.37	110.00	1	1
3.00	8.93	37.37	110.00	1	1
2.00	11.67	48.84	110.00	1	1

Shoring/Reshoring				
Level	SqFt of Floor	S.F/day	# of Crews	Total Days
Roof	25,373.0	1,400.0	2.0	9
15.0	25,373.0	1,400.0	2.0	9
14.0	25,373.0	1,400.0	2.0	9
13.0	25,373.0	1,400.0	2.0	9
12.0	32,980.0	1,400.0	2.0	12
11.0	32,980.0	1,400.0	2.0	12
10.0	32,980.0	1,400.0	2.0	12
9.0	32,974.0	1,400.0	2.0	12
8.0	40,789.0	1,400.0	2.0	15
7.0	40,789.0	1,400.0	2.0	15
6.0	40,789.0	1,400.0	2.0	15
5.0	40,789.0	1,400.0	2.0	15
4.0	30,507.0	1,400.0	2.0	11
3.0	30,510.0	1,400.0	2.0	11
2.0	22,988.0	1,400.0	2.0	8
1.0	19,103.0	1,400.0	2.0	7

Level	Total Days of Formwork/Pouring for Slabs/Cols/S.W.
Roof	19
15	20
14	20
13	20
12	24
11	24
10	24
9	24
8	30
7	30
6	30
5	28
4	22
3	22
2	17
Foundations	33

Level	Stress/Strip/Reshore
Roof	9
15	9
14	9
13	9
12	12
11	12
10	12
9	12
8	15
7	15
6	15
5	15
4	11
3	11
2	8

Appendix F

Columns From 4-5	Ht	# of Columns	Cost/Linear Ft	L.F./day	# of Crews	Total Days
W12X40	9	42	55.99	550	1	0.7
W12X45	9	2	55.99	550	1	0.0
W12X53	9	32	55.99	550	1	0.5
W12X65	9	15	55.99	550	1	0.2
W12X79	9	3	94.66	550	1	0.0
W12X87	9	40	94.66	550	1	0.7
						2.2
Columns From 5-6	Ht	# of Columns	Cost/Linear Ft	L.F./day	# of Crews	Total Days
W12X40	9	42	55.99	550	1	0.7
W12X45	9	2	55.99	550	1	0.0
W12X53	9	32	55.99	550	1	0.5
W12X65	9	15	55.99	550	1	0.2
W12X79	9	3	94.66	550	1	0.0
W12X87	9	40	94.66	550	1	0.7
						2.2
Columns From 6-7	Ht	# of Columns	Cost/Linear Ft	L.F./day	# of Crews	Total Days
W12X40	9	42	55.99	550	1	0.7
W12X45	9	2	55.99	550	1	0.0
W12X53	9	32	55.99	550	1	0.5
W12X65	9	15	55.99	550	1	0.2
W12X79	9	3	94.66	550	1	0.0
W12X87	9	40	94.66	550	1	0.7
						2.2
Columns From 7-8	Ht	# of Columns	Cost/Linear Ft	L.F./day	# of Crews	Total Days
W12X40	9	42	55.99	550	1	0.7
W12X45	9	2	55.99	550	1	0.0
W12X53	9	32	55.99	550	1	0.5
W12X65	9	15	55.99	550	1	0.2
W12X79	9	3	94.66	550	1	0.0
W12X87	9	40	94.66	550	1	0.7
						2.2
Columns From 8-9	Ht	# of Columns	Cost/Linear Ft	L.F./day	# of Crews	Total Days
W12X40	9	42	55.99	550	1	0.7
W12X45	9	2	55.99	550	1	0.0
W12X53	9	32	55.99	550	1	0.5
W12X65	9	15	55.99	550	1	0.2
W12X79	9	3	94.66	550	1	0.0
W12X87	9	40	94.66	550	1	0.7
						2.2

Columns From 9-10	Ht	# of Columns	Cost/Linear Ft	L.F./day	# of Crews	Total Days
W12X40	9	66	55.99	550	1	1.1
W12X53	9	5	55.99	550	1	0.1
W12X65	9	40	55.99	550	1	0.7
						1.8
Columns From 10-11	Ht	# of Columns	Cost/Linear Ft	L.F./day	# of Crews	Total Days
W12X40	9	66	55.99	550	1	1.1
W12X53	9	5	55.99	550	1	0.1
W12X65	9	40	55.99	550	1	0.7
						1.8
Columns From 11-12	Ht	# of Columns	Cost/Linear Ft	L.F./day	# of Crews	Total Days
W12X40	9	66	55.99	550	1	1.1
W12X53	9	5	55.99	550	1	0.1
W12X65	9	40	55.99	550	1	0.7
						1.8
Columns From 12-13	Ht	# of Columns	Cost/Linear Ft	L.F./day	# of Crews	Total Days
W12X40	9	66	55.99	550	1	1.1
W12X53	9	5	55.99	550	1	0.1
W12X65	9	40	55.99	550	1	0.7
						1.8
Columns From 13-14	Ht	# of Columns	Cost/Linear Ft	L.F./day	# of Crews	Total Days
W12X40	9	86	55.99	550	1	1.4
Columns From 14-Roof	Ht	# of Columns	Cost/Linear Ft	L.F./day	# of Crews	Total Days
W12X40	9	86	55.99	550	1	1.4

Supporting Floors 2-8						
D-Beams	Length	# of Beams	Weight of Beam	L.F./day	# of Crews	Total Days/Floor
DB 9X46	17	120	45.8	972	1	2.098765432
Supporting Floors 9-12						
D-Beams	Length	# of Beams	Weight of Beam	L.F./day	# of Crews	Total Days/Floor
DB 9X46	17	100	45.8	972	1	1.748971193
Supporting Floors 13-14						
D-Beams	Length	# of Beams	Weight of Beam	L.F./day	# of Crews	Total Days/Floor
DB 9X46	17	80	45.8	972	1	1.399176955
Balconies (All Stories)						
D-Beams	Length	# of Beams	Weight of Beam	L.F./day	# of Crews	Total Days/Floor
DB 9X41	4	60	40.7	972	1	0.24691358
Roof Beams and Girders	Length	# of Beams	L.F./day	# of Crews	Total Days/Floor	
W16X31	17	142	984	1	2.453252033	
W24X68	28	67	984	1	1.906504065	
					4.359756098	

Hollow-core Planks				
Level	Sq.Ft.	Sq.Ft./day	# of Crews	Total Days
Roof	28,843	3,200.00	2	4
14	28,843	3,200.00	2	4
13	28,843	3,200.00	2	4
12	38,185	3,200.00	2	4
11	38,185	3,200.00	2	5
10	38,185	3,200.00	2	5
9	38,179	3,200.00	2	5
8	47,518	3,200.00	2	5
7	47,518	3,200.00	2	5
6	47,518	3,200.00	2	5
5	47,518	3,200.00	2	5
4	34,380	3,200.00	2	5
3	34,368	3,200.00	2	5
2	28,708	3,200.00	2	5
1	25,064	3,200.00	2	

Formwork				
Level	Perimeter	L.F./day	# of Crews	Total Days
Roof	836.00	500.00	1.50	1.1
14.00	836.00	500.00	1.50	1.1
13.00	836.00	500.00	1.50	1.1
12.00	1172.00	500.00	1.50	1.6
11.00	1172.00	500.00	1.50	1.6
10.00	1172.00	500.00	1.50	1.6
9.00	1172.00	500.00	1.50	1.6
8.00	1308.00	500.00	1.50	1.7
7.00	1308.00	500.00	1.50	1.7
6.00	1308.00	500.00	1.50	1.7
5.00	1308.00	500.00	1.50	1.7
4.00	1580.00	500.00	1.50	2.1
3.00	1580.00	500.00	1.50	2.1
2.00	1580.00	500.00	1.50	2.1

Foundations							
# of Footings	Average Size of Foo	Average Thickness of Footing	Cubic Yards	Total C.Y.	C.Y./day	# of Crew	Total Days
136	12'X12'	24"	10.66666667	1450.666667	38.1	1	38

Concrete Topping						
Level	Sq.Ft.	Thickness of Floor	Total C.Y.	C.Y./Day	# of Crews	Total Days
		(ft)				
Roof	28,843	0.167	178.4	160	2.0	0.557497801
14	28,843	0.167	178.4	160	2.0	0.557497801
13	28,843	0.167	178.4	160	2.0	0.557497801
12	38,185	0.167	236.2	160	2.0	0.738066551
11	38,185	0.167	236.2	160	2.0	0.738066551
10	38,185	0.167	236.2	160	2.0	0.738066551
9	38,179	0.167	236.1	160	2.0	0.737950579
8	47,518	0.167	293.9	160	2.0	0.918461343
7	47,518	0.167	293.9	160	2.0	0.918461343
6	47,518	0.167	293.9	160	2.0	0.918461343
5	47,518	0.167	293.9	160	2.0	0.918461343
4	34,380	0.167	212.6	160	2.0	0.664520833
3	34,368	0.167	212.6	160	2.0	0.664288889
2	28,708	0.167	177.6	160	2.0	0.554888426
1	25,064	0.167	155.0	160	2.0	0.48445463

Braced Frames				
	L.F.	L.F./day	# of Crews	Total for Whole Building
W8X31 Smallest Size	10290	1080	1	10
Fire Protection				
	S.F.	S.F./day	# of Crews	
Roof	28,843	1500	4	5

Appendix G

A-1	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof	0	0	0	0	0
14	0	0	0	0	0
13				0	0
12				0	0
11				0	0
10				0	0
9				0	0
8	119	101.25	30	169.5	20170.5
7	119	121.25	37.5	205.5	24454.5
6	119	121.25	37.5	205.5	24454.5
5	119	121.25	37.5	205.5	24454.5
4	119	121.25	37.5	205.5	24454.5
3	119	121.25	37.5	205.5	24454.5
2	119	121.25	37.5	205.5	24454.5
SUM	0	0	0	0	166897.5

A-2	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof	0	0	0	0	0
14	0	0	0	0	0
13				0	0
12				0	0
11				0	0
10				0	0
9				0	0
8	238	101.25	30	169.5	40341
7	238	121.25	29.4	192.54	45824.52
6	238	121.25	29.4	192.54	45824.52
5	238	121.25	29.4	192.54	45824.52
4	238	121.25	29.4	192.54	45824.52
3	238	121.25	29.4	192.54	45824.52
2	238	121.25	29.4	192.54	45824.52
SUM	0	0	0	0	315288.1

A-3	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof		0	0	0	0
14	0	0	0	0	0
13				0	0
12				0	0
11				0	0
10				0	0
9				0	0
8	238	101.25	30	169.5	40341
7	238	121.25	29.4	192.54	45824.52
6	238	121.25	29.4	192.54	45824.52
5	238	121.25	29.4	192.54	45824.52
4	238	121.25	29.4	192.54	45824.52
3	238	121.25	29.4	192.54	45824.52
2	238	121.25	29.4	192.54	45824.52
SUM				0	315288.1

A-4	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof					
14	0	0	0	0	0
13				0	0
12				0	0
11				0	0
10				0	0
9				0	0
8	238	101.25	30	169.5	40341
7	238	121.25	29.4	192.54	45824.52
6	238	121.25	29.4	192.54	45824.52
5	238	121.25	29.4	192.54	45824.52
4	238	121.25	29.4	192.54	45824.52
3	238	121.25	29.4	192.54	45824.52
2	238	121.25	29.4	192.54	45824.52
SUM				0	315288.1

A-5	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof				0	0
14	0	0	0	0	0
13				0	0
12				0	0
11				0	0
10				0	0
9				0	0
8	119	101.25	30	169.5	20170.5
7	119	121.25	37.5	205.5	24454.5
6	119	121.25	37.5	205.5	24454.5
5	119	121.25	37.5	205.5	24454.5
4	119	121.25	37.5	205.5	24454.5
3	119	121.25	37.5	205.5	24454.5
2	119	121.25	37.5	205.5	24454.5
SUM				0	166897.5

A-15	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof				0	0
14	0	0	0	0	0
13				0	0
12	119	101.25	30	169.5	20170.5
11	119	121.25	37.5	205.5	24454.5
10	119	121.25	37.5	205.5	24454.5
9	119	121.25	37.5	205.5	24454.5
8	119	121.25	37.5	205.5	24454.5
7	119	121.25	37.5	205.5	24454.5
6	119	121.25	37.5	205.5	24454.5
5	119	121.25	37.5	205.5	24454.5
4	119	121.25	37.5	205.5	24454.5
3	119	121.25	37.5	205.5	24454.5
2	119	121.25	37.5	205.5	24454.5
SUM				0	264715.5

A-16	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof				0	0
14	0	0	0	0	0
13				0	0
12	238	101.25	30	169.5	40341
11	238	121.25	29.4	192.54	45824.52
10	238	121.25	29.4	192.54	45824.52
9	238	121.25	29.4	192.54	45824.52
8	238	121.25	29.4	192.54	45824.52
7	238	121.25	29.4	192.54	45824.52
6	238	121.25	29.4	192.54	45824.52
5	238	121.25	29.4	192.54	45824.52
4	238	121.25	29.4	192.54	45824.52
3	238	121.25	29.4	192.54	45824.52
2	238	121.25	29.4	192.54	45824.52
SUM				0	498586.2

A-17	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof				0	0
14	0	0	0	0	0
13				0	0
12	238	101.25	30	169.5	40341
11	238	121.25	29.4	192.54	45824.52
10	238	121.25	29.4	192.54	45824.52
9	238	121.25	29.4	192.54	45824.52
8	238	121.25	29.4	192.54	45824.52
7	238	121.25	29.4	192.54	45824.52
6	238	121.25	29.4	192.54	45824.52
5	238	121.25	29.4	192.54	45824.52
4	238	121.25	29.4	192.54	45824.52
3	238	121.25	29.4	192.54	45824.52
2	238	121.25	29.4	192.54	45824.52
SUM				0	498586.2

A-18	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof				0	0
14	0	0	0	0	0
13				0	0
12	238	101.25	30	169.5	40341
11	238	121.25	29.4	192.54	45824.52
10	238	121.25	29.4	192.54	45824.52
9	238	121.25	29.4	192.54	45824.52
8	238	121.25	29.4	192.54	45824.52
7	238	121.25	29.4	192.54	45824.52
6	238	121.25	29.4	192.54	45824.52
5	238	121.25	29.4	192.54	45824.52
4	238	121.25	29.4	192.54	45824.52
3	238	121.25	29.4	192.54	45824.52
2	238	121.25	29.4	192.54	45824.52
SUM				0	498586.2

A-19	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof				0	0
14	0	0	0	0	0
13				0	0
12	119	101.25	30	169.5	20170.5
11	119	121.25	37.5	205.5	24454.5
10	119	121.25	37.5	205.5	24454.5
9	119	121.25	37.5	205.5	24454.5
8	119	121.25	37.5	205.5	24454.5
7	119	121.25	37.5	205.5	24454.5
6	119	121.25	37.5	205.5	24454.5
5	119	121.25	37.5	205.5	24454.5
4	119	121.25	37.5	205.5	24454.5
3	119	121.25	37.5	205.5	24454.5
2	119	121.25	37.5	205.5	24454.5
SUM				0	264715.5

B-1	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof				0	0
14	0	0	0	0	0
13				0	0
12				0	0
11				0	0
10				0	0
9				0	0
8	238	101.25	30	169.5	40341
7	238	121.25	29.4	192.54	45824.52
6	238	121.25	29.4	192.54	45824.52
5	238	121.25	29.4	192.54	45824.52
4	238	121.25	29.4	192.54	45824.52
3	238	121.25	29.4	192.54	45824.52
2	238	121.25	29.4	192.54	45824.52
SUM				0	315288.1

B-2	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof				0	0
14	0	0	0	0	0
13				0	0
12				0	0
11				0	0
10				0	0
9				0	0
8	476	101.25	30	169.5	80682
7	476	121.25	23.75	183.5	87346
6	476	121.25	23.75	183.5	87346
5	476	121.25	23.75	183.5	87346
4	476	121.25	23.75	183.5	87346
3	476	121.25	23.75	183.5	87346
2	476	121.25	23.75	183.5	87346
SUM				0	604758

B-3	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof				0	0
14	0	0	0	0	0
13				0	0
12				0	0
11				0	0
10				0	0
9				0	0
8	476	101.25	30	169.5	80682
7	476	121.25	23.75	183.5	87346
6	476	121.25	23.75	183.5	87346
5	476	121.25	23.75	183.5	87346
4	476	121.25	23.75	183.5	87346
3	476	121.25	23.75	183.5	87346
2	476	121.25	23.75	183.5	87346
SUM				0	604758

B-4	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof				0	0
14	0	0	0	0	0
13				0	0
12				0	0
11				0	0
10				0	0
9				0	0
8	476	101.25	30	169.5	80682
7	476	121.25	23.75	183.5	87346
6	476	121.25	23.75	183.5	87346
5	476	121.25	23.75	183.5	87346
4	476	121.25	23.75	183.5	87346
3	476	121.25	23.75	183.5	87346
2	476	121.25	23.75	183.5	87346
SUM				0	604758

B-5	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof				0	0
14	0	0	0	0	0
13				0	0
12				0	0
11				0	0
10				0	0
9				0	0
8	238	101.25	30	169.5	40341
7	238	121.25	29.4	192.54	45824.52
6	238	121.25	29.4	192.54	45824.52
5	238	121.25	29.4	192.54	45824.52
4	238	121.25	29.4	192.54	45824.52
3	238	121.25	29.4	192.54	45824.52
2	238	121.25	29.4	192.54	45824.52
SUM				0	315288.1

B-15	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof				0	0
14	0	0	0	0	0
13				0	0
12	238	101.25	30	169.5	40341
11	238	121.25	29.4	192.54	45824.52
10	238	121.25	29.4	192.54	45824.52
9	238	121.25	29.4	192.54	45824.52
8	238	121.25	29.4	192.54	45824.52
7	238	121.25	29.4	192.54	45824.52
6	238	121.25	29.4	192.54	45824.52
5	238	121.25	29.4	192.54	45824.52
4	238	121.25	29.4	192.54	45824.52
3	238	121.25	29.4	192.54	45824.52
2	238	121.25	29.4	192.54	45824.52
SUM				0	498586.2

B-16	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof				0	0
14	0	0	0	0	0
13				0	0
12	476	101.25	30	169.5	80682
11	476	121.25	23.75	183.5	87346
10	476	121.25	23.75	183.5	87346
9	476	121.25	23.75	183.5	87346
8	476	121.25	23.75	183.5	87346
7	476	121.25	23.75	183.5	87346
6	476	121.25	23.75	183.5	87346
5	476	121.25	23.75	183.5	87346
4	476	121.25	23.75	183.5	87346
3	476	121.25	23.75	183.5	87346
2	476	121.25	23.75	183.5	87346
SUM				0	954142

B-17	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof				0	0
14	0	0	0	0	0
13				0	0
12	476	101.25	30	169.5	80682
11	476	121.25	23.75	183.5	87346
10	476	121.25	23.75	183.5	87346
9	476	121.25	23.75	183.5	87346
8	476	121.25	23.75	183.5	87346
7	476	121.25	23.75	183.5	87346
6	476	121.25	23.75	183.5	87346
5	476	121.25	23.75	183.5	87346
4	476	121.25	23.75	183.5	87346
3	476	121.25	23.75	183.5	87346
2	476	121.25	23.75	183.5	87346
SUM				0	954142

B-18	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof				0	0
14	0	0	0	0	0
13				0	0
12	476	101.25	30	169.5	80682
11	476	121.25	23.75	183.5	87346
10	476	121.25	23.75	183.5	87346
9	476	121.25	23.75	183.5	87346
8	476	121.25	23.75	183.5	87346
7	476	121.25	23.75	183.5	87346
6	476	121.25	23.75	183.5	87346
5	476	121.25	23.75	183.5	87346
4	476	121.25	23.75	183.5	87346
3	476	121.25	23.75	183.5	87346
2	476	121.25	23.75	183.5	87346
SUM				0	954142

B-19	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof				0	0
14	0	0	0	0	0
13				0	0
12	238	101.25	30	169.5	40341
11	238	121.25	29.4	192.54	45824.52
10	238	121.25	29.4	192.54	45824.52
9	238	121.25	29.4	192.54	45824.52
8	238	121.25	29.4	192.54	45824.52
7	238	121.25	29.4	192.54	45824.52
6	238	121.25	29.4	192.54	45824.52
5	238	121.25	29.4	192.54	45824.52
4	238	121.25	29.4	192.54	45824.52
3	238	121.25	29.4	192.54	45824.52
2	238	121.25	29.4	192.54	45824.52
SUM				0	498586.2

C-1	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof				0	0
14	0	0	0	0	0
13				0	0
12				0	0
11				0	0
10				0	0
9				0	0
8	238	101.25	30	169.5	40341
7	238	121.25	29.4	192.54	45824.52
6	238	121.25	29.4	192.54	45824.52
5	238	121.25	29.4	192.54	45824.52
4	119	121.25	37.5	205.5	24454.5
3	119	121.25	37.5	205.5	24454.5
2	119	121.25	37.5	205.5	24454.5
SUM				0	251178.1

C-2	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof				0	0
14	0	0	0	0	0
13				0	0
12				0	0
11				0	0
10				0	0
9				0	0
8	476	101.25	30	169.5	80682
7	476	121.25	23.75	183.5	87346
6	476	121.25	23.75	183.5	87346
5	476	121.25	23.75	183.5	87346
4	238	121.25	29.4	192.54	45824.52
3	238	121.25	29.4	192.54	45824.52
2	238	121.25	29.4	192.54	45824.52
SUM				0	480193.6

C-3	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof				0	0
14	0	0	0	0	0
13				0	0
12				0	0
11				0	0
10				0	0
9				0	0
8	476	101.25	30	169.5	80682
7	476	121.25	23.75	183.5	87346
6	476	121.25	23.75	183.5	87346
5	476	121.25	23.75	183.5	87346
4	238	121.25	29.4	192.54	45824.52
3	238	121.25	29.4	192.54	45824.52
2	238	121.25	29.4	192.54	45824.52
SUM				0	480193.6

C-4	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof				0	0
14	0	0	0	0	0
13				0	0
12				0	0
11				0	0
10				0	0
9				0	0
8	476	101.25	30	169.5	80682
7	476	121.25	23.75	183.5	87346
6	476	121.25	23.75	183.5	87346
5	476	121.25	23.75	183.5	87346
4	238	121.25	29.4	192.54	45824.52
3	238	121.25	29.4	192.54	45824.52
2	238	121.25	29.4	192.54	45824.52
SUM				0	480193.6

C-5	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof				0	0
14	0	0	0	0	0
13				0	0
12				0	0
11				0	0
10				0	0
9				0	0
8	238	101.25	30	169.5	40341
7	238	121.25	29.4	192.54	45824.52
6	238	121.25	29.4	192.54	45824.52
5	238	121.25	29.4	192.54	45824.52
4	119	121.25	37.5	205.5	24454.5
3	119	121.25	37.5	205.5	24454.5
2	119	121.25	37.5	205.5	24454.5
SUM				0	251178.1

C-15	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof				0	0
14	0	0	0	0	0
13				0	0
12	238	101.25	30	169.5	40341
11	238	121.25	29.4	192.54	45824.52
10	238	121.25	29.4	192.54	45824.52
9	238	121.25	29.4	192.54	45824.52
8	238	121.25	29.4	192.54	45824.52
7	238	121.25	29.4	192.54	45824.52
6	238	121.25	29.4	192.54	45824.52
5	238	121.25	29.4	192.54	45824.52
4	238	121.25	29.4	192.54	45824.52
3	238	121.25	29.4	192.54	45824.52
2	238	121.25	29.4	192.54	45824.52
SUM				0	498586.2

C-16	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof				0	0
14	0	0	0	0	0
13				0	0
12	476	101.25	30	169.5	80682
11	476	121.25	23.75	183.5	87346
10	476	121.25	23.75	183.5	87346
9	476	121.25	23.75	183.5	87346
8	476	121.25	23.75	183.5	87346
7	476	121.25	23.75	183.5	87346
6	476	121.25	23.75	183.5	87346
5	476	121.25	23.75	183.5	87346
4	476	121.25	23.75	183.5	87346
3	476	121.25	23.75	183.5	87346
2	476	121.25	23.75	183.5	87346
SUM				0	954142

C-17	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof				0	0
14	0	0	0	0	0
13				0	0
12	476	101.25	30	169.5	80682
11	476	121.25	23.75	183.5	87346
10	476	121.25	23.75	183.5	87346
9	476	121.25	23.75	183.5	87346
8	476	121.25	23.75	183.5	87346
7	476	121.25	23.75	183.5	87346
6	476	121.25	23.75	183.5	87346
5	476	121.25	23.75	183.5	87346
4	476	121.25	23.75	183.5	87346
3	476	121.25	23.75	183.5	87346
2	476	121.25	23.75	183.5	87346
SUM				0	954142

C-18	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof				0	0
14	0	0	0	0	0
13				0	0
12	476	101.25	30	169.5	80682
11	476	121.25	23.75	183.5	87346
10	476	121.25	23.75	183.5	87346
9	476	121.25	23.75	183.5	87346
8	476	121.25	23.75	183.5	87346
7	476	121.25	23.75	183.5	87346
6	476	121.25	23.75	183.5	87346
5	476	121.25	23.75	183.5	87346
4	476	121.25	23.75	183.5	87346
3	476	121.25	23.75	183.5	87346
2	476	121.25	23.75	183.5	87346
SUM				0	954142

C-19	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof				0	0
14	0	0	0	0	0
13				0	0
12	238	101.25	30	169.5	40341
11	238	121.25	29.4	192.54	45824.52
10	238	121.25	29.4	192.54	45824.52
9	238	121.25	29.4	192.54	45824.52
8	238	121.25	29.4	192.54	45824.52
7	238	121.25	29.4	192.54	45824.52
6	238	121.25	29.4	192.54	45824.52
5	238	121.25	29.4	192.54	45824.52
4	238	121.25	29.4	192.54	45824.52
3	238	121.25	29.4	192.54	45824.52
2	238	121.25	29.4	192.54	45824.52
SUM				0	498586.2

D-1	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof				0	0
14	0	0	0	0	0
13				0	0
12				0	0
11				0	0
10				0	0
9				0	0
8	238	101.25	30	169.5	40341
7	238	121.25	29.4	192.54	45824.52
6	238	121.25	29.4	192.54	45824.52
5	238	121.25	29.4	192.54	45824.52
4	119	121.25	37.5	205.5	24454.5
3	119	121.25	37.5	205.5	24454.5
2	119	121.25	37.5	205.5	24454.5
SUM				0	251178.1

D-2	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof				0	0
14	0	0	0	0	0
13				0	0
12				0	0
11				0	0
10				0	0
9				0	0
8	476	101.25	30	169.5	80682
7	476	121.25	23.75	183.5	87346
6	476	121.25	23.75	183.5	87346
5	476	121.25	23.75	183.5	87346
4	238	121.25	29.4	192.54	45824.52
3	238	121.25	29.4	192.54	45824.52
2	238	121.25	29.4	192.54	45824.52
SUM				0	480193.6

D-3	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof				0	0
14	0	0	0	0	0
13				0	0
12				0	0
11				0	0
10				0	0
9				0	0
8	476	101.25	30	169.5	80682
7	476	121.25	23.75	183.5	87346
6	476	121.25	23.75	183.5	87346
5	476	121.25	23.75	183.5	87346
4	238	121.25	29.4	192.54	45824.52
3	238	121.25	29.4	192.54	45824.52
2	238	121.25	29.4	192.54	45824.52
SUM				0	480193.6

D-4	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof				0	0
14	0	0	0	0	0
13				0	0
12				0	0
11				0	0
10				0	0
9				0	0
8	476	101.25	30	169.5	80682
7	476	121.25	23.75	183.5	87346
6	476	121.25	23.75	183.5	87346
5	476	121.25	23.75	183.5	87346
4	238	121.25	29.4	192.54	45824.52
3	238	121.25	29.4	192.54	45824.52
2	238	121.25	29.4	192.54	45824.52
SUM				0	480193.6

D-5	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof				0	0
14	0	0	0	0	0
13				0	0
12				0	0
11				0	0
10				0	0
9				0	0
8	238	101.25	30	169.5	40341
7	238	121.25	29.4	192.54	45824.52
6	238	121.25	29.4	192.54	45824.52
5	238	121.25	29.4	192.54	45824.52
4	119	121.25	37.5	205.5	24454.5
3	119	121.25	37.5	205.5	24454.5
2	119	121.25	37.5	205.5	24454.5
SUM				0	251178.1

D-15	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof				0	0
14	0	0	0	0	0
13				0	0
12	238	101.25	30	169.5	40341
11	238	121.25	29.4	192.54	45824.52
10	238	121.25	29.4	192.54	45824.52
9	238	121.25	29.4	192.54	45824.52
8	238	121.25	29.4	192.54	45824.52
7	238	121.25	29.4	192.54	45824.52
6	238	121.25	29.4	192.54	45824.52
5	238	121.25	29.4	192.54	45824.52
4	119	121.25	37.5	205.5	24454.5
3	119	121.25	37.5	205.5	24454.5
2	119	121.25	37.5	205.5	24454.5
SUM				0	434476.1

D-16	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof				0	0
14	0	0	0	0	0
13				0	0
12	476	101.25	30	169.5	80682
11	476	121.25	23.75	183.5	87346
10	476	121.25	23.75	183.5	87346
9	476	121.25	23.75	183.5	87346
8	476	121.25	23.75	183.5	87346
7	476	121.25	23.75	183.5	87346
6	476	121.25	23.75	183.5	87346
5	476	121.25	23.75	183.5	87346
4	238	121.25	29.4	192.54	45824.52
3	238	121.25	29.4	192.54	45824.52
2	238	121.25	29.4	192.54	45824.52
SUM				0	829577.6

D-17	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof				0	0
14	0	0	0	0	0
13				0	0
12	476	101.25	30	169.5	80682
11	476	121.25	23.75	183.5	87346
10	476	121.25	23.75	183.5	87346
9	476	121.25	23.75	183.5	87346
8	476	121.25	23.75	183.5	87346
7	476	121.25	23.75	183.5	87346
6	476	121.25	23.75	183.5	87346
5	476	121.25	23.75	183.5	87346
4	238	121.25	29.4	192.54	45824.52
3	238	121.25	29.4	192.54	45824.52
2	238	121.25	29.4	192.54	45824.52
SUM				0	829577.6

D-18	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof				0	0
14	0	0	0	0	0
13				0	0
12	476	101.25	30	169.5	80682
11	476	121.25	23.75	183.5	87346
10	476	121.25	23.75	183.5	87346
9	476	121.25	23.75	183.5	87346
8	476	121.25	23.75	183.5	87346
7	476	121.25	23.75	183.5	87346
6	476	121.25	23.75	183.5	87346
5	476	121.25	23.75	183.5	87346
4	238	121.25	29.4	192.54	45824.52
3	238	121.25	29.4	192.54	45824.52
2	238	121.25	29.4	192.54	45824.52
SUM				0	829577.6

D-19	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof				0	0
14	0	0	0	0	0
13				0	0
12	238	101.25	30	169.5	40341
11	238	121.25	29.4	192.54	45824.52
10	238	121.25	29.4	192.54	45824.52
9	238	121.25	29.4	192.54	45824.52
8	238	121.25	29.4	192.54	45824.52
7	238	121.25	29.4	192.54	45824.52
6	238	121.25	29.4	192.54	45824.52
5	238	121.25	29.4	192.54	45824.52
4	119	121.25	37.5	205.5	24454.5
3	119	121.25	37.5	205.5	24454.5
2	119	121.25	37.5	205.5	24454.5
SUM				0	434476.1

E-1	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof				0	0
14	0	0	0	0	0
13				0	0
12				0	0
11				0	0
10				0	0
9				0	0
8	238	101.25	30	169.5	40341
7	238	121.25	29.4	192.54	45824.52
6	238	121.25	29.4	192.54	45824.52
5	238	121.25	29.4	192.54	45824.52
4	238	121.25	29.4	192.54	45824.52
3	238	121.25	29.4	192.54	45824.52
2	238	121.25	29.4	192.54	45824.52
SUM				0	315288.1

E-2	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof				0	0
14	0	0	0	0	0
13				0	0
12				0	0
11				0	0
10				0	0
9				0	0
8	476	101.25	30	169.5	80682
7	476	121.25	23.75	183.5	87346
6	476	121.25	23.75	183.5	87346
5	476	121.25	23.75	183.5	87346
4	476	121.25	23.75	183.5	87346
3	476	121.25	23.75	183.5	87346
2	476	121.25	23.75	183.5	87346
SUM				0	604758

E-3	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof				0	0
14	0	0	0	0	0
13				0	0
12				0	0
11				0	0
10				0	0
9				0	0
8	476	101.25	30	169.5	80682
7	476	121.25	23.75	183.5	87346
6	476	121.25	23.75	183.5	87346
5	476	121.25	23.75	183.5	87346
4	476	121.25	23.75	183.5	87346
3	476	121.25	23.75	183.5	87346
2	476	121.25	23.75	183.5	87346
SUM				0	604758

E-4	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof				0	0
14	0	0	0	0	0
13				0	0
12				0	0
11				0	0
10				0	0
9				0	0
8	476	101.25	30	169.5	80682
7	476	121.25	23.75	183.5	87346
6	476	121.25	23.75	183.5	87346
5	476	121.25	23.75	183.5	87346
4	476	121.25	23.75	183.5	87346
3	476	121.25	23.75	183.5	87346
2	476	121.25	23.75	183.5	87346
SUM				0	604758

E-5	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof				0	0
14	0	0	0	0	0
13				0	0
12				0	0
11				0	0
10				0	0
9				0	0
8	238	101.25	30	169.5	40341
7	238	121.25	29.4	192.54	45824.52
6	238	121.25	29.4	192.54	45824.52
5	238	121.25	29.4	192.54	45824.52
4	238	121.25	29.4	192.54	45824.52
3	238	121.25	29.4	192.54	45824.52
2	238	121.25	29.4	192.54	45824.52
SUM				0	315288.1

E-15	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof				0	0
14	0	0	0	0	0
13				0	0
12	238	101.25	30	169.5	40341
11	238	121.25	29.4	192.54	45824.52
10	238	121.25	29.4	192.54	45824.52
9	238	121.25	29.4	192.54	45824.52
8	238	121.25	29.4	192.54	45824.52
7	238	121.25	29.4	192.54	45824.52
6	238	121.25	29.4	192.54	45824.52
5	119	121.25	37.5	205.5	24454.5
4	119	121.25	37.5	205.5	24454.5
3	119	121.25	37.5	205.5	24454.5
2	119	121.25	37.5	205.5	24454.5
SUM				0	413106.1

E-16	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof				0	0
14	0	0	0	0	0
13				0	0
12	476	101.25	30	169.5	80682
11	476	121.25	23.75	183.5	87346
10	476	121.25	23.75	183.5	87346
9	476	121.25	23.75	183.5	87346
8	476	121.25	23.75	183.5	87346
7	476	121.25	23.75	183.5	87346
6	476	121.25	23.75	183.5	87346
5	476	121.25	23.75	183.5	87346
4	476	121.25	23.75	183.5	87346
3	476	121.25	23.75	183.5	87346
2	476	121.25	23.75	183.5	87346
SUM				0	954142

E-17	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof				0	0
14	0	0	0	0	0
13				0	0
12	476	101.25	30	169.5	80682
11	476	121.25	23.75	183.5	87346
10	476	121.25	23.75	183.5	87346
9	476	121.25	23.75	183.5	87346
8	476	121.25	23.75	183.5	87346
7	476	121.25	23.75	183.5	87346
6	476	121.25	23.75	183.5	87346
5	476	121.25	23.75	183.5	87346
4	476	121.25	23.75	183.5	87346
3	476	121.25	23.75	183.5	87346
2	476	121.25	23.75	183.5	87346
SUM				0	954142

E-18	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof				0	0
14	0	0	0	0	0
13				0	0
12	476	101.25	30	169.5	80682
11	476	121.25	23.75	183.5	87346
10	476	121.25	23.75	183.5	87346
9	476	121.25	23.75	183.5	87346
8	476	121.25	23.75	183.5	87346
7	476	121.25	23.75	183.5	87346
6	476	121.25	23.75	183.5	87346
5	476	121.25	23.75	183.5	87346
4	476	121.25	23.75	183.5	87346
3	476	121.25	23.75	183.5	87346
2	476	121.25	23.75	183.5	87346
SUM				0	954142

E-19	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof				0	0
14	0	0	0	0	0
13				0	0
12	238	101.25	30	169.5	40341
11	238	121.25	29.4	192.54	45824.52
10	238	121.25	29.4	192.54	45824.52
9	238	121.25	29.4	192.54	45824.52
8	238	121.25	29.4	192.54	45824.52
7	238	121.25	29.4	192.54	45824.52
6	238	121.25	29.4	192.54	45824.52
5	119	121.25	37.5	205.5	24454.5
4	119	121.25	37.5	205.5	24454.5
3	119	121.25	37.5	205.5	24454.5
2	119	121.25	37.5	205.5	24454.5
SUM				0	413106.1

F-1	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof	119	86.25	150	343.5	40876.5
14	119	121.25	37.5	205.5	24454.5
13	119	121.25	37.5	205.5	24454.5
12	119	121.25	37.5	205.5	24454.5
11	119	121.25	37.5	205.5	24454.5
10	119	121.25	37.5	205.5	24454.5
9	119	121.25	37.5	205.5	24454.5
8	238	101.25	48.5	199.1	47385.8
7	238	121.25	29.4	192.54	45824.52
6	238	121.25	29.4	192.54	45824.52
5	238	121.25	29.4	192.54	45824.52
4	238	121.25	29.4	192.54	45824.52
3	238	121.25	29.4	192.54	45824.52
2	238	121.25	29.4	192.54	45824.52
SUM				0	509936.4

F-2	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof	238	86.25	150	343.5	81753
14	238	121.25	29.4	192.54	45824.52
13	238	121.25	29.4	192.54	45824.52
12	238	121.25	29.4	192.54	45824.52
11	238	121.25	29.4	192.54	45824.52
10	238	121.25	29.4	192.54	45824.52
9	238	121.25	29.4	192.54	45824.52
8	476	101.25	48.5	199.1	94771.6
7	476	121.25	23.75	183.5	87346
6	476	121.25	23.75	183.5	87346
5	476	121.25	23.75	183.5	87346
4	476	121.25	23.75	183.5	87346
3	476	121.25	23.75	183.5	87346
2	476	121.25	23.75	183.5	87346
SUM				0	975547.7

F-3	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof	238	86.25	150	343.5	81753
14	238	121.25	29.4	192.54	45824.52
13	238	121.25	29.4	192.54	45824.52
12	238	121.25	29.4	192.54	45824.52
11	238	121.25	29.4	192.54	45824.52
10	238	121.25	29.4	192.54	45824.52
9	238	121.25	29.4	192.54	45824.52
8	476	101.25	48.5	199.1	94771.6
7	476	121.25	23.75	183.5	87346
6	476	121.25	23.75	183.5	87346
5	476	121.25	23.75	183.5	87346
4	476	121.25	23.75	183.5	87346
3	476	121.25	23.75	183.5	87346
2	476	121.25	23.75	183.5	87346
SUM				0	975547.7

F-4	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof	238	86.25	150	343.5	81753
14	238	121.25	29.4	192.54	45824.52
13	238	121.25	29.4	192.54	45824.52
12	238	121.25	29.4	192.54	45824.52
11	238	121.25	29.4	192.54	45824.52
10	238	121.25	29.4	192.54	45824.52
9	238	121.25	29.4	192.54	45824.52
8	476	101.25	48.5	199.1	94771.6
7	476	121.25	23.75	183.5	87346
6	476	121.25	23.75	183.5	87346
5	476	121.25	23.75	183.5	87346
4	476	121.25	23.75	183.5	87346
3	476	121.25	23.75	183.5	87346
2	476	121.25	23.75	183.5	87346
SUM				0	975547.7

F-5	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof	119	86.25	150	343.5	40876.5
14	119	121.25	37.5	205.5	24454.5
13	119	121.25	37.5	205.5	24454.5
12	119	121.25	37.5	205.5	24454.5
11	119	121.25	37.5	205.5	24454.5
10	119	121.25	37.5	205.5	24454.5
9	119	121.25	37.5	205.5	24454.5
8	238	101.25	48.5	199.1	47385.8
7	238	121.25	29.4	192.54	45824.52
6	238	121.25	29.4	192.54	45824.52
5	238	121.25	29.4	192.54	45824.52
4	238	121.25	29.4	192.54	45824.52
3	238	121.25	29.4	192.54	45824.52
2	238	121.25	29.4	192.54	45824.52
SUM				0	509936.4

F-15	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof	119	86.25	150	343.5	40876.5
14	119	121.25	37.5	205.5	24454.5
13	119	121.25	37.5	205.5	24454.5
12	238	101.25	48.5	199.1	47385.8
11	238	121.25	29.4	192.54	45824.52
10	238	121.25	29.4	192.54	45824.52
9	238	121.25	29.4	192.54	45824.52
8	238	121.25	29.4	192.54	45824.52
7	238	121.25	29.4	192.54	45824.52
6	238	121.25	29.4	192.54	45824.52
5	238	121.25	29.4	192.54	45824.52
4	238	121.25	29.4	192.54	45824.52
3	238	121.25	29.4	192.54	45824.52
2	238	121.25	29.4	192.54	45824.52
SUM				0	595416.5

F-16	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof	238	86.25	150	343.5	81753
14	238	121.25	29.4	192.54	45824.52
13	238	121.25	29.4	192.54	45824.52
12	476	101.25	48.5	199.1	94771.6
11	476	121.25	23.75	183.5	87346
10	476	121.25	23.75	183.5	87346
9	476	121.25	23.75	183.5	87346
8	476	121.25	23.75	183.5	87346
7	476	121.25	23.75	183.5	87346
6	476	121.25	23.75	183.5	87346
5	476	121.25	23.75	183.5	87346
4	476	121.25	23.75	183.5	87346
3	476	121.25	23.75	183.5	87346
2	476	121.25	23.75	183.5	87346
SUM				0	1141634

F-17	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof	238	86.25	150	343.5	81753
14	238	121.25	29.4	192.54	45824.52
13	238	121.25	29.4	192.54	45824.52
12	476	101.25	48.5	199.1	94771.6
11	476	121.25	23.75	183.5	87346
10	476	121.25	23.75	183.5	87346
9	476	121.25	23.75	183.5	87346
8	476	121.25	23.75	183.5	87346
7	476	121.25	23.75	183.5	87346
6	476	121.25	23.75	183.5	87346
5	476	121.25	23.75	183.5	87346
4	476	121.25	23.75	183.5	87346
3	476	121.25	23.75	183.5	87346
2	476	121.25	23.75	183.5	87346
SUM				0	1141634

F-18	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof	238	86.25	150	343.5	81753
14	238	121.25	29.4	192.54	45824.52
13	238	121.25	29.4	192.54	45824.52
12	476	101.25	48.5	199.1	94771.6
11	476	121.25	23.75	183.5	87346
10	476	121.25	23.75	183.5	87346
9	476	121.25	23.75	183.5	87346
8	476	121.25	23.75	183.5	87346
7	476	121.25	23.75	183.5	87346
6	476	121.25	23.75	183.5	87346
5	476	121.25	23.75	183.5	87346
4	476	121.25	23.75	183.5	87346
3	476	121.25	23.75	183.5	87346
2	476	121.25	23.75	183.5	87346
SUM				0	1141634

F-19	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof	119	86.25	150	343.5	40876.5
14	119	121.25	37.5	205.5	24454.5
13	119	121.25	37.5	205.5	24454.5
12	238	101.25	48.5	199.1	47385.8
11	238	121.25	29.4	192.54	45824.52
10	238	121.25	29.4	192.54	45824.52
9	238	121.25	29.4	192.54	45824.52
8	238	121.25	29.4	192.54	45824.52
7	238	121.25	29.4	192.54	45824.52
6	238	121.25	29.4	192.54	45824.52
5	238	121.25	29.4	192.54	45824.52
4	238	121.25	29.4	192.54	45824.52
3	238	121.25	29.4	192.54	45824.52
2	238	121.25	29.4	192.54	45824.52
SUM				0	595416.5

G-1	Trib Area	Dead	Live	1.2D+1.6L	Load (lbs)
Roof	238	86.25	150	343.5	81753
14	238	121.25	29.4	192.54	45824.52
13	238	121.25	29.4	192.54	45824.52
12	238	121.25	29.4	192.54	45824.52
11	238	121.25	29.4	192.54	45824.52
10	238	121.25	29.4	192.54	45824.52
9	238	121.25	29.4	192.54	45824.52
8	238	121.25	29.4	192.54	45824.52
7	238	121.25	29.4	192.54	45824.52
6	238	121.25	29.4	192.54	45824.52
5	238	121.25	29.4	192.54	45824.52
4	238	121.25	29.4	192.54	45824.52
3	238	121.25	29.4	192.54	45824.52
2	238	121.25	29.4	192.54	45824.52
SUM				0	677471.8

G-2	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof	476	86.25	150	343.5	163506
14	476	121.25	23.75	183.5	87346
13	476	121.25	23.75	183.5	87346
12	476	121.25	23.75	183.5	87346
11	476	121.25	23.75	183.5	87346
10	476	121.25	23.75	183.5	87346
9	476	121.25	23.75	183.5	87346
8	476	121.25	23.75	183.5	87346
7	476	121.25	23.75	183.5	87346
6	476	121.25	23.75	183.5	87346
5	476	121.25	23.75	183.5	87346
4	476	121.25	23.75	183.5	87346
3	476	121.25	23.75	183.5	87346
2	476	121.25	23.75	183.5	87346
SUM				0	1299004

G-3	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof	476	86.25	150	343.5	163506
14	476	121.25	23.75	183.5	87346
13	476	121.25	23.75	183.5	87346
12	476	121.25	23.75	183.5	87346
11	476	121.25	23.75	183.5	87346
10	476	121.25	23.75	183.5	87346
9	476	121.25	23.75	183.5	87346
8	476	121.25	23.75	183.5	87346
7	476	121.25	23.75	183.5	87346
6	476	121.25	23.75	183.5	87346
5	476	121.25	23.75	183.5	87346
4	476	121.25	23.75	183.5	87346
3	476	121.25	23.75	183.5	87346
2	476	121.25	23.75	183.5	87346
SUM				0	1299004

G-4	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof	476	86.25	150	343.5	163506
14	476	121.25	23.75	183.5	87346
13	476	121.25	23.75	183.5	87346
12	476	121.25	23.75	183.5	87346
11	476	121.25	23.75	183.5	87346
10	476	121.25	23.75	183.5	87346
9	476	121.25	23.75	183.5	87346
8	476	121.25	23.75	183.5	87346
7	476	121.25	23.75	183.5	87346
6	476	121.25	23.75	183.5	87346
5	476	121.25	23.75	183.5	87346
4	476	121.25	23.75	183.5	87346
3	476	121.25	23.75	183.5	87346
2	476	121.25	23.75	183.5	87346
SUM				0	1299004

G-5	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof	357	86.25	150	343.5	122629.5
14	357	121.25	25.88	186.908	66726.16
13	357	121.25	25.88	186.908	66726.16
12	357	121.25	25.88	186.908	66726.16
11	357	121.25	25.88	186.908	66726.16
10	357	121.25	25.88	186.908	66726.16
9	357	121.25	25.88	186.908	66726.16
8	357	121.25	25.88	186.908	66726.16
7	357	121.25	25.88	186.908	66726.16
6	357	121.25	25.88	186.908	66726.16
5	357	121.25	25.88	186.908	66726.16
4	357	121.25	25.88	186.908	66726.16
3	357	121.25	25.88	186.908	66726.16
2	357	121.25	25.88	186.908	66726.16
SUM				0	990069.5

G-6	Trib Area	Dead	Live	1.2D+1.6L	Load (lbs)
Roof	238	86.25	150	343.5	81753
14	238	121.25	29.4	192.54	45824.52
13	238	121.25	29.4	192.54	45824.52
12	238	121.25	29.4	192.54	45824.52
11	238	121.25	29.4	192.54	45824.52
10	238	121.25	29.4	192.54	45824.52
9	238	121.25	29.4	192.54	45824.52
8	238	121.25	29.4	192.54	45824.52
7	238	121.25	29.4	192.54	45824.52
6	238	121.25	29.4	192.54	45824.52
5	238	121.25	29.4	192.54	45824.52
4	238	121.25	29.4	192.54	45824.52
3	238	121.25	29.4	192.54	45824.52
2	238	121.25	29.4	192.54	45824.52
SUM				0	677471.8

G-7	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof	238	86.25	150	343.5	81753
14	238	121.25	29.4	192.54	45824.52
13	238	121.25	29.4	192.54	45824.52
12	238	121.25	29.4	192.54	45824.52
11	238	121.25	29.4	192.54	45824.52
10	238	121.25	29.4	192.54	45824.52
9	238	121.25	29.4	192.54	45824.52
8	238	121.25	29.4	192.54	45824.52
7	238	121.25	29.4	192.54	45824.52
6	238	121.25	29.4	192.54	45824.52
5	238	121.25	29.4	192.54	45824.52
4	238	121.25	29.4	192.54	45824.52
3	238	121.25	29.4	192.54	45824.52
2	238	121.25	29.4	192.54	45824.52
SUM				0	677471.8

G-8	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof	238	86.25	150	343.5	81753
14	238	121.25	29.4	192.54	45824.52
13	238	121.25	29.4	192.54	45824.52
12	238	121.25	29.4	192.54	45824.52
11	238	121.25	29.4	192.54	45824.52
10	238	121.25	29.4	192.54	45824.52
9	238	121.25	29.4	192.54	45824.52
8	238	121.25	29.4	192.54	45824.52
7	238	121.25	29.4	192.54	45824.52
6	238	121.25	29.4	192.54	45824.52
5	238	121.25	29.4	192.54	45824.52
4	238	121.25	29.4	192.54	45824.52
3	238	121.25	29.4	192.54	45824.52
2	238	121.25	29.4	192.54	45824.52
SUM				0	677471.8

G-9	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof	238	86.25	150	343.5	81753
14	238	121.25	29.4	192.54	45824.52
13	238	121.25	29.4	192.54	45824.52
12	238	121.25	29.4	192.54	45824.52
11	238	121.25	29.4	192.54	45824.52
10	238	121.25	29.4	192.54	45824.52
9	238	121.25	29.4	192.54	45824.52
8	238	121.25	29.4	192.54	45824.52
7	238	121.25	29.4	192.54	45824.52
6	238	121.25	29.4	192.54	45824.52
5	238	121.25	29.4	192.54	45824.52
4	238	121.25	29.4	192.54	45824.52
3	238	121.25	29.4	192.54	45824.52
2	238	121.25	29.4	192.54	45824.52
SUM				0	677471.8

G-10	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof	238	86.25	150	343.5	81753
14	238	121.25	29.4	192.54	45824.52
13	238	121.25	29.4	192.54	45824.52
12	238	121.25	29.4	192.54	45824.52
11	238	121.25	29.4	192.54	45824.52
10	238	121.25	29.4	192.54	45824.52
9	238	121.25	29.4	192.54	45824.52
8	238	121.25	29.4	192.54	45824.52
7	238	121.25	29.4	192.54	45824.52
6	238	121.25	29.4	192.54	45824.52
5	238	121.25	29.4	192.54	45824.52
4	238	121.25	29.4	192.54	45824.52
3	238	121.25	29.4	192.54	45824.52
2	238	121.25	29.4	192.54	45824.52
SUM				0	677471.8

G-11	Trib Area	Dead	Live	1.2D+1.6L	Load (lbs)
Roof	238	86.25	150		
14	238	121.25	29.4	192.54	45824.52
13	238	121.25	29.4	192.54	45824.52
12	238	121.25	29.4	192.54	45824.52
11	238	121.25	29.4	192.54	45824.52
10	238	121.25	29.4	192.54	45824.52
9	238	121.25	29.4	192.54	45824.52
8	238	121.25	29.4	192.54	45824.52
7	238	121.25	29.4	192.54	45824.52
6	238	121.25	29.4	192.54	45824.52
5	238	121.25	29.4	192.54	45824.52
4	238	121.25	29.4	192.54	45824.52
3	238	121.25	29.4	192.54	45824.52
2	238	121.25	29.4	192.54	45824.52
SUM				0	595718.8

G-12	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof	238	86.25	150	343.5	81753
14	238	121.25	29.4	192.54	45824.52
13	238	121.25	29.4	192.54	45824.52
12	238	121.25	29.4	192.54	45824.52
11	238	121.25	29.4	192.54	45824.52
10	238	121.25	29.4	192.54	45824.52
9	238	121.25	29.4	192.54	45824.52
8	238	121.25	29.4	192.54	45824.52
7	238	121.25	29.4	192.54	45824.52
6	238	121.25	29.4	192.54	45824.52
5	238	121.25	29.4	192.54	45824.52
4	238	121.25	29.4	192.54	45824.52
3	238	121.25	29.4	192.54	45824.52
2	238	121.25	29.4	192.54	45824.52
SUM				0	677471.8

G-13	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof	238	86.25	150	343.5	81753
14	238	121.25	29.4	192.54	45824.52
13	238	121.25	29.4	192.54	45824.52
12	238	121.25	29.4	192.54	45824.52
11	238	121.25	29.4	192.54	45824.52
10	238	121.25	29.4	192.54	45824.52
9	238	121.25	29.4	192.54	45824.52
8	238	121.25	29.4	192.54	45824.52
7	238	121.25	29.4	192.54	45824.52
6	238	121.25	29.4	192.54	45824.52
5	238	121.25	29.4	192.54	45824.52
4	238	121.25	29.4	192.54	45824.52
3	238	121.25	29.4	192.54	45824.52
2	238	121.25	29.4	192.54	45824.52
SUM				0	677471.8

G-14	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof	238	86.25	150	343.5	81753
14	238	121.25	29.4	192.54	45824.52
13	238	121.25	29.4	192.54	45824.52
12	238	121.25	29.4	192.54	45824.52
11	238	121.25	29.4	192.54	45824.52
10	238	121.25	29.4	192.54	45824.52
9	238	121.25	29.4	192.54	45824.52
8	238	121.25	29.4	192.54	45824.52
7	238	121.25	29.4	192.54	45824.52
6	238	121.25	29.4	192.54	45824.52
5	238	121.25	29.4	192.54	45824.52
4	238	121.25	29.4	192.54	45824.52
3	238	121.25	29.4	192.54	45824.52
2	238	121.25	29.4	192.54	45824.52
SUM				0	677471.8

G-15	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof	357	86.25	150	343.5	122629.5
14	357	121.25	25.88	186.908	66726.16
13	357	121.25	25.88	186.908	66726.16
12	357	121.25	25.88	186.908	66726.16
11	357	121.25	25.88	186.908	66726.16
10	357	121.25	25.88	186.908	66726.16
9	357	121.25	25.88	186.908	66726.16
8	357	121.25	25.88	186.908	66726.16
7	357	121.25	25.88	186.908	66726.16
6	357	121.25	25.88	186.908	66726.16
5	357	121.25	25.88	186.908	66726.16
4	357	121.25	25.88	186.908	66726.16
3	357	121.25	25.88	186.908	66726.16
2	357	121.25	25.88	186.908	66726.16
SUM				0	990069.5

G-16	Trib Area	Dead	Live	1.2D+1.6L	Load (lbs)
Roof	238	86.25	150	343.5	81753
14	476	121.25	23.75	183.5	87346
13	476	121.25	23.75	183.5	87346
12	476	121.25	23.75	183.5	87346
11	476	121.25	23.75	183.5	87346
10	476	121.25	23.75	183.5	87346
9	476	121.25	23.75	183.5	87346
8	476	121.25	23.75	183.5	87346
7	476	121.25	23.75	183.5	87346
6	476	121.25	23.75	183.5	87346
5	476	121.25	23.75	183.5	87346
4	476	121.25	23.75	183.5	87346
3	476	121.25	23.75	183.5	87346
2	476	121.25	23.75	183.5	87346
SUM				0	1217251

G-17	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof	238	86.25	150	343.5	81753
14	476	121.25	23.75	183.5	87346
13	476	121.25	23.75	183.5	87346
12	476	121.25	23.75	183.5	87346
11	476	121.25	23.75	183.5	87346
10	476	121.25	23.75	183.5	87346
9	476	121.25	23.75	183.5	87346
8	476	121.25	23.75	183.5	87346
7	476	121.25	23.75	183.5	87346
6	476	121.25	23.75	183.5	87346
5	476	121.25	23.75	183.5	87346
4	476	121.25	23.75	183.5	87346
3	476	121.25	23.75	183.5	87346
2	476	121.25	23.75	183.5	87346
SUM				0	1217251

G-18	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof	238	86.25	150	343.5	81753
14	476	121.25	23.75	183.5	87346
13	476	121.25	23.75	183.5	87346
12	476	121.25	23.75	183.5	87346
11	476	121.25	23.75	183.5	87346
10	476	121.25	23.75	183.5	87346
9	476	121.25	23.75	183.5	87346
8	476	121.25	23.75	183.5	87346
7	476	121.25	23.75	183.5	87346
6	476	121.25	23.75	183.5	87346
5	476	121.25	23.75	183.5	87346
4	476	121.25	23.75	183.5	87346
3	476	121.25	23.75	183.5	87346
2	476	121.25	23.75	183.5	87346
SUM				0	1217251

G-19	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof	238	86.25	150	343.5	81753
14	238	121.25	29.4	192.54	45824.52
13	238	121.25	29.4	192.54	45824.52
12	238	121.25	29.4	192.54	45824.52
11	238	121.25	29.4	192.54	45824.52
10	238	121.25	29.4	192.54	45824.52
9	238	121.25	29.4	192.54	45824.52
8	238	121.25	29.4	192.54	45824.52
7	238	121.25	29.4	192.54	45824.52
6	238	121.25	29.4	192.54	45824.52
5	238	121.25	29.4	192.54	45824.52
4	238	121.25	29.4	192.54	45824.52
3	238	121.25	29.4	192.54	45824.52
2	238	121.25	29.4	192.54	45824.52
SUM				0	677471.8

H-1	Trib Area	Dead	Live	1.2D+1.6L	Load (lbs)
Roof	238	86.25	150	343.5	81753
14	238	121.25	29.4	192.54	45824.52
13	238	121.25	29.4	192.54	45824.52
12	238	121.25	29.4	192.54	45824.52
11	238	121.25	29.4	192.54	45824.52
10	238	121.25	29.4	192.54	45824.52
9	238	121.25	29.4	192.54	45824.52
8	238	121.25	29.4	192.54	45824.52
7	238	121.25	29.4	192.54	45824.52
6	238	121.25	29.4	192.54	45824.52
5	238	121.25	29.4	192.54	45824.52
4	238	121.25	29.4	192.54	45824.52
3	238	121.25	29.4	192.54	45824.52
2	238	121.25	29.4	192.54	45824.52
SUM				0	677471.8

H-2	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof	476	86.25	150	343.5	163506
14	476	121.25	23.75	183.5	87346
13	476	121.25	23.75	183.5	87346
12	476	121.25	23.75	183.5	87346
11	476	121.25	23.75	183.5	87346
10	476	121.25	23.75	183.5	87346
9	476	121.25	23.75	183.5	87346
8	476	121.25	23.75	183.5	87346
7	476	121.25	23.75	183.5	87346
6	476	121.25	23.75	183.5	87346
5	476	121.25	23.75	183.5	87346
4	476	121.25	23.75	183.5	87346
3	476	121.25	23.75	183.5	87346
2	476	121.25	23.75	183.5	87346
SUM				0	1299004

H-3	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof	476	86.25	150	343.5	163506
14	476	121.25	23.75	183.5	87346
13	476	121.25	23.75	183.5	87346
12	476	121.25	23.75	183.5	87346
11	476	121.25	23.75	183.5	87346
10	476	121.25	23.75	183.5	87346
9	476	121.25	23.75	183.5	87346
8	476	121.25	23.75	183.5	87346
7	476	121.25	23.75	183.5	87346
6	476	121.25	23.75	183.5	87346
5	476	121.25	23.75	183.5	87346
4	476	121.25	23.75	183.5	87346
3	476	121.25	23.75	183.5	87346
2	476	121.25	23.75	183.5	87346
SUM				0	1299004

H-4	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof	476	86.25	150	343.5	163506
14	476	121.25	23.75	183.5	87346
13	476	121.25	23.75	183.5	87346
12	476	121.25	23.75	183.5	87346
11	476	121.25	23.75	183.5	87346
10	476	121.25	23.75	183.5	87346
9	476	121.25	23.75	183.5	87346
8	476	121.25	23.75	183.5	87346
7	476	121.25	23.75	183.5	87346
6	476	121.25	23.75	183.5	87346
5	476	121.25	23.75	183.5	87346
4	476	121.25	23.75	183.5	87346
3	476	121.25	23.75	183.5	87346
2	476	121.25	23.75	183.5	87346
SUM				0	1299004

H-5	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof	476	86.25	150	343.5	163506
14	476	121.25	23.75	183.5	87346
13	476	121.25	23.75	183.5	87346
12	476	121.25	23.75	183.5	87346
11	476	121.25	23.75	183.5	87346
10	476	121.25	23.75	183.5	87346
9	476	121.25	23.75	183.5	87346
8	476	121.25	23.75	183.5	87346
7	476	121.25	23.75	183.5	87346
6	476	121.25	23.75	183.5	87346
5	476	121.25	23.75	183.5	87346
4	476	121.25	23.75	183.5	87346
3	476	121.25	23.75	183.5	87346
2	476	121.25	23.75	183.5	87346
SUM				0	1299004

H-6	Trib Area	Dead	Live	1.2D+1.6L	Load (lbs)
Roof	476	86.25	150	343.5	163506
14	476	121.25	23.75	183.5	87346
13	476	121.25	23.75	183.5	87346
12	476	121.25	23.75	183.5	87346
11	476	121.25	23.75	183.5	87346
10	476	121.25	23.75	183.5	87346
9	476	121.25	23.75	183.5	87346
8	476	121.25	23.75	183.5	87346
7	476	121.25	23.75	183.5	87346
6	476	121.25	23.75	183.5	87346
5	476	121.25	23.75	183.5	87346
4	476	121.25	23.75	183.5	87346
3	476	121.25	23.75	183.5	87346
2	476	121.25	23.75	183.5	87346
SUM				0	1299004

H-7	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof	476	86.25	150	343.5	163506
14	476	121.25	23.75	183.5	87346
13	476	121.25	23.75	183.5	87346
12	476	121.25	23.75	183.5	87346
11	476	121.25	23.75	183.5	87346
10	476	121.25	23.75	183.5	87346
9	476	121.25	23.75	183.5	87346
8	476	121.25	23.75	183.5	87346
7	476	121.25	23.75	183.5	87346
6	476	121.25	23.75	183.5	87346
5	476	121.25	23.75	183.5	87346
4	476	121.25	23.75	183.5	87346
3	476	121.25	23.75	183.5	87346
2	476	121.25	23.75	183.5	87346
SUM				0	1299004

H-8	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof	476	86.25	150	343.5	163506
14	476	121.25	23.75	183.5	87346
13	476	121.25	23.75	183.5	87346
12	476	121.25	23.75	183.5	87346
11	476	121.25	23.75	183.5	87346
10	476	121.25	23.75	183.5	87346
9	476	121.25	23.75	183.5	87346
8	476	121.25	23.75	183.5	87346
7	476	121.25	23.75	183.5	87346
6	476	121.25	23.75	183.5	87346
5	476	121.25	23.75	183.5	87346
4	476	121.25	23.75	183.5	87346
3	476	121.25	23.75	183.5	87346
2	476	121.25	23.75	183.5	87346
SUM				0	1299004

H-9	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof	476	86.25	150	343.5	163506
14	476	121.25	23.75	183.5	87346
13	476	121.25	23.75	183.5	87346
12	476	121.25	23.75	183.5	87346
11	476	121.25	23.75	183.5	87346
10	476	121.25	23.75	183.5	87346
9	476	121.25	23.75	183.5	87346
8	476	121.25	23.75	183.5	87346
7	476	121.25	23.75	183.5	87346
6	476	121.25	23.75	183.5	87346
5	476	121.25	23.75	183.5	87346
4	476	121.25	23.75	183.5	87346
3	476	121.25	23.75	183.5	87346
2	476	121.25	23.75	183.5	87346
SUM				0	1299004

H-10	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof	476	86.25	150	343.5	163506
14	476	121.25	23.75	183.5	87346
13	476	121.25	23.75	183.5	87346
12	476	121.25	23.75	183.5	87346
11	476	121.25	23.75	183.5	87346
10	476	121.25	23.75	183.5	87346
9	476	121.25	23.75	183.5	87346
8	476	121.25	23.75	183.5	87346
7	476	121.25	23.75	183.5	87346
6	476	121.25	23.75	183.5	87346
5	476	121.25	23.75	183.5	87346
4	476	121.25	23.75	183.5	87346
3	476	121.25	23.75	183.5	87346
2	476	121.25	23.75	183.5	87346
SUM				0	1299004

H-11	Trib Area	Dead	Live	1.2D+1.6L	Load (lbs)
Roof	476	86.25	150		
14	476	121.25	23.75	183.5	87346
13	476	121.25	23.75	183.5	87346
12	476	121.25	23.75	183.5	87346
11	476	121.25	23.75	183.5	87346
10	476	121.25	23.75	183.5	87346
9	476	121.25	23.75	183.5	87346
8	476	121.25	23.75	183.5	87346
7	476	121.25	23.75	183.5	87346
6	476	121.25	23.75	183.5	87346
5	476	121.25	23.75	183.5	87346
4	476	121.25	23.75	183.5	87346
3	476	121.25	23.75	183.5	87346
2	476	121.25	23.75	183.5	87346
SUM				0	1135498

H-12	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof	476	86.25	150	343.5	163506
14	476	121.25	23.75	183.5	87346
13	476	121.25	23.75	183.5	87346
12	476	121.25	23.75	183.5	87346
11	476	121.25	23.75	183.5	87346
10	476	121.25	23.75	183.5	87346
9	476	121.25	23.75	183.5	87346
8	476	121.25	23.75	183.5	87346
7	476	121.25	23.75	183.5	87346
6	476	121.25	23.75	183.5	87346
5	476	121.25	23.75	183.5	87346
4	476	121.25	23.75	183.5	87346
3	476	121.25	23.75	183.5	87346
2	476	121.25	23.75	183.5	87346
SUM				0	1299004

H-13	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof	476	86.25	150	343.5	163506
14	476	121.25	23.75	183.5	87346
13	476	121.25	23.75	183.5	87346
12	476	121.25	23.75	183.5	87346
11	476	121.25	23.75	183.5	87346
10	476	121.25	23.75	183.5	87346
9	476	121.25	23.75	183.5	87346
8	476	121.25	23.75	183.5	87346
7	476	121.25	23.75	183.5	87346
6	476	121.25	23.75	183.5	87346
5	476	121.25	23.75	183.5	87346
4	476	121.25	23.75	183.5	87346
3	476	121.25	23.75	183.5	87346
2	476	121.25	23.75	183.5	87346
SUM				0	1299004

G-14	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof	476	86.25	150	343.5	163506
14	476	121.25	23.75	183.5	87346
13	476	121.25	23.75	183.5	87346
12	476	121.25	23.75	183.5	87346
11	476	121.25	23.75	183.5	87346
10	476	121.25	23.75	183.5	87346
9	476	121.25	23.75	183.5	87346
8	476	121.25	23.75	183.5	87346
7	476	121.25	23.75	183.5	87346
6	476	121.25	23.75	183.5	87346
5	476	121.25	23.75	183.5	87346
4	476	121.25	23.75	183.5	87346
3	476	121.25	23.75	183.5	87346
2	476	121.25	23.75	183.5	87346
SUM				0	1299004

H-15	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof	476	86.25	150	343.5	163506
14	476	121.25	23.75	183.5	87346
13	476	121.25	23.75	183.5	87346
12	476	121.25	23.75	183.5	87346
11	476	121.25	23.75	183.5	87346
10	476	121.25	23.75	183.5	87346
9	476	121.25	23.75	183.5	87346
8	476	121.25	23.75	183.5	87346
7	476	121.25	23.75	183.5	87346
6	476	121.25	23.75	183.5	87346
5	476	121.25	23.75	183.5	87346
4	476	121.25	23.75	183.5	87346
3	476	121.25	23.75	183.5	87346
2	476	121.25	23.75	183.5	87346
SUM				0	1299004

H-16	Trib Area	Dead	Live	1.2D+1.6L	Load (lbs)
Roof	476	86.25	150	343.5	163506
14	476	121.25	23.75	183.5	87346
13	476	121.25	23.75	183.5	87346
12	476	121.25	23.75	183.5	87346
11	476	121.25	23.75	183.5	87346
10	476	121.25	23.75	183.5	87346
9	476	121.25	23.75	183.5	87346
8	476	121.25	23.75	183.5	87346
7	476	121.25	23.75	183.5	87346
6	476	121.25	23.75	183.5	87346
5	476	121.25	23.75	183.5	87346
4	476	121.25	23.75	183.5	87346
3	476	121.25	23.75	183.5	87346
2	476	121.25	23.75	183.5	87346
SUM				0	1299004

H-17	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof	476	86.25	150	343.5	163506
14	476	121.25	23.75	183.5	87346
13	476	121.25	23.75	183.5	87346
12	476	121.25	23.75	183.5	87346
11	476	121.25	23.75	183.5	87346
10	476	121.25	23.75	183.5	87346
9	476	121.25	23.75	183.5	87346
8	476	121.25	23.75	183.5	87346
7	476	121.25	23.75	183.5	87346
6	476	121.25	23.75	183.5	87346
5	476	121.25	23.75	183.5	87346
4	476	121.25	23.75	183.5	87346
3	476	121.25	23.75	183.5	87346
2	476	121.25	23.75	183.5	87346
SUM				0	1299004

H-18	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof	476	86.25	150	343.5	163506
14	476	121.25	23.75	183.5	87346
13	476	121.25	23.75	183.5	87346
12	476	121.25	23.75	183.5	87346
11	476	121.25	23.75	183.5	87346
10	476	121.25	23.75	183.5	87346
9	476	121.25	23.75	183.5	87346
8	476	121.25	23.75	183.5	87346
7	476	121.25	23.75	183.5	87346
6	476	121.25	23.75	183.5	87346
5	476	121.25	23.75	183.5	87346
4	476	121.25	23.75	183.5	87346
3	476	121.25	23.75	183.5	87346
2	476	121.25	23.75	183.5	87346
SUM				0	1299004

H-19	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof	238	86.25	150	343.5	81753
14	238	121.25	29.4	192.54	45824.52
13	238	121.25	29.4	192.54	45824.52
12	238	121.25	29.4	192.54	45824.52
11	238	121.25	29.4	192.54	45824.52
10	238	121.25	29.4	192.54	45824.52
9	238	121.25	29.4	192.54	45824.52
8	238	121.25	29.4	192.54	45824.52
7	238	121.25	29.4	192.54	45824.52
6	238	121.25	29.4	192.54	45824.52
5	238	121.25	29.4	192.54	45824.52
4	238	121.25	29.4	192.54	45824.52
3	238	121.25	29.4	192.54	45824.52
2	238	121.25	29.4	192.54	45824.52
SUM				0	677471.8

I-1	Trib Area	Dead	Live	1.2D+1.6L	Load (lbs)
Roof	238	86.25	150	343.5	81753
14	238	121.25	29.4	192.54	45824.52
13	238	121.25	29.4	192.54	45824.52
12	238	121.25	29.4	192.54	45824.52
11	238	121.25	29.4	192.54	45824.52
10	238	121.25	29.4	192.54	45824.52
9	238	121.25	29.4	192.54	45824.52
8	238	121.25	29.4	192.54	45824.52
7	238	121.25	29.4	192.54	45824.52
6	238	121.25	29.4	192.54	45824.52
5	238	121.25	29.4	192.54	45824.52
4	238	121.25	29.4	192.54	45824.52
3	238	121.25	29.4	192.54	45824.52
2	238	121.25	29.4	192.54	45824.52
SUM				0	677471.8

I-2	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof	476	86.25	150	343.5	163506
14	476	121.25	23.75	183.5	87346
13	476	121.25	23.75	183.5	87346
12	476	121.25	23.75	183.5	87346
11	476	121.25	23.75	183.5	87346
10	476	121.25	23.75	183.5	87346
9	476	121.25	23.75	183.5	87346
8	476	121.25	23.75	183.5	87346
7	476	121.25	23.75	183.5	87346
6	476	121.25	23.75	183.5	87346
5	476	121.25	23.75	183.5	87346
4	476	121.25	23.75	183.5	87346
3	476	121.25	23.75	183.5	87346
2	476	121.25	23.75	183.5	87346
SUM				0	1299004

I-3	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof	476	86.25	150	343.5	163506
14	476	121.25	23.75	183.5	87346
13	476	121.25	23.75	183.5	87346
12	476	121.25	23.75	183.5	87346
11	476	121.25	23.75	183.5	87346
10	476	121.25	23.75	183.5	87346
9	476	121.25	23.75	183.5	87346
8	476	121.25	23.75	183.5	87346
7	476	121.25	23.75	183.5	87346
6	476	121.25	23.75	183.5	87346
5	476	121.25	23.75	183.5	87346
4	476	121.25	23.75	183.5	87346
3	476	121.25	23.75	183.5	87346
2	476	121.25	23.75	183.5	87346
SUM				0	1299004

I-4	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof	476	86.25	150	343.5	163506
14	476	121.25	23.75	183.5	87346
13	476	121.25	23.75	183.5	87346
12	476	121.25	23.75	183.5	87346
11	476	121.25	23.75	183.5	87346
10	476	121.25	23.75	183.5	87346
9	476	121.25	23.75	183.5	87346
8	476	121.25	23.75	183.5	87346
7	476	121.25	23.75	183.5	87346
6	476	121.25	23.75	183.5	87346
5	476	121.25	23.75	183.5	87346
4	476	121.25	23.75	183.5	87346
3	476	121.25	23.75	183.5	87346
2	476	121.25	23.75	183.5	87346
SUM				0	1299004

I-5	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof	476	86.25	150	343.5	163506
14	476	121.25	23.75	183.5	87346
13	476	121.25	23.75	183.5	87346
12	476	121.25	23.75	183.5	87346
11	476	121.25	23.75	183.5	87346
10	476	121.25	23.75	183.5	87346
9	476	121.25	23.75	183.5	87346
8	476	121.25	23.75	183.5	87346
7	476	121.25	23.75	183.5	87346
6	476	121.25	23.75	183.5	87346
5	476	121.25	23.75	183.5	87346
4	476	121.25	23.75	183.5	87346
3	476	121.25	23.75	183.5	87346
2	476	121.25	23.75	183.5	87346
SUM				0	1299004

I-6	Trib Area	Dead	Live	1.2D+1.6L	Load (lbs)
Roof	476	86.25	150	343.5	163506
14	476	121.25	23.75	183.5	87346
13	476	121.25	23.75	183.5	87346
12	476	121.25	23.75	183.5	87346
11	476	121.25	23.75	183.5	87346
10	476	121.25	23.75	183.5	87346
9	476	121.25	23.75	183.5	87346
8	476	121.25	23.75	183.5	87346
7	476	121.25	23.75	183.5	87346
6	476	121.25	23.75	183.5	87346
5	476	121.25	23.75	183.5	87346
4	476	121.25	23.75	183.5	87346
3	476	121.25	23.75	183.5	87346
2	476	121.25	23.75	183.5	87346
SUM				0	1299004

I-7	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof	476	86.25	150	343.5	163506
14	476	121.25	23.75	183.5	87346
13	476	121.25	23.75	183.5	87346
12	476	121.25	23.75	183.5	87346
11	476	121.25	23.75	183.5	87346
10	476	121.25	23.75	183.5	87346
9	476	121.25	23.75	183.5	87346
8	476	121.25	23.75	183.5	87346
7	476	121.25	23.75	183.5	87346
6	476	121.25	23.75	183.5	87346
5	476	121.25	23.75	183.5	87346
4	476	121.25	23.75	183.5	87346
3	476	121.25	23.75	183.5	87346
2	476	121.25	23.75	183.5	87346
SUM				0	1299004

I-8	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof	476	86.25	150	343.5	163506
14	476	121.25	23.75	183.5	87346
13	476	121.25	23.75	183.5	87346
12	476	121.25	23.75	183.5	87346
11	476	121.25	23.75	183.5	87346
10	476	121.25	23.75	183.5	87346
9	476	121.25	23.75	183.5	87346
8	476	121.25	23.75	183.5	87346
7	476	121.25	23.75	183.5	87346
6	476	121.25	23.75	183.5	87346
5	476	121.25	23.75	183.5	87346
4	476	121.25	23.75	183.5	87346
3	476	121.25	23.75	183.5	87346
2	476	121.25	23.75	183.5	87346
SUM				0	1299004

I-9	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof	476	86.25	150	343.5	163506
14	476	121.25	23.75	183.5	87346
13	476	121.25	23.75	183.5	87346
12	476	121.25	23.75	183.5	87346
11	476	121.25	23.75	183.5	87346
10	476	121.25	23.75	183.5	87346
9	476	121.25	23.75	183.5	87346
8	476	121.25	23.75	183.5	87346
7	476	121.25	23.75	183.5	87346
6	476	121.25	23.75	183.5	87346
5	476	121.25	23.75	183.5	87346
4	476	121.25	23.75	183.5	87346
3	476	121.25	23.75	183.5	87346
2	476	121.25	23.75	183.5	87346
SUM				0	1299004

I-10	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof	476	86.25	150	343.5	163506
14	476	121.25	23.75	183.5	87346
13	476	121.25	23.75	183.5	87346
12	476	121.25	23.75	183.5	87346
11	476	121.25	23.75	183.5	87346
10	476	121.25	23.75	183.5	87346
9	476	121.25	23.75	183.5	87346
8	476	121.25	23.75	183.5	87346
7	476	121.25	23.75	183.5	87346
6	476	121.25	23.75	183.5	87346
5	476	121.25	23.75	183.5	87346
4	476	121.25	23.75	183.5	87346
3	476	121.25	23.75	183.5	87346
2	476	121.25	23.75	183.5	87346
SUM				0	1299004

I-11	Trib Area	Dead	Live	1.2D+1.6L	Load (lbs)
Roof	476	86.25	150		
14	476	121.25	23.75	183.5	87346
13	476	121.25	23.75	183.5	87346
12	476	121.25	23.75	183.5	87346
11	476	121.25	23.75	183.5	87346
10	476	121.25	23.75	183.5	87346
9	476	121.25	23.75	183.5	87346
8	476	121.25	23.75	183.5	87346
7	476	121.25	23.75	183.5	87346
6	476	121.25	23.75	183.5	87346
5	476	121.25	23.75	183.5	87346
4	476	121.25	23.75	183.5	87346
3	476	121.25	23.75	183.5	87346
2	476	121.25	23.75	183.5	87346
SUM				0	1135498

I-12	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof	476	86.25	150	343.5	163506
14	476	121.25	23.75	183.5	87346
13	476	121.25	23.75	183.5	87346
12	476	121.25	23.75	183.5	87346
11	476	121.25	23.75	183.5	87346
10	476	121.25	23.75	183.5	87346
9	476	121.25	23.75	183.5	87346
8	476	121.25	23.75	183.5	87346
7	476	121.25	23.75	183.5	87346
6	476	121.25	23.75	183.5	87346
5	476	121.25	23.75	183.5	87346
4	476	121.25	23.75	183.5	87346
3	476	121.25	23.75	183.5	87346
2	476	121.25	23.75	183.5	87346
SUM				0	1299004

I-13	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof	476	86.25	150	343.5	163506
14	476	121.25	23.75	183.5	87346
13	476	121.25	23.75	183.5	87346
12	476	121.25	23.75	183.5	87346
11	476	121.25	23.75	183.5	87346
10	476	121.25	23.75	183.5	87346
9	476	121.25	23.75	183.5	87346
8	476	121.25	23.75	183.5	87346
7	476	121.25	23.75	183.5	87346
6	476	121.25	23.75	183.5	87346
5	476	121.25	23.75	183.5	87346
4	476	121.25	23.75	183.5	87346
3	476	121.25	23.75	183.5	87346
2	476	121.25	23.75	183.5	87346
SUM				0	1299004

I-14	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof	476	86.25	150	343.5	163506
14	476	121.25	23.75	183.5	87346
13	476	121.25	23.75	183.5	87346
12	476	121.25	23.75	183.5	87346
11	476	121.25	23.75	183.5	87346
10	476	121.25	23.75	183.5	87346
9	476	121.25	23.75	183.5	87346
8	476	121.25	23.75	183.5	87346
7	476	121.25	23.75	183.5	87346
6	476	121.25	23.75	183.5	87346
5	476	121.25	23.75	183.5	87346
4	476	121.25	23.75	183.5	87346
3	476	121.25	23.75	183.5	87346
2	476	121.25	23.75	183.5	87346
SUM				0	1299004

I-15	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof	476	86.25	150	343.5	163506
14	476	121.25	23.75	183.5	87346
13	476	121.25	23.75	183.5	87346
12	476	121.25	23.75	183.5	87346
11	476	121.25	23.75	183.5	87346
10	476	121.25	23.75	183.5	87346
9	476	121.25	23.75	183.5	87346
8	476	121.25	23.75	183.5	87346
7	476	121.25	23.75	183.5	87346
6	476	121.25	23.75	183.5	87346
5	476	121.25	23.75	183.5	87346
4	476	121.25	23.75	183.5	87346
3	476	121.25	23.75	183.5	87346
2	476	121.25	23.75	183.5	87346
SUM				0	1299004

I-16	Trib Area	Dead	Live	1.2D+1.6L	Load (lbs)
Roof	476	86.25	150	343.5	163506
14	476	121.25	23.75	183.5	87346
13	476	121.25	23.75	183.5	87346
12	476	121.25	23.75	183.5	87346
11	476	121.25	23.75	183.5	87346
10	476	121.25	23.75	183.5	87346
9	476	121.25	23.75	183.5	87346
8	476	121.25	23.75	183.5	87346
7	476	121.25	23.75	183.5	87346
6	476	121.25	23.75	183.5	87346
5	476	121.25	23.75	183.5	87346
4	476	121.25	23.75	183.5	87346
3	476	121.25	23.75	183.5	87346
2	476	121.25	23.75	183.5	87346
SUM				0	1299004

I-17	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof	476	86.25	150	343.5	163506
14	476	121.25	23.75	183.5	87346
13	476	121.25	23.75	183.5	87346
12	476	121.25	23.75	183.5	87346
11	476	121.25	23.75	183.5	87346
10	476	121.25	23.75	183.5	87346
9	476	121.25	23.75	183.5	87346
8	476	121.25	23.75	183.5	87346
7	476	121.25	23.75	183.5	87346
6	476	121.25	23.75	183.5	87346
5	476	121.25	23.75	183.5	87346
4	476	121.25	23.75	183.5	87346
3	476	121.25	23.75	183.5	87346
2	476	121.25	23.75	183.5	87346
SUM				0	1299004

I-18	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof	476	86.25	150	343.5	163506
14	476	121.25	23.75	183.5	87346
13	476	121.25	23.75	183.5	87346
12	476	121.25	23.75	183.5	87346
11	476	121.25	23.75	183.5	87346
10	476	121.25	23.75	183.5	87346
9	476	121.25	23.75	183.5	87346
8	476	121.25	23.75	183.5	87346
7	476	121.25	23.75	183.5	87346
6	476	121.25	23.75	183.5	87346
5	476	121.25	23.75	183.5	87346
4	476	121.25	23.75	183.5	87346
3	476	121.25	23.75	183.5	87346
2	476	121.25	23.75	183.5	87346
SUM				0	1299004

I-19	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof	238	86.25	150	343.5	81753
14	238	121.25	29.4	192.54	45824.52
13	238	121.25	29.4	192.54	45824.52
12	238	121.25	29.4	192.54	45824.52
11	238	121.25	29.4	192.54	45824.52
10	238	121.25	29.4	192.54	45824.52
9	238	121.25	29.4	192.54	45824.52
8	238	121.25	29.4	192.54	45824.52
7	238	121.25	29.4	192.54	45824.52
6	238	121.25	29.4	192.54	45824.52
5	238	121.25	29.4	192.54	45824.52
4	238	121.25	29.4	192.54	45824.52
3	238	121.25	29.4	192.54	45824.52
2	238	121.25	29.4	192.54	45824.52
SUM				0	677471.8

J-1	Trib Area	Dead	Live	1.2D+1.6L	Load (lbs)
Roof	119	86.25	150	343.5	40876.5
14	119	121.25	37.5	205.5	24454.5
13	119	121.25	37.5	205.5	24454.5
12	119	121.25	37.5	205.5	24454.5
11	119	121.25	37.5	205.5	24454.5
10	119	121.25	37.5	205.5	24454.5
9	119	121.25	37.5	205.5	24454.5
8	119	121.25	37.5	205.5	24454.5
7	119	121.25	37.5	205.5	24454.5
6	119	121.25	37.5	205.5	24454.5
5	119	121.25	37.5	205.5	24454.5
4	119	121.25	37.5	205.5	24454.5
3	119	121.25	37.5	205.5	24454.5
2	119	121.25	37.5	205.5	24454.5
SUM				0	358.785

J-2	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof	238	86.25	150	343.5	81753
14	238	121.25	29.4	192.54	45824.52
13	238	121.25	29.4	192.54	45824.52
12	238	121.25	29.4	192.54	45824.52
11	238	121.25	29.4	192.54	45824.52
10	238	121.25	29.4	192.54	45824.52
9	238	121.25	29.4	192.54	45824.52
8	238	121.25	29.4	192.54	45824.52
7	238	121.25	29.4	192.54	45824.52
6	238	121.25	29.4	192.54	45824.52
5	238	121.25	29.4	192.54	45824.52
4	238	121.25	29.4	192.54	45824.52
3	238	121.25	29.4	192.54	45824.52
2	238	121.25	29.4	192.54	45824.52
SUM				0	677.4718

J-3	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof	238	86.25	150	343.5	81753
14	238	121.25	29.4	192.54	45824.52
13	238	121.25	29.4	192.54	45824.52
12	238	121.25	29.4	192.54	45824.52
11	238	121.25	29.4	192.54	45824.52
10	238	121.25	29.4	192.54	45824.52
9	238	121.25	29.4	192.54	45824.52
8	238	121.25	29.4	192.54	45824.52
7	238	121.25	29.4	192.54	45824.52
6	238	121.25	29.4	192.54	45824.52
5	238	121.25	29.4	192.54	45824.52
4	238	121.25	29.4	192.54	45824.52
3	238	121.25	29.4	192.54	45824.52
2	238	121.25	29.4	192.54	45824.52
SUM				0	677.4718

J-4	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof	238	86.25	150	343.5	81753
14	238	121.25	29.4	192.54	45824.52
13	238	121.25	29.4	192.54	45824.52
12	238	121.25	29.4	192.54	45824.52
11	238	121.25	29.4	192.54	45824.52
10	238	121.25	29.4	192.54	45824.52
9	238	121.25	29.4	192.54	45824.52
8	238	121.25	29.4	192.54	45824.52
7	238	121.25	29.4	192.54	45824.52
6	238	121.25	29.4	192.54	45824.52
5	238	121.25	29.4	192.54	45824.52
4	238	121.25	29.4	192.54	45824.52
3	238	121.25	29.4	192.54	45824.52
2	238	121.25	29.4	192.54	45824.52
SUM				0	677.4718

J-5	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof	238	86.25	150	343.5	81753
14	238	121.25	29.4	192.54	45824.52
13	238	121.25	29.4	192.54	45824.52
12	238	121.25	29.4	192.54	45824.52
11	238	121.25	29.4	192.54	45824.52
10	238	121.25	29.4	192.54	45824.52
9	238	121.25	29.4	192.54	45824.52
8	238	121.25	29.4	192.54	45824.52
7	238	121.25	29.4	192.54	45824.52
6	238	121.25	29.4	192.54	45824.52
5	238	121.25	29.4	192.54	45824.52
4	238	121.25	29.4	192.54	45824.52
3	238	121.25	29.4	192.54	45824.52
2	238	121.25	29.4	192.54	45824.52
SUM				0	677.4718

J-6	Trib Area	Dead	Live	1.2D+1.6L	Load (lbs)
Roof	238	86.25	150	343.5	81753
14	238	121.25	29.4	192.54	45824.52
13	238	121.25	29.4	192.54	45824.52
12	238	121.25	29.4	192.54	45824.52
11	238	121.25	29.4	192.54	45824.52
10	238	121.25	29.4	192.54	45824.52
9	238	121.25	29.4	192.54	45824.52
8	238	121.25	29.4	192.54	45824.52
7	238	121.25	29.4	192.54	45824.52
6	238	121.25	29.4	192.54	45824.52
5	238	121.25	29.4	192.54	45824.52
4	238	121.25	29.4	192.54	45824.52
3	238	121.25	29.4	192.54	45824.52
2	238	121.25	29.4	192.54	45824.52
SUM				0	677.4718

J-7	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof	238	86.25	150	343.5	81753
14	238	121.25	29.4	192.54	45824.52
13	238	121.25	29.4	192.54	45824.52
12	238	121.25	29.4	192.54	45824.52
11	238	121.25	29.4	192.54	45824.52
10	238	121.25	29.4	192.54	45824.52
9	238	121.25	29.4	192.54	45824.52
8	238	121.25	29.4	192.54	45824.52
7	238	121.25	29.4	192.54	45824.52
6	238	121.25	29.4	192.54	45824.52
5	238	121.25	29.4	192.54	45824.52
4	238	121.25	29.4	192.54	45824.52
3	238	121.25	29.4	192.54	45824.52
2	238	121.25	29.4	192.54	45824.52
SUM				0	677.4718

J-8	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof	238	86.25	150	343.5	81753
14	238	121.25	29.4	192.54	45824.52
13	238	121.25	29.4	192.54	45824.52
12	238	121.25	29.4	192.54	45824.52
11	238	121.25	29.4	192.54	45824.52
10	238	121.25	29.4	192.54	45824.52
9	238	121.25	29.4	192.54	45824.52
8	238	121.25	29.4	192.54	45824.52
7	238	121.25	29.4	192.54	45824.52
6	238	121.25	29.4	192.54	45824.52
5	238	121.25	29.4	192.54	45824.52
4	238	121.25	29.4	192.54	45824.52
3	238	121.25	29.4	192.54	45824.52
2	238	121.25	29.4	192.54	45824.52
SUM				0	677.4718

J-9	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof	238	86.25	150	343.5	81753
14	238	121.25	29.4	192.54	45824.52
13	238	121.25	29.4	192.54	45824.52
12	238	121.25	29.4	192.54	45824.52
11	238	121.25	29.4	192.54	45824.52
10	238	121.25	29.4	192.54	45824.52
9	238	121.25	29.4	192.54	45824.52
8	238	121.25	29.4	192.54	45824.52
7	238	121.25	29.4	192.54	45824.52
6	238	121.25	29.4	192.54	45824.52
5	238	121.25	29.4	192.54	45824.52
4	238	121.25	29.4	192.54	45824.52
3	238	121.25	29.4	192.54	45824.52
2	238	121.25	29.4	192.54	45824.52
SUM				0	677.4718

J-10	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof	238	86.25	150	343.5	81753
14	238	121.25	29.4	192.54	45824.52
13	238	121.25	29.4	192.54	45824.52
12	238	121.25	29.4	192.54	45824.52
11	238	121.25	29.4	192.54	45824.52
10	238	121.25	29.4	192.54	45824.52
9	238	121.25	29.4	192.54	45824.52
8	238	121.25	29.4	192.54	45824.52
7	238	121.25	29.4	192.54	45824.52
6	238	121.25	29.4	192.54	45824.52
5	238	121.25	29.4	192.54	45824.52
4	238	121.25	29.4	192.54	45824.52
3	238	121.25	29.4	192.54	45824.52
2	238	121.25	29.4	192.54	45824.52
SUM				0	677.4718

J-11	Trib Area	Dead	Live	1.2D+1.6L	Load (lbs)
Roof	238	86.25	150	343.5	81753
14	238	121.25	29.4	192.54	45824.52
13	238	121.25	29.4	192.54	45824.52
12	238	121.25	29.4	192.54	45824.52
11	238	121.25	29.4	192.54	45824.52
10	238	121.25	29.4	192.54	45824.52
9	238	121.25	29.4	192.54	45824.52
8	238	121.25	29.4	192.54	45824.52
7	238	121.25	29.4	192.54	45824.52
6	238	121.25	29.4	192.54	45824.52
5	238	121.25	29.4	192.54	45824.52
4	238	121.25	29.4	192.54	45824.52
3	238	121.25	29.4	192.54	45824.52
2	238	121.25	29.4	192.54	45824.52
SUM				0	677.4718

J-12	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof	238	86.25	150	343.5	81753
14	238	121.25	29.4	192.54	45824.52
13	238	121.25	29.4	192.54	45824.52
12	238	121.25	29.4	192.54	45824.52
11	238	121.25	29.4	192.54	45824.52
10	238	121.25	29.4	192.54	45824.52
9	238	121.25	29.4	192.54	45824.52
8	238	121.25	29.4	192.54	45824.52
7	238	121.25	29.4	192.54	45824.52
6	238	121.25	29.4	192.54	45824.52
5	238	121.25	29.4	192.54	45824.52
4	238	121.25	29.4	192.54	45824.52
3	238	121.25	29.4	192.54	45824.52
2	238	121.25	29.4	192.54	45824.52
SUM				0	677.4718

J-13	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof	238	86.25	150	343.5	81753
14	238	121.25	29.4	192.54	45824.52
13	238	121.25	29.4	192.54	45824.52
12	238	121.25	29.4	192.54	45824.52
11	238	121.25	29.4	192.54	45824.52
10	238	121.25	29.4	192.54	45824.52
9	238	121.25	29.4	192.54	45824.52
8	238	121.25	29.4	192.54	45824.52
7	238	121.25	29.4	192.54	45824.52
6	238	121.25	29.4	192.54	45824.52
5	238	121.25	29.4	192.54	45824.52
4	238	121.25	29.4	192.54	45824.52
3	238	121.25	29.4	192.54	45824.52
2	238	121.25	29.4	192.54	45824.52
SUM				0	677.4718

J-14	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof	238	86.25	150	343.5	81753
14	238	121.25	29.4	192.54	45824.52
13	238	121.25	29.4	192.54	45824.52
12	238	121.25	29.4	192.54	45824.52
11	238	121.25	29.4	192.54	45824.52
10	238	121.25	29.4	192.54	45824.52
9	238	121.25	29.4	192.54	45824.52
8	238	121.25	29.4	192.54	45824.52
7	238	121.25	29.4	192.54	45824.52
6	238	121.25	29.4	192.54	45824.52
5	238	121.25	29.4	192.54	45824.52
4	238	121.25	29.4	192.54	45824.52
3	238	121.25	29.4	192.54	45824.52
2	238	121.25	29.4	192.54	45824.52
SUM				0	677.4718

J-15	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof	238	86.25	150	343.5	81753
14	238	121.25	29.4	192.54	45824.52
13	238	121.25	29.4	192.54	45824.52
12	238	121.25	29.4	192.54	45824.52
11	238	121.25	29.4	192.54	45824.52
10	238	121.25	29.4	192.54	45824.52
9	238	121.25	29.4	192.54	45824.52
8	238	121.25	29.4	192.54	45824.52
7	238	121.25	29.4	192.54	45824.52
6	238	121.25	29.4	192.54	45824.52
5	238	121.25	29.4	192.54	45824.52
4	238	121.25	29.4	192.54	45824.52
3	238	121.25	29.4	192.54	45824.52
2	238	121.25	29.4	192.54	45824.52
SUM				0	677.4718

J-16	Trib Area	Dead	Live	1.2D+1.6L	Load (lbs)
Roof	238	86.25	150	343.5	81753
14	238	121.25	29.4	192.54	45824.52
13	238	121.25	29.4	192.54	45824.52
12	238	121.25	29.4	192.54	45824.52
11	238	121.25	29.4	192.54	45824.52
10	238	121.25	29.4	192.54	45824.52
9	238	121.25	29.4	192.54	45824.52
8	238	121.25	29.4	192.54	45824.52
7	238	121.25	29.4	192.54	45824.52
6	238	121.25	29.4	192.54	45824.52
5	238	121.25	29.4	192.54	45824.52
4	238	121.25	29.4	192.54	45824.52
3	238	121.25	29.4	192.54	45824.52
2	238	121.25	29.4	192.54	45824.52
SUM				0	677.4718

J-17	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof	238	86.25	150	343.5	81753
14	238	121.25	29.4	192.54	45824.52
13	238	121.25	29.4	192.54	45824.52
12	238	121.25	29.4	192.54	45824.52
11	238	121.25	29.4	192.54	45824.52
10	238	121.25	29.4	192.54	45824.52
9	238	121.25	29.4	192.54	45824.52
8	238	121.25	29.4	192.54	45824.52
7	238	121.25	29.4	192.54	45824.52
6	238	121.25	29.4	192.54	45824.52
5	238	121.25	29.4	192.54	45824.52
4	238	121.25	29.4	192.54	45824.52
3	238	121.25	29.4	192.54	45824.52
2	238	121.25	29.4	192.54	45824.52
SUM				0	677.4718

J-18	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof	238	86.25	150	343.5	81753
14	238	121.25	29.4	192.54	45824.52
13	238	121.25	29.4	192.54	45824.52
12	238	121.25	29.4	192.54	45824.52
11	238	121.25	29.4	192.54	45824.52
10	238	121.25	29.4	192.54	45824.52
9	238	121.25	29.4	192.54	45824.52
8	238	121.25	29.4	192.54	45824.52
7	238	121.25	29.4	192.54	45824.52
6	238	121.25	29.4	192.54	45824.52
5	238	121.25	29.4	192.54	45824.52
4	238	121.25	29.4	192.54	45824.52
3	238	121.25	29.4	192.54	45824.52
2	238	121.25	29.4	192.54	45824.52
SUM				0	677.4718

J-19	Trib Area	Dead (psf)	Live (psf)	1.2D+1.6L	Load (lbs)
Roof	119	86.25	150	343.5	40876.5
14	119	121.25	37.5	205.5	24454.5
13	119	121.25	37.5	205.5	24454.5
12	119	121.25	37.5	205.5	24454.5
11	119	121.25	37.5	205.5	24454.5
10	119	121.25	37.5	205.5	24454.5
9	119	121.25	37.5	205.5	24454.5
8	119	121.25	37.5	205.5	24454.5
7	119	121.25	37.5	205.5	24454.5
6	119	121.25	37.5	205.5	24454.5
5	119	121.25	37.5	205.5	24454.5
4	119	121.25	37.5	205.5	24454.5
3	119	121.25	37.5	205.5	24454.5
2	119	121.25	37.5	205.5	24454.5
SUM				0	358.785

Appendix H

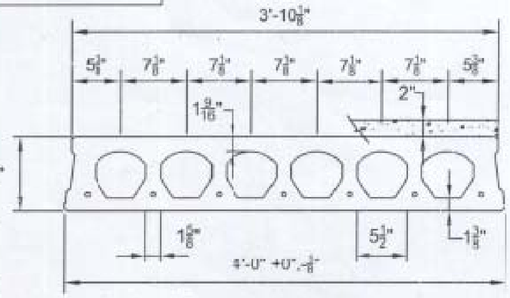
USE LOWE'S HARE
FOR ETASS

Prestressed Concrete
8"x4'-0" Hollow Core Plank

2 Hour Fire Resistance Rating With 2" Topping

PHYSICAL PROPERTIES
Composite Section

A_c = 301 in.^{2}	Precast S_{bc} = 617 in.^{3}
I_c = 3134 in.^{4}	Topping S_{tc} = 902 in.^{3}
Y_{bc} = 5.09 in.	Precast S_{tc} = 1076 in.^{3}
Y_{tc} = 2.91 in.	Wt.= 245 PLF
	Wt.= 61.25 PSF



DESIGN DATA

1. Precast Strength @ 28 days = 6000 PSI
2. Precast Strength @ release = 3500 PSI.
3. Precast Density = 150 PCF
4. Strand = 1/2"Ø 270K Lo-Relaxation.
5. Strand Height = 1.75 in.
6. Ultimate moment capacity (when fully developed)...
   4-1/2"Ø, 270K = 92.3 k-ft
   7-1/2"Ø, 270K = 147.7 k-ft
7. Maximum bottom tensile stress is $7.5\sqrt{f'c}$ = 580 PSI
8. All superimposed load is treated as live load in the strength analysis of flexure and shear.
9. Flexural strength capacity is based on stress/strain strand relationships.
10. Deflection limits were not considered when determining allowable loads in this table.
11. Topping Strength @ 28 days = 3000 PSI. Topping Weight = 25 PSF.
12. These tables are based upon the topping having a uniform 2" thickness over the entire span. A lesser thickness might occur if camber is not taken into account during design, thus reducing the load capacity.
13. Load values to the left of the solid line are controlled by ultimate shear strength.
14. Load values to the right are controlled by ultimate flexural strength or fire endurance limits.
15. Load values may be different for IBC 2000 & ACI 318-99. Load tables are available upon request.
16. Camber is inherent in all prestressed hollow core slabs and is a function of the amount of eccentric prestressing force needed to carry the superimposed design loads along with a number of other variables. Because prediction of camber is based on empirical formulas it is at best an estimate, with the actual camber usually higher than calculated values.

SAFE SUPERIMPOSED SERVICE LOADS		IBC 2003 & ACI 318-02 (1.2 D - 1.6 L)																		
Strand Pattern		SPAN (FEET)																		
		17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
4 - 1/2"ø	LOAD (PSF)	275	236	203	175	150	129	111	95	81	68	57	47	38						
7 - 1/2"ø	LOAD (PSF)	367	342	319	299	281	265	243	216	193	171	153	136	121	107	95	84	74	63	53

NITTERHOUSE
CONCRETE PRODUCTS

2655 Molly Pitcher Hwy. South, Box N
Chambersburg, PA 17201-0813
717-267-4505 Fax 717-267-4518

This table is for simple spans and uniform loads. Design data for any of these span-load conditions is available on request. Individual designs may be furnished to satisfy unusual conditions of heavy loads, concentrated loads, cantilevers, flange or stem openings and narrow widths. The allowable loads shown in this table reflect a 2 Hour & 0 Minute fire resistance rating.

08/10/07

8SF2.0T

TYPICAL BAY DESIGN FOR GIRDER-SLAB SYSTEM

1/4

DB-8 – NO TOPPING
DB-9 → 2" TOPPING ASSEMBLIES 20'x28' very effecient
PLANK DL = 61.25PSF, PARTITION LOAD = 20PSF, LIVE LOAD = 40PSF
TOPPING = 25PSF
PLANK f'c = 6,000PSI GROUT f'c =
TOPPING f'c = 3,000 PSI

DEADLOAD

LIVE LOAD = 40PSF

PARTITIONS = 20PSF
MEP = 10 PSF
FINISHES & MISC = 5PSF
TOPPING = 25PSF
8" HOLLOW CORE PLANK SPAN 28'
DB SPAN 20'

BEING conservative by factoring

$$1.2D+1.6L = 1.2(\overset{35}{20+10+5}) + 1.6(40) = 42 + 64 = 106\,PSF$$

NITTERHOUSE
↳ 8"x4' PLANK 7-½"Ø = 136PSF ≥ 106 ✓OK

$$\text{ALLOWABLE } \Delta_{LL} = L/360 = \frac{20 \cdot 12}{360} = .67in$$

INITIAL LOAD = PRECOMPOSITE

$$M_{DL} = \frac{(28')(\overset{\text{w/ topping}}{.06125})(20)^2}{8} = 85.75 \geq 84 \text{ : NO GOOD}$$

TRY SPAN OF 18'

$$\Delta_{LL} = L/360 = \frac{18 \cdot 12}{360} = .6 \text{ inches}$$

DB 9x46

INITIAL LOAD

$$M_{DL} = \frac{(28')(.06125)(18)^2}{8} = 69.46 \leq 84 \ \checkmark OK$$

2/4

$$\Delta_{DL} = \frac{(5)(28)(.06125)(18)^4(1728)}{384(29{,}000)(195)} = .716$$

TOTAL LOAD COMPOSITE

$$M_{SUP} = \frac{(28')(.02+.04+.025+.01+.005)(18)^2}{8} = 113.4\ k'$$

$$M_{TL} = 69.46 + 113.4 = 182.86$$

$$S_{req} = \frac{(182.86)(12)}{(.6)(50)} = 73.144 > 68.6\ \checkmark\ \text{NO GOOD.}$$

TRY SPAN = 17'

$$\Delta_{LL} = L/360 = \frac{17 \times 12}{360} = .567\text{ in}$$

INITIAL DB9x46.

$$M_{DL} = \frac{(28')(.06125)(17')^2}{8} = 61.95 \le 84$$

$$\Delta_{DL} = \frac{(5)(28)(.06125)(17)^4(1728)}{384(29{,}000)(195)} = .57\text{ in}$$

$$\text{TOTAL } M_{SUP} = \frac{(28)(.1)(17)^2}{8} = 101.15k'$$

$$M_{TL} = 61.95 + 101.15 = 163.10\ k'$$

$$S_{req} = \frac{(163.10)(12)}{(.6)(50)} = 65.24 \le 68.6\ \checkmark\ \text{OK.}$$

$$\Delta_{SUP} = \frac{(5)(28)(.1)(17)^4(1728)}{384(356)(29{,}000)} = .510 < .567\text{ in}\ \checkmark\ \text{OK}$$

3/4

Compressive stress on concrete

$N_{value} = \frac{E_{steel}}{E_{conc}} = \frac{29000\,ksi}{57{,}000\sqrt{4{,}000}} = \frac{29{,}000}{3{,}605} = 8.04$

$S_{tc} = 8.04(68.6) = 551.54\,in^3$

$f_c = \frac{(101.15)(12)}{551.54} = 2.20$

$F_c = .45(4\,ksi) = 1.8 < 2.20$ ✓ NO GOOD

TRY GROUT OF 5KSI ⇒ this works if you reduce live LOAD.

SEE CALCS ATTACHED

$\frac{29{,}000}{57{,}000\sqrt{5{,}000}} = 7.195(68.6) = 493.585$

$f_c = \frac{(101.15)(12)}{493.58} = 2.46$

$(.45)(5) = 2.25 < 2.46$ ✓ NO GOOD

TRY 6KSI

$\frac{29{,}000}{57{,}000\sqrt{6{,}000}} = 6.57(68.6) = 450.702$

$f_c = \frac{(101.15)(12)}{450.702} = 2.69$

$.45(6) = 2.70 > 2.69$ ✓ OK

Check BOT. FLANGE TENSION (TOT. LOAD)

$f_b = \frac{(61.95)(12)}{50.8} + \frac{(101.15)(12)}{80.6} = 14.63 + 15.06 = 29.69\,ksi$

$F_b = (.9)(50) = 45\,ksi > 29.69$ ✓ OK

4/4

Check Shear

TOTAL LOAD $(61.25 + 20 + 10 + 5 + 25 + 40) = 161.25psf$

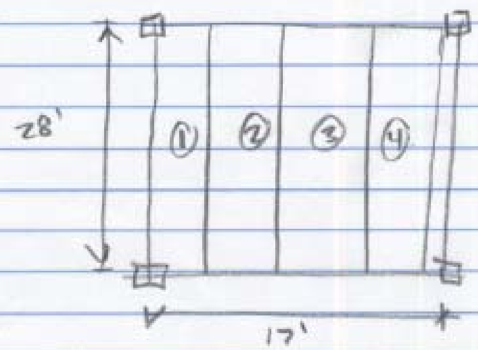
$w = (.16125)(28') = 4.515 k/l$

$R = \frac{4.515(17')}{2} = 38.38 k$

$f_v = \frac{38.38^k}{(.375)(5.75)} = 17.80$

$F_v = .4(50) = 20 ksi > 17.80 ksi$ ✓OK

DB 9X46 SPAN 17' USE 6KSI GROUT
NITTERHOUSE 8'x4" 2in topping SPAN 28'



TOTAL SLAB DEPTH = 10"

D-Beam® Calculator Reference Tool

2/18/2008

Project Name: Wisconsin Place Residential
Job Number: Kurt's Thesis

Design Information

Dead Load =	61.25	psf
S.I.D.L. Partition Load =	35	psf = 20+10MEP+5FINISHES
Live Load =	40	psf
Topping Load =	25	psf
DB Span =	17	ft
Plank Span =	28	ft
Grout f'c =	5000	psi
Allowable Δ_{LL} = L /	360	
Allowable Δ_{LL} =	0.57	in

DB Properties

DB Size ---------------> DB 9 x 46

Steel Section			Transformed Section		
I_s =	195	in^4	I_t =	356	in^4
S_t =	33.7	in^3	S_t =	68.6	in^3
S_b =	50.8	in^3	S_b =	80.6	in^3
M_{scas} =	84.0	ft-k			
t_w =	0.375	in			
b =	5.75	in			

Live Load Reduction (IBC 00/03/06)

Include LLR	☑	(Check for Yes) N/A
% Reduction =	26.38	%
Reduced Load =	29.4	psf

Initial Load - Precomposite

M_{DL} =	62.0 ft-k	<	84.0 ft-k	OK
Δ_{DL} =	0.57 in			
Δ Ratio = L /	358			
Camber D-Beam	☐ (Check for Yes)			
D-Beam Camber	1 in			

Total Load - Composite

M_{sup} =	90.5 ft-k			
M_{TL} =	152.4 ft-k			
S_{REQ} =	61.0 in^3	<	68.6 in^3	OK
Δ_{SUP} =	0.46 in	<	0.57 in	OK
Δ_{TOT} =	1.03 in	= L/ 199		

Superimposed Compressive Stress on Concrete

N value =	7.20			
S_{tc} =	494 in^3			
f_c =	2.20 ksi			
F_c =	2.25 ksi	>	2.20 ksi	OK

Bottom Flange Tension Stress (Total Load)

f_b =	28.1 ksi			
F_b =	45 ksi	>	28.1 ksi	OK

Shear Check

Total Load =	151 psf			
w =	4.22 klf			
R =	35.9 k			
f_v =	16.6 ksi			
Fv =	20 ksi	>	16.6 ksi	OK

D-Beam® Calculator Reference Tool

2/21/2008

Project Name: Wisconsin Place Residential Roof @ 8th and 12th
Job Number: NOT INCLUDING SNOW DRIFT.

Design Information

Dead Load =	61.25	psf
Partition Load =	15	psf (MEP+FINISHES)
Live Load =	30	psf (LIVE)
Topping Load =	25	psf
DB Span =	17	ft
Plank Span =	28	ft
Grout f'c =	3000	psi
Allowable Δ_{LL} = L /	360	
Allowable Δ_{LL} =	0.57	in

DB Properties

DB Size ------------> DB 9 x 46

Steel Section		Transformed Section	
I_s =	195 in^4	I_t =	356 in^4
S_t =	33.7 in^3	S_t =	68.6 in^3
S_b =	50.8 in^3	S_b =	80.6 in^3
M_{ncap} =	84.0 ft-k		
t_w =	0.375 in		
b =	5.75 in		

Live Load Reduction (IBC 00/03/06)

Include LLR ☐ (Check for Yes)
% Reduction = N/A
Reduced Load = N/A

Initial Load - Precomposite

M_{DL} =	62.0 ft-k	<	84.0 ft-k	OK
Δ_{DL} =	0.57 in			
Δ Ratio = L /	358			
Camber D-Beam ☐	(Check for Yes)			
D-Beam Camber	1 in			

Total Load - Composite

M_{sup} =	70.8 ft-k			
M_{TL} =	132.8 ft-k			
S_{REQ} =	53.1 in^3	<	68.6 in^3	OK
Δ_{SUP} =	0.36 in	<	0.57 in	OK
Δ_{TOT} =	0.93 in	= L/ 220		

Superimposed Compressive Stress on Concrete

N value =	9.29			
S_{tc} =	637 in^3			
f_c =	1.33 ksi			
F_c =	1.35 ksi	>	1.33 ksi	OK

Bottom Flange Tension Stress (Total Load)

f_b =	25.2 ksi			
F_b =	45 ksi	>	25.2 ksi	OK

Shear Check

Total Load =	131 psf			
w =	3.68 klf			
R =	31.2 k			
f_v =	14.5 ksi			
Fv =	20 ksi	>	14.5 ksi	OK

D-Beam® Calculator Reference Tool

2/21/2008

Project Name: Wisconsin Place Residential Roof @ 8th a

Job Number: DRIFTING AREA.

Design Information

Dead Load =	61.25	psf
Partition Load =	15	psf SIDL
Live Load =	48.5	psf
Topping Load =	25	psf
DB Span =	17	ft
Plank Span =	26	ft
Grout f'c =	6000	psi
Alowable Δ_{LL} = L /	360	
Allowable Δ_{LL} =	0.57	in

DB Properties

DB Size ------------> DB 9 x 46

Steel Section			Transformed Section		
I_s =	195	in^4	I_t =	356	in^4
S_t =	33.7	in^3	S_t =	68.6	in^3
S_b =	50.8	in^3	S_b =	80.6	in^3
M_{ncap} =	84.0	ft-k			
t_w =	0.375	in			
b =	5.75	in			

Live Load Reduction (IBC 00/03/06)

Include LLR ☐ (Check for Yes)

% Reduction = N/A

Reduced Load = N/A

Initial Load - Precomposite

M_{DL} =	62.0 ft-k	<	84.0 ft-k	OK
Δ_{DL} =	0.57 in			
Δ Ratio = L /	358			
Camber D-Beam ☐	(Check for Yes)			
D-Beam Camber	1 in			

Total Load - Composite

M_{sup} =	89.5 ft-k			
M_{TL} =	151.5 ft-k			
S_{REQ} =	60.6 in^3	<	68.6 in^3	OK
Δ_{SUP} =	0.45 in	<	0.57 in	OK
Δ_{TOT} =	1.02 in	= L/ 200		

Superimposed Compressive Stress on Concrete

N value =	6.57			
S_{tc} =	451 in^3			
f_c =	2.38 ks			
F_c =	2.70 ks	>	2.38 ksi	OK

Bottom Flange Tension Stress (Total Load)

f_b =	28.0 ksi			
F_b =	45 ksi	>	28.0 ksi	OK

Shear Check

Total Load =	150 psf			
w =	4.19 klf			
R =	35.6 k			
f_v =	16.5 ksi			
Fv =	20 ksi	>	16.5 ksi	OK

$\frac{1}{1}$

SNOW DRIFT

$pf = .7 C_e C_t I p_g$

$pf = .7(.9)(1.0)(1.0)(30)$

$pf = 18.9$, $min = 20(I) = 20(1.0) = 20psf$

$\gamma = .13(pg) + 14 \leq 30$

$.13(30) + 14 = 17.9$

$h_b = pf/\gamma = 20/17.9 = 1.12$

$h_c = 30' - 1.12' = 28.88'$

$h_c/h_b = 28.88/1.12 = 25.79 \geq .2$ DRIFT NEEDS TO BE CONSIDERED

LEEWARD $hd = 3.7'$ FROM FIG 7-9 & $L_u = 112'$

WINDWARD $hd = 3/4 (3.8) = .6$

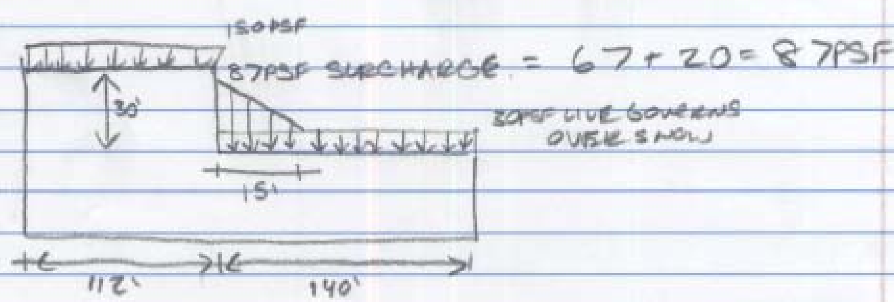
LEEWARD GOVERNS USE 3.7'

because $hd < hc$

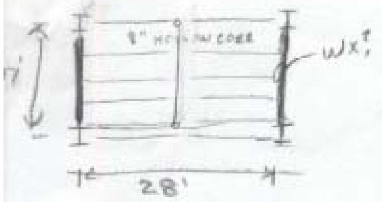
$hd = 3.7$

$w = 4hd = 14.8 \rightarrow 15'$

$pd = hd\gamma = 3.7(17.9) = 66.23 \rightarrow 67 \text{ lb/ft}^2$



ROOF CALCS.



DEAD LOAD

TOPPING = 25PSF
PLANK = 61.25PSF
NO PARTITIONS, MEP, FINISHES

LIVE LOAD = 150PSF

SUPERIMPOSED LOAD = 150 PSF

14' SPAN WILL WORK BASED ON NITTERHOUSE TABLES; USE 28' PLANK.

TOTAL DEAD:

PLANK = 61.25PSF
TOPPING = 25PSF
APPROX BEAM SELF = 75PLF

$86.25(14)+75 = 1282.5$

$150(14) = 2100$

$1.2D + 1.6L$

$1.2(1282.5) + 1.6(2100) = 4899 plf$

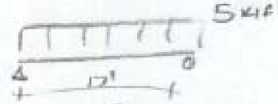
$\approx 5^{kip}$

TOTAL LIVE

150PSF PENTHOUSE & MECH ROOM

BEAM LOAD

$433.5(14') = 6069 PLF$



$M_u \; \frac{5(17')^2}{8} = 180.6^{k'}$

DEFLECTION — LIVE LOAD

$\Delta_L \le \frac{L}{360} = \frac{17\times12}{360} = .57$

$.57 \ge \frac{5wL^4}{384EI}$

$.57 \ge \frac{5(2.1)(17)^4(1728)}{384(29,000)I}$

$I \ge 238.74$

TOT. LOAD ⇒

$\Delta_T \le L/_{240} = \frac{17\times12}{240} = .85$

$.85 \le \frac{5\left(\frac{1282.5+2100}{1000}\right)(17^4)(1728)}{384(29,000)I}$

$I \ge 257.9$

CONTROLS

TRY W16X31

$W16\times31 \Rightarrow I_x: 203^{k'} > 180.6^{k'}$ ✓OK

$I = 375 \ge 257.9$ ✓OK

USE ACTUAL WT OF BEAM

$DL = 86.25(14) + 31 = 1238.5$

$LL \; 150(14) = 2100$

$1.2(1238.5) + 1.6(2100) = 4846.2 plf$

$M_u = \frac{4.8(17)^2}{8} = 173.4^k$

Δ_T:

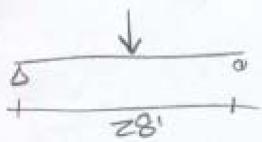
$.85 \le \frac{5(3.34)(17^4)(1728)}{384(29,000)I}$

$I \ge 254.679$ ✓OK

USE W16X31 BEAMS

SPAN 17' SPACED EVERY 14'

GIRDER



$86.25(14)+31 = 1238.5$ $\quad$ $1.2D+1.6L$

$150(14) = 2100$ $\quad$ $1.2(1238.5)+1.6(2100)$

$1486.2 + 3360$

TOT = 4846.2 PLF ≈ 4.8 KLF

$(4.8\,k/ft)(17') = 81.6^k/2 = 40.8^k \times 2 = 81.6^k$

FOR TWO BEAMS JOINING.

ASSUME SELF. WT OF GIRDER = 170 lb/ft

$$\Delta_{TOT} = \frac{Pl^3}{48EI} + \frac{5wl^4}{384EI}$$

$$\Delta_{TOT} = \frac{(81.6)(28)^3(1728)}{48(29{,}000)(I)} + \frac{5(.17)(28)^4(1728)}{384(29{,}000)(I)}$$

$$\frac{L}{240} = \frac{28\times 12}{240} = 1.4''$$

$$1.4'' = \frac{2223.66}{I} + \frac{81.071}{I}$$

$$1.4'' \le \frac{2304.73}{I}$$

$I \ge 1646.24$ CONTROLS.

$$M_u = \frac{Pl}{4} + \frac{wl^2}{8} = \frac{(81.6)(28)}{4} + \frac{.170(28)^2}{8}$$

$571.2 + 16.66 = 587.86$

TRY USING W24X68

$$\Delta_{TOT} = \frac{(81.6)(28)^3(1728)}{48(29{,}000)\,I} + \frac{5(.068)(28)^4(1728)}{384(29{,}000)\,I}$$

$$M_u = \frac{81.6(28)}{4} + \frac{.068(28)^2}{8}$$

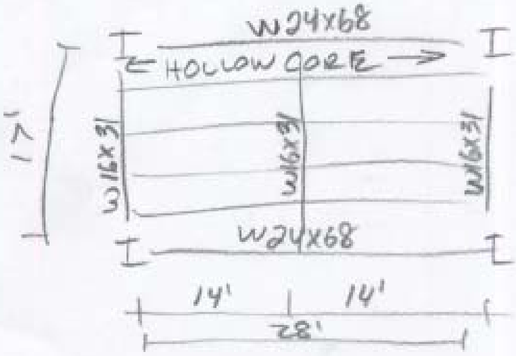
$$1.4 = \frac{2223.66}{I} + \frac{32.42}{I}$$

$M_u = 577.86\,k\cdot$

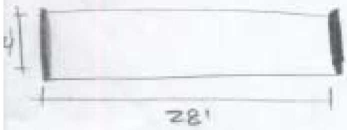
$I \ge 1611.49$

W24x68 ⇒ 664 ≥ 577 ✓OK

1830 ≥ 1611 ✓OK.



TYP. BAY FOR MAIN ROOF.



TOTAL LOAD — DEAD: PLANK = 61.25, TOP = 25PSF — LIVE: 100PSF

BALCONY DESIGN.

$\Delta_{LL} = l/360 \quad \frac{4'(12)}{360} = .133''$

USE DB9X41
GROUT $f'c \geq 4KSi$
CANTILEVER.

8" SOLID PLANK
$8/12 \times 150 = 100psf$

INITIAL LOAD

$(.100)(28') = 2.8\ k/l$

$\frac{(2.8)(4)^2}{2} = M_{DL} = 22.4 < 61k'\ \checkmark ok$

$\Delta_{DL}: \frac{wl^4}{8EI} = \frac{(2.8)(4)^4(1728)}{8(29,000)(159)} = .034''$

DB9X41
$I_s = 159 in^4$
$S_t = 24.4$
$S_b = 51.0$
$M_{SCAP} = 61$
$t_w = .375$

$I_t = 332 in^4$
$S_t = 62.1 in^3$
$S_b = 77.7 in^3$
$b = 5.25$

TOT LOAD

$M_{sup}: (.100 + .025)(28) = 3.5\ k/l$

$\frac{(3.5)(4)^2}{2} = 28\ k'$

$M_{TL} = 22.4 + 28 = 50.4$

$S_{req}: \frac{(50.4)(12)}{(.6)(50)} = 20.16 < 62.1 in^3\ \checkmark ok.$

$\Delta_{sup}: \frac{(3.5)(4)^4(1728)}{8(29,000)(332)} = .0201'' < .133''\ \checkmark ok.$

Check Shear

TOT LOAD $= (100 + 100 + 25) = 225 PSF$

$V = (.225)(28) = 6.3\ k/l$

$V = 6.3(4') = 25.2$

$f_v = \frac{25.2}{(.375)(5.25)} = 12.80\ ksi$

$F_v = .4(50) = 20\ ksi > 12.80\ ksi\ \checkmark ok.$

Check compressive Stress on Concrete

$N_{value} = \frac{E_{steel}}{E_{conc.}} = \frac{29,000}{57,000\sqrt{4,000}} = \frac{29000}{3605} = 8.04$

$S_{tc} = 8.04(62.1) = 499$

$f_c = \frac{(28k)(12)}{499} = .67 \qquad F_c = .45(4) = 1.80 > .67\ \checkmark ok$

Check BOT FLANGE TENSION STRESS (TOT. LOAD)

$f_b = \frac{22.4(12)}{51} + \frac{28(12)}{77.7} = 5.27 + 4.32 = 9.6$

$F_b = .9(50) = 45 ksi > 9.6\ \checkmark ok$

1/1

LIVE LOAD REDUCTIONS

$L = L_o(.25 + 15/\sqrt{K_{LL}A_T})$

FOR CORNER COL.
$4(119) \ge 400$
$476 \ge 400$
$A_T = 119$

$L = 40(.25 + 15/\sqrt{4(14 \times 17/2)})$

$L = 37.5\text{psf} \ge .4L_o = 16$

$L = 40(.25 + 15/\sqrt{4(17 \times 14)})$

EXT COLUMN
$A_T = 238$

$L = 29.4\text{ psf} \ge 16$

$L = 40(.25 + \frac{15}{\sqrt{4(17 \times 28)}}$

INT. COL.
$A_T = 476$

$L = 23.75\text{psf} \ge 16$

MAINROOF DESIGN FOR 150 lb/ft²
NOT REDUCED

ALL OTHER ROOFS 30 lb/ft²
NOT REDUCED.

$L = 40(.25 + 15/\sqrt{4(357)}) = 25.88$

INT CORNER COLUMN

$L = 25.88 \ge 16$

$A_T = 357$

FLOOR DEAD	ROOF DEAD (8 & 12th)	MAINROOF DEAD
61.25 PLANK	61.25	61.25
25 TOPPING	25.00	25.00
10 MEP	10 MEP	86.25PSF
5 FINISHES	5 FINISHE	
20 PARTITIONS	101.25 PSF	
121.25PSF		

SEISMIC DESIGN FOR NEW BUILDING.

BUILDING ON SITE CLASS B IS 136.98'

LATITUDE: 38.96

LONGITUDE: -77.09 $T_L = 8 sec \geq T: 2.04s$

$S_S = .154g$

$S_1 = .050$ $K = 1.23$

$F_a = 1.0$

$F_v = 1.0$

$S_{MS} = F_a \cdot S_S = 1.0(.154) = .154g$

$S_{M1} = F_v \cdot S_1 = 1.0(.050) = .050g$

$S_{DS} = 2/3 S_{MS} = 2/3(.154) = .103$

$S_{D1} = 2/3 S_{M1} = 2/3(.050) = .034$

SPECIAL STEEL CONCENTRICALLY BRACED FRAMES

R = 6.0 (SCBF)

IMPORTANCE FACTOR, I = 1.0

OCCUPANCY CATEGORY: II & $S_{DS} < 0.167$ ∴ SDC = A use E

BASESHEAR: $V_b = C_s W$

$T_a = C_t h_n^x$

$T_a = .02(136.98)^{.75}$

$T_a = .801s$

$T = C_u \cdot T_a$ (1.7)(.801) = 1.36s

$C_u = 1.7$

$\frac{1}{1.36} < 1$ ∴ FLEXIBLE

$$\min \begin{cases} C_s = \dfrac{S_{DS}}{R/I} = \dfrac{.103}{6/1.0} = .017 \\ C_s = \dfrac{S_{D1}}{T(R/I)} = \dfrac{.034}{1.36(6/1)} = .0042 \end{cases}$$

$C_s = .010$ GOVERNS

$V_b = C_s(W)$

$V_b = .01(69,328) = 693.28$ $\boxed{V_b = 694^K}$

change 12-14
E-W
area.

1/3

GUST FACTOR - FLEXIBLE BUILDING.

$$Gf = .925\left(\frac{1+1.7I_{\bar{z}}\sqrt{g_Q^2 Q^2 + g_R^2 R^2}}{1+1.7g_v I_{\bar{z}}}\right)$$

$g_Q = 3.4$, $g_v = 3.4$ $\quad n_1 = 1.36$

$$g_r = \sqrt{2\ln(3600n_1)} + \frac{.577}{\sqrt{2\ln(3600n_1)}}$$

$g_r = 4.12 + .140$

$g_r = 4.26$ $\quad \bar{z} = .6h = .6(136.98) = 82.19$ OK✓

$z_{min} = 30'$

$$R = \sqrt{\tfrac{1}{\beta}R_n R_h R_B (.53 + .47R_L)}$$

$$R_n = \frac{7.47N_1}{(1+10.3N_1)^{5/3}} \qquad N_1 = \frac{n_1 L_{\bar{z}}}{\bar{V}_{\bar{z}}} \qquad \bar{V}_z = \bar{b}\left(\frac{\bar{z}}{33}\right)^{\bar{\alpha}} V\left(\frac{88}{60}\right)$$

$\bar{\alpha} = .25$ $\quad \bar{V}_z = .45\left(\frac{82.19}{33}\right)^{.25} 90\left(\frac{88}{60}\right)$

$\bar{b} = .45$

$\bar{V}_z = 74.62$

$$L_{\bar{z}} = l\left(\frac{\bar{z}}{33}\right)^{\bar{\epsilon}} = 320\left(82.19/33\right)^{.333} = 433.63$$

$L_{\bar{z}} = 433.63$

$l = 320$

$\bar{\epsilon} = .333$ $\quad N_1 = \frac{(1.36)(433.63)}{74.62} = 7.90 = N_1$

$$R_n = \frac{7.47(7.90)}{(1+10.3(7.9))^{5/3}} = .038 = R_n$$

$R_l = \frac{1}{\eta} - \frac{1}{2\eta^2}(1-e^{-2\eta})$ for $\eta > 0$

$$I_{\bar{z}} = c\left(\frac{33}{\bar{z}}\right)^{1/6} = .3\left(\frac{33}{82.19}\right)^{1/6} = .258 = I_{\bar{z}}$$

NORTH - SOUTH

$\eta = 4.6 n_1 (h/\bar{V}_z)$ $\qquad \eta = (4.6)(1.36)(136.98/74.62) = 11.48$ $\qquad 2/3$

$\eta = 4.6 n_1 EB/\bar{V}_z$ $\qquad \eta = 4.6(1.36)(306)/74.62 = 25.65$

$\eta = 15.4 n_1 L/\bar{V}_z$ $\qquad \eta = 15.4(1.36)(252)/74.62 = 70.73$

N-S ⇒ $L = 252$, $B = 306$

E-W $L = 306$, $B = 252$

EAST WEST

$\eta = 11.48$

$\eta = 4.6(1.36)(252)/74.62 = 21.13$

$\eta = 15.4(1.36)(306)/74.62 = 85.89$

NORTH - SOUTH

$$R_h = \frac{1}{11.48} - \frac{1}{2(11.48)^2}\left(1 - e^{-2(11.48)}\right) = .087 - (.0038)(1 - 1.06E{-10})$$

$R_h = .0832$

$$R_B = \frac{1}{25.65} - \frac{1}{2(25.65)^2}\left(1 - e^{-2(25.65)}\right) = .039 - (7.59E{-4})(1 - 5.25E{-23})$$

$R_B = .0382$

$$R_L = \frac{1}{70.73} - \frac{1}{2(70.73)^2}\left(1 - e^{-2(70.73)}\right) = .014 - (9.99E{-5})(1 - 3.47E{-62})$$

$R_L = .0139$

EAST - WEST

$R_h = .0832$

R_H = SAME

$$R_B = \frac{1}{21.13} - \frac{1}{2(21.13)^2}\left(1 - e^{-2(21.13)}\right) = .047 - (.0011)(1 - 4.43E{-19})$$

$R_B = .0459$

$$R_L = \frac{1}{85.89} - \frac{1}{2(85.89)^2}\left(1 - e^{-2(85.89)}\right) = .012 - (6.78E{-5})(1 - 2.49E{-75})$$

$R_L = .0119$

NORTH - SOUTH

$$R = \sqrt{\tfrac{1}{\beta} R_n R_h R_B (.53 + .47 R_L)} = \sqrt{\tfrac{1}{.05}(.038)(.0832)(.0382)(.53 + .47(.0139))}$$

$R = .036$ NORTH - SOUTH

EAST - WEST

$$R = \sqrt{\tfrac{1}{.05}(.038)(.0832)(.0459)(.53 + .47(.0119))}$$

$R = .039$

3/3

NORTH - SOUTH

$$G_f = .925\left(\frac{1+1.7(.258)\sqrt{(3.4)^2(.781)^2+(4.26)^2(.036)^2}}{1+1.7(3.4)(.258)}\right)$$

$$G_f = .925\left(\frac{1+.4386(2.66)}{2.49}\right)$$

$$\boxed{G_f = .80}$$

2.26?

EAST - WEST

$$G_f = .925\left(\frac{1+1.7(.258)\sqrt{(3.4)^2(.793)^2+(4.26)^2(.039)^2}}{1+1.7(3.4)(.258)}\right)$$

$$G_f = .925\left(\frac{1+.4386(2.70)}{2.49}\right)$$

$$\boxed{G_f = .81}$$

NORTH - SOUTH

EAST WEST

$$Q = \sqrt{\frac{1}{1+.63\left(\frac{B+h}{L_2}\right)^{.63}}}$$

$$Q = \sqrt{\frac{1}{1+.63\left(\frac{306+136.48}{433.63}\right)^{.63}}}$$

$$Q = \sqrt{\frac{1}{1+.63\left(\frac{252+136.48}{433.63}\right)^{.63}}}$$

$Q = .781$

$Q = .793$