AE SENIOR THESIS
FINAL REPORT

SCHOOL WITHOUT WALLS

SHAUN KREIDEL

STRUCTURAL OPTION

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4/12/2010

The School Without Walls

Washington, D.C.

http://www.engr.psu.edu/ae/thesis/portfolios/2010/smk5085/

project team

architect : ehrenkrantz eckstut & kuhn
structural engineer: restl designers
mep engineer: golden engineering
civil engineer: ccjm
geotechincal engineer : thomas l brown associates
general contractor: turner construction

statistics

location: 2130 g street nw, washington, d.c.
levels: 4 stories above, 1 stories below grade
square footage of original school: 32,300 sq ft
size of new addition : 68,000 sq ft
construction dates: june2008 –august2009
delivery method: guaranteed maximum price
project phase: completed

architecture

-the new 68,000 square foot addition blends the 19th century school with a modern design
-damaged bricks were replaced and existing bricks were repointed
-the new addition sports a glass curtain wall façade facing G Street.
-the old section of the school is made up of four large classrooms, one at each corner of the square building
-the new addition of the school provides an additional two large classrooms on each floor.
-an additional fourth floor was added to serve as a library space.

structural

-wood joists are used, and remain in the original portion of the school
-a shallow foundation type is utilized
-existing footings, which support load bearing masonry walls, were to be under-pinned
-strip footings and grade beams were used in the foundation of the addition
-structural steel framing with composite metal deck / lwc topping
-reinforced concrete spread footings at a maximum depth of 49'-0" below grade
-typical floor to floor heights are 15' above grade & 12' below grade
-typical beams range from W10to W24 in size in the addition
-typical columns range from W10 to W12 sections in the addition
-lateral resistance provided by a combination of concrete shear walls and structural steel braced frames

mechanical

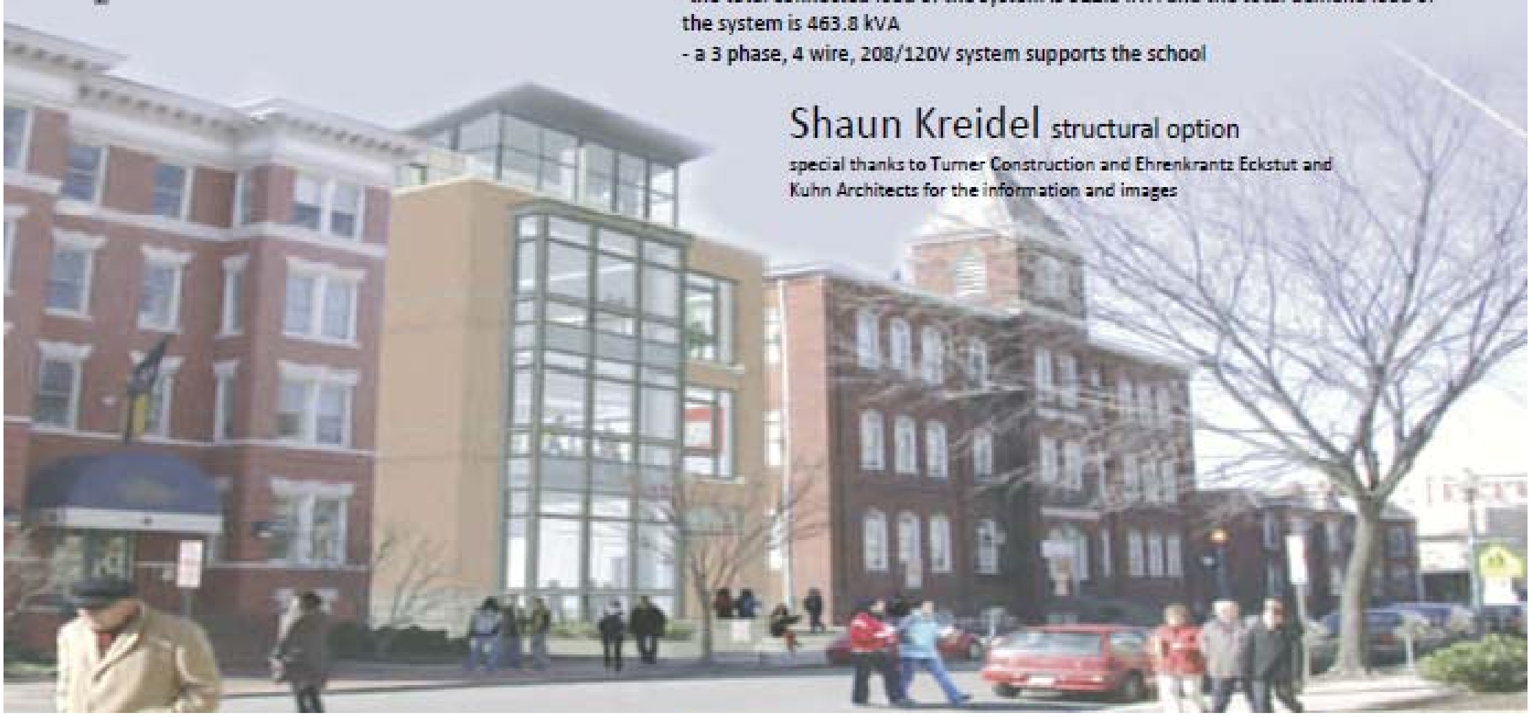
-mechanical system which was used in the school previously was completely re-moved and replaced
-a four pipe central ventilation unit (100% O.A.) supply air to existing building
- a gas fired ventilation unit (100% O.A.) supply air to new building
-central chilled water system supply chilled water to all four air handling units
-a central hot water heating system consisting of two gas fired boilers will supply heating water to all air handling units
-exhaust fans were installed that were specifically dedicated for science room fume hoods and kiln rooms
-roof mounted and ceiling mounted exhaust fans will be used for ventilation

electrical

-the total connected load of the system is 522.3 kVA and the total demand load of the system is 463.8 kVA
- a 3 phase, 4 wire, 208/120V system supports the school

Shaun Kreidel structural option

special thanks to Turner Construction and Ehrenkrantz Eckstut and Kuhn Architects for the information and images



EXECUTIVE SUMMARY

The Grant School has stood in the heart of the George Washington University campus since 1882 and has housed the School Without Walls since 1977. In 2008, a 68,000 square foot addition was added along the south and east faces of the building. In addition to the building's expansion, the mechanical and electrical systems were replaced and updated.

Currently, the School Without Walls expansion project calls for a floor system that requires beams which range from W10 to W33 sections. With the addition of a 5 ¼" metal deck floor system, the total floor depth amounts to 38 ¼". A larger clearance between the ceiling and the floor system above would create an easier coordination of the electrical and mechanical systems in the building.

The structural design utilizes expansion joints to separate the 68,000 square foot addition from the historic building. These joints require the slab to cantilever from the column line to the edge of the existing historic building. To achieve this using the current steel system, moment connections are required.

This report explores an alternate gravity and lateral system design to the current steel system system. The proposed design consists of a one way post tensioned slab which spans across wide, but shallow post tensioned beams. Using this system easily allows the construction of the required cantilevered sections of the structure. Concrete moment frames, which eliminate the need for the current braced frames and shear walls, will be responsible for resisting the lateral loads that are exerted on the structure.

In addition to the structural depth study, two breadth topics were researched. The construction management breadth focuses on the effect the change in structural system has on schedule and overall cost.

The architectural breadth studies how dropping the ceilings of the existing building architecturally affects the spaces. Lowering the ceiling heights will allow for easier MEP coordination.

ACKNOWLEDGEMENTS

I would like to extend a special thanks to the following individuals and firms who were essential to the success of this thesis project:

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Kevin Parfitt

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Ehrenkrantz Eckstut & Kuhn Architects

I would like to also thank all of my friends and family for their continuing support throughout the senior thesis process.

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INTRODUCTION

The Grant School, located as the red object in Figure 1, has stood in the heart of the George Washington University campus in Washington, D.C. at 2130 G Street NW since 1882 and has housed the School Without Walls since 1977. The "School Without Walls" name comes from the faculties' encouragement for students to use Washington D.C. as an active classroom, thus not restraining learning to the walls of the senior high school.

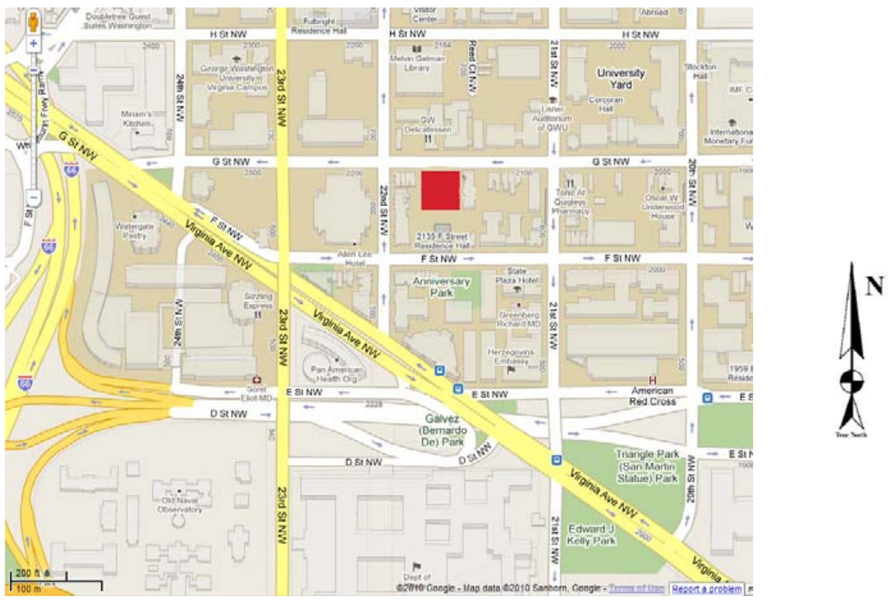


Figure 1: Area Map

The original 32,300 square foot, three story school was in dire need of modernization and expansion due to the increasing number of students and outdated mechanical and electrical equipment. The 68,000 square foot addition and renovation, as seen in blue in Figure 2, blends the 19th century school with a modern design. This is achieved by combining existing brick patterns with glass, steel and curtain walls. The School Without Walls project is expected to receive LEED Gold Certification.

The existing three story school is made up of four large classrooms per floor, one at each corner of the square building. The new addition to the school provides an additional two large classrooms on each floor, an open atrium space, a large student commons, roof terrace area and a library. The basement was also reengineered and redesigned to serve as scientific laboratories for the school.

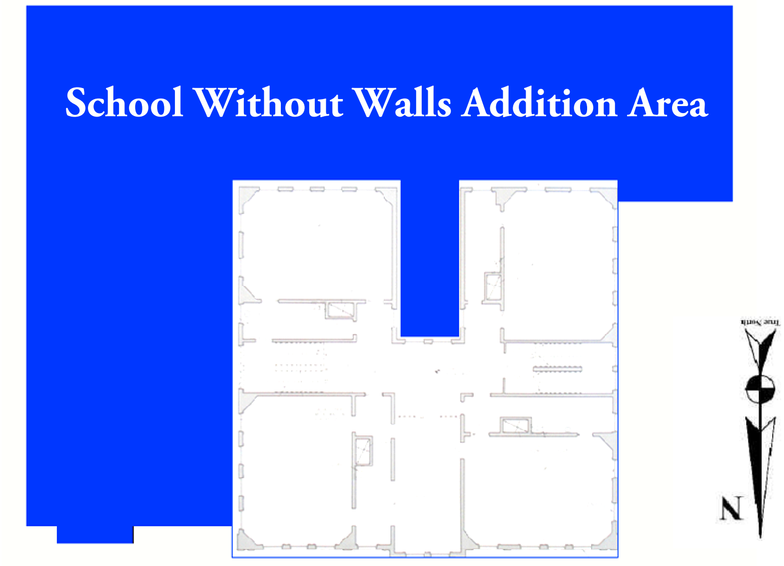


Figure 2: Floor Plan Showing Expansion

EXISTING STRUCTURAL SYSTEM

The 68,000 square foot addition to the School Without Walls project is located in blue in Figure 2. Due to expansion joints located at the interface of the addition and the existing building, the structural systems of the existing and new building work independently. A detail of this expansion joint can be viewed in Figure 3. As stated in the drawing, the expansion joint along the east side of the existing building is 4", and is 2" along the south side.

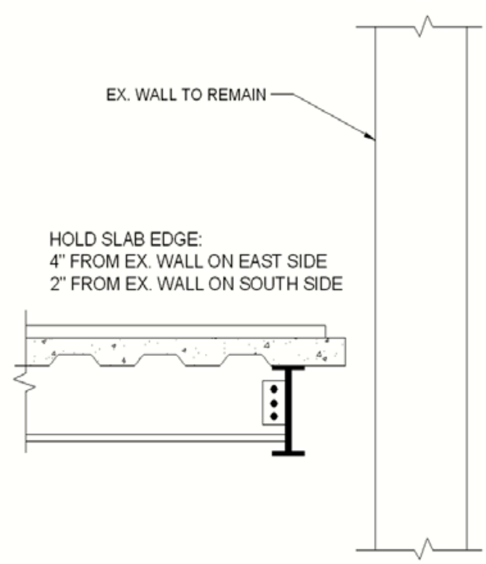


Figure 3: Expansion Joint Detail

The new addition to the School Without Walls itself is divided by an expansion joint. This expansion joint therefore creates a total of three independently acting structural systems. The division of the new addition can be viewed in Figure 4. These separate structural systems, which can be distinguished in Figures 4 and 5, will be referred to as "Area 1" and "Area 2" throughout this report.

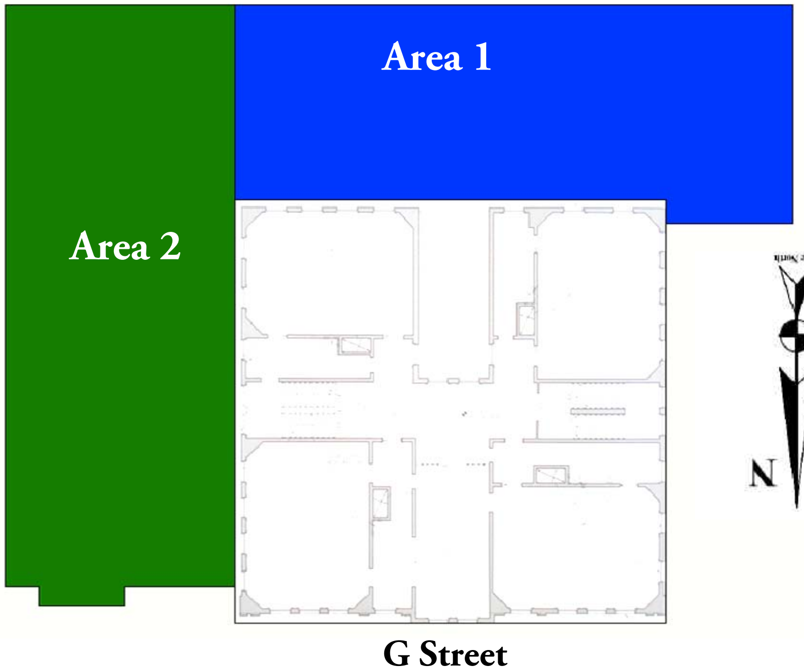


Figure 4: Floor Plan Showing Building Separation

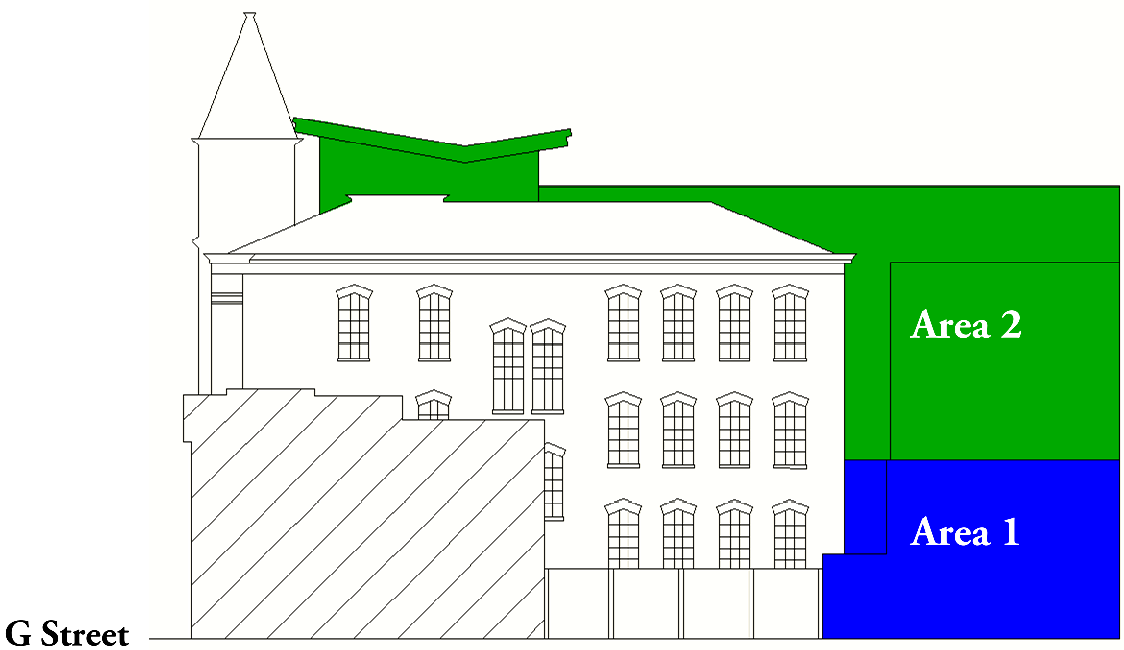


Figure 5: West Elevation

Foundation

The geotechnical engineering study was performed by Thomas L. Brown Associates, P.C. on January 28, 2007. After performing a series of in-situ tests, considering the lab test results, anticipated loads, and settlement analyses, a shallow foundation consisting of reinforced cast-in-place spread footings and grade beams was deemed appropriate. Based on the testing and analysis, the footings should be designed for an allowable bearing capacity of 3.0 ksf. The addition utilizes typical footings which are 2' 6" wide by 2'0" deep and rest on compacted earth 3'0" below the top of the slab-on-grade. Grade beams are also used in the foundation of the new addition. The beams measure 30"x30" along the east side and 30"x24" along the south side of the building.

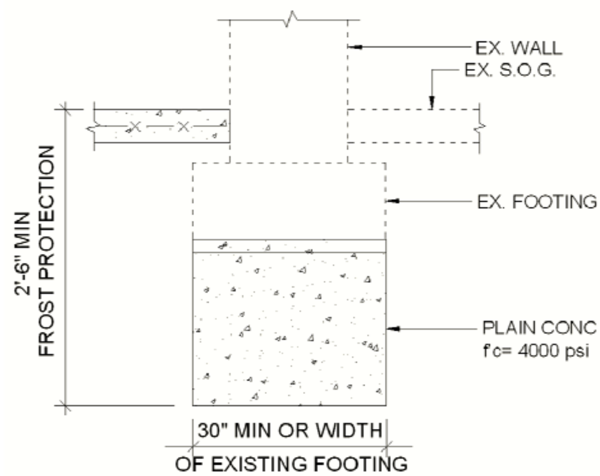


Figure 6: Underpinning Detail

Due to the increased load and the disruption of earth, underpinning the existing footings of the school became necessary. An underpinning detail is located in Figure 6. The underpinning sequence was performed in sections of no larger than 4 feet wide, approximately spaced 12-15 feet apart.

Floor System

The floor system of School Without Walls is a composite steel system. The floor slab of the new addition is 3 ¼" LWC topping over a 2" 20 GA LOK composite steel floor decking, bringing the total floor slab to 5 ¼" thick. Along the top flange of the beam, ¾"x4" long headed shear studs are used for composite action. A section of this floor system is shown above in Figure 7.

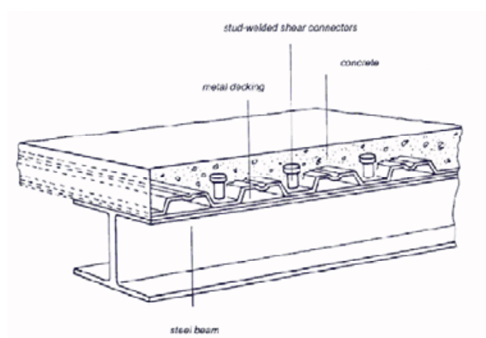


Figure 7: Typical Composite Steel Construction (www.epitech.com)

Lateral System Summary

The lateral system of School Without Walls works as three different systems due to expansion joints as stated before and show above in Figures 4 and 5. Both braced frames and shear walls, located in blue and green respectively in Figure 8, are used to resist lateral loads that are applied to the building.

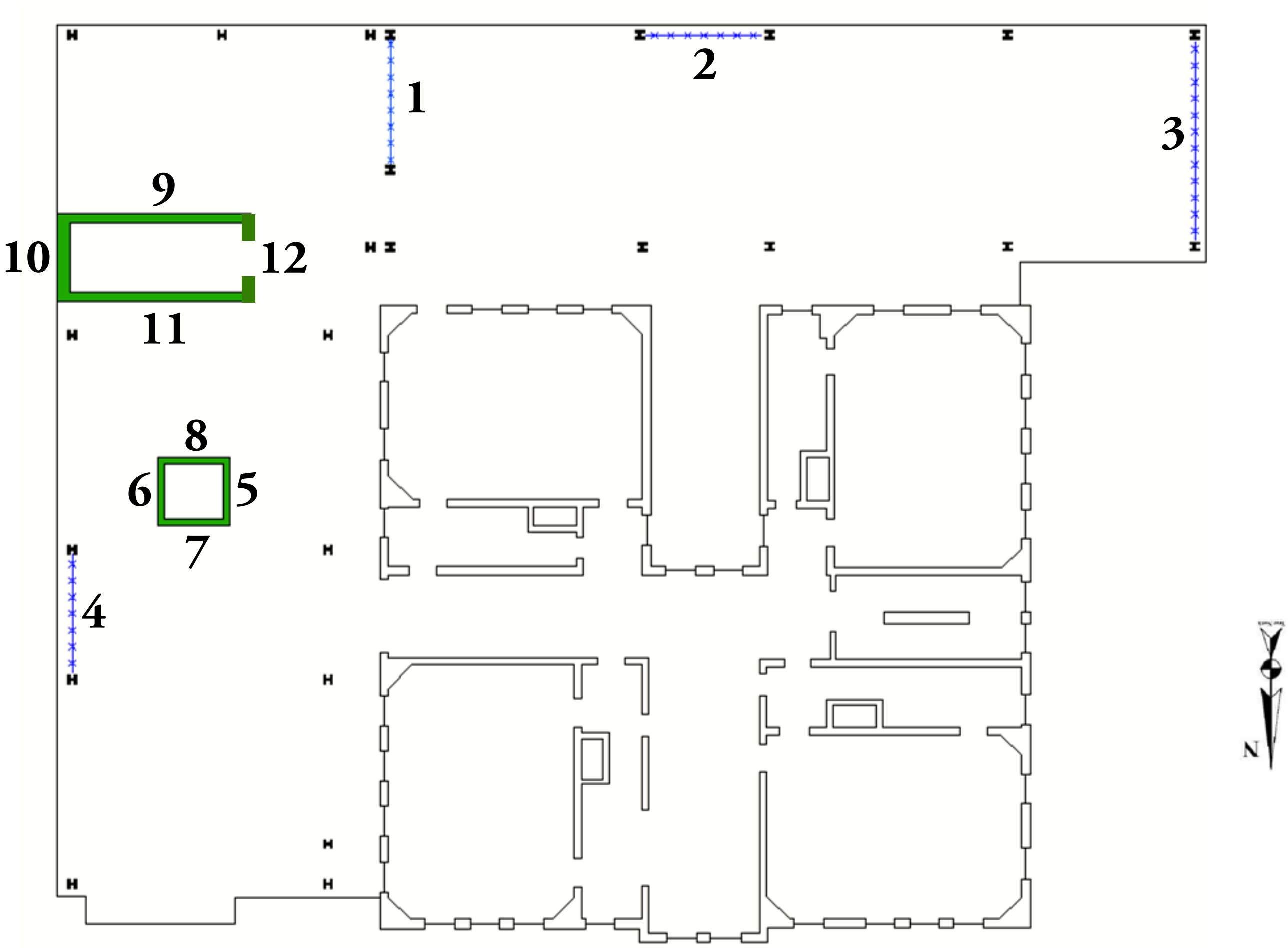


Figure 8: Summary of Lateral Systems

Area 1 Lateral System

The two story structure supporting the outside roof terrace (Area 1) utilizes only braced frames for lateral support. All of the braced frames located in this section of building are comprised of only HSS6x6x3/8 sections. Diagonal, cross, and chevron bracing are utilized in braced frames 1, 2 and 3 respectively as labeled in Figures 9, 10 and 11. All of the braced frames extend the entirety of the two story section of building.

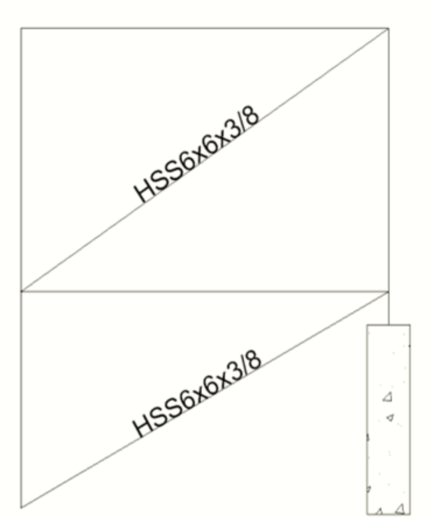


Figure 9: Braced Frame 1

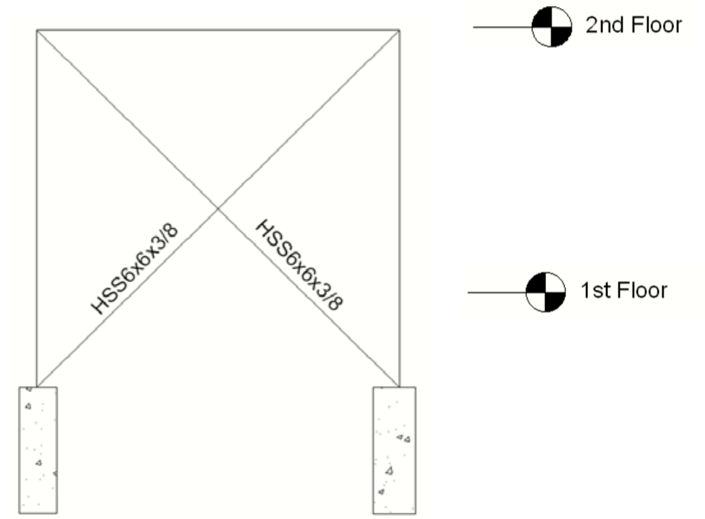


Figure 10: Braced Frame 2

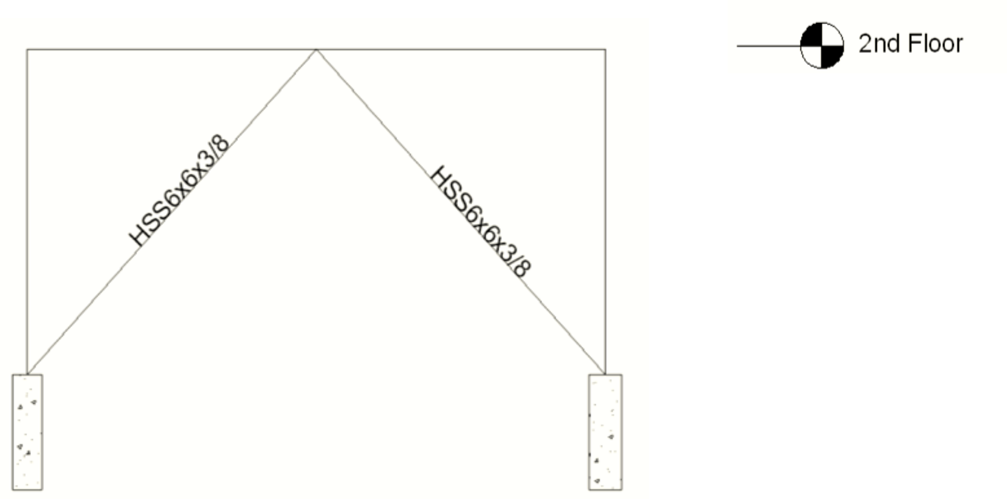


Figure 10: Braced Frame 3

Area 2 Lateral System

The four story structure supporting the library, referred to as Area 2 in this technical report, uses a combination of a braced frame system and a shear wall system to resist lateral loads. The braced frame, comprised of HSS square sections reaches from the ground to the roof level as seen in Figure 11. The shear walls are located around both the elevator core and the stair core. The shear walls surrounding the stair well are all 12" thick and are reinforced with #5 vertical bars spaced at 10" on center and #4 horizontal bars spaced at 12" on center at each face. The shear walls surrounding the elevator core are all 8" thick and are reinforced with #5 vertical bars spaced at 10" on center and #4 horizontal bars spaced at 12" on center at each face.

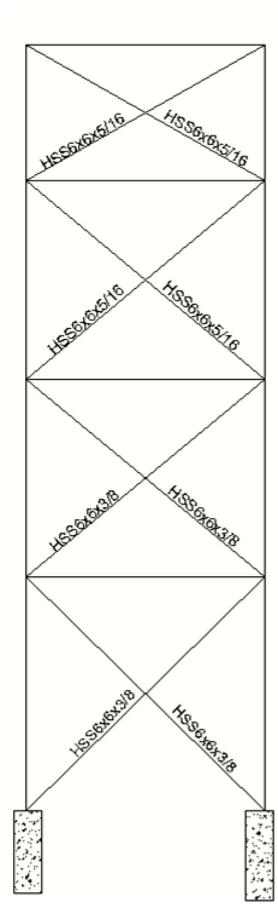


Figure 11: Braced Frame 4

PROBLEM STATEMENT

Currently, the School Without Walls project current floor system calls for steel wide flange beams which range from W10 to W33 sections. With the addition of a 5 ¼" decking system, the total floor depth amounts to 38 ¼". Due to the updated mechanical system of the existing building and the addition of the science labs a larger clearance between the ceiling and the floor system above would create an easier coordination of the electrical and mechanical systems in the building. In addition to the benefits of a larger ceiling to floor clearance area, the cantilevered sections are typically more easily constructed in concrete than in steel. This is due in part to the welded moment connections required in steel cantilever construction.

SOLUTION METHOD

To limit the total depth of the floor system, the gravity resisting systems were altered from the current steel composite system to a concrete system. An important goal was to keep the column lines relatively in the same position, therefore effectively meeting the layout which was required by the architect.

A post-tensioned concrete system is very applicable to this project because of the relatively large spans the building layout requires and the desire for minimal floor deflection. Post-tensioning of the beams and the slab allowed for the desired cantilever along the face of the existing building and reduced deflections.

Concrete columns were also designed as part of this concrete system and replaced the current steel columns.

The expansion joints which separate the School Without Walls into three different zones remained, therefore, creating three different lateral systems. The lateral systems of both Area 1 and Area 2 were redesigned, introducing concrete moment frames and thus removing the both the braced frames and shear walls which currently resist lateral loads.

ACI 318-05 was referenced throughout in the design of the concrete system. PCA column was utilized as an aid in the structural design of the columns and ADAPT PT was used to assist in the design of the post tensioning in the building. An ETABS model was also built in order to effectively analyze the lateral system of the building. Hand calculations were performed to confirm and verify the accuracy of the computer programs.

ALTERED FLOOR PLANS

Area 1

Throughout the structural redesign of the two story addition of the School Without Walls, the architectural drawings were continually referenced to ensure that the structural components did not interfere with the designed layouts of each floor. In the attempt not to change the architectural layouts, column line positions were altered as little as possible. A revit model was built as an aid to study how the alterations of the structural components affect the architectural layout. Column lines G, 7, and 5, as displayed in Figure 12 were the only column lines which were altered in this portion of the School Without Wall's structural redesign. Column lines G and 7 were both moved 6.25" towards the interior of the building. Column line 5 was moved 14.25" south of the original line provided by the architectural drawings.

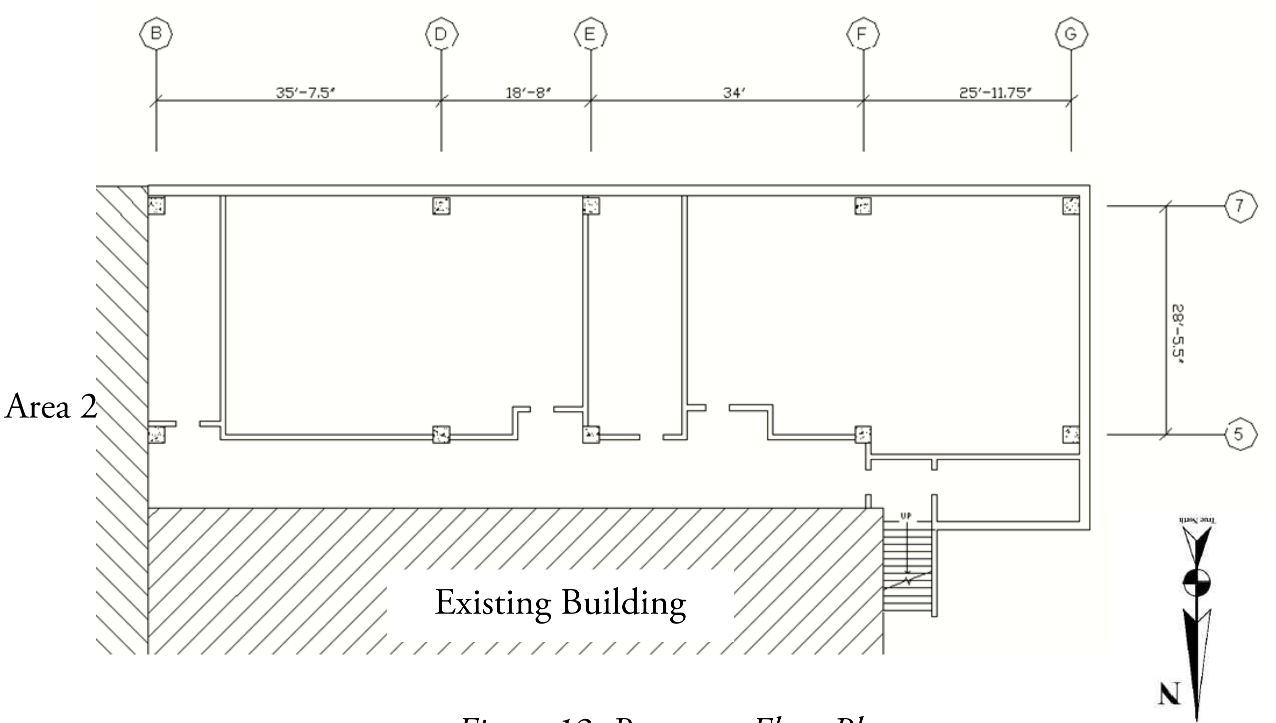


Figure 12: Basement Floor Plan

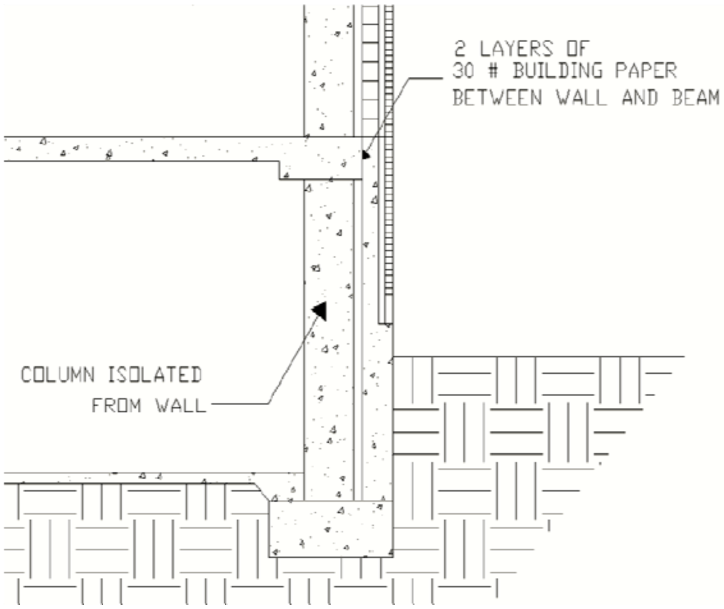


Figure 13: Exterior Wall Section

In post tension design, it is important to allow for the shortening of the slab without restraint. Removing this restraint reduces the amount of cracking due to shrinkage which can be viewed in Figure 14. To avoid restraining the slab, the column lines were displaced from the foundation wall. A typical exterior wall section of Area 1 can be viewed in Figure 13.

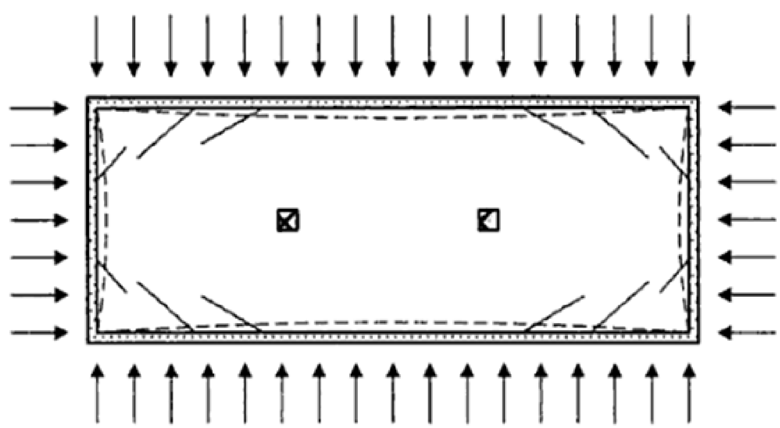


Figure 14: Cracking Due to Wall Restraint

Because of the expansion joint located at the interface of the existing school it was necessary to cantilever the slab on the first floor in the area supporting the Student Commons. The slab cantilevered 9'-2.25" from column line 5 in this area as seen in Figure 15.

The service area located on the first floor, as stated in Figure 15 works independently from the reinforced loading dock. A section cut is taken at this point in the North-South direction as seen in Figure 16 to display the interaction of the loading dock and the post tensioned floor slab. Because the slab is not restrained to the wall, shortening is possible which limits the amount of cracking due to shrinkage.

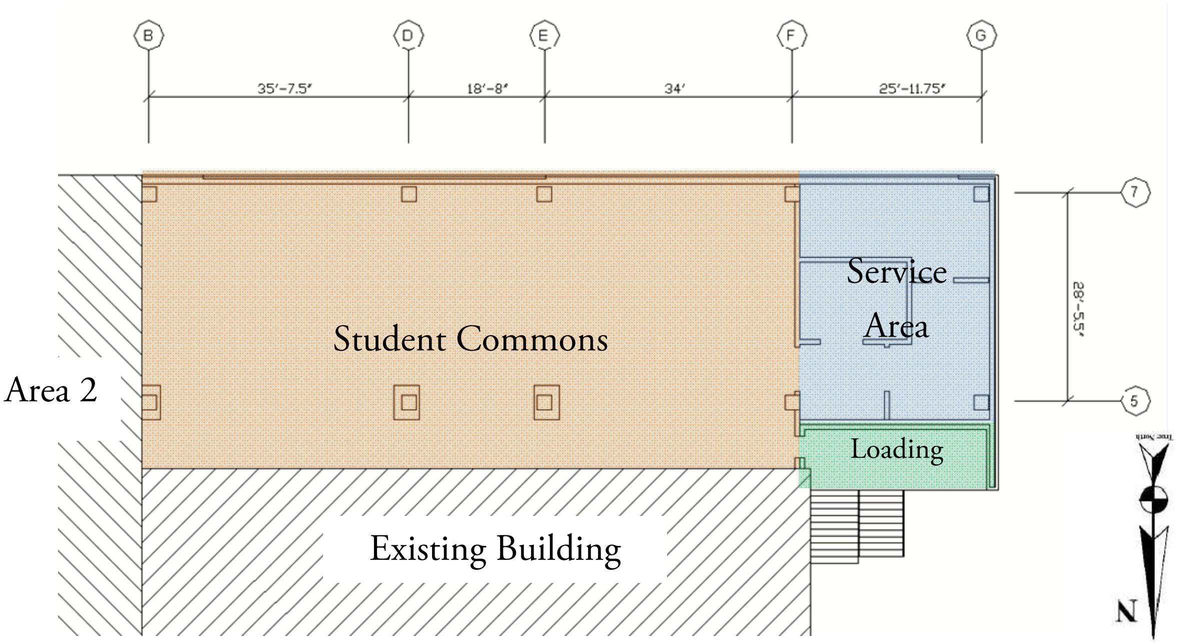


Figure 15: First Floor Plan

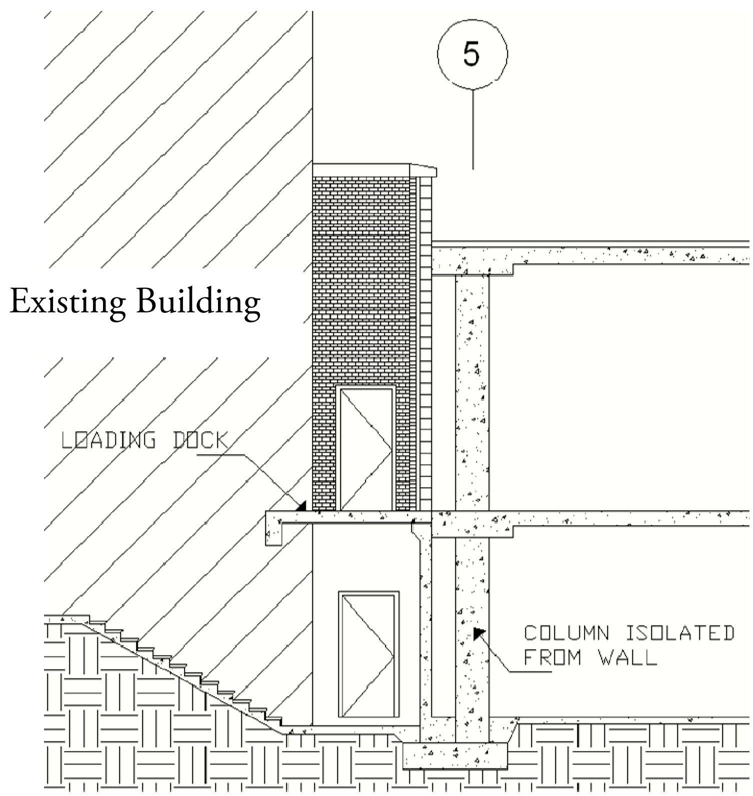


Figure 16: Service Area- Loading Dock Section

Area 2

Likewise as in the structural redesign of Area 1, the architectural drawings were continually referenced in the attempt not to change the architectural layouts. Column lines positions were altered as little as possible. A revit model for Area 2 was built as an aid to study how the alterations of the structural components affects the architectural layout. Column line A was shifted 14" to the west and B was shifted 16" to the east in order to accommodate the beam geometry. Column lines 1 and 7 were both shifted 6" to the south and north respectively. Because of the cantilever capablity of concrete, columns along A.5 and C, located in red, were deleted. The column located in green in Figure 17 was the only column which was added to the School Without Walls. This column necessary to divide the span between 4 and 7 (a span of 46'-6.5").

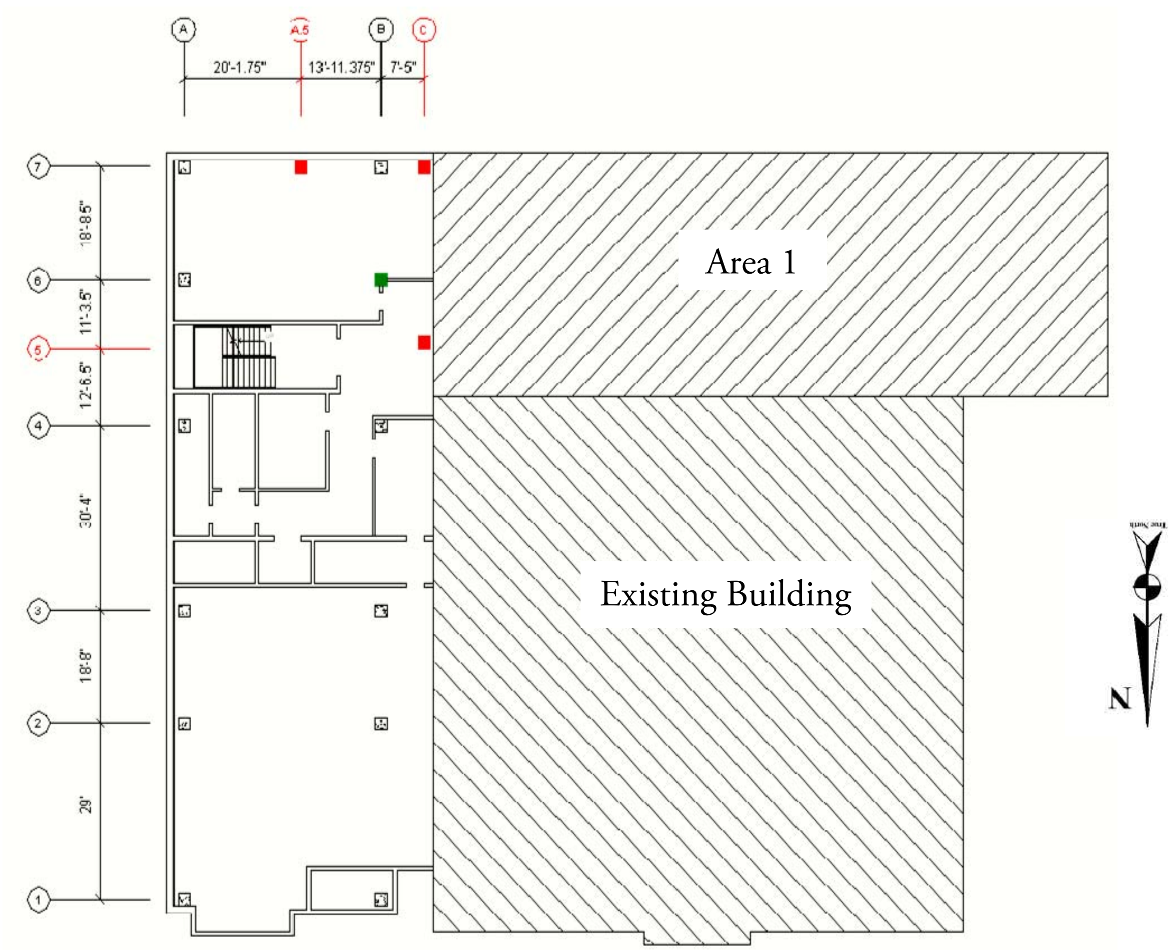


Figure 17: Basement Floor Plan

Because of the expansion joint located at the interface of the existing school it was necessary to cantilever the slab in the East West direction. The slab cantilevers 9' from column line B in this area as seen in Figure 18. Because of the presence of an atrium space, as located as the "X" areas in Figure 18, the slab is simply supported on the second, third and fourth floor. Because of the increased of span and removal of the cantilever in sections, the slab thickness was increased.

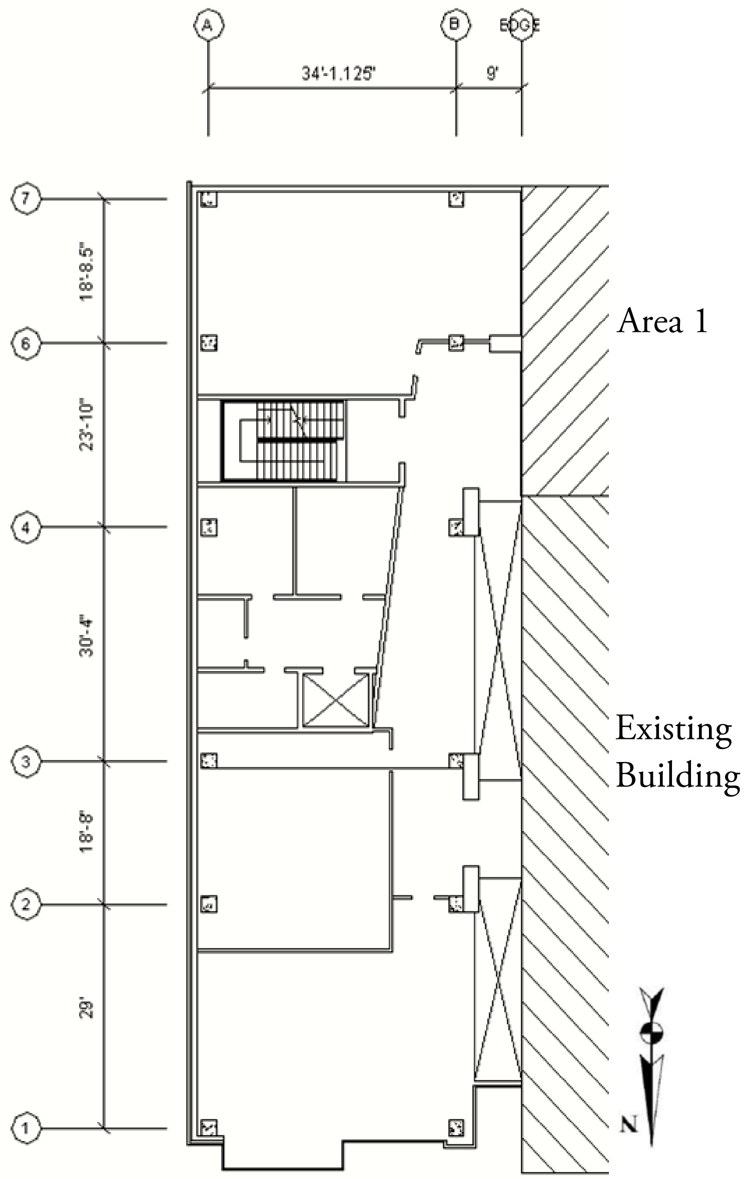


Figure 18: Second Floor Plan

Area 2 required an exterior wall construction much like the type shown in Figure 13 in order to allow for the shortening of the slab without restraint.

It must be noted that only the structure supporting floors 1 through 4 were redesigned in concrete. The remaining penthouse level housing the library remained constructed as steel utilizing both wide flange shapes and hollow steel sections. Even though the mixing of trades is not an ideal situation, the complex design of the roof required steel members to be used.

POST TENSIONED DESIGN

The method of post-tensioning involves the tensioning of steel tendons after the concrete has hardened. Unbonded tendons were utilized in all post-tensioning applications in this structural redesign. These tendons are fabricated with a plastic sheathing and grease to prevent a bond with the concrete. All of the tendons used in design were ½" diameter, 7-wire strands. The tendon properties can be viewed in Table 1.

Area= .153 in^2
f_{pu}= 270 ksi
Estimated Prestress Loss= 15ksi
f_{se}= .7*(f_{pu})- 15ksi= 174
P_{eff}=A* f_{se}= 26.6 kip/tendon
P/A: Max=300, Min=150

Table 1: Tendon Properties

The beams were modeled as either as T or L sections based on their geometry. The effective flange was calculated in accordance with Chapter 8 of ACI 318-05. ADAPT PT was used as an aid in designing the post-tensioned beams. The beams were designed in accordance with Chapter 18 of ACI 318-05. After analyzing each beam in the ADAPT PT program, the tendon drape was adjusted to best balance the dead loads. The balanced dead loads, even though not a code requirement, were targeted as 70-80% of the dead load for beams and 60-70% of the dead load for slabs. Superimposed dead loads were not included into this percentage because they are not present at the time of stressing.

Area 1 Beams

The four beams located in Area 1 span in the east-west direction as seen in Figure 19. This orientation was chosen because the number of beams can be limited which allowed for more ceiling to floor area. Trial sizes of the beams were determined using an L/d ratio of 30. These trial sizes were adjusted based on the architectural components present.

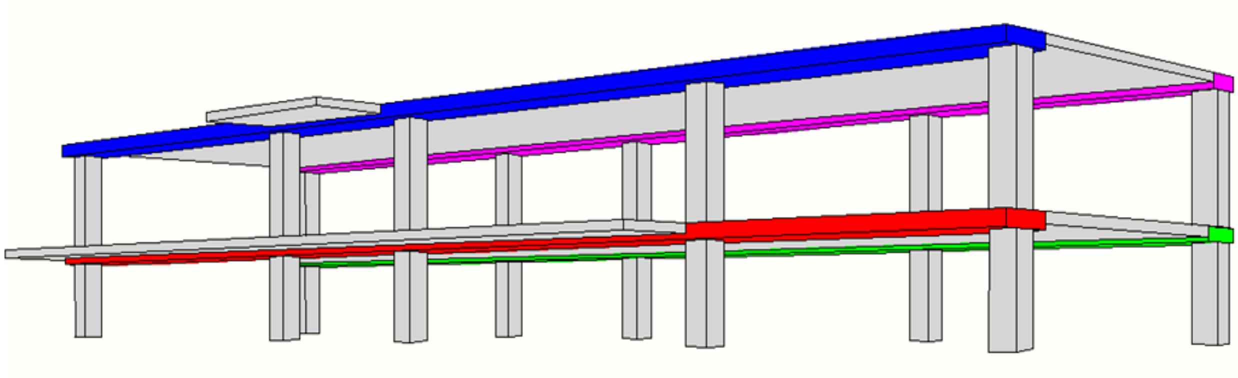


Figure 19: Isometric View of Column

The finalized design of the beams resulted in 18" deep beams supporting the first floor, located in red and green, and 20" deep beams supporting the roof terrace, located in blue and magenta. The beams spanning in the direction of column line 5 are 56" wide, and the beams in the direction of column line 7 measure 40" wide. A detailed output including tendon profiles and required post-tension forces and required reinforcement for Beams B1-B4 as labeled in Figures 19 and 20 can be viewed in Appendix A.

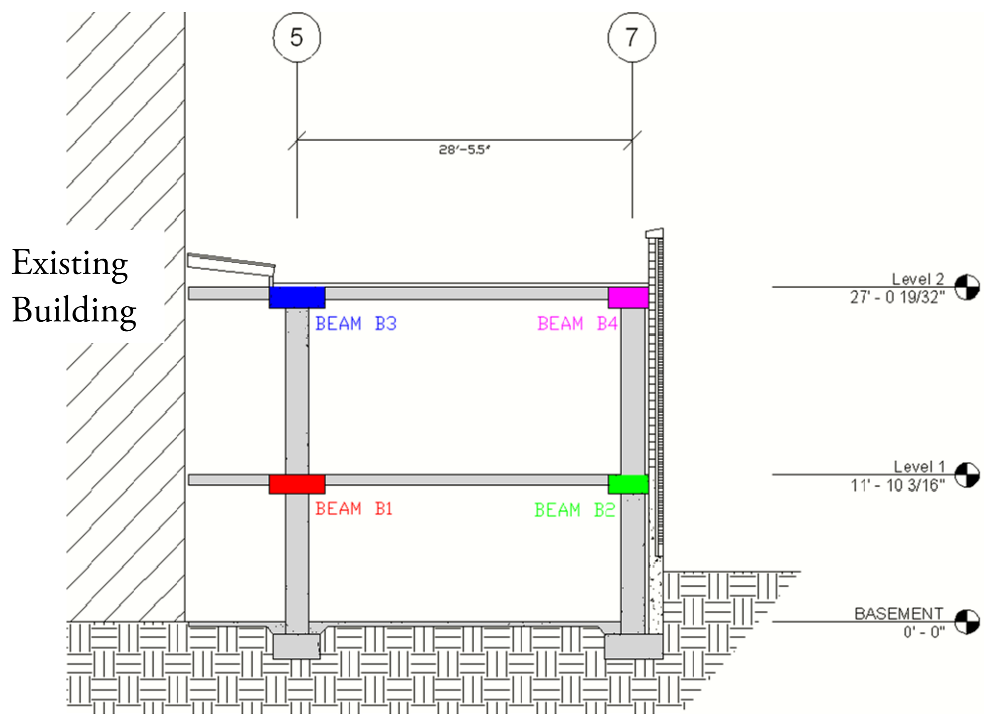


Figure 20: East-West Section Cut of Area 1

Area 1 Slabs

The post-tensioned slab in Area 1 spans in the north-south direction perpendicular to the post tensioned beams located in Figures 19and 20. Design was carried out using ADAPT PT as an aid while complying with Chapter 18 of ACI 318-05. A spot hand calculation was performed to verify the accuracy of the ADAPT PT program. It was determined that the hand calculation results and computer output were comparable.

Preliminary design for the slab thickness was determined by using an L/d ratio equal to 35. The live loads of these slabs were not be reduced because of section 4.8.4 of ASCE 7-05, which states that live loads of 100 lb/ft^2 or less shall not be reduced in public assembly areas.

During design, the unit strip method was utilized and the one way post tensioned slab was modelled as a 12” wide beam. The transverse beams were modelled into the analysis as well which shortened the clear span of the slab.

After completing the analysis, it was found that the required slab on the first floor measures 10” thick throughout and the slab on the second floor, or roof terrace measures 11”. In design, it was assumed that because the roof is acting as an assembly space, therefore there will not be an instance where both the live load and snow load will exist concurently. The assembly load will control over the snow load, therefore the current design for 100 psf of live load is adequate. The super imposed dead load of the roof terrace was also increased for design to account for the roof pavers that were specified by the architect.

A detailed output of these slabs containing post tension force, profile and rebar specification can be found in Appendix B.

Area 2 Beams

The ten beams located in Area 2 span in the north south direction as seen in Figure 21. This orientation was chosen because the number of beams can be limited which will allow for more ceiling to floor area. Trial sizes of the beams were determined using an L/d ratio of 30 and a b/d ratio of 3. These trial sizes were adjusted based on the architectural components present.

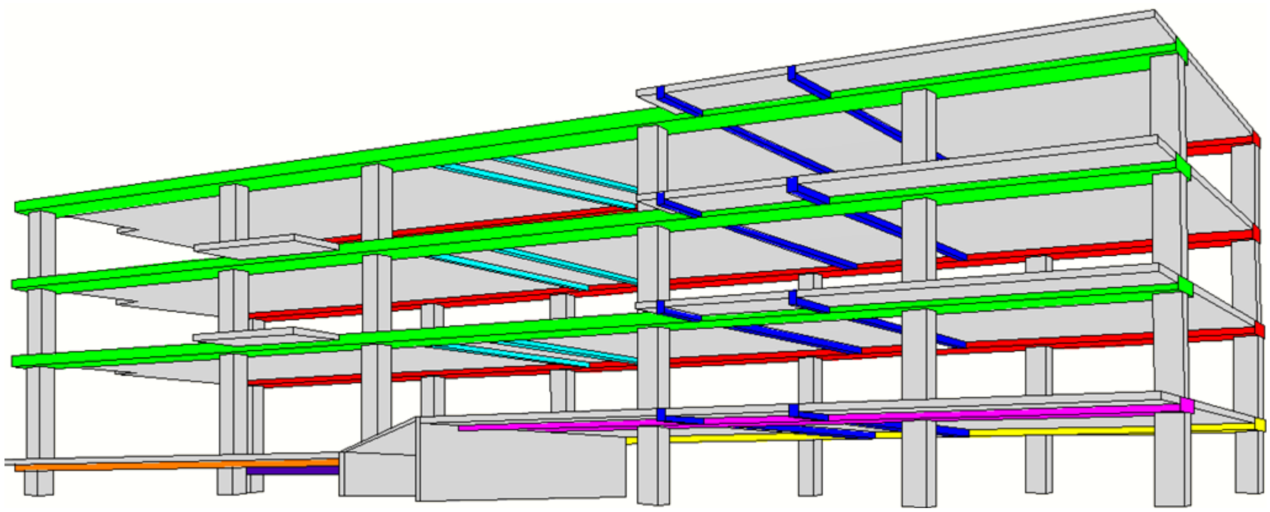


Figure 21: Isometric View of Area 2

The beams supporting the second through fourth floors referred to as Beams 9 and 10 located in green and red respectively in Figure 21, run the extent of the building. Due to the split entrance/first floor level, four beams were designed to carry the loads of the areas. These beams located in Magenta, Yellow, Orange and Purple in Figure 21 are referred to as Beam 5, Beam 6, Beam 7 and Beam 8 respectively throughout the remainder of this report and the Appendices.

The dark blue and cyan colored beams running in the east west direction are necessary to carry the loads of the partition walls from the stairwell and elevator shaft, as well as the one way mildly reinforced slab which spans between each section. These beams were assumed to impose a point load on the main beams. The loads can be viewed in Appendix A.

The finalized design of the beams resulted in 18" depth for beams located on the entrance and first level in Area 2. The beams on the remaining floors in Area 2 all measure 20" deep.

In the direction of column line B, columns measure 60" wide and those spanning in the direction of column line A are 40" wide for all floors. A detailed output including tendon profiles and required post-tension forces for Beams B5-B10 as labeled in Figures 21 and 22 can be viewed in Appendix A.

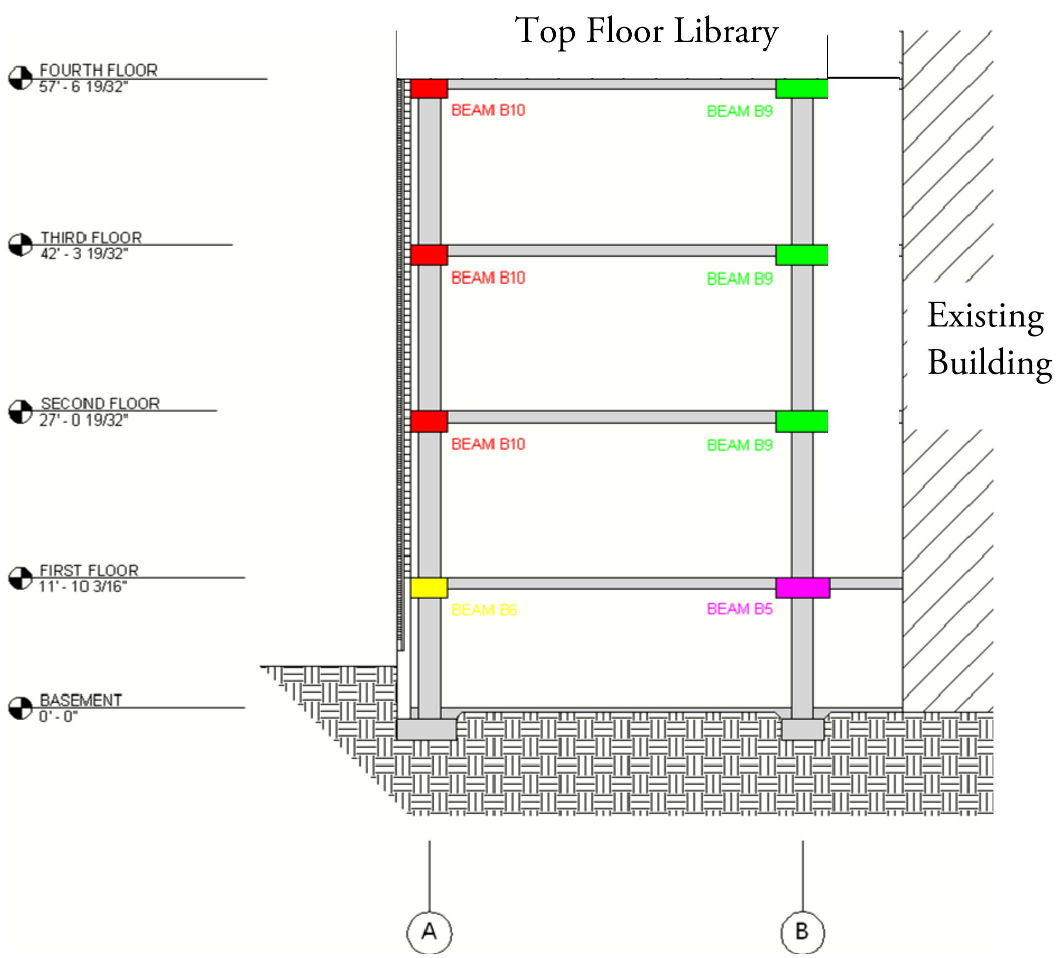


Figure 22: North-South Section

Area 2 Slabs

The post-tensioned slab in Area 2 spans in the east-west direction perpendicular to the post tensioned beams located in Figure 22. Design was carried out using ADAPT PT as an aid and complied with Chapter 18 of ACI 318-05.

Preliminary design for the slab thickness was determined by using an L/d ratio equal to 35. Live loads were reduced according to Section 4.8 of ASCE 7-05 using the equation:

$$L = L_o\left(0.25 + \frac{15}{\sqrt{K_{LL}A_T}}\right) \qquad (4\text{-}1)$$

Similar to the design method used to calculate the slabs in Area 1, the unit strip method was utilized and the one way post tensioned slab was modelled as a 12" wide beam. The transverse beams were modelled into the analysis as well which shortened the clear span of the slab.

It was found that the required slab on the first floor, entrance level and the slab that supports the southern most classroom all measure 10" thick. The simple span areas require a 12" slab. These slab areas can be distiguished in the red and blue areas respectively in Figure 23.

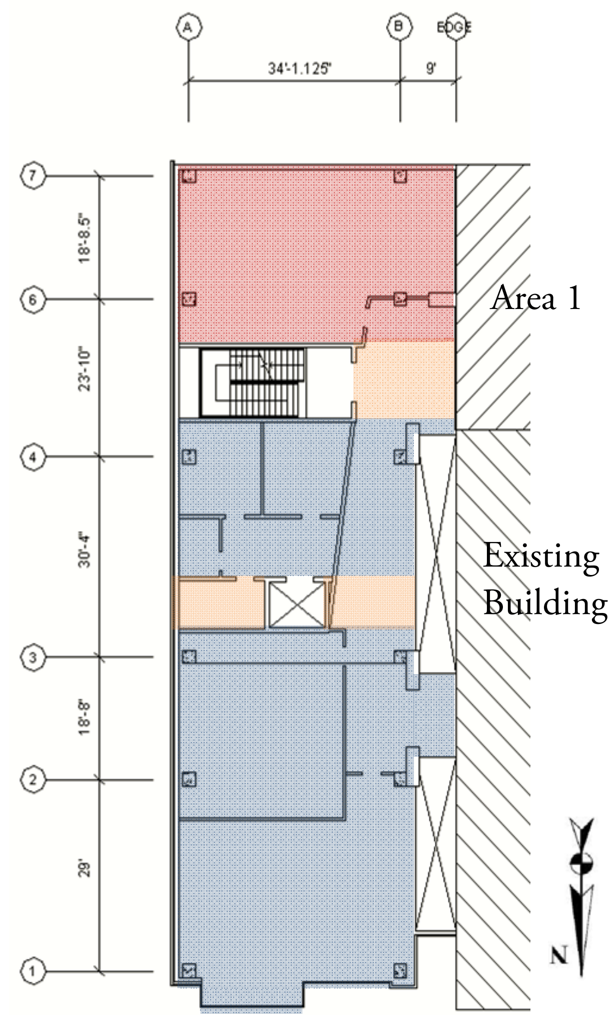


Figure 23: Second Floor Plan Showing Slab Thicknesses

To account for the slab area around the stair wells, a one way 8" reinforced slab is utilized located in orange in Figure 23. This slab spans between the transverse beams indicated in dark blue and cyan in Figure 21.

A detailed output of these slabs containing post tension force, profile and rebar specification can be found in Appendix B.

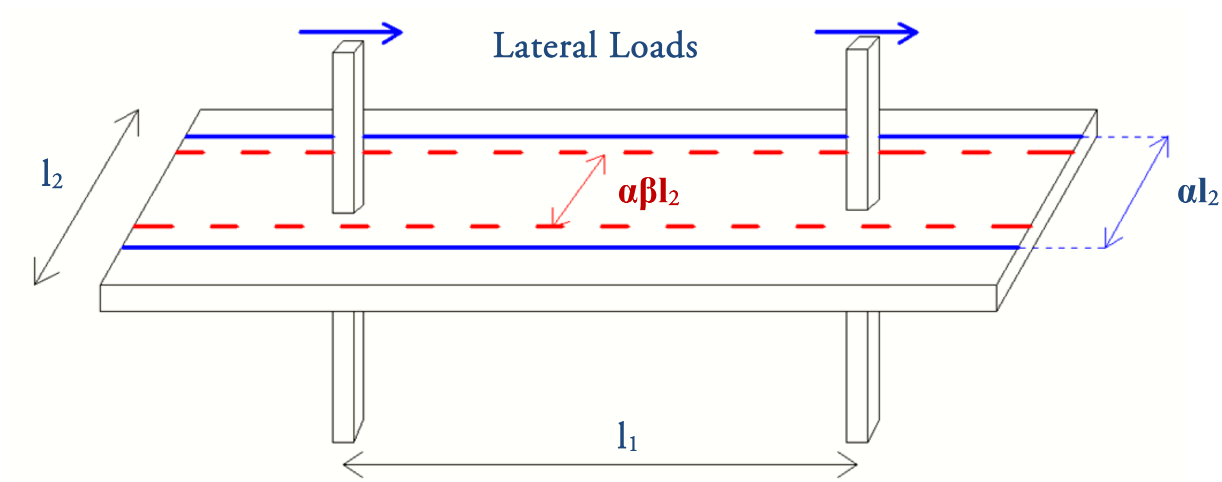
LATERAL DESIGN

The lateral system was changed from one that utilized shear walls and braced frames to one that relies on concrete moment frames. In the direction in which load is applied parallel to the beams, the post tensioned beams and columns work together to create the moment frame. In the case where the lateral load is being applied perpendicular to the beams, the slab interacts with the columns to create a moment frame.

The stiffness properties of the lateral force resisting members were modified assuming cracked sections. The section properties that were used are:

Beams: $I_{eff}= .35I_g$
Columns: $I_{eff}=.70I_g$

To aid in creating an ETABS model, the ACI Journal entry "Dynamic Responses of Flat Plate Systems with Shear Reinforcement" by Thomas Kang and John Wallace was referenced. From this document, guidelines on modeling and calculating the effective width of the slab were determined and are summarized in Figure 24. The slab was modeled with rigid end zones at the joints.



α: Effective Beam Width Factor= .65
β: Coefficient accounting for Cracking= .5

Figure 24: Effective Beam Width Model

Area 1 Lateral Loads

Area 1 has a total height of approximately 22 feet above grade, therefore, it is considered a low rise building and was designed in accordance to Method 1 as listed in Chapter 6 of ASCE 7-05. The applied lateral pressures due to wind are located in Table 2. To simplify calculations, pressures resulting from Zone A, or the End Zone, located in Figure 25 were applied for the entire building. This resulted in a conservative design.

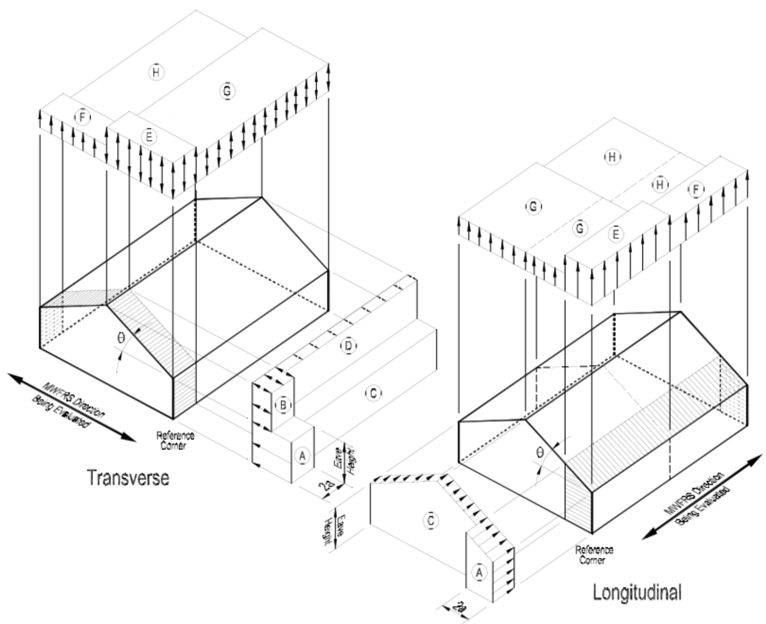


Figure 25: Wind Designation for Area 1

	Horizontal Pressures (psf)			Vertical Pressures (psf)			
A	B	C	D	E	F	G	H
12.8	-6.7	8.5	-4.0	-15.4	-8.8	-10.7	-6.8
	Adjusted Pressures (psf)			Adjusted Pressures (psf)			
14.7	-7.7	9.8	-4.6	17.71	-10.1	-12.3	-7.8

Table 2: Wind Pressures for Area 1

The seismic loads were calculated using Chapters 11 and 12 of ASCE 7-05. This seismic analysis includes dead loads from beams, slabs, columns and M/E/P equipment. A takedown of the building weight can be viewed in Appendix C. A summary of these forces can be viewed in Table 3, and a detailed breakdown of these calculations can be viewed in Appendix D of this report.

Floor	w_x (kip)	h_x	k	$w_x h_x^k$	$\sum w_i h_i^k$	F_x (kip)	Story Shear V_x (kip)	Moment (k-ft)
2	923	27	1.014	26105.63	37216.05	36.41	--	983.15
1	976	11	1.014	11110.42	37216.05	15.50	36.41	170.47
Total	1899	27	1.014	37216.05	37216.05	51.91	**51.91**	**1153.61**

Table 3: Seismic Loads for Area 1

Area 1 Lateral Analysis

To aid in the analysis of the lateral system, an ETABS model of Area 1 was created as shown in Figure 26. The seismic and wind loads were applied to the model and drift was compared for the four wind cases stated by ASCE 7-05, and seismic loads. It was determined that the seismic loads will control the design of the building in both directions. A summary of the drifts can be found in Table 4. The total building drift has been limited to H/400. It is assumed that spread footings will be adequate for this section of the building. The base supports were modelled as pinned supports to effectively account for the behavior of the spread footings.

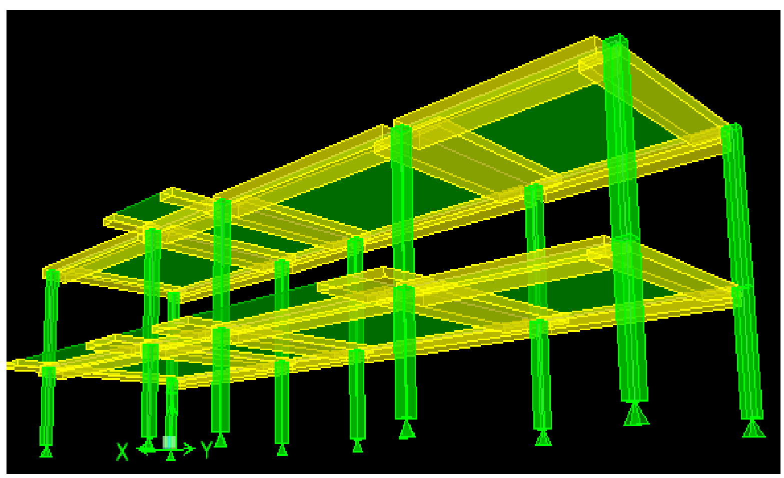


Figure 26: Area 1 ETABS Model

Story	Diaphragm	Load	UX (in)	UY (in)
STORY2	D2	XWIND	0.3308	0
STORY2	D2	YWIND	0.0002	0.091
STORY2	D2	XQUAKE	0.6515	-0.0001
STORY2	D2	YQUAKE	0	0.5129
STORY2	D2	CASE2X	0.2461	-0.0002
STORY2	D2	CASE2Y	0.0004	0.0683
STORY2	D2	CASE3	0.2482	0.0682
STORY2	D2	CASE4	0.2464	0.0681
STORY1	D1	XWIND	0.2121	0.0002
STORY1	D1	YWIND	0.0003	0.0617
STORY1	D1	XQUAKE	0.3827	0.0006
STORY1	D1	YQUAKE	0.0003	0.3133
STORY1	D1	CASE2X	0.1556	-0.0033
STORY1	D1	CASE2Y	0.0007	0.0467
STORY1	D1	CASE3	0.1593	0.0464
STORY1	D1	CASE4	0.1562	0.0434

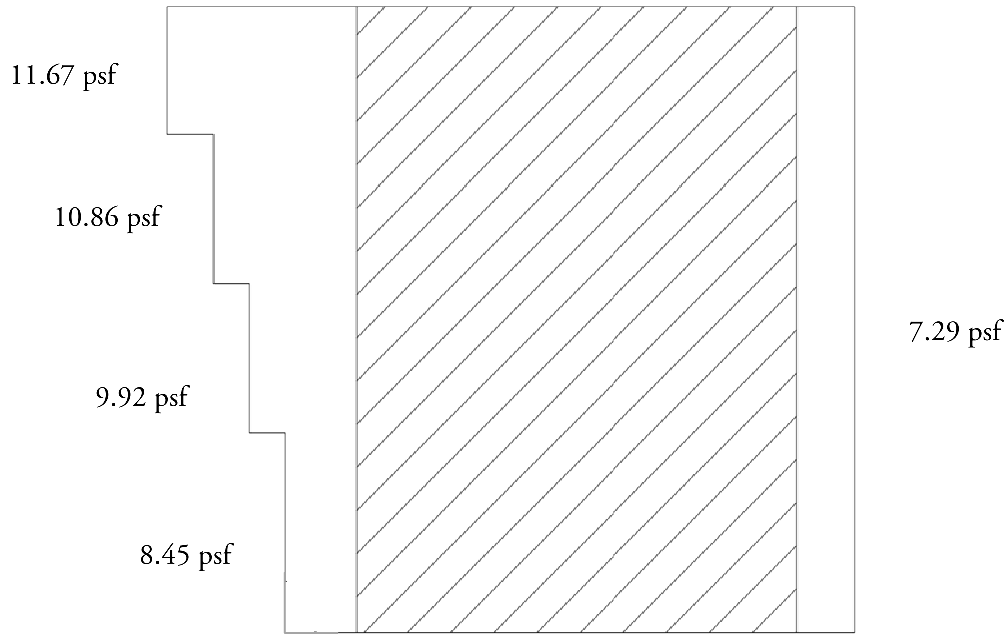
Table 4: Drifts Due to Lateral Loads

Area 2 Lateral Loads

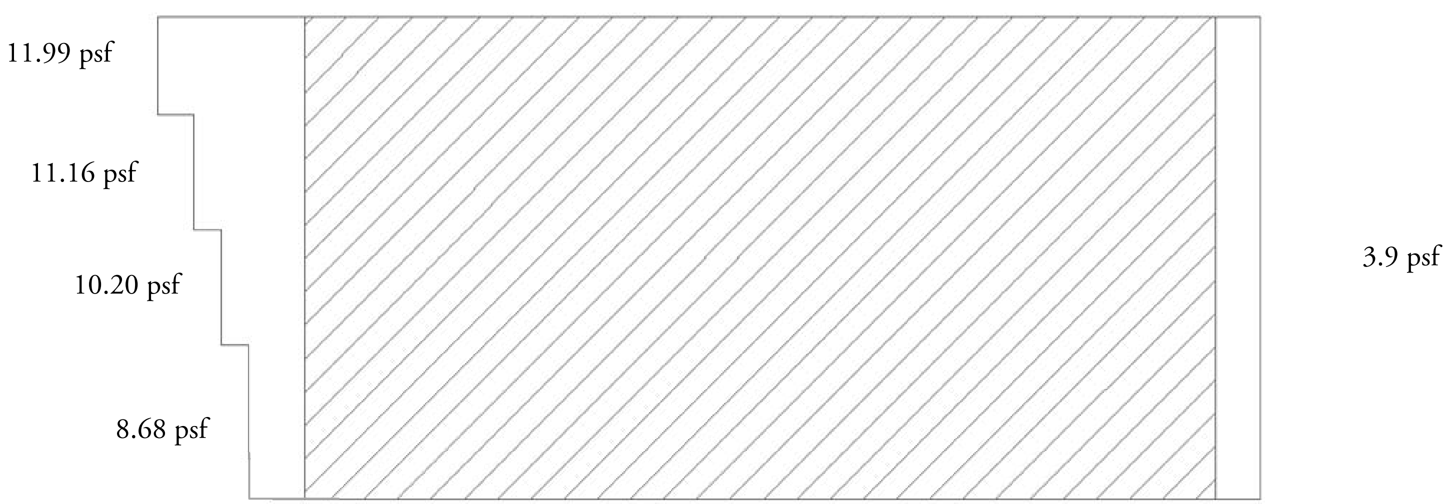
Method 2 located in Chapter 6 of ASCE 7-05 was used to determine the wind loads acting on Area 2. This method was chosen because the mean height of the building is greater than 60'. The resulting pressure diagrams can be viewed in Figures 27 and 28, and tabulated in Tables 6 and 7.

Classification	Category
V, Basic Wind Speed (Fig. 6-1)	90 mph
K_d (Table 6-4)	0.85
I (Table 6-1)	1.15
Occupancy Category (Table 1-1)	III
Exposure Category	B
K_{zt} (Topographic Factor)	1

Table 5: Wind Classifications



East-West Wind Pressure Diagram (Figure 27)



North-South Wind Pressure Diagram (Figure 28)

Wind Forces (North-South Direction)						
				Load (kip)	Shear (kip)	Moment (ft-kip)
Level	Trib Height (ft)	Total Load N-S (psf)	Tributary Width (ft)	N-S	N-S	N-S
Roof	6	15.90	46	4.39	0.00	279.15
4	13.6	15.90	46	9.95	4.39	506.80
3	15.2	15.06	46	10.53	14.34	375.92
2	17.6	14.10	46	11.42	24.87	233.44
Ground	10	12.58	46	5.79	36.28	0.00
					42.07	**1395.31**

Table 6: North-South Wind Forces

Wind Forces (East-West Direction)						
				Load (kip)	Shear (kip)	Moment (ft-kip)
Level	Trib Height (ft)	Total Load E-W (psf)	Tributary Width (ft)	E-W	E-W	E-W
Roof	6	18.96	129	14.68	0.00	933.48
4	13.6	18.96	129	33.26	14.68	1694.77
3	15.2	18.15	129	35.59	47.94	1270.51
2	17.6	17.21	129	39.07	83.53	799.05
Ground	10	15.74	129	20.30	122.60	0.00
					142.91	**4697.82**

Table 7: East-West Wind Forces

The seismic loads were calculated in a similar manner to those of Area 1 using Chapters 11 and 12 of ASCE 7-05. A takedown of the building weight can be viewed in Appendix C. A summary of these forces can be viewed in Table 8, and a detailed breakdown of these calculations can be viewed in Appendix D of this report.

Floor	w_x (kip)	h_x	k	$w_x h_x^k$	$\sum w_i h_i^k$	F_x (kip)	Story Shear V_x (kip)	Moment (k-ft)
ROOF	164	69.5	1.014	12067	177100	8.81		612.14
4	1139	57.5	1.014	69329	177100	50.60	8.81	2909.78
3	1204	42.25	1.014	53635	177100	39.15	59.41	1654.06
2	1204	27	1.014	34060	177100	24.86	98.56	671.25
1	1113	7	1.014	8010	177100	5.85	123.42	40.93
Total	4824	69.5	1.014	177100	177100	129.27	**129.27**	**5888.15**

Table 8: Seismic Loads for Area 2

Area 1 Lateral Analysis

An ETABS model of Area 2, as seen in Figure 29, was created to aid in the lateral system analysis. The seismic and wind loads were applied to the model and drift was compared for the four wind cases stated by ASCE 7-05, and seismic loads. It was determined that the seismic loads will control the design in the North-South direction, however, wind will control in the East-West direction. This was expected because of the large surface area of the East-West side of the building and the relatively small surface areas of the transverse elevations. A summary of the drifts can be found in Table 9. Because drift is a serviceability check, load factors were not applied to the loads. The total building drift has been limited to H/400. It is assumed that because of the increase in weight of the building, the foundation system will need to change to a mat slab or pile system. Because of this, the base restriants were modelled as fixed connections.

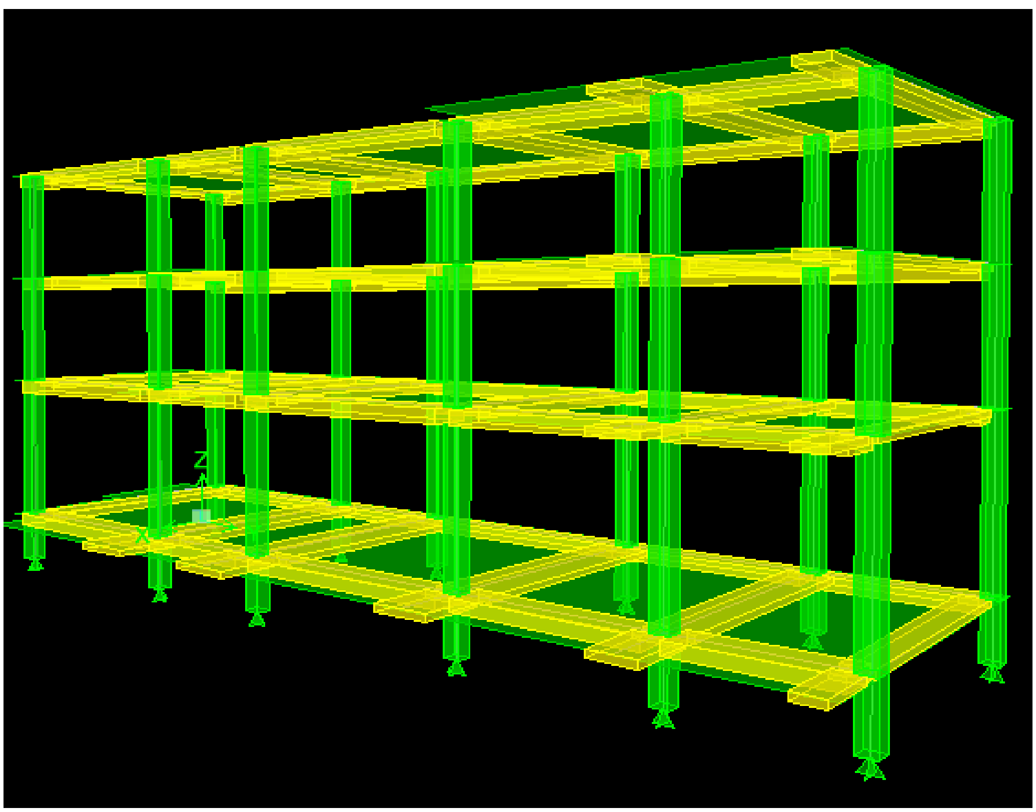


Figure 29: Area 2 ETABS Model

Story	Diaphragm	Load	UX (in)	UY (in)
STORY4	D4	XWIND	1.1218	0.0007
STORY4	D4	YWIND	-0.0012	0.1851
STORY4	D4	XQUAKE	1.331	0.0016
STORY4	D4	YQUAKE	0.0013	0.7267
STORY4	D4	CASE3	0.8405	0.1394
STORY4	D4	CASE2X	0.8772	0.0033
STORY4	D4	CASE2Y	-0.0047	0.1386
STORY4	D4	CASE4	0.8725	0.1418
STORY3	D3	XWIND	0.9105	0.0003
STORY3	D3	YWIND	-0.0008	0.1591
STORY3	D3	XQUAKE	1.0466	0.0003
STORY3	D3	YQUAKE	0.0007	0.6051
STORY3	D3	CASE3	0.6823	0.1196
STORY3	D3	CASE2X	0.705	-0.0002
STORY3	D3	CASE2Y	-0.0029	0.1194
STORY3	D3	CASE4	0.7021	0.1192
STORY2	D2	XWIND	0.5796	0.0004
STORY2	D2	YWIND	-0.0003	0.1097
STORY2	D2	XQUAKE	0.6395	0.0002
STORY2	D2	YQUAKE	0.0003	0.4
STORY2	D2	CASE3	0.4345	0.0826
STORY2	D2	CASE2X	0.4444	-0.0008
STORY2	D2	CASE2Y	-0.0013	0.0824
STORY2	D2	CASE4	0.4431	0.0816
ENTRANCE	D1	XWIND	0.0622	0.0001
ENTRANCE	D1	YWIND	0	0.0116
ENTRANCE	D1	XQUAKE	0.0652	0
ENTRANCE	D1	YQUAKE	0	0.0401
ENTRANCE	D1	CASE3	0.0466	0.0088
ENTRANCE	D1	CASE2X	0.0467	-0.0006
ENTRANCE	D1	CASE2Y	0	0.0088
ENTRANCE	D1	CASE4	0.0467	0.0082

Table 9: Drifts Due to Lateral Loads

COLUMN DESIGN

As seen from the lateral system analysis, the columns were designed to handle the demands of both the gravity system, and to transfer lateral loads. PCA Column was used as an aid to verify column sizes and rebar requirements. A excel spread sheet was created to determine the axial loads imposed on the each column. The moments exerted on the columns were determined from the ETABS model created. The following load combinations were applied to determine the controlling load factors:

$$1.4D$$
$$1.2D + 1.6L$$
$$\mathbf{1.2D + 1.6W + 0.5L}$$
$$1.2D \pm 1.0E + 0.5L$$
$$0.9D \pm (1.6W \text{ or } 1.0E)$$

D = dead load
L = live load
W = wind load
E = earthquake load

For this report, Column B-2 as designated in Figure 18 was spot checked. A detailed breakdown of the load combinations can be found in Appendix E. It was found that (8) #10 bars will be adequate to carry the loads imposed on the column. An interaction diagram can be viewed in Figure 30.

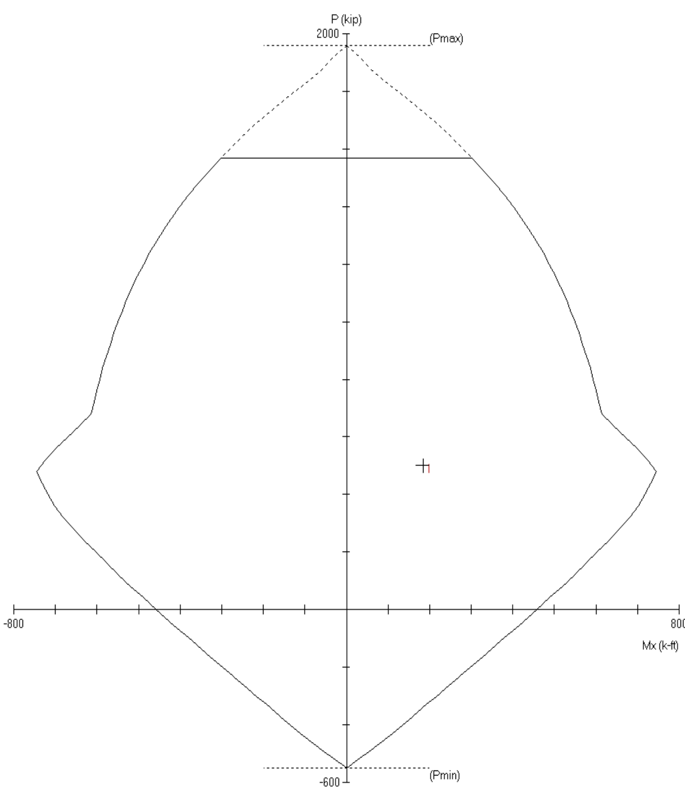


Figure 30: Interaction Diagram

From the interaction diagram, it is clear to see that this column does not utilize all of its strength capacity. A more efficient column based on strength requirements was investigated, however using a smaller column results in an unacceptable drift.

DEPTH STUDY CONCLUSION

The goal of reducing the total depth of the floor system was successfully reached by changing the gravity system from a composite steel deck and steel beam system to a concrete system that utilizes the trade of post tensioning. ADAPT PT was used as an aid in design of both the beams and one ways slabs. The deepest beam required in the redesign measured 20”. Spanning the beams in the suggested positions allowed for maximum clearance space. The maximum slab depth measured 12” which was necessary to support the loads over the simple spanned areas.

Redesign of the lateral system was required to complement the gravity system. The original braced frames and shear walls were removed from the lateral system. All lateral loads are resisted by concrete moment frames. An ETABS model of the building was created in order to determine the drift and moments the applied lateral loads create.

Total drift of the building was limited to H/400. From the column analysis, it is clear to see that the columns chosen were not the most efficient section from a strength standpoint, however were necessary to meet the serviceability requirement of drift.

Because the weight of the building increased upon changing structural systems, the foundation system must be altered. Strip footings should be adequate in the case of Area 1; however, the foundation type supporting Area 2 will most likely change. Because of the existing historic building using piles may not be the best alternative due to the vibration they create on impact. A mat foundation therefore could be a viable option for this foundation system.

CONSTRUCTION MANAGEMENT BREADTH

The goal of the construction management breath was to study the cost and schedule impact when changing the current system to a post tensioned concrete system. To accurately compare the cost and schedule of the two different systems, an analysis for both the concrete and steel buildings was conducted using MC^2 as an aid.

A post tensioned concrete system is a very viable alternative when it comes to geography. Because of the height restrictions of buildings in Washington D.C., post tensioned construction is a common practice in the area.

Four separate cost analysis were conducted in order to effectively make comparisons for both Area 1 and Area 2. A detailed takedown and assumptions for each estimate can be found in Appendices F-I. Because the structural system was the only system under investigation and comparison, the beams, columns floor slabs, and lateral resisting components were the only items inserted into the program. It must be noted that the foundation was not incorporated into the estimate. This will most likely add cost to the concrete estimate, because typically, concrete buildings require large foundations.

From the analysis of the proposed post-tensioned concrete system, it was found that Area 1 would cost approximately $150,000 and Area 2 approximately $350,000. This was compared to the existing steel system which cost approximately $100,000 for Area 1 and $400,000 for Area 2.

From the comparison of the total costs, it was found that both systems cost roughly $500,000. From the detailed cost breakdown of the different elements, it is clear to see that even though the proposed concrete system requires formwork of the columns beams and slab, the eight shear walls, additional fireproofing and steel moment connections are eliminated, which effectively offsets the costs.

When comparing the durations of the tasks, a linear progression using one crew was assumed. It was determined that the concrete system took 40% longer to construct than the existing steel system. Even though the time of erection is significantly longer, the lead time is typically much shorter for concrete construction.

ARCHITECTURAL BREADTH

The existing historic building utilizes 2x6 wood joists to transfer gravity loads to load bearing walls. From Figure 31 it is apparent that the direction in which the joists run varies throughout the building.

For the historic restoration of School Without Walls, it was detailed by the architect that the gypsum wall board ceiling was to be directly attached to the wood joists as seen in Figure 32.

Figure 31: Existing Wood Joist Layout

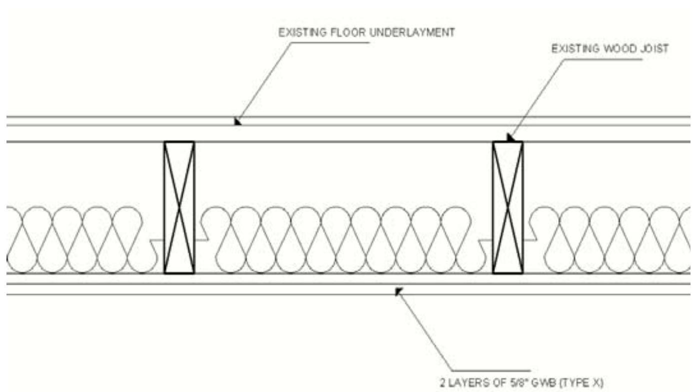


Figure 32: Existing Ceiling Detail

Due to the upgraded mechanical systems as part of the modernization process, ceiling clearance is very important. The construction team was challenged with the task of containing the electrical and mechanical systems in the space between the 2x6 joists. In addition to the limited space between joists, careful coordination had to occur when joists running in the transverse direction were encountered. The objective of this breadth is to show that the architecture of each classroom is not compromised by dropping the ceiling to allow for more clearance.

The dropped ceiling requires crossties and hangers to be used in order to attach the ceiling to the joists. A detailed section of the proposed ceiling system can be viewed in Figures 33 and 34. The architectural impact was studied if the ceiling is dropped 8”.

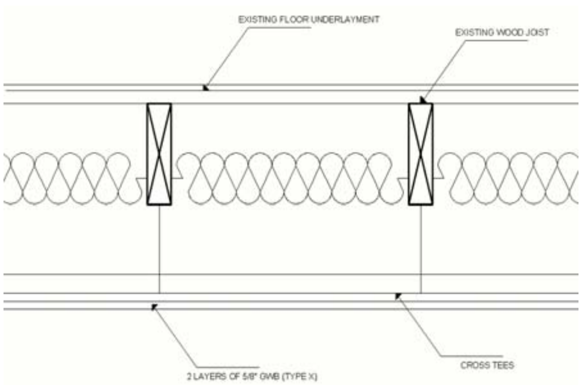


Figure 33: Dropped Ceiling Section

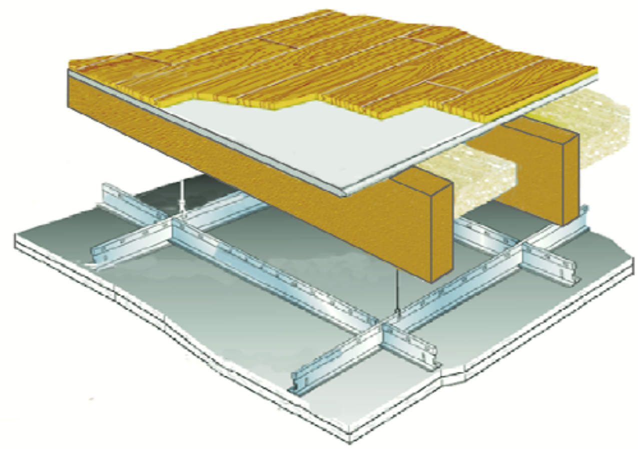


Figure 34: Isometric Ceiling Section

In order to effectively the aesthetic changes, a typical classroom was modeled in REVIT. Renderings were created in different areas of the room showing both the existing ceiling, and proposed dropped ceiling. These renderings can be viewed in Figures 35 through 40.

Figure 35: Existing Classroom Render

Figure 36: Dropped Ceiling Render

Figure 37: Existing Classroom Render

Figure 38: Dropped Ceiling Render

Figure 39: Existing Classroom Render

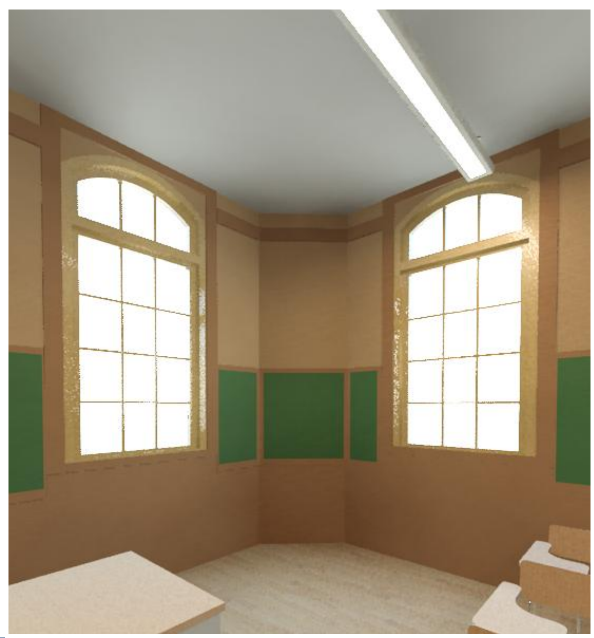


Figure 40: Dropped Ceiling Render

From the architectural investigation, it appears that the drop ceiling does not interfere with any major architectural elements. Using a dropped ceiling, therefore is a very viable option in this instance. Using this type of construction can eliminate extra costs involving MEP coordination without majorly effecting the architectural appeal of the room.

CONCLUSION

The goal of reducing the total depth of the floor system was successfully reached by changing the gravity system from a composite steel deck and steel beam system to a concrete system that utilizes the trade of post tensioning. ADAPT PT was used as an aid in design of both the beams and one ways slabs. The deepest beam required in the redesign measured 20". Spanning the beams in the suggested positions allowed for maximum clearance space. The maximum slab depth measured 12" which was necessary to support the loads over the simple spanned areas.

The lateral system required redesign to complement the gravity system. The original braced frames and shear walls were removed from the lateral system. All lateral loads are resisted by concrete moment frames. An ETABS model of the building was created in order to determine the drift and moments the applied lateral loads create.

Total drift of the building was limited to H/400. From the column analysis, it is clear to see that the columns chosen were not the most efficient section from a strength standpoint, however were necessary to meet the serviceability requirements.

The change in systems required an analysis of the cost of the project. A cost breakdown was performed for both the steel and concrete systems using MC^2 as an aid. It was found that when comparing the structure cost it was found that the change in systems did not dramatically change the price. The increased labor costs of the concrete building due to formwork were offset by the elimination of shear walls, steel moment connections and required additional fireproofing.

Because of the increased weight of the building when changing structural systems, the foundation system must be altered. Strip footings should be adequate in the case of Area 1; however, the foundation supporting Area 2 will most likely change. Because of the existing historic building using piles may not be the best alternative due to the vibration they create on impact. A mat foundation therefore could be a viable option for this foundation system.

A benefit of reducing the floor system depth of Area 1 and Area 2 is that it allows an easier coordination of the trades between the ceiling, and floor above. Likewise in the existing historic building, more clearance space allows for easier trade coordination.

The architectural breadth for the school without walls studies the aesthetic impact dropping the ceiling 8”. After creating a REVIT model and exporting renderings of the space, it was determined that dropping the ceiling was in fact a viable option from an architectural standpoint.

REFERENCES

1. American Concrete Institute (2008) *Building Code Requirements for Structural Concrete (ACI 318-08)*, ACI, Farmington Hills, MI

2. American Institute of Steel Construction (2005) *Steel Construction Manual,* Thirteenth Edition, AISC, Chicago, IL

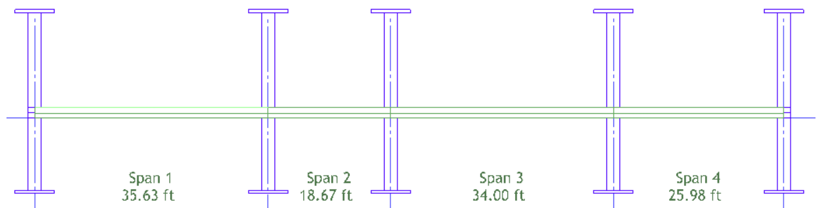
3. American Society of Civil Engineers (2005) *ASCE 7-05:Minimum Design Loads for Building and Other Structures,* ASCE, Reston, VA

4. Allred, Brian. *Common Post-Tensioning and Construction Issues.* Structure Magazine, July 2005

5. Kang, T. H.-K., and J. W. Wallace, 2005. Dynamic Responses of Flat Plate Systems with Shear Reinforcement, *ACI Structural Journal*, 102 (5), 763-773.

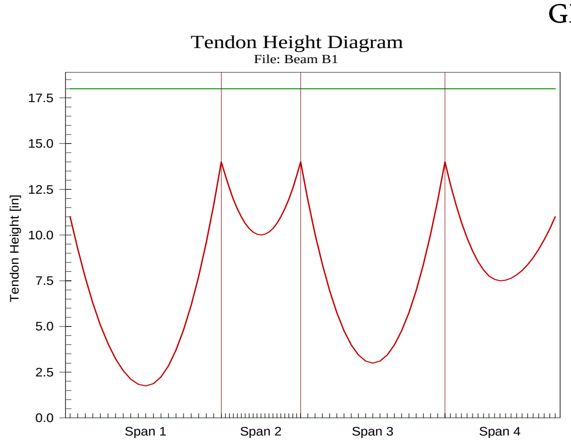
APPENDIX A

AREA 1
BEAM B1

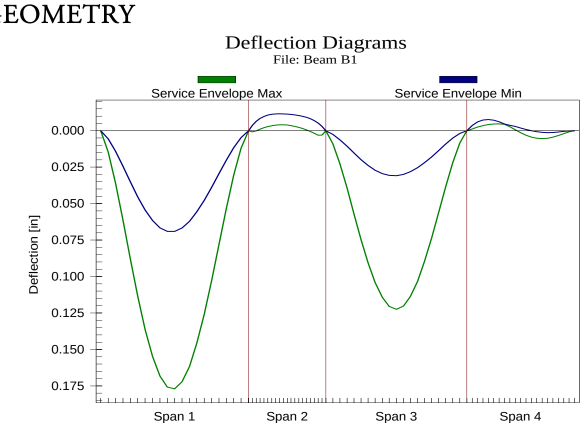


Span	Form	Length	Width	Depth	TF Width	TF Thick.	Rh	Right Mult.	Left Mult.
		ft	in	in	in	in	in		
1	2	35.63	56.00	18.00	281.00	10.00	18.00	0.61	0.39
2	2	18.67	56.00	18.00	281.00	10.00	18.00	0.61	0.39
3	2	34.00	56.00	18.00	281.00	10.00	18.00	0.61	0.39
4	2	25.98	56.00	18.00	199.76	10.00	18.00	0.86	0.14

GEOMETRY



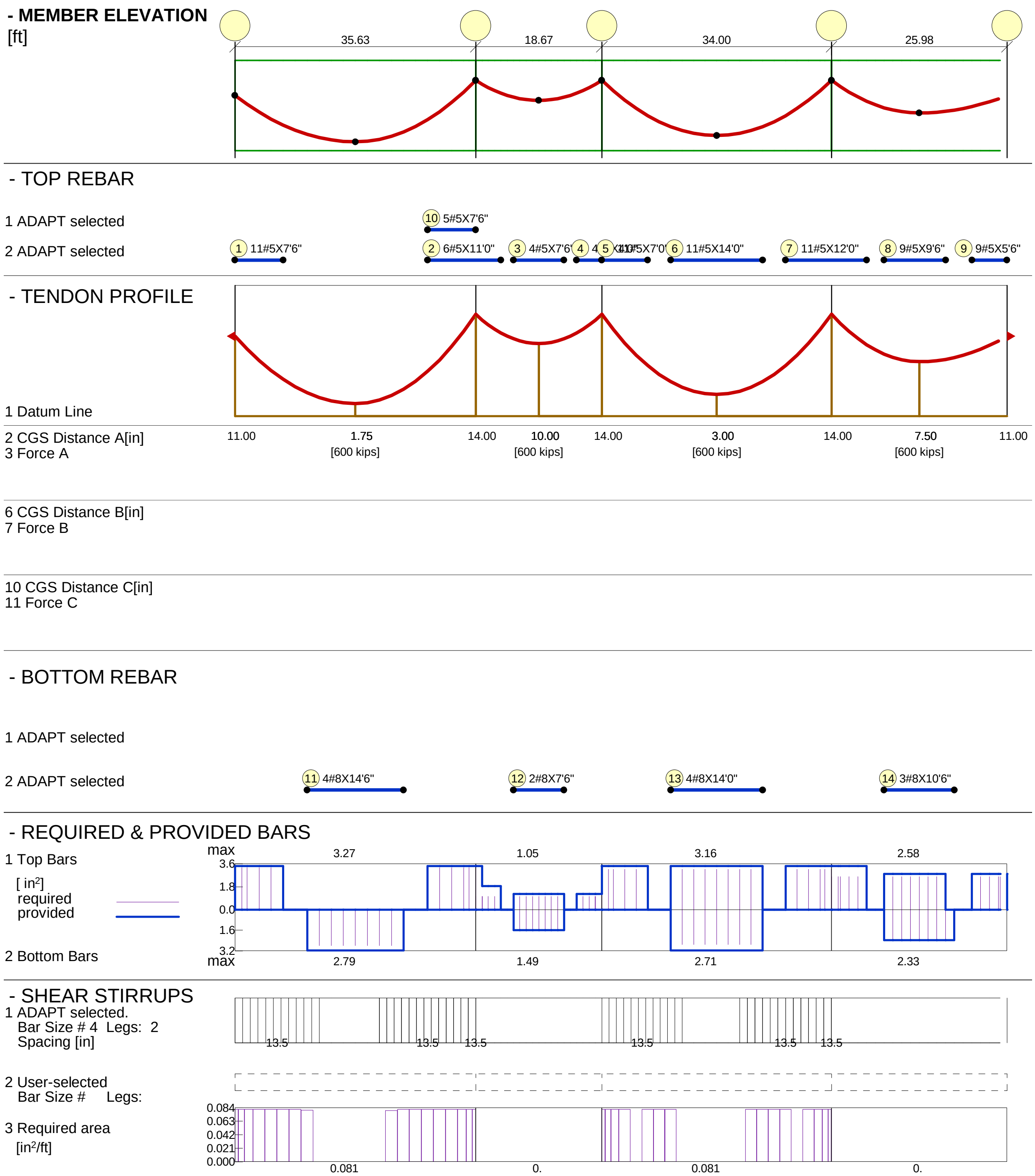
POST-TENSIONING PROFILE



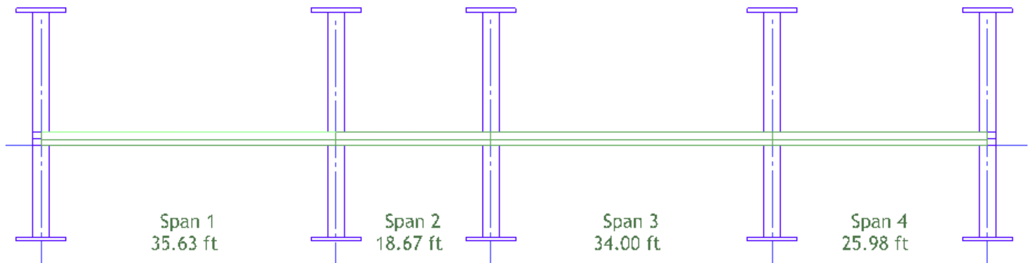
DEFLECTION

Span	Class	Type	W
			k/ft2
1	LL	U	0.100
1	SDL	U	0.015
2	LL	U	0.100
2	SDL	U	0.015
3	LL	U	0.100
3	SDL	U	0.015
4	LL	U	0.050
4	SDL	U	0.015

INPUT APPLIED LOADING

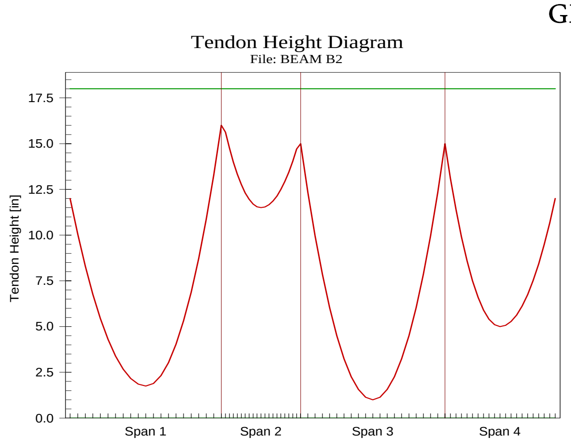

- MEMBER ELEVATION
[ft]
35.63
18.67
34.00
25.98
- TOP REBAR
1 ADAPT selected
10 5#5X7'6"
2 ADAPT selected
1 11#5X7'6"
2 6#5X11'0"
3 4#5X7'6"
6 11#5X14'0"
7 11#5X12'0"
8 9#5X9'6"
9 9#5X5'6"
- TENDON PROFILE
1 Datum Line
2 CGS Distance A[in]
3 Force A
11.00
1.75
[600 kips]
14.00
10.00
[600 kips]
14.00
3.00
[600 kips]
14.00
7.50
[600 kips]
11.00
6 CGS Distance B[in]
7 Force B
10 CGS Distance C[in]
11 Force C
- BOTTOM REBAR
1 ADAPT selected
2 ADAPT selected
11 4#8X14'6"
12 2#8X7'6"
13 4#8X14'0"
14 3#8X10'6"
- REQUIRED & PROVIDED BARS
1 Top Bars
[in²]
required
provided
2 Bottom Bars
max
3.6
1.8
0.0
1.6
3.2
max
3.27
1.05
3.16
2.58
2.79
1.49
2.71
2.33
- SHEAR STIRRUPS
1 ADAPT selected.
Bar Size # 4 Legs: 2
Spacing [in]
13.5
13.5
13.5
13.5
13.5
13.5
2 User-selected
Bar Size # Legs:
3 Required area
[in²/ft]
0.084
0.063
0.042
0.021
0.000
0.081
0.
0.081
0.

AREA 1
BEAM B2

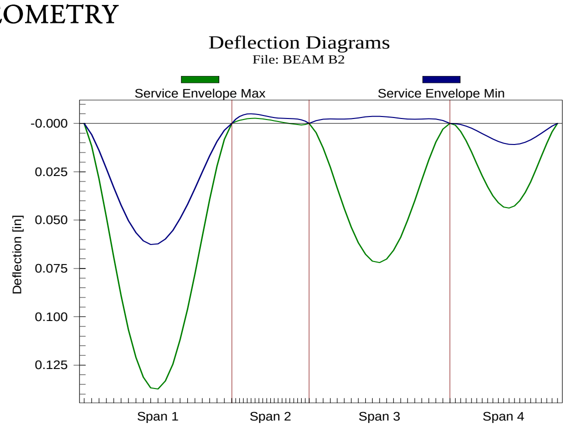


Span	Form	Length	Width	Depth	TF Width	TF Thick.	Rh	Right Mult.	Left Mult.
		ft	in	in	in	in	in		
1	2	35.63	40.00	18.00	168.75	10.00	18.00	0.10	0.90
2	2	18.67	40.00	18.00	168.75	10.00	18.00	0.10	0.90
3	2	34.00	40.00	18.00	168.75	10.00	18.00	0.10	0.90
4	2	25.98	40.00	18.00	168.75	10.00	18.00	0.10	0.90

GEOMETRY



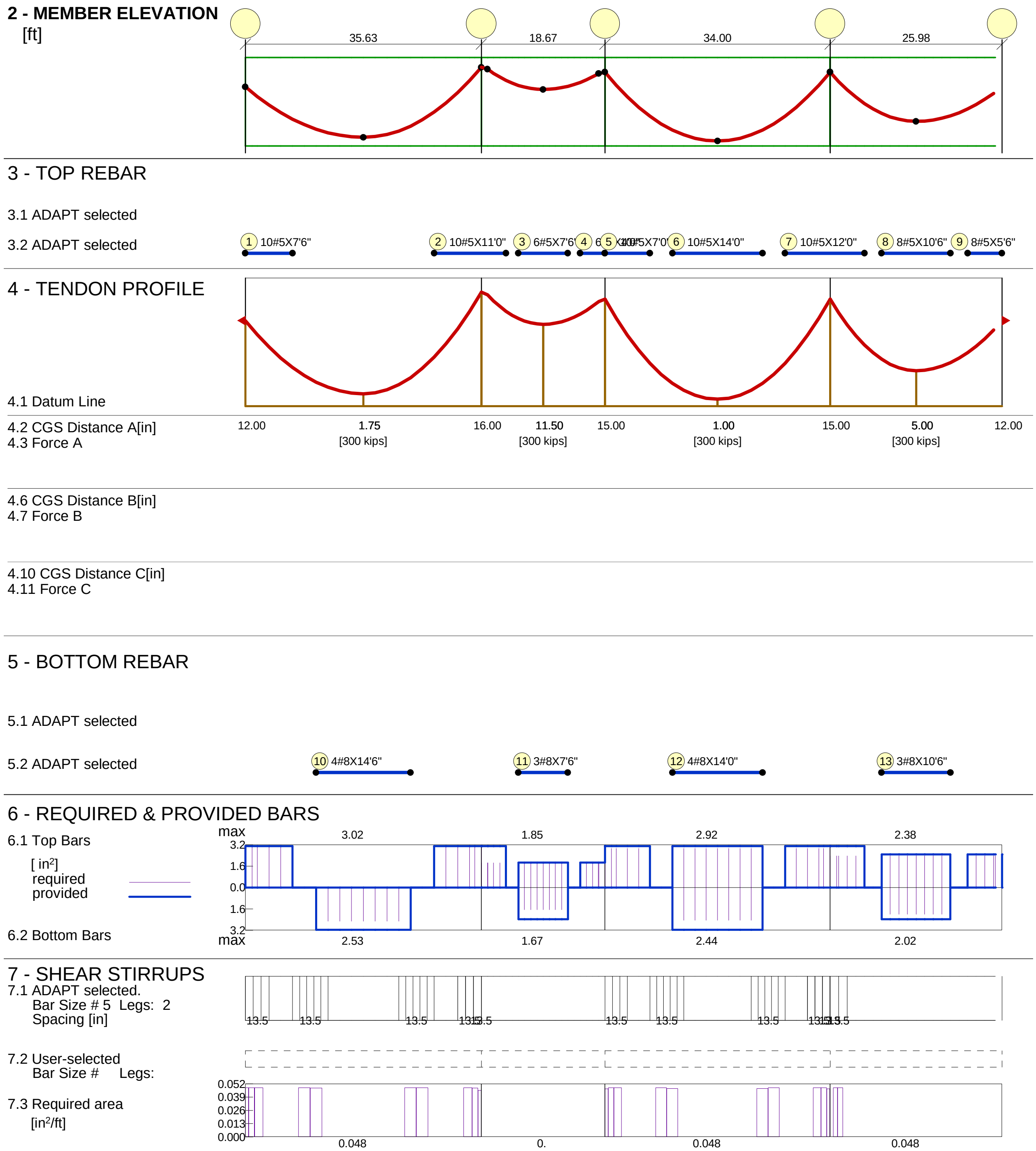
POST-TENSIONING PROFILE



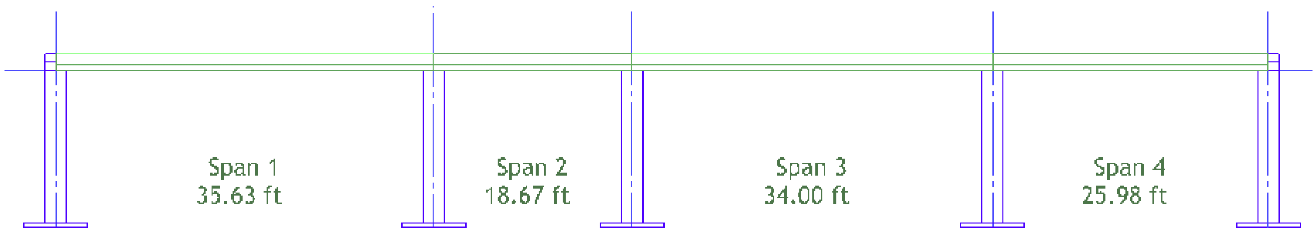
DEFLECTION

Span	Class	Type	W
			k/ft2
1	LL	U	0.100
1	SDL	U	0.015
2	LL	U	0.100
2	SDL	U	0.015
3	LL	U	0.100
3	SDL	U	0.015
4	LL	U	0.050
4	SDL	U	0.015

INPUT APPLIED LOADING

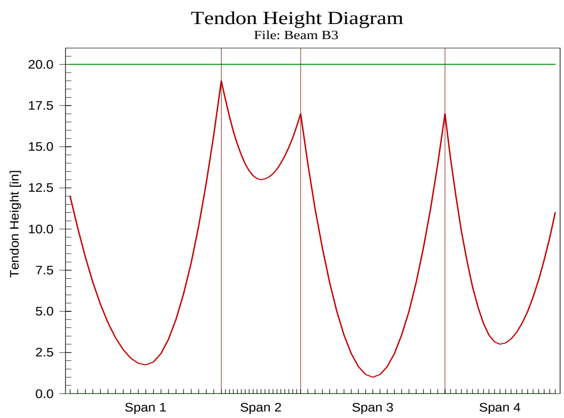

2 - MEMBER ELEVATION
[ft]
35.63
18.67
34.00
25.98
3 - TOP REBAR
3.1 ADAPT selected
3.2 ADAPT selected
1 10#5X7'6"
2 10#5X11'0"
3 6#5X7'6"
4
5
6 10#5X14'0"
7 10#5X12'0"
8 8#5X10'6"
9 8#5X5'6"
4 - TENDON PROFILE
4.1 Datum Line
4.2 CGS Distance A[in]
4.3 Force A
12.00
1.75
[300 kips]
16.00
11.50
[300 kips]
15.00
1.00
[300 kips]
15.00
5.00
[300 kips]
12.00
4.6 CGS Distance B[in]
4.7 Force B
4.10 CGS Distance C[in]
4.11 Force C
5 - BOTTOM REBAR
5.1 ADAPT selected
5.2 ADAPT selected
10 4#8X14'6"
11 3#8X7'6"
12 4#8X14'0"
13 3#8X10'6"
6 - REQUIRED & PROVIDED BARS
6.1 Top Bars
[in²]
required
provided
6.2 Bottom Bars
max
3.2
1.6
0.0
1.6
3.2
max
3.02
1.85
2.92
2.38
2.53
1.67
2.44
2.02
7 - SHEAR STIRRUPS
7.1 ADAPT selected.
Bar Size # 5 Legs: 2
Spacing [in]
13.5
7.2 User-selected
Bar Size # Legs:
7.3 Required area
[in²/ft]
0.052
0.039
0.026
0.013
0.000
0.048
0.
0.048
0.048

AREA 1
BEAM B3

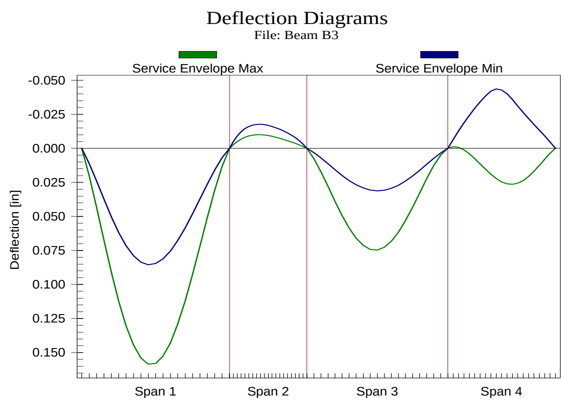


Span	Form	Length	Width	Depth	TF Width	TF Thick.	Rh	Right Mult.	Left Mult.
		ft	in	in	in	in	in		
1	2	35.63	56.00	20.00	196.75	11.00	20.00	0.86	0.14
2	2	18.67	56.00	20.00	196.75	11.00	20.00	0.86	0.14
3	2	34.00	56.00	20.00	196.75	11.00	20.00	0.86	0.14
4	2	25.98	56.00	20.00	196.75	11.00	20.00	0.86	0.14

GEOMETRY



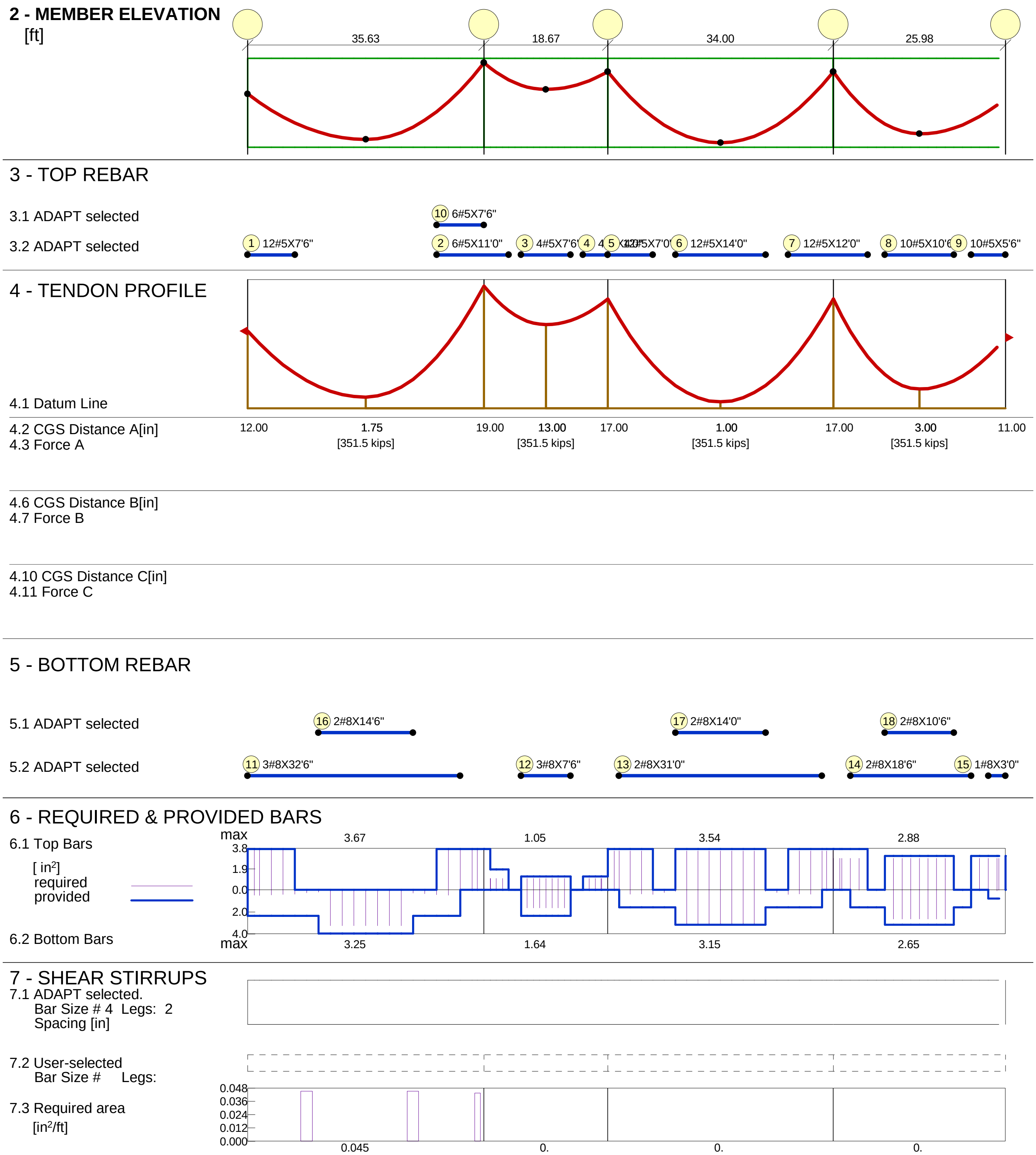
POST-TENSIONING PROFILE



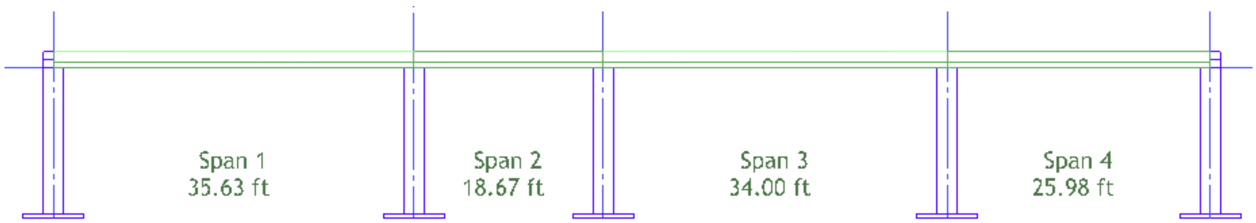
DEFLECTION

Span	Class	Type	W
			k/ft2
1	LL	U	0.100
1	SDL	U	0.025
2	LL	U	0.100
2	SDL	U	0.025
3	LL	U	0.100
3	SDL	U	0.025
4	LL	U	0.150
4	SDL	U	0.025

INPUT APPLIED LOADING

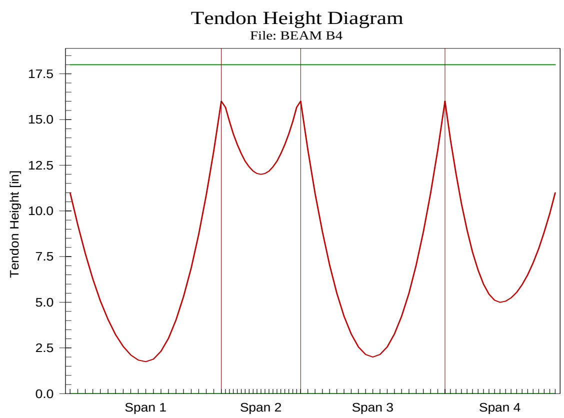

2 - MEMBER ELEVATION
[ft]
35.63
18.67
34.00
25.98
3 - TOP REBAR
3.1 ADAPT selected
3.2 ADAPT selected
10 6#5X7'6"
1 12#5X7'6"
2 6#5X11'0"
3 4#5X7'6"
4
5
6 12#5X14'0"
7 12#5X12'0"
8 10#5X10'6"
9 10#5X5'6"
4 - TENDON PROFILE
4.1 Datum Line
4.2 CGS Distance A[in]
4.3 Force A
12.00
1.75
[351.5 kips]
19.00
13.00
[351.5 kips]
17.00
1.00
[351.5 kips]
17.00
3.00
[351.5 kips]
11.00
4.6 CGS Distance B[in]
4.7 Force B
4.10 CGS Distance C[in]
4.11 Force C
5 - BOTTOM REBAR
5.1 ADAPT selected
5.2 ADAPT selected
16 2#8X14'6"
17 2#8X14'0"
18 2#8X10'6"
11 3#8X32'6"
12 3#8X7'6"
13 2#8X31'0"
14 2#8X18'6"
15 1#8X3'0"
6 - REQUIRED & PROVIDED BARS
6.1 Top Bars
[in²]
required
provided
6.2 Bottom Bars
max
3.8
1.9
0.0
2.0
4.0
max
3.67
1.05
3.54
2.88
3.25
1.64
3.15
2.65
7 - SHEAR STIRRUPS
7.1 ADAPT selected.
Bar Size # 4 Legs: 2
Spacing [in]
7.2 User-selected
Bar Size # Legs:
7.3 Required area
[in²/ft]
0.048
0.036
0.024
0.012
0.000
0.045
0.
0.
0.

AREA 1
BEAM B4

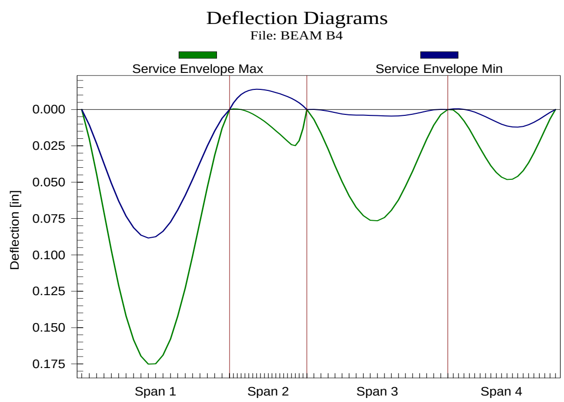


Span	Form	Length	Width	Depth	TF Width	TF Thick.	Rh	Right Mult.	Left Mult.
		ft	in	in	in	in	in		
1	2	35.63	40.00	20.00	168.75	11.00	20.00	0.10	0.90
2	2	18.67	40.00	20.00	168.75	11.00	20.00	0.10	0.90
3	2	34.00	40.00	20.00	168.75	11.00	20.00	0.10	0.90
4	2	25.98	40.00	20.00	168.75	11.00	20.00	0.10	0.90

GEOMETRY



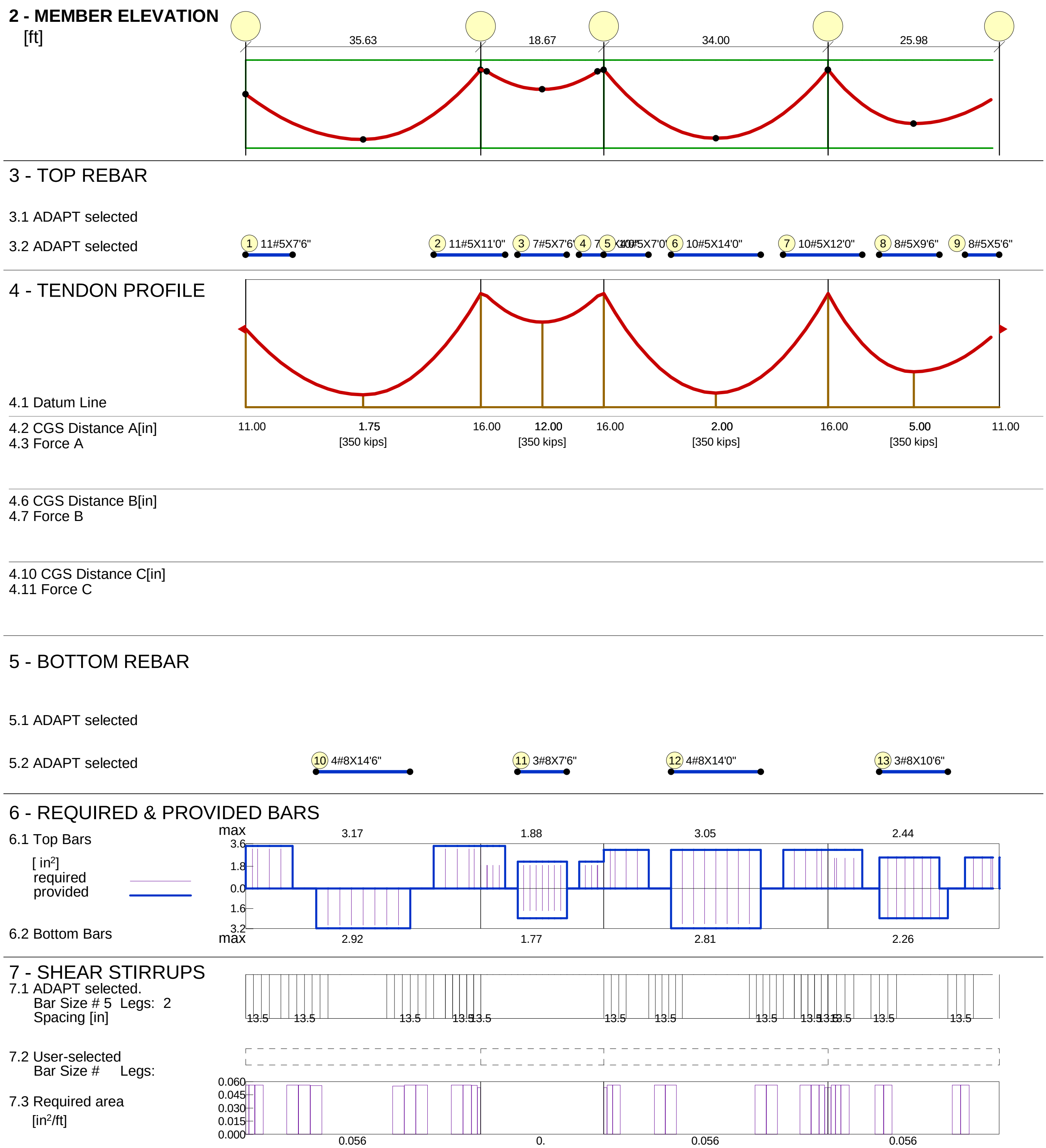
POST-TENSIONING PROFILE



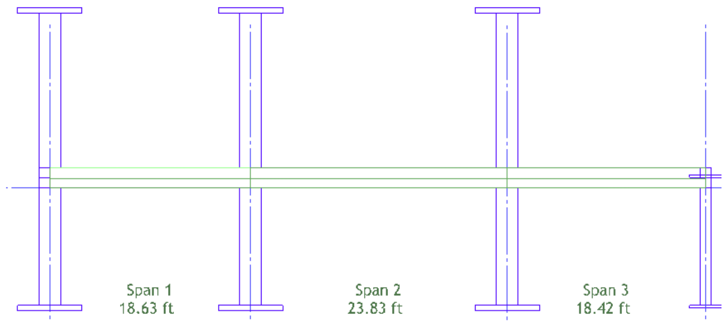
DEFLECTION

Span	Class	Type	W
			k/ft2
1	LL	U	0.100
1	SDL	U	0.025
2	LL	U	0.100
2	SDL	U	0.025
3	LL	U	0.100
3	SDL	U	0.025
4	LL	U	0.150
4	SDL	U	0.025

INPUT APPLIED LOADING

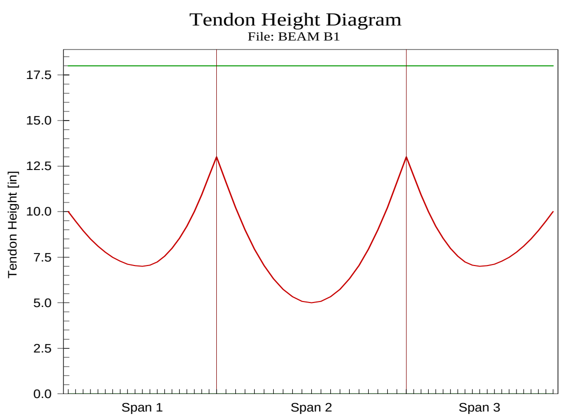

2 - MEMBER ELEVATION
[ft]
35.63
18.67
34.00
25.98
3 - TOP REBAR
3.1 ADAPT selected
3.2 ADAPT selected
1 11#5X7'6"
2 11#5X11'0"
3 7#5X7'6"
4
5
6 10#5X14'0"
7 10#5X12'0"
8 8#5X9'6"
9 8#5X5'6"
4 - TENDON PROFILE
4.1 Datum Line
4.2 CGS Distance A[in]
4.3 Force A
11.00
1.75
16.00
12.00
16.00
2.00
16.00
5.00
11.00
[350 kips]
[350 kips]
[350 kips]
[350 kips]
4.6 CGS Distance B[in]
4.7 Force B
4.10 CGS Distance C[in]
4.11 Force C
5 - BOTTOM REBAR
5.1 ADAPT selected
5.2 ADAPT selected
10 4#8X14'6"
11 3#8X7'6"
12 4#8X14'0"
13 3#8X10'6"
6 - REQUIRED & PROVIDED BARS
6.1 Top Bars
[in²]
required
provided
6.2 Bottom Bars
max
3.6
1.8
0.0
1.6
3.2
max
3.17
1.88
3.05
2.44
2.92
1.77
2.81
2.26
7 - SHEAR STIRRUPS
7.1 ADAPT selected.
Bar Size # 5 Legs: 2
Spacing [in]
13.5
7.2 User-selected
Bar Size # Legs:
7.3 Required area
[in²/ft]
0.060
0.045
0.030
0.015
0.000
0.056
0.
0.056
0.056

AREA 2
BEAM B5

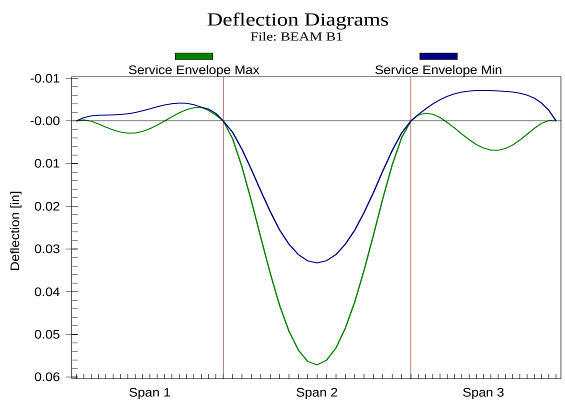


Span	Form	Length	Width	Depth	TF Width	TF Thick.	Rh	Right Mult.	Left Mult.
		ft	in	in	in	in	in		
1	2	18.63	60.00	18.00	312.00	10.00	18.00	0.35	0.65
2	2	23.83	60.00	18.00	312.00	10.00	18.00	0.35	0.65
3	2	18.42	60.00	18.00	312.00	10.00	18.00	0.35	0.65

GEOMETRY



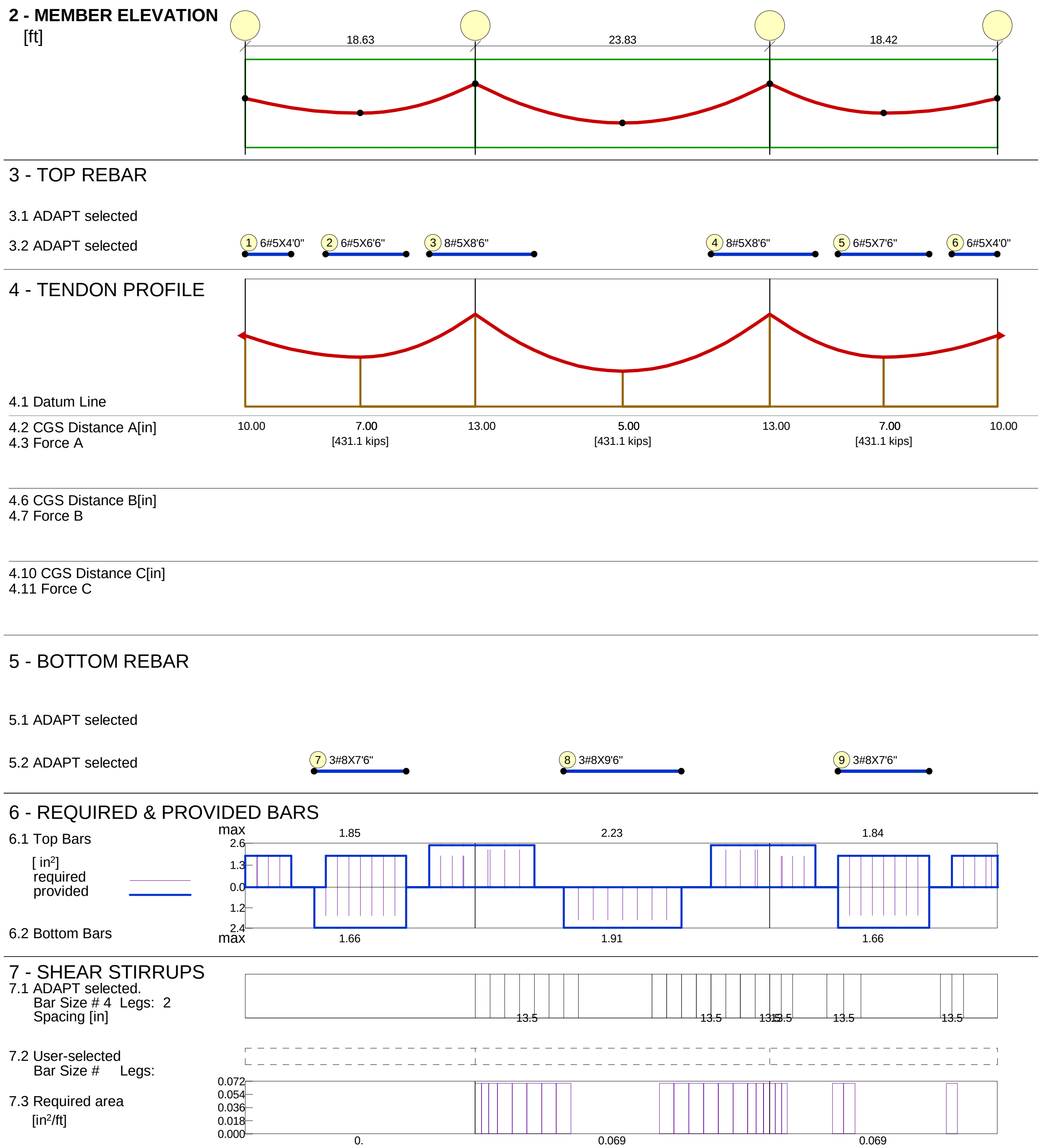
POST-TENSIONING PROFILE



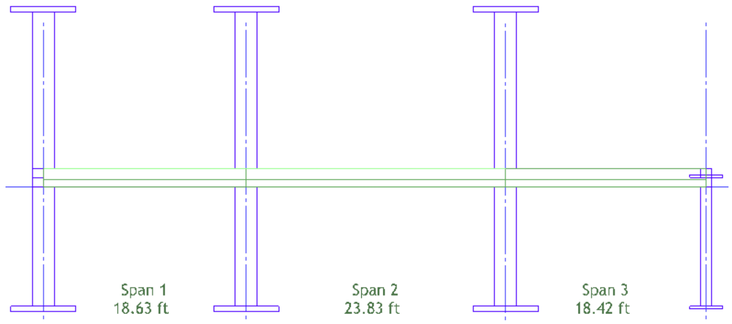
DEFLECTION

Span	Class	Type	W	A	F
			k/ft2	ft	k
1	LL	U	0.050		
1	SDL	U	0.015		
2	LL	U	0.082		
2	SDL	U	0.015		
2	SDL	C		6.670	13.000
2	SDL	C		18.000	13.000
3	LL	U	0.082		
3	SDL	U	0.015		

INPUT APPLIED LOADING

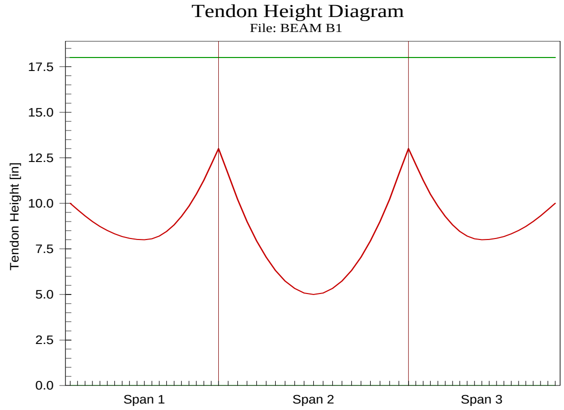

2 - MEMBER ELEVATION
[ft]
18.63
23.83
18.42
3 - TOP REBAR
3.1 ADAPT selected
3.2 ADAPT selected
1 6#5X4'0"
2 6#5X6'6"
3 8#5X8'6"
4 8#5X8'6"
5 6#5X7'6"
6 6#5X4'0"
4 - TENDON PROFILE
4.1 Datum Line
4.2 CGS Distance A[in]
4.3 Force A
10.00
7.00
[431.1 kips]
13.00
5.00
[431.1 kips]
13.00
7.00
[431.1 kips]
10.00
4.6 CGS Distance B[in]
4.7 Force B
4.10 CGS Distance C[in]
4.11 Force C
5 - BOTTOM REBAR
5.1 ADAPT selected
5.2 ADAPT selected
7 3#8X7'6"
8 3#8X9'6"
9 3#8X7'6"
6 - REQUIRED & PROVIDED BARS
6.1 Top Bars
[in²]
required
provided
6.2 Bottom Bars
max
2.6
1.3
0.0
1.2
2.4
max
1.85
2.23
1.84
1.66
1.91
1.66
7 - SHEAR STIRRUPS
7.1 ADAPT selected.
Bar Size # 4 Legs: 2
Spacing [in]
13.5
13.5
13.5
13.5
13.5
7.2 User-selected
Bar Size # Legs:
7.3 Required area
[in²/ft]
0.072
0.054
0.036
0.018
0.000
0.
0.069
0.069

AREA 2
BEAM B6

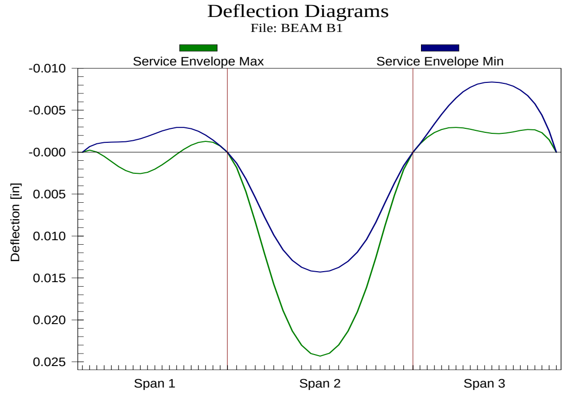


Span	Form	Length	Width	Depth	TF Width	TF Thick.	Rh	Right Mult.	Left Mult.
		ft	in	in	in	in	in		
1	2	18.63	40.00	18.00	224.56	10.00	18.00	0.09	0.91
2	2	23.83	40.00	18.00	224.56	10.00	18.00	0.09	0.91
3	2	18.42	40.00	18.00	224.56	10.00	18.00	0.09	0.91

GEOMETRY



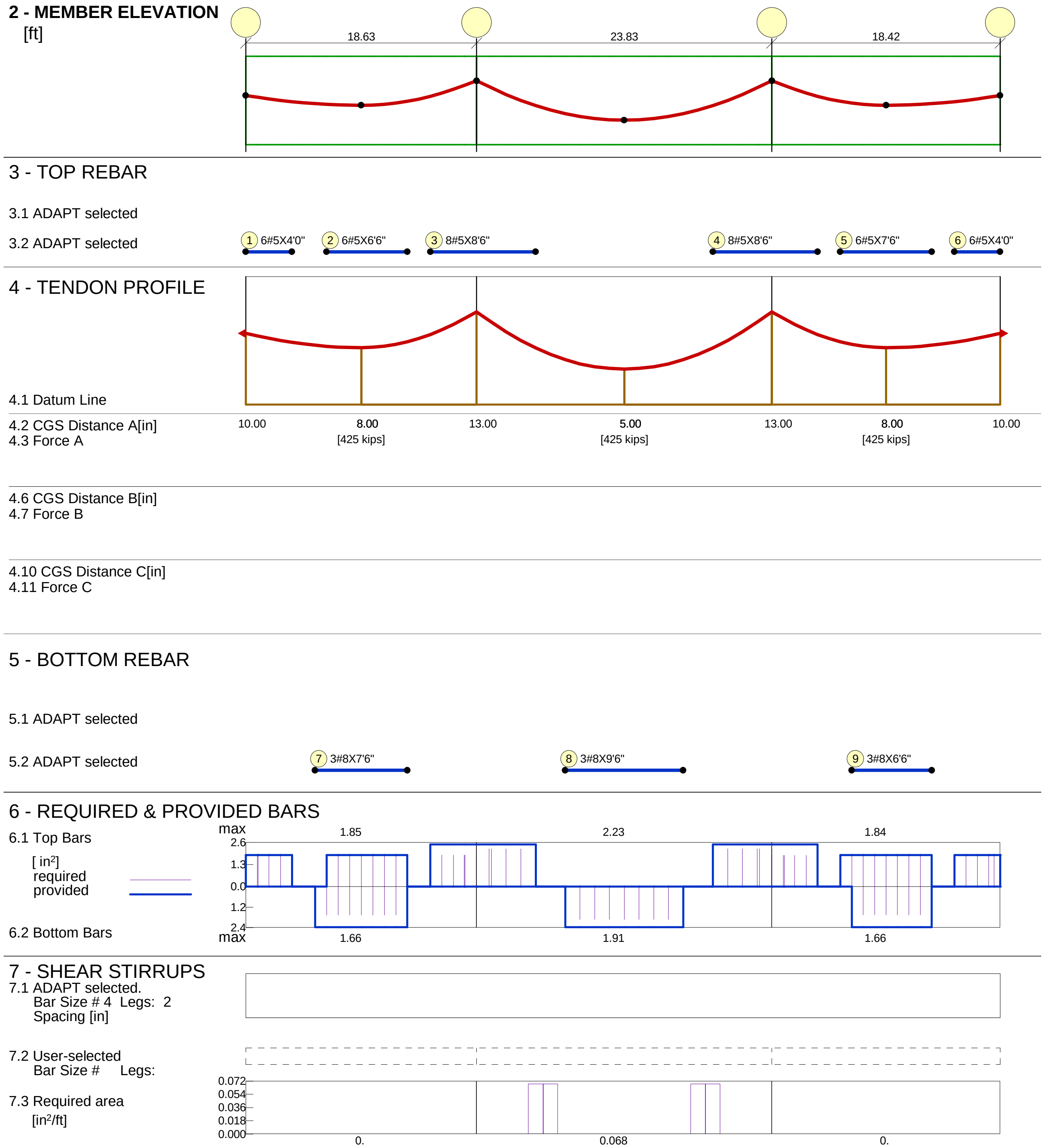
POST-TENSIONING PROFILE



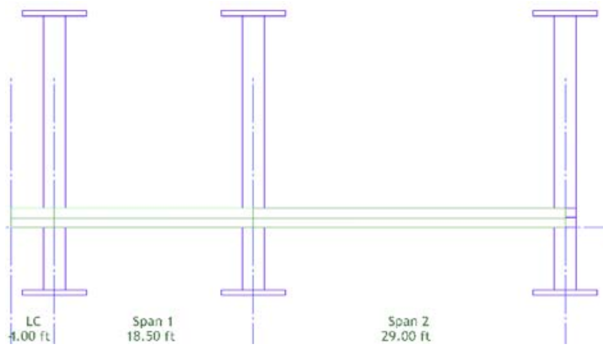
DEFLECTION

Span	Class	Type	W	A	F
			k/ft2	ft	k
1	LL	U	0.050		
1	SDL	U	0.015		
2	LL	U	0.050		
2	SDL	U	0.015		
2	SDL	C		6.670	16.000
2	SDL	C		18.000	16.000
3	LL	U	0.050		
3	SDL	U	0.015		

INPUT APPLIED LOADING

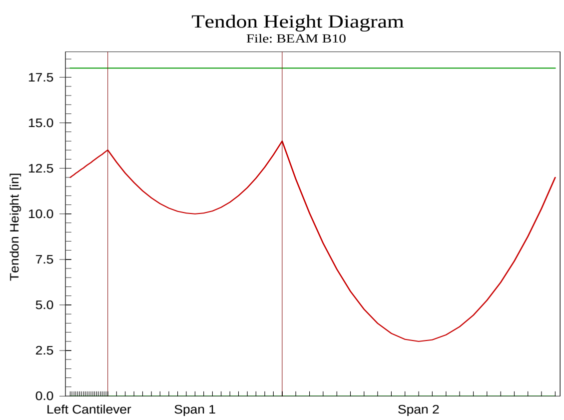

2 - MEMBER ELEVATION
[ft]
18.63
23.83
18.42
3 - TOP REBAR
3.1 ADAPT selected
3.2 ADAPT selected
1 6#5X4'0"
2 6#5X6'6"
3 8#5X8'6"
4 8#5X8'6"
5 6#5X7'6"
6 6#5X4'0"
4 - TENDON PROFILE
4.1 Datum Line
4.2 CGS Distance A[in]
4.3 Force A
10.00
8.00
[425 kips]
13.00
5.00
[425 kips]
13.00
8.00
[425 kips]
10.00
4.6 CGS Distance B[in]
4.7 Force B
4.10 CGS Distance C[in]
4.11 Force C
5 - BOTTOM REBAR
5.1 ADAPT selected
5.2 ADAPT selected
7 3#8X7'6"
8 3#8X9'6"
9 3#8X6'6"
6 - REQUIRED & PROVIDED BARS
6.1 Top Bars
[in²]
required
provided
6.2 Bottom Bars
max
2.6
1.3
0.0
1.2
2.4
max
1.85
2.23
1.84
1.66
1.91
1.66
7 - SHEAR STIRRUPS
7.1 ADAPT selected.
Bar Size # 4 Legs: 2
Spacing [in]
7.2 User-selected
Bar Size # Legs:
7.3 Required area
[in²/ft]
0.072
0.054
0.036
0.018
0.000
0.
0.068
0.

AREA 2
BEAM B7

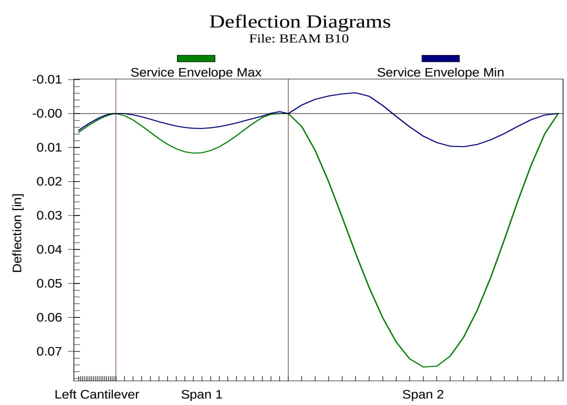


Span	Form	Length	Width	Depth	TF Width	TF Thick.	Rh	Right Mult.	Left Mult.
		ft	in	in	in	in	in		
C	2	4.00	60.00	18.00	312.00	10.00	18.00	0.35	0.65
1	2	18.50	60.00	18.00	312.00	10.00	18.00	0.35	0.65
2	2	29.00	60.00	18.00	312.00	10.00	18.00	0.35	0.65

GEOMETRY



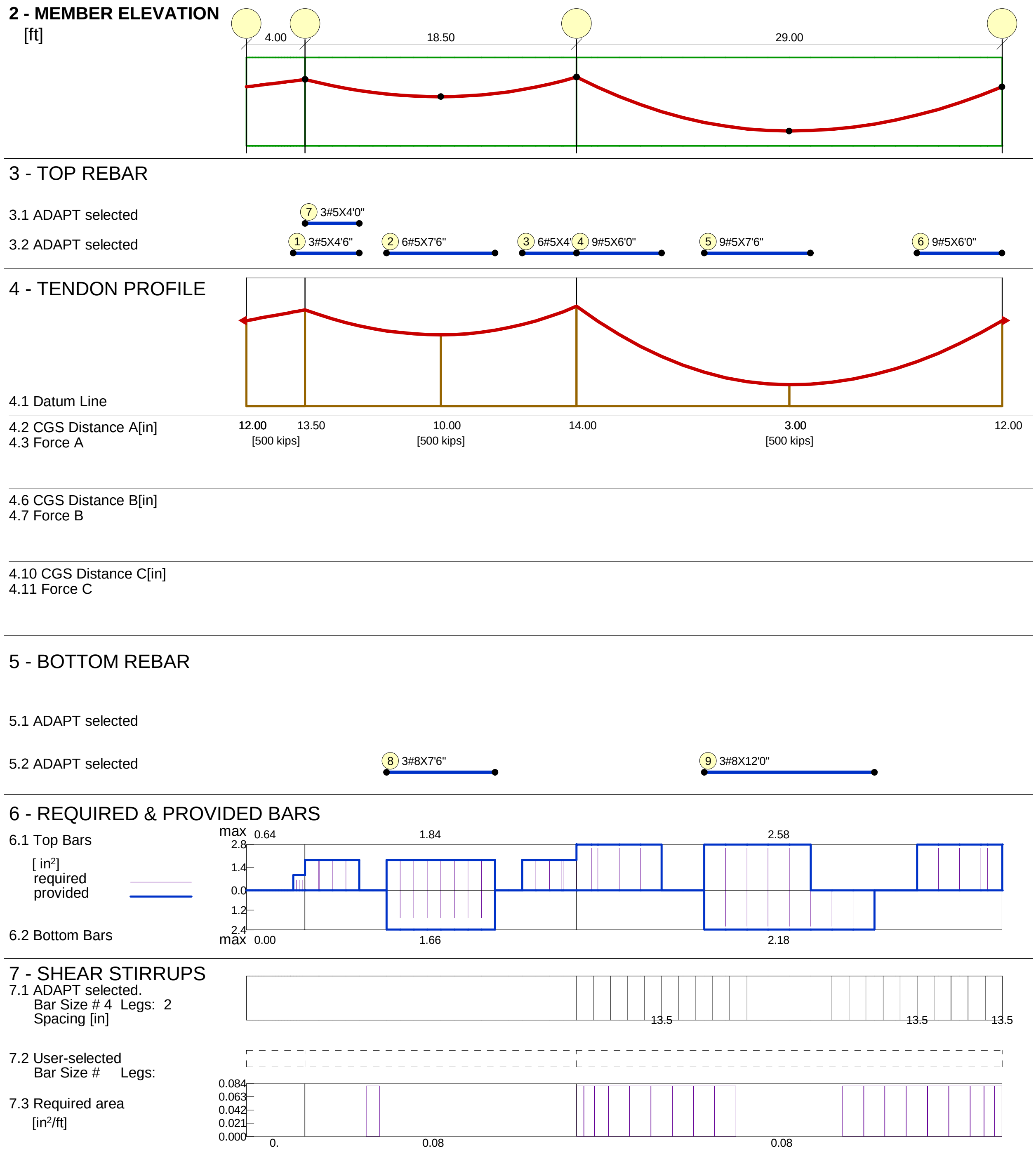
POST-TENSIONING PROFILE



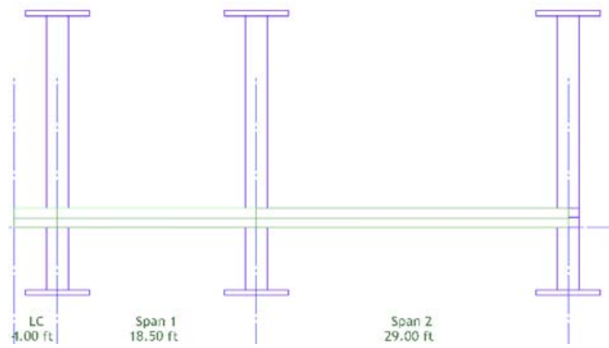
DEFLECTION

Span	Class	Type	W
			k/ft2
CANT	LL	U	0.082
CANT	SDL	U	0.015
1	LL	U	0.082
1	SDL	U	0.015
2	LL	U	0.082
2	SDL	U	0.015

INPUT APPLIED LOADING

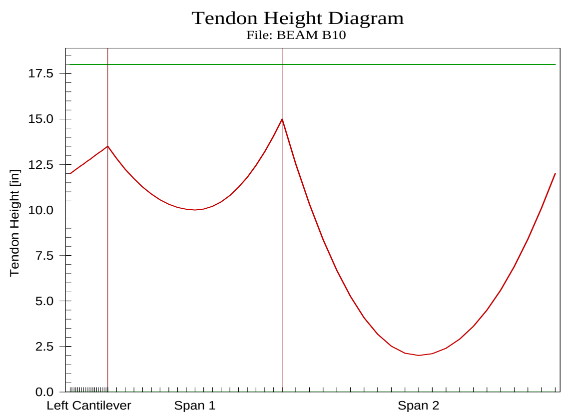

2 - MEMBER ELEVATION
[ft]
4.00
18.50
29.00
3 - TOP REBAR
3.1 ADAPT selected
3.2 ADAPT selected
7 3#5X4'0"
1 3#5X4'6"
2 6#5X7'6"
3 6#5X4'
4 9#5X6'0"
5 9#5X7'6"
6 9#5X6'0"
4 - TENDON PROFILE
4.1 Datum Line
4.2 CGS Distance A[in]
4.3 Force A
12.00
13.50
10.00
14.00
3.00
12.00
[500 kips]
[500 kips]
[500 kips]
4.6 CGS Distance B[in]
4.7 Force B
4.10 CGS Distance C[in]
4.11 Force C
5 - BOTTOM REBAR
5.1 ADAPT selected
5.2 ADAPT selected
8 3#8X7'6"
9 3#8X12'0"
6 - REQUIRED & PROVIDED BARS
6.1 Top Bars
[in2]
required
provided
6.2 Bottom Bars
max
0.64
1.84
2.58
2.8
1.4
0.0
1.2
2.4
max
0.00
1.66
2.18
7 - SHEAR STIRRUPS
7.1 ADAPT selected.
Bar Size # 4 Legs: 2
Spacing [in]
13.5
13.5
13.5
7.2 User-selected
Bar Size # Legs:
7.3 Required area
[in2/ft]
0.084
0.063
0.042
0.021
0.000
0.
0.08
0.08

AREA 2
BEAM B8

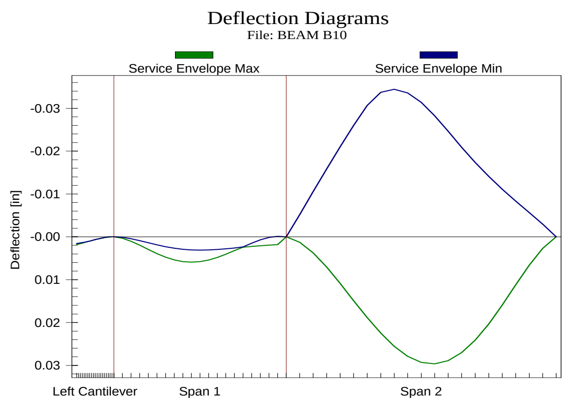


Span	Form	Length	Width	Depth	TF Width	TF Thick.	Rh	Right Mult.	Left Mult.
		ft	in	in	in	in	in		
C	2	4.00	40.00	18.00	224.56	10.00	18.00	0.09	0.91
1	2	18.50	40.00	18.00	224.56	10.00	18.00	0.09	0.91
2	2	29.00	40.00	18.00	224.56	10.00	18.00	0.09	0.91

GEOMETRY



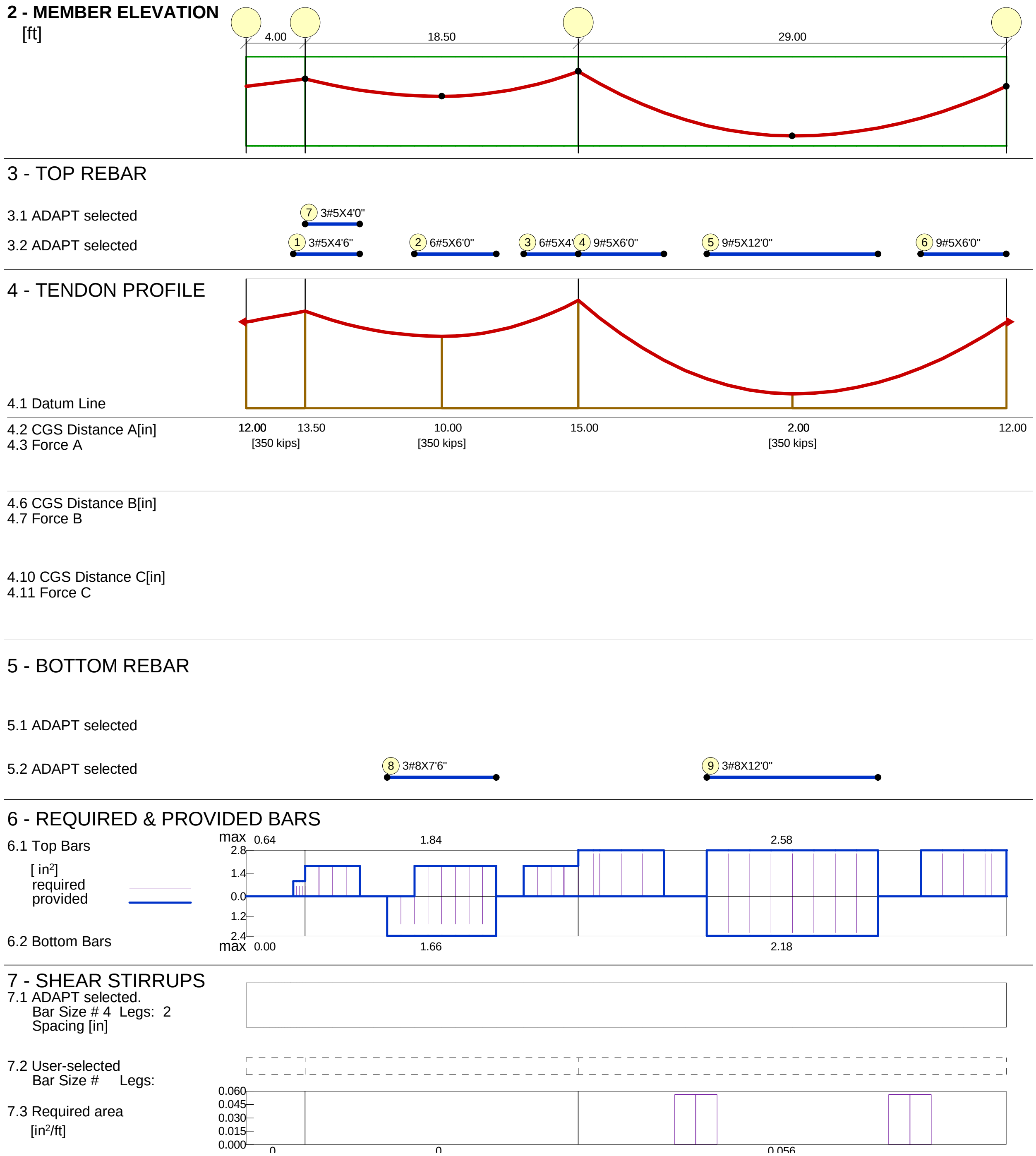
POST-TENSIONING PROFILE



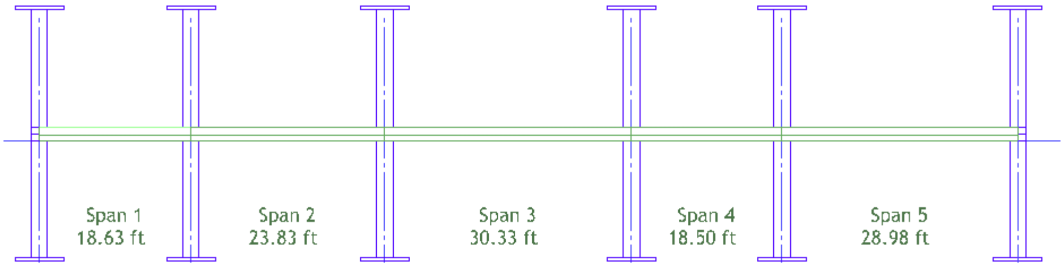
DEFLECTION

Span	Class	Type	W
			k/ft2
CANT	LL	U	0.057
CANT	SDL	U	0.015
1	LL	U	0.057
1	SDL	U	0.015
2	LL	U	0.057
2	SDL	U	0.015

INPUT APPLIED LOADING

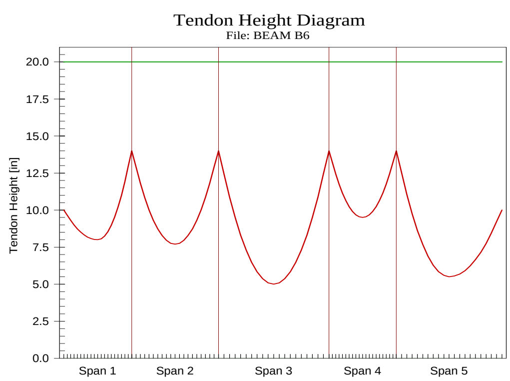

2 - MEMBER ELEVATION
[ft]
4.00
18.50
29.00
3 - TOP REBAR
3.1 ADAPT selected
3.2 ADAPT selected
7 3#5X4'0"
1 3#5X4'6"
2 6#5X6'0"
3 6#5X4'
4 9#5X6'0"
5 9#5X12'0"
6 9#5X6'0"
4 - TENDON PROFILE
4.1 Datum Line
4.2 CGS Distance A[in]
4.3 Force A
12.00
13.50
10.00
15.00
2.00
12.00
[350 kips]
[350 kips]
[350 kips]
4.6 CGS Distance B[in]
4.7 Force B
4.10 CGS Distance C[in]
4.11 Force C
5 - BOTTOM REBAR
5.1 ADAPT selected
5.2 ADAPT selected
8 3#8X7'6"
9 3#8X12'0"
6 - REQUIRED & PROVIDED BARS
6.1 Top Bars
[in²]
required
provided
6.2 Bottom Bars
max 0.64
1.84
2.58
2.8
1.4
0.0
1.2
2.4
max 0.00
1.66
2.18
7 - SHEAR STIRRUPS
7.1 ADAPT selected.
Bar Size # 4 Legs: 2
Spacing [in]
7.2 User-selected
Bar Size # Legs:
7.3 Required area
[in²/ft]
0.060
0.045
0.030
0.015
0.000
0
0
0.056

AREA 2
BEAM B9

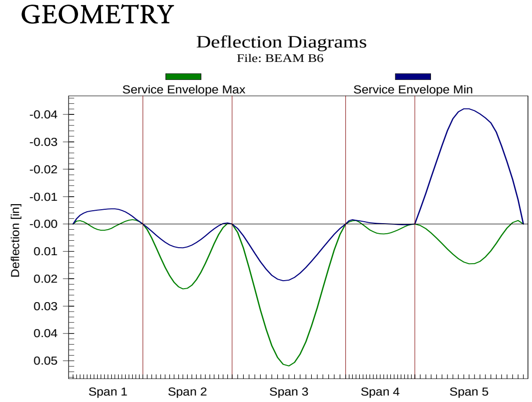


Span	Form	Length	Width	Depth	TF Width	TF Thick.	Rh	Right Mult.	Left Mult.
		ft	in	in	in	in	in		
1	2	18.63	60.00	20.00	312.56	12.00	20.00	0.35	0.65
2	2	23.83	60.00	20.00	312.56	12.00	20.00	0.35	0.65
3	2	30.33	60.00	20.00	234.56	12.00	20.00	0.13	0.87
4	2	18.50	60.00	20.00	312.56	10.00	20.00	0.35	0.65
5	2	28.98	60.00	20.00	234.56	10.00	20.00	0.13	0.87

GEOMETRY



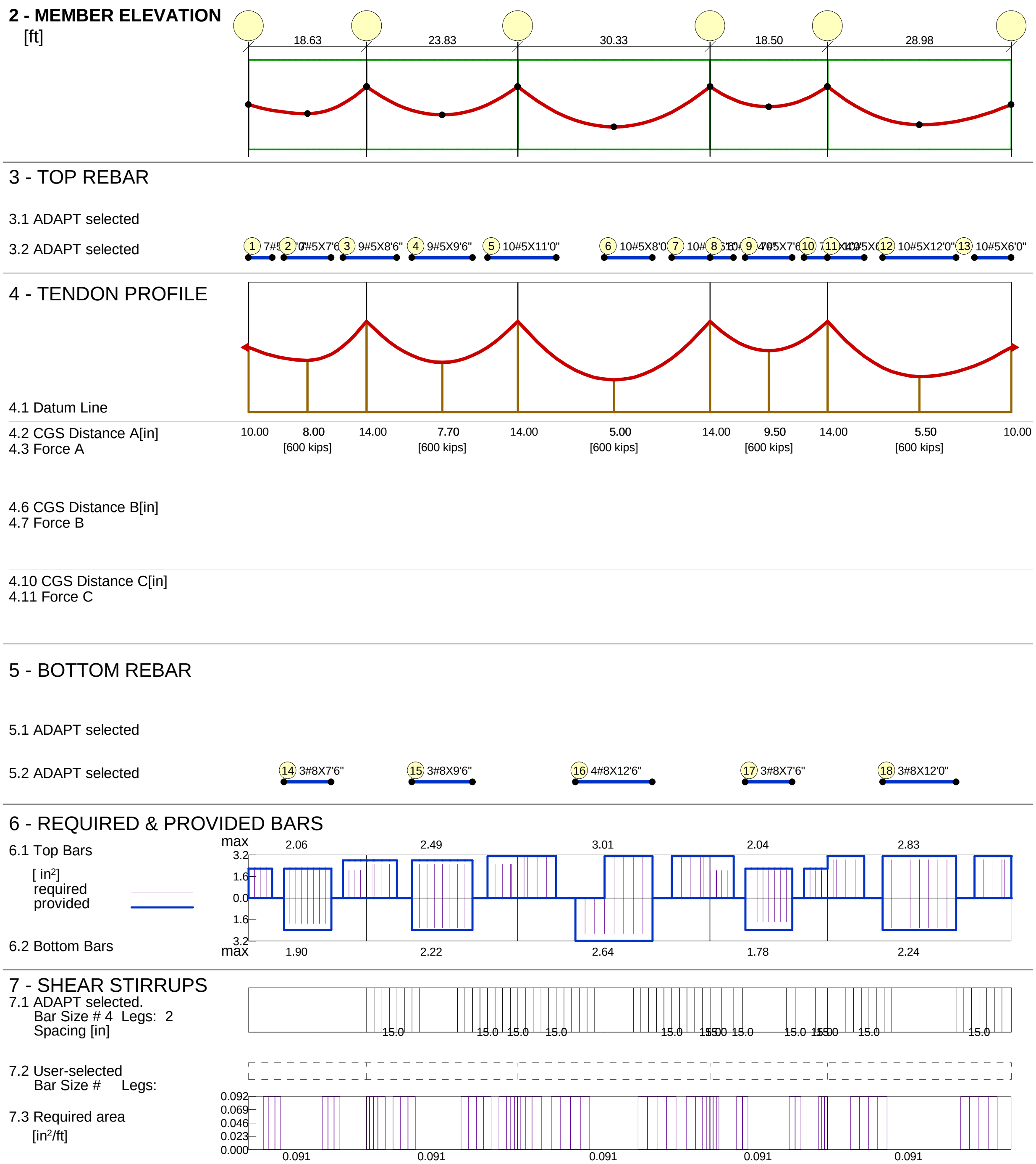
POST-TENSIONING PROFILE



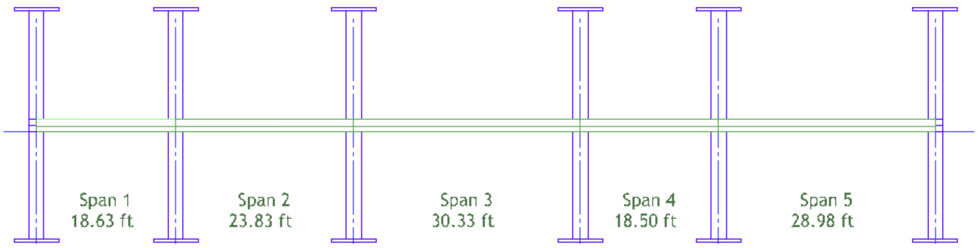
DEFLECTION

Span	Class	Type	W	A	F
			k/ft2	ft	k
1	LL	U	0.082		
1	SDL	U	0.015		
2	LL	U	0.082		
2	SDL	U	0.015		
3	LL	U	0.082		
3	SDL	U	0.015		
3	SDL	C		4.000	8.000
3	SDL	C		12.000	8.000
4	LL	U	0.082		
4	SDL	U	0.015		
4	SDL	C		6.000	13.000
4	SDL	C		17.000	13.000
5	LL	U	0.050		
5	SDL	U	0.015		

INPUT APPLIED LOADING

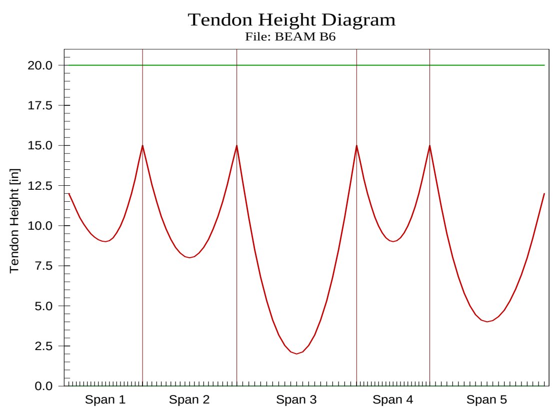

2 - MEMBER ELEVATION
[ft]
18.63
23.83
30.33
18.50
28.98
3 - TOP REBAR
3.1 ADAPT selected
3.2 ADAPT selected
4 - TENDON PROFILE
4.1 Datum Line
4.2 CGS Distance A[in]
4.3 Force A
10.00
8.00
14.00
7.70
14.00
5.00
14.00
9.50
14.00
5.50
10.00
[600 kips]
4.6 CGS Distance B[in]
4.7 Force B
4.10 CGS Distance C[in]
4.11 Force C
5 - BOTTOM REBAR
5.1 ADAPT selected
5.2 ADAPT selected
3#8X7'6"
3#8X9'6"
4#8X12'6"
3#8X7'6"
3#8X12'0"
6 - REQUIRED & PROVIDED BARS
6.1 Top Bars
[in²]
required
provided
6.2 Bottom Bars
max
2.06
2.49
3.01
2.04
2.83
1.90
2.22
2.64
1.78
2.24
7 - SHEAR STIRRUPS
7.1 ADAPT selected.
Bar Size # 4 Legs: 2
Spacing [in]
15.0
7.2 User-selected
Bar Size # Legs:
7.3 Required area
[in²/ft]
0.092
0.069
0.046
0.023
0.000
0.091

AREA 2
BEAM B10

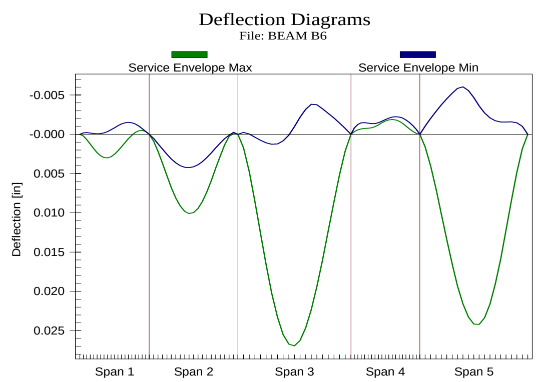


Span	Form	Length	Width	Depth	TF Width	TF Thick.	Rh	Right Mult.	Left Mult.
		ft	in	in	in	in	in		
1	2	18.63	40.00	20.00	224.56	12.00	20.00	0.09	0.91
2	2	23.83	40.00	20.00	224.56	12.00	20.00	0.09	0.91
3	2	30.33	40.00	20.00	224.56	12.00	20.00	0.09	0.91
4	2	18.50	40.00	20.00	224.56	10.00	20.00	0.09	0.91
5	2	28.98	40.00	20.00	224.56	10.00	20.00	0.09	0.91

GEOMETRY



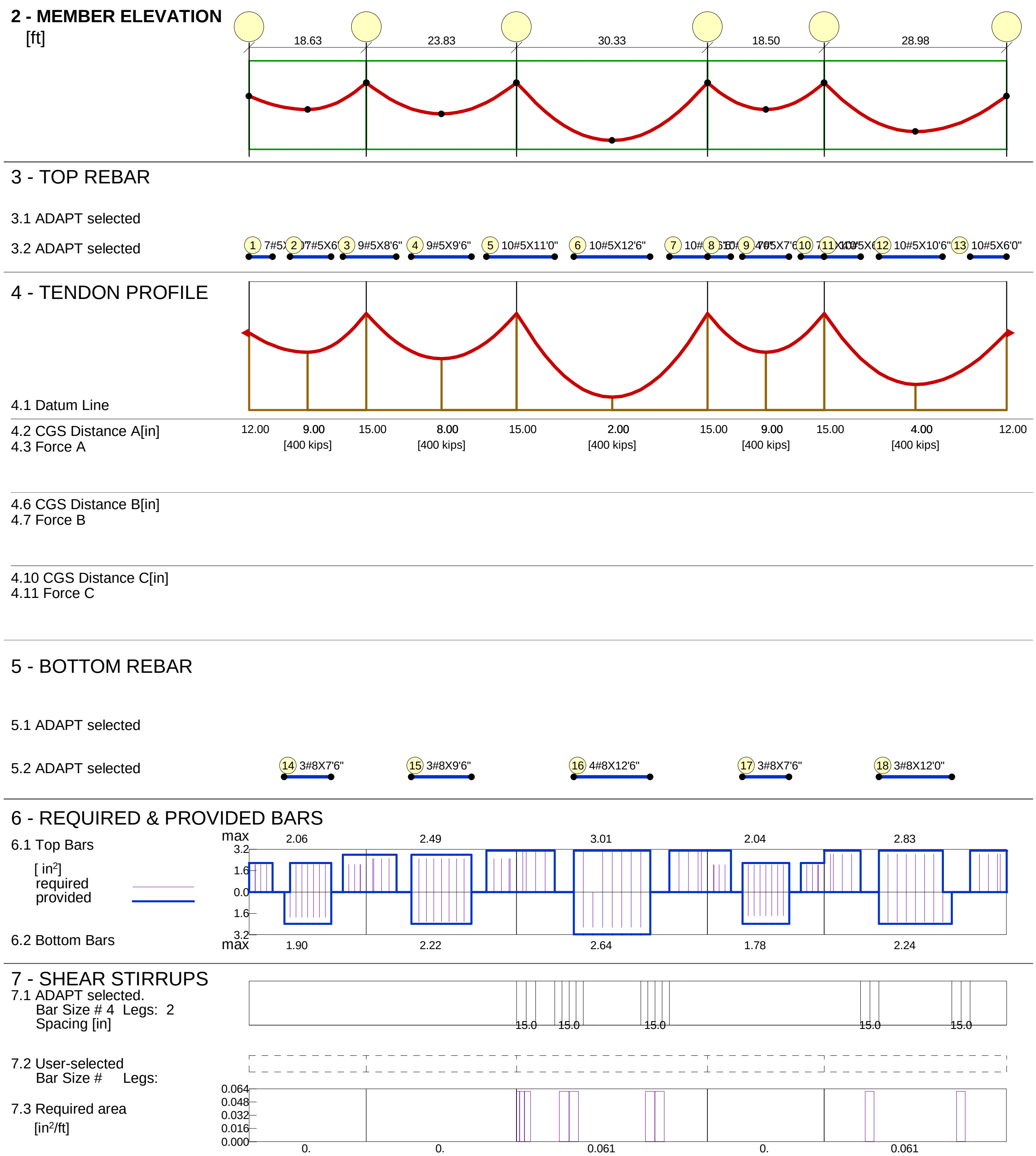
POST-TENSIONING PROFILE



DEFLECTION

Span	Class	Type	W	A	F
			k/ft2	ft	k
1	LL	U	0.050		
1	SDL	U	0.015		
2	LL	U	0.050		
2	SDL	U	0.015		
3	LL	U	0.050		
3	SDL	U	0.015		
3	SDL	C		4.000	5.000
3	SDL	C		12.000	5.000
4	LL	U	0.050		
4	SDL	U	0.015		
4	SDL	C		6.000	16.000
4	SDL	C		17.000	16.000
5	LL	U	0.050		
5	SDL	U	0.015		

INPUT APPLIED LOADING


2 - MEMBER ELEVATION
[ft]
18.63
23.83
30.33
18.50
28.98
3 - TOP REBAR
3.1 ADAPT selected
3.2 ADAPT selected
9#5X8'6"
9#5X9'6"
10#5X11'0"
10#5X12'6"
10#5X10'6"
10#5X6'0"
4 - TENDON PROFILE
4.1 Datum Line
4.2 CGS Distance A[in]
4.3 Force A
12.00
9.00
15.00
8.00
15.00
2.00
15.00
9.00
15.00
4.00
12.00
[400 kips]
[400 kips]
[400 kips]
[400 kips]
[400 kips]
4.6 CGS Distance B[in]
4.7 Force B
4.10 CGS Distance C[in]
4.11 Force C
5 - BOTTOM REBAR
5.1 ADAPT selected
5.2 ADAPT selected
3#8X7'6"
3#8X9'6"
4#8X12'6"
3#8X7'6"
3#8X12'0"
6 - REQUIRED & PROVIDED BARS
6.1 Top Bars
[in²]
required
provided
6.2 Bottom Bars
max
3.2
1.6
0.0
1.6
3.2
max
2.06
2.49
3.01
2.04
2.83
1.90
2.22
2.64
1.78
2.24
7 - SHEAR STIRRUPS
7.1 ADAPT selected.
Bar Size # 4 Legs: 2
Spacing [in]
15.0
15.0
15.0
15.0
15.0
7.2 User-selected
Bar Size # Legs:
7.3 Required area
[in²/ft]
0.064
0.048
0.032
0.016
0.000
0.
0.
0.061
0.
0.061

APPENDIX B

HAND CALCULATION SPOT CHECK AREA 1 CANTILEVER SLAB

Preliminary Slab Thickness

Longest span	28.5	ft
L/d=	45	
h=	7.59	in
Assume	10	in

Materials

Normal Weight Concrete	150	pcf
8" Concrete Block	55	psf
f'_c=	5000	psi
f_y=	60	ksi
1/2"ϕ, 7 Wire Tendon	0.153	in^2
f_{pu} =	270	ksi
Loss Assumed	15	ksi
f_{se}=	174	ksi
P_{eff}=	26.622	kip/tendon

Set Design Parameters

At time of jacking

f'_{ci}=	3000	psi
Compression=	1800	psi
Tension=	164	psi

At service loads

f'_c=	5000	psi
Compression=	2250	psi
Tension=	424	psi

Precompression Limits

P/A=	125	psi	min
	300	psi	max

Section Properties

A=	120	in^2
S=	200	in^3

Prestress force required for balancing

Trib Width=	12.00	in	UNIT STRIP		
L=	37.458	ft			
x=	9	ft			
L-x=	28.458	ft			
x/L=	0.240			USE	
e_1=	3.75	in	max	3.25	in
e_2=	1.88	in		4	in
h=	5.25	in			
w_b=	0.09	k/ft			
P=	21.69	kip			

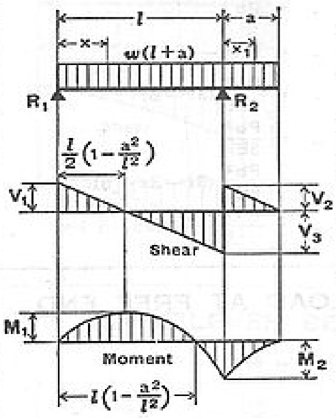
Precompression Allowance

# tendons=	0.815			USE 1 TENDON
P_{act}=	26.622	kip		
w_b=	0.11505	k/ft		
P_{act}/A=	221.85	psi	>125 psi	
			<300 psi	

Loading

Dead Loads		
Slab	125	plf
Finishes	5	plf
MEP	10	psf
	140	plf
Live Load	100	psf

24. BEAM OVERHANGING ONE SUPPORT—UNIFORMLY DISTRIBUTED LOAD



$R_1 = V_1 \quad . . . . \quad = \frac{w}{2l}(l^2 - a^2)$

$R_2 = V_2 + V_3 \quad . . . . \quad = \frac{w}{2l}(l + a)^2$

$V_2 \quad . . . . \quad = wa$

$V_3 \quad . . . . \quad = \frac{w}{2l}(l^2 + a^2)$

V_x (between supports) . . $= R_1 - wx$

V_{x_1} (for overhang) . . . . $= w(a - x_1)$

M_1 $\left(\text{at } x = \frac{l}{2}\left[1 - \frac{a^2}{l^2}\right]\right)$ . . $= \frac{w}{8l^2}(l + a)^2(l - a)^2$

M_2 (at R_2) . . . . $= \frac{wa^2}{2}$

M_x (between supports) . . $= \frac{wx}{2l}(l^2 - a^2 - xl)$

M_{x_1} (for overhang) . . . . $= \frac{w}{2}(a - x_1)^2$

Δx (between supports) . . $= \frac{wx}{24EIl}(l^4 - 2l^2x^2 + lx^3 - 2a^2l^2 + 2a^2x^2)$

Δx_1 (for overhang) . . . . $= \frac{wx_1}{24EI}(4a^2l - l^3 + 6a^2x_1 - 4ax_1^2 + x_1^3)$

Dead Load			Live Load			Balanced Load		
w_{DL}=	0.14	klf	w_{LL}=	0.10	klf	w_{DL}=	0.12	klf
R_A=	1.79	k	R_A=	1.28	k	R_A=	1.47	k
R_B=	3.45	k	R_B=	2.47	k	R_B=	2.84	k
M_A=	11.48	ft-k	M_A=	8.20	ft-k	M_A=	9.43	ft-k
M_B=	5.67	ft-k	M_B=	4.05	ft-k	M_B=	4.66	ft-k

Stage 1: Stresses immediately after jacking (DL+PT)

Midspan Stresses

f_{top}=	-344.579	psi	COMP
f_{bot}=	-99.121	psi	COMP

Support Stresses

f_{top}=	-161.23	psi	COMP
f_{bot}=	-282.47	psi	COMP

Stage 2: Stresses at service loads (DL + LL + PT)

Midspan Stresses

f_{top}=	-836.548	psi	COMP
f_{bot}=	392.8484	psi	TENS

Support Stresses

f_{top}=	81.76991	psi	TENS
f_{bot}=	-525.47	psi	COMP

Ultimate Strength

M_1=	8.87	ft-k
M_{sec}=	-4.21	ft-k

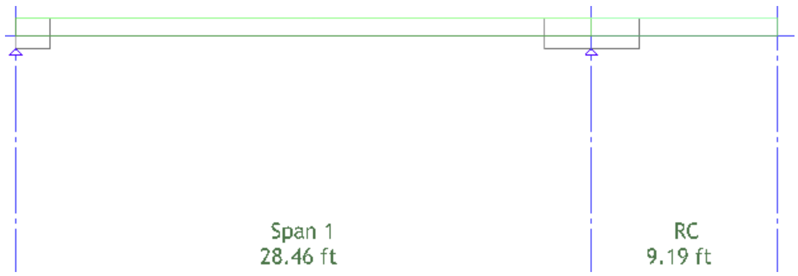
Midspan Moment

M_u=	22.67999	ft-k

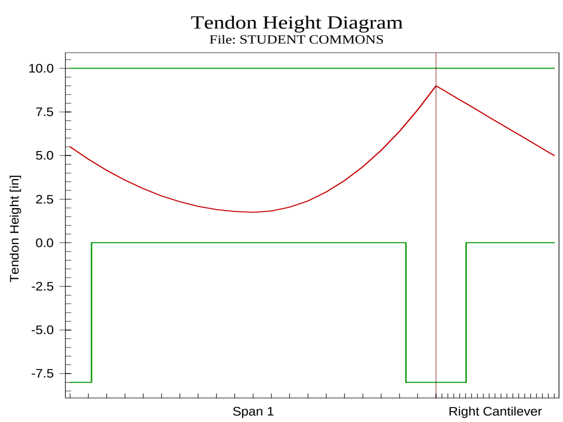
Support Moment

M_u=	-17.4983	ft-k

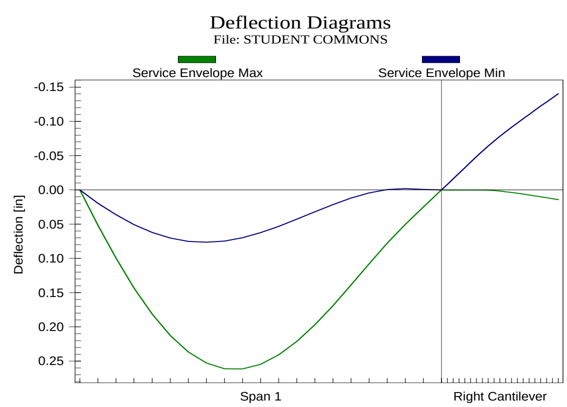
AREA 1
STUDENT COMMONS CANTILEVER SLAB



Span	Form	Length	Width	Depth	Rh	Right Mult.	Left Mult.
		ft	in	in	in		
1	1	28.46	12.00	10.00	10.00	0.50	0.50
C	1	9.19	12.00	10.00	10.00	0.50	0.50



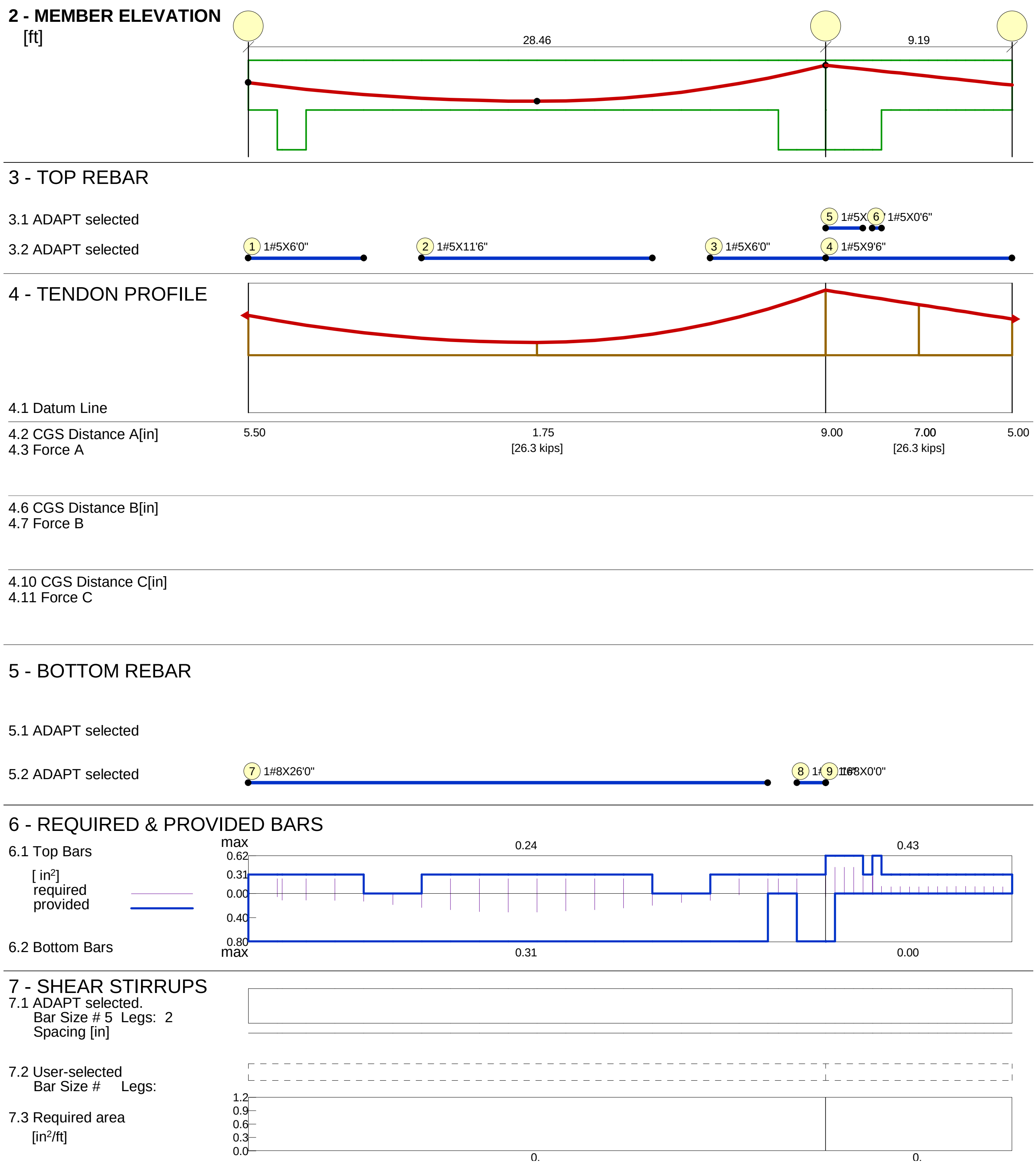
POST-TENSIONING PROFILE



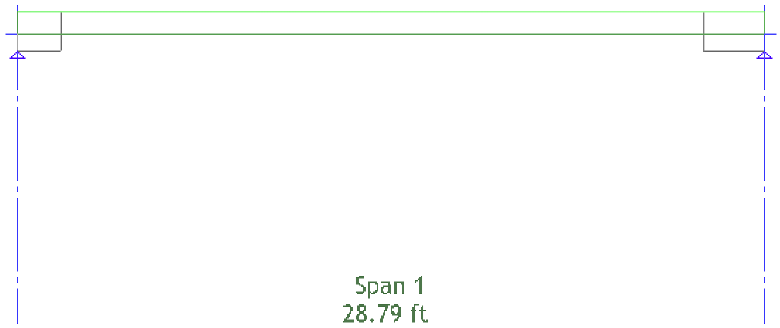
DEFLECTION

Span	Class	Type	W
			k/ft2
1	LL	U	0.100
1	SDL	U	0.015
CANT	LL	U	0.100
CANT	SDL	U	0.015

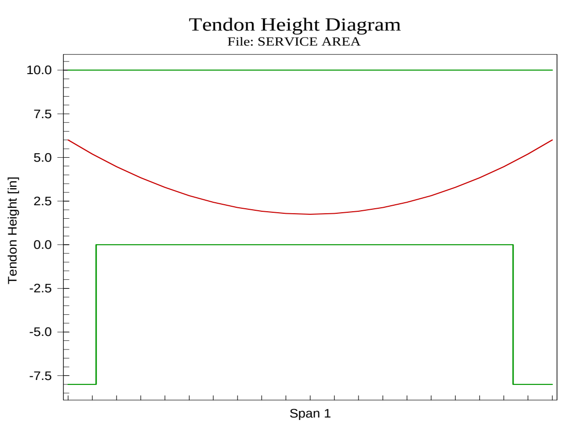
INPUT LOADING


2 - MEMBER ELEVATION
[ft]
28.46
9.19
3 - TOP REBAR
3.1 ADAPT selected
3.2 ADAPT selected
1 1#5X6'0"
2 1#5X11'6"
3 1#5X6'0"
4 1#5X9'6"
5 1#5X
6 1#5X0'6"
4 - TENDON PROFILE
4.1 Datum Line
4.2 CGS Distance A[in]
4.3 Force A
5.50
1.75
[26.3 kips]
9.00
7.00
[26.3 kips]
5.00
4.6 CGS Distance B[in]
4.7 Force B
4.10 CGS Distance C[in]
4.11 Force C
5 - BOTTOM REBAR
5.1 ADAPT selected
5.2 ADAPT selected
7 1#8X26'0"
8 1#
9 1#8X0'0"
6 - REQUIRED & PROVIDED BARS
6.1 Top Bars
[in²]
required
provided
6.2 Bottom Bars
max
0.62
0.31
0.00
0.40
0.80
max
0.24
0.43
0.31
0.00
7 - SHEAR STIRRUPS
7.1 ADAPT selected.
Bar Size # 5 Legs: 2
Spacing [in]
7.2 User-selected
Bar Size # Legs:
7.3 Required area
[in²/ft]
1.2
0.9
0.6
0.3
0.0
0.
0.

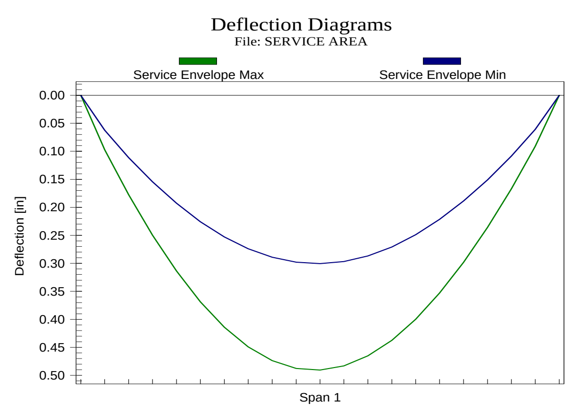
AREA 1
SERVICE AREA SIMPLE SLAB



Span	Form	Length	Width	Depth	Rh	Right Mult.	Left Mult.
		ft	in	in	in		
1	1	28.79	12.00	10.00	10.00	0.50	0.50



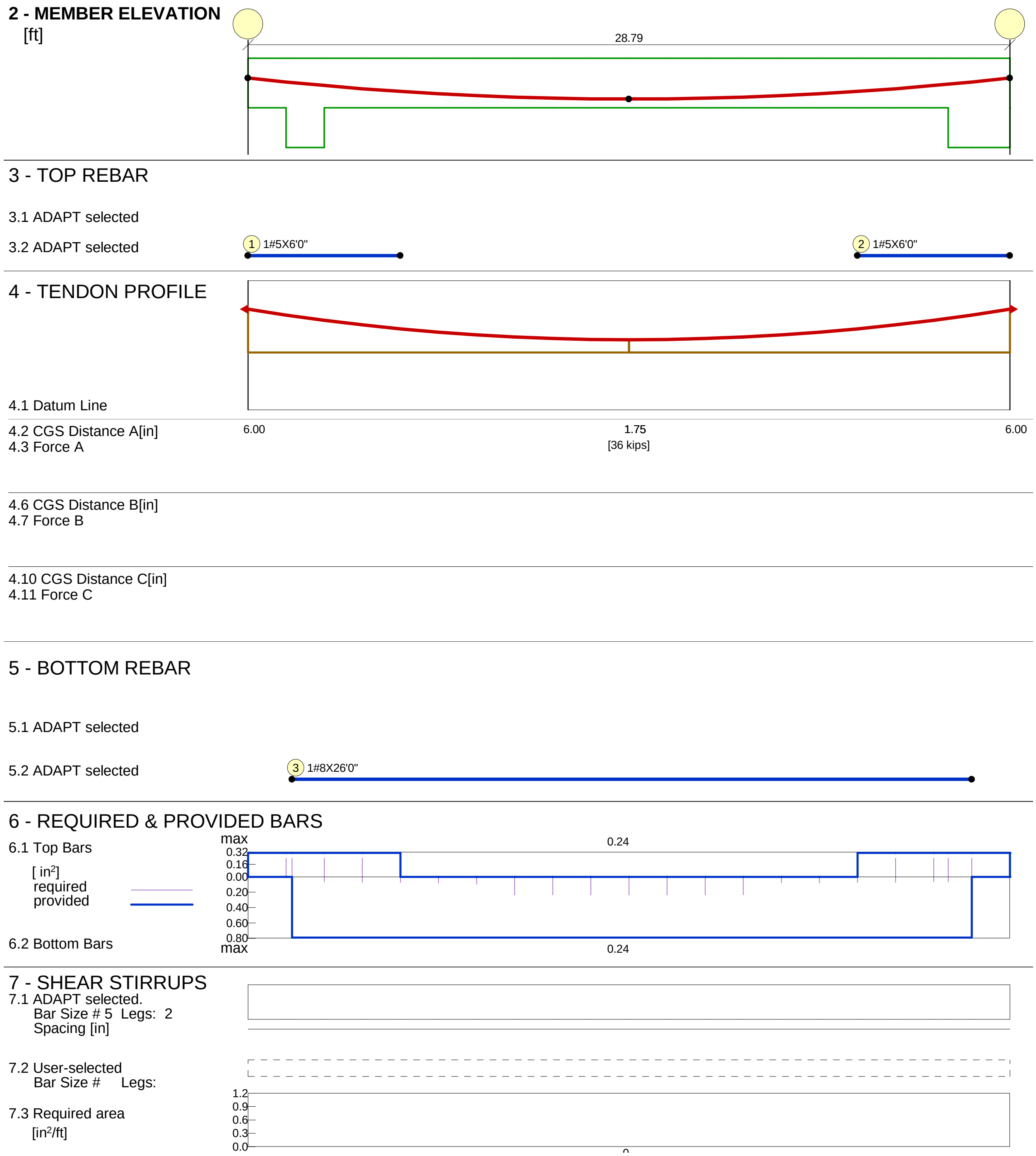
POST-TENSIONING PROFILE



DEFLECTION

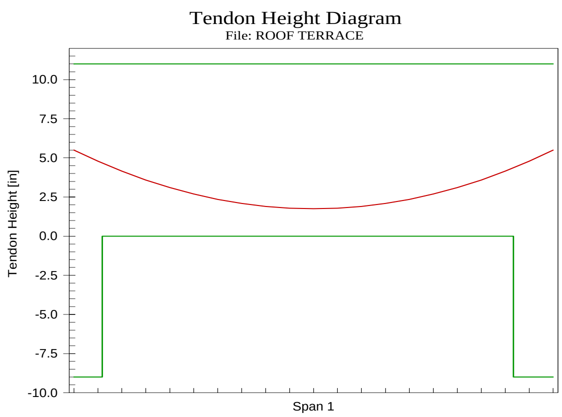
Span	Class	Type	W	A	B
			k/ft2	ft	ft
1	LL	P	0.150	0.000	8.600
1	LL	P	0.050	8.600	28.790
1	SDL	U	0.015		

INPUT LOADING

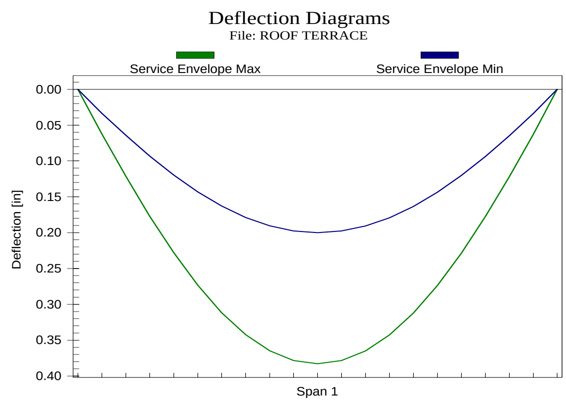

2 - MEMBER ELEVATION
[ft]
28.79
3 - TOP REBAR
3.1 ADAPT selected
3.2 ADAPT selected
1 1#5X6'0"
2 1#5X6'0"
4 - TENDON PROFILE
4.1 Datum Line
4.2 CGS Distance A[in]
4.3 Force A
6.00
1.75
[36 kips]
6.00
4.6 CGS Distance B[in]
4.7 Force B
4.10 CGS Distance C[in]
4.11 Force C
5 - BOTTOM REBAR
5.1 ADAPT selected
5.2 ADAPT selected
3 1#8X26'0"
6 - REQUIRED & PROVIDED BARS
6.1 Top Bars
[in²]
required
provided
6.2 Bottom Bars
max
0.32
0.16
0.00
0.20
0.40
0.60
0.80
max
0.24
0.24
7 - SHEAR STIRRUPS
7.1 ADAPT selected.
Bar Size # 5 Legs: 2
Spacing [in]
7.2 User-selected
Bar Size # Legs:
7.3 Required area
[in²/ft]
1.2
0.9
0.6
0.3
0.0

AREA 1
ROOF TERRACE SIMPLE SLAB

Span	Form	Length	Width	Depth	Rh	Right Mult.	Left Mult.
		ft	in	in	in		
1	1	28.13	12.00	11.00	11.00	0.50	0.50



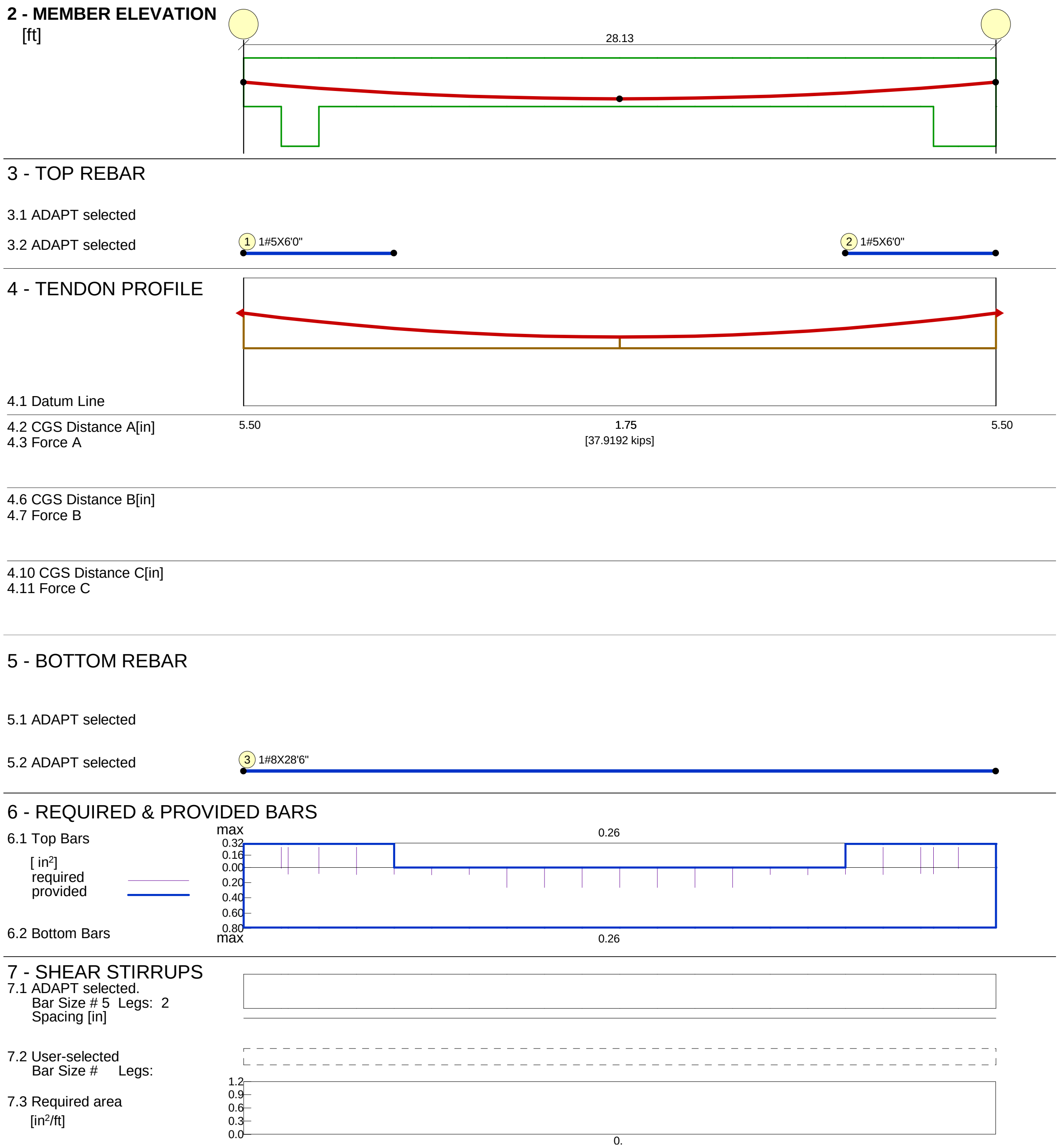
POST-TENSIONING PROFILE



DEFLECTION

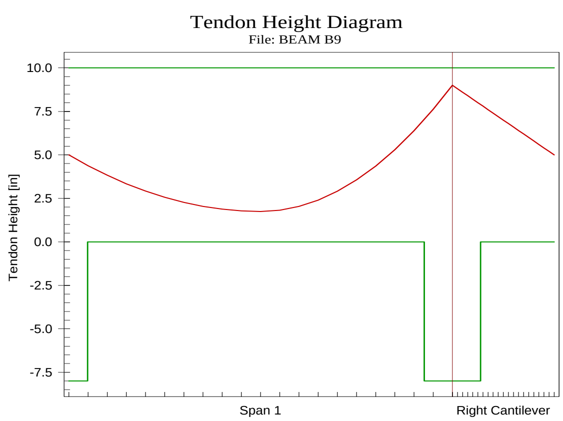
Span	Class	Type	W
			k/ft2
1	LL	U	0.100
1	SDL	U	0.025

INPUT LOADING

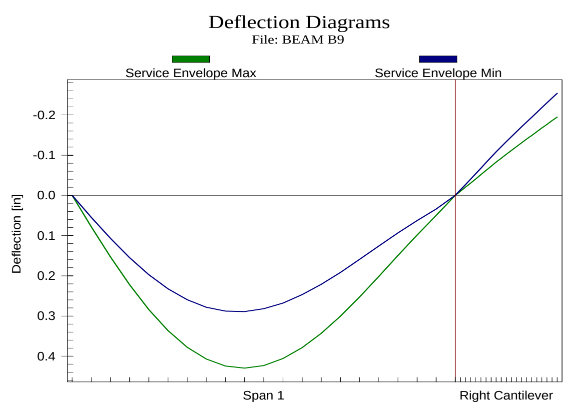

2 - MEMBER ELEVATION
[ft]
28.13
3 - TOP REBAR
3.1 ADAPT selected
3.2 ADAPT selected
1 1#5X6'0"
2 1#5X6'0"
4 - TENDON PROFILE
4.1 Datum Line
4.2 CGS Distance A[in]
4.3 Force A
5.50
1.75
[37.9192 kips]
5.50
4.6 CGS Distance B[in]
4.7 Force B
4.10 CGS Distance C[in]
4.11 Force C
5 - BOTTOM REBAR
5.1 ADAPT selected
5.2 ADAPT selected
3 1#8X28'6"
6 - REQUIRED & PROVIDED BARS
6.1 Top Bars
[in²]
required
provided
6.2 Bottom Bars
max
0.32
0.16
0.00
0.20
0.40
0.60
0.80
max
0.26
0.26
7 - SHEAR STIRRUPS
7.1 ADAPT selected.
Bar Size # 5 Legs: 2
Spacing [in]
7.2 User-selected
Bar Size # Legs:
7.3 Required area
[in²/ft]
1.2
0.9
0.6
0.3
0.0
0.

AREA 2
ENTRANCE CANTILEVER SLAB

Span	Form	Length	Width	Depth	Rh	Right Mult.	Left Mult.
		ft	in	in	in		
1	1	34.09	12.00	10.00	10.00	0.50	0.50
C	1	9.05	12.00	10.00	10.00	0.50	0.50



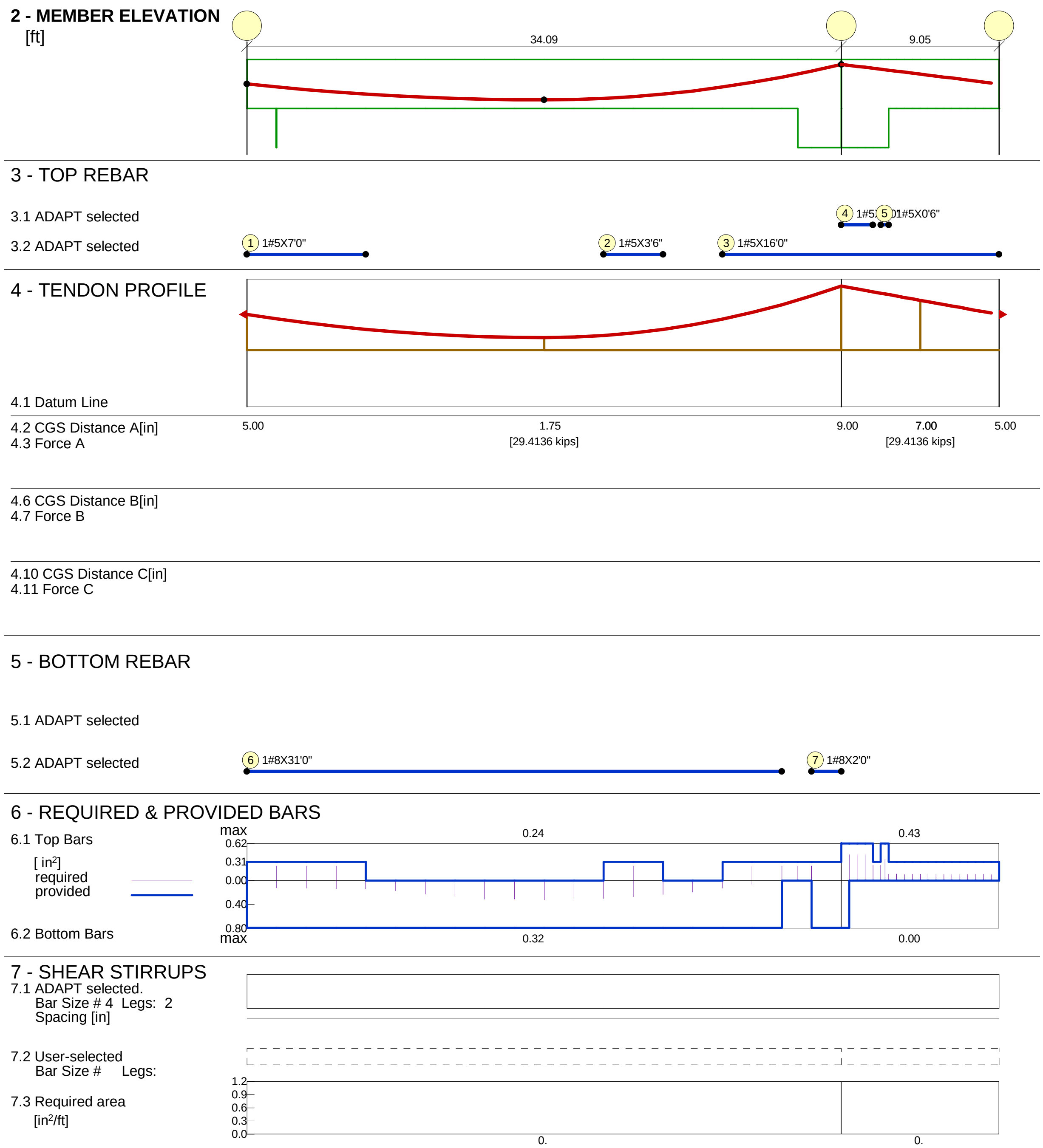
POST-TENSIONING PROFILE



DEFLECTION

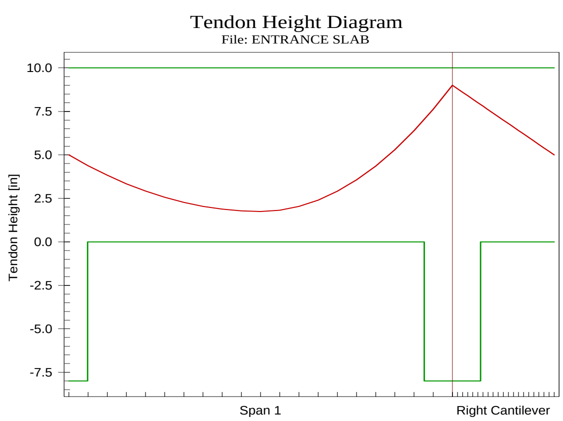
Span	Class	Type	W	A	B
			k/ft2	ft	ft
1	LL	P	0.050	0.000	22.000
1	LL	P	0.082	22.000	34.090
1	SDL	U	0.015		
CANT	LL	U	0.082		
CANT	SDL	U	0.015		

INPUT LOADING

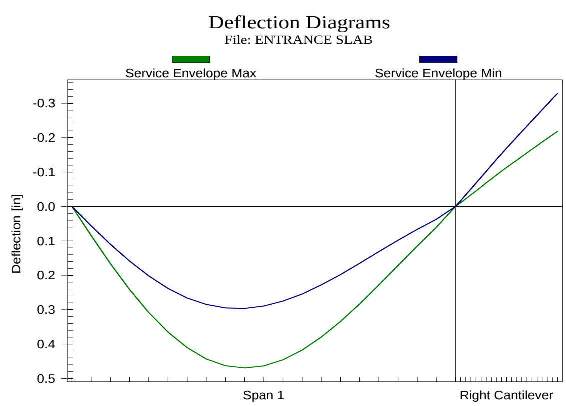

2 - MEMBER ELEVATION
[ft]
34.09
9.05
3 - TOP REBAR
3.1 ADAPT selected
3.2 ADAPT selected
1 1#5X7'0"
2 1#5X3'6"
3 1#5X16'0"
4
5 1#5X0'6"
4 - TENDON PROFILE
4.1 Datum Line
4.2 CGS Distance A[in]
4.3 Force A
5.00
1.75
[29.4136 kips]
9.00
7.00
5.00
[29.4136 kips]
4.6 CGS Distance B[in]
4.7 Force B
4.10 CGS Distance C[in]
4.11 Force C
5 - BOTTOM REBAR
5.1 ADAPT selected
5.2 ADAPT selected
6 1#8X31'0"
7 1#8X2'0"
6 - REQUIRED & PROVIDED BARS
6.1 Top Bars
[in²]
required
provided
6.2 Bottom Bars
max
0.62
0.31
0.00
0.40
0.80
max
0.24
0.43
0.32
0.00
7 - SHEAR STIRRUPS
7.1 ADAPT selected.
Bar Size # 4 Legs: 2
Spacing [in]
7.2 User-selected
Bar Size # Legs:
7.3 Required area
[in²/ft]
1.2
0.9
0.6
0.3
0.0
0.
0.

AREA 2
FIRST FLOOR CLASSROOM CANTILEVER SLAB

Span	Form	Length	Width	Depth	Rh	Right Mult.	Left Mult.
		ft	in	in	in		
1	1	34.09	12.00	10.00	10.00	0.50	0.50
C	1	9.05	12.00	10.00	10.00	0.50	0.50



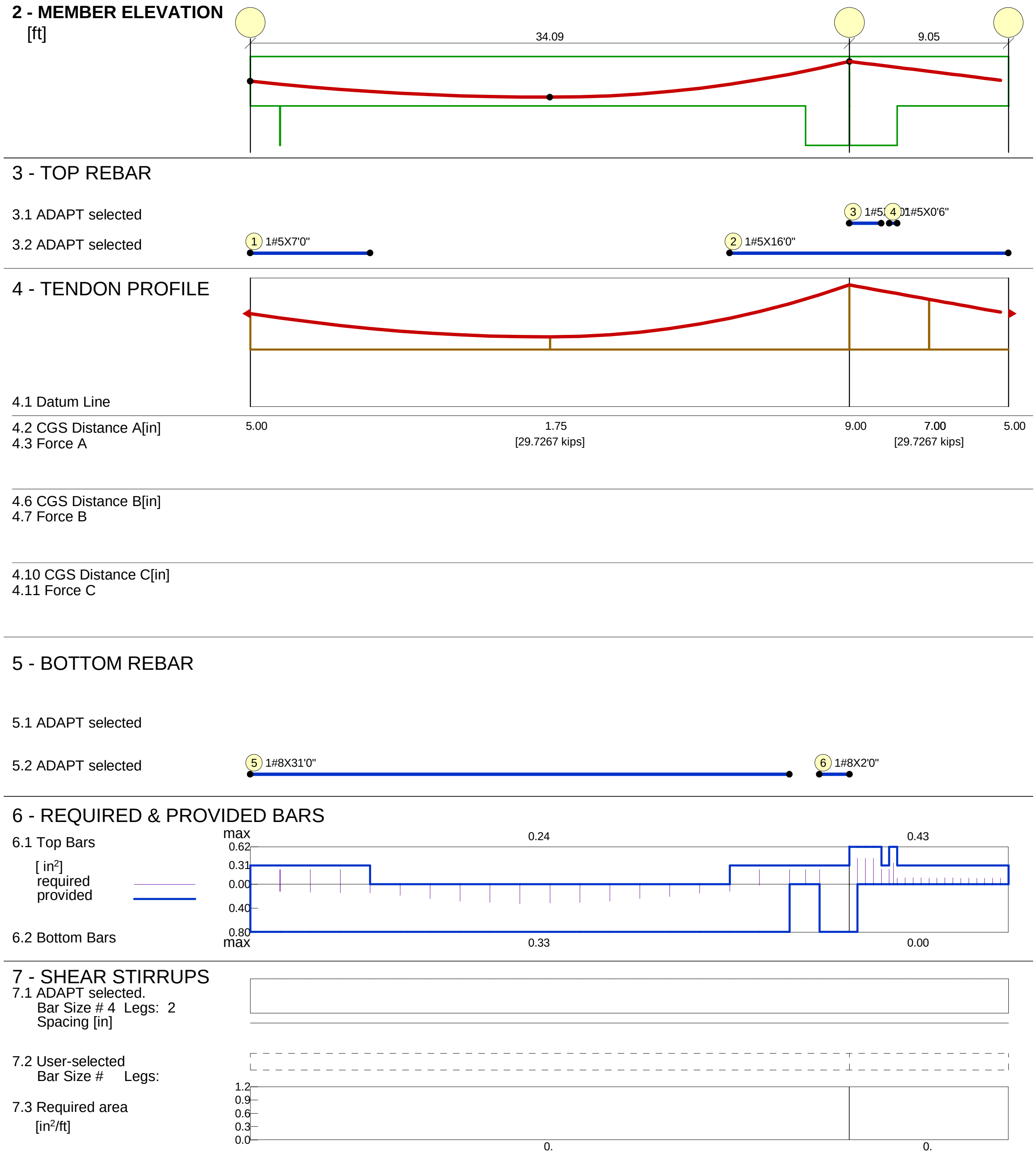
POST-TENSIONING PROFILE



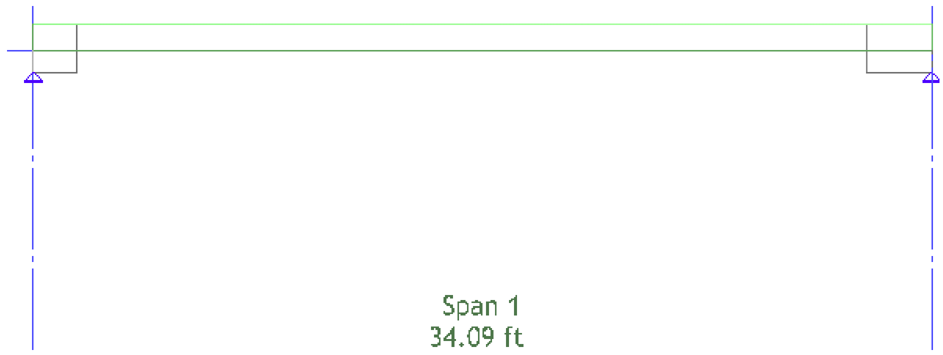
DEFLECTION

Span	Class	Type	W
			k/ft2
1	LL	U	0.05
1	SDL	U	0.015
CANT	LL	U	0.050
CANT	SDL	U	0.015

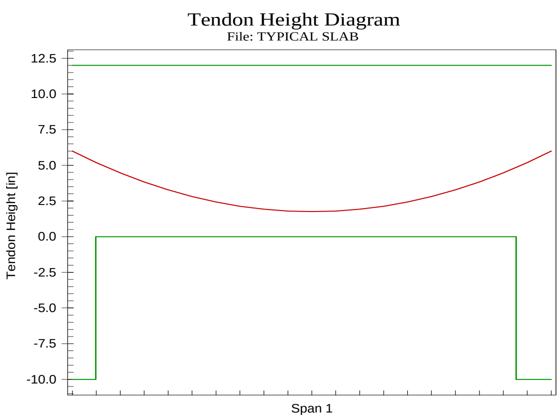
INPUT LOADING


2 - MEMBER ELEVATION
[ft]
34.09
9.05
3 - TOP REBAR
3.1 ADAPT selected
3.2 ADAPT selected
1#5X7'0"
1#5X16'0"
1#5X0'6"
4 - TENDON PROFILE
4.1 Datum Line
4.2 CGS Distance A[in]
4.3 Force A
5.00
1.75
[29.7267 kips]
9.00
7.00
[29.7267 kips]
5.00
4.6 CGS Distance B[in]
4.7 Force B
4.10 CGS Distance C[in]
4.11 Force C
5 - BOTTOM REBAR
5.1 ADAPT selected
5.2 ADAPT selected
1#8X31'0"
1#8X2'0"
6 - REQUIRED & PROVIDED BARS
6.1 Top Bars
[in2]
required
provided
6.2 Bottom Bars
max
0.62
0.31
0.00
0.40
0.80
max
0.24
0.43
0.33
0.00
7 - SHEAR STIRRUPS
7.1 ADAPT selected.
Bar Size # 4 Legs: 2
Spacing [in]
7.2 User-selected
Bar Size # Legs:
7.3 Required area
[in2/ft]
1.2
0.9
0.6
0.3
0.0
0.
0.

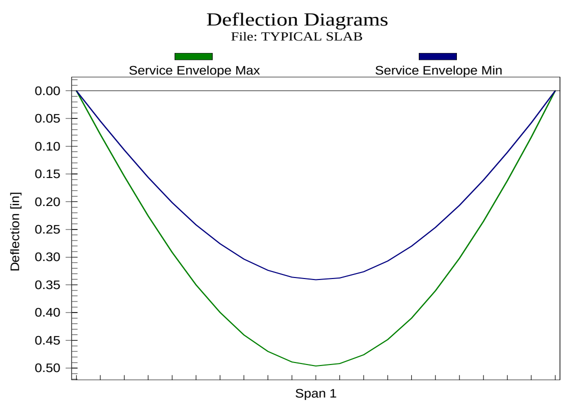
AREA 2
TYPICAL SIMPLE SLAB



Span	Form	Length	Width	Depth	Rh	Right Mult.	Left Mult.
		ft	in	in	in		
1	1	34.09	12.00	12.00	12.00	0.50	0.50



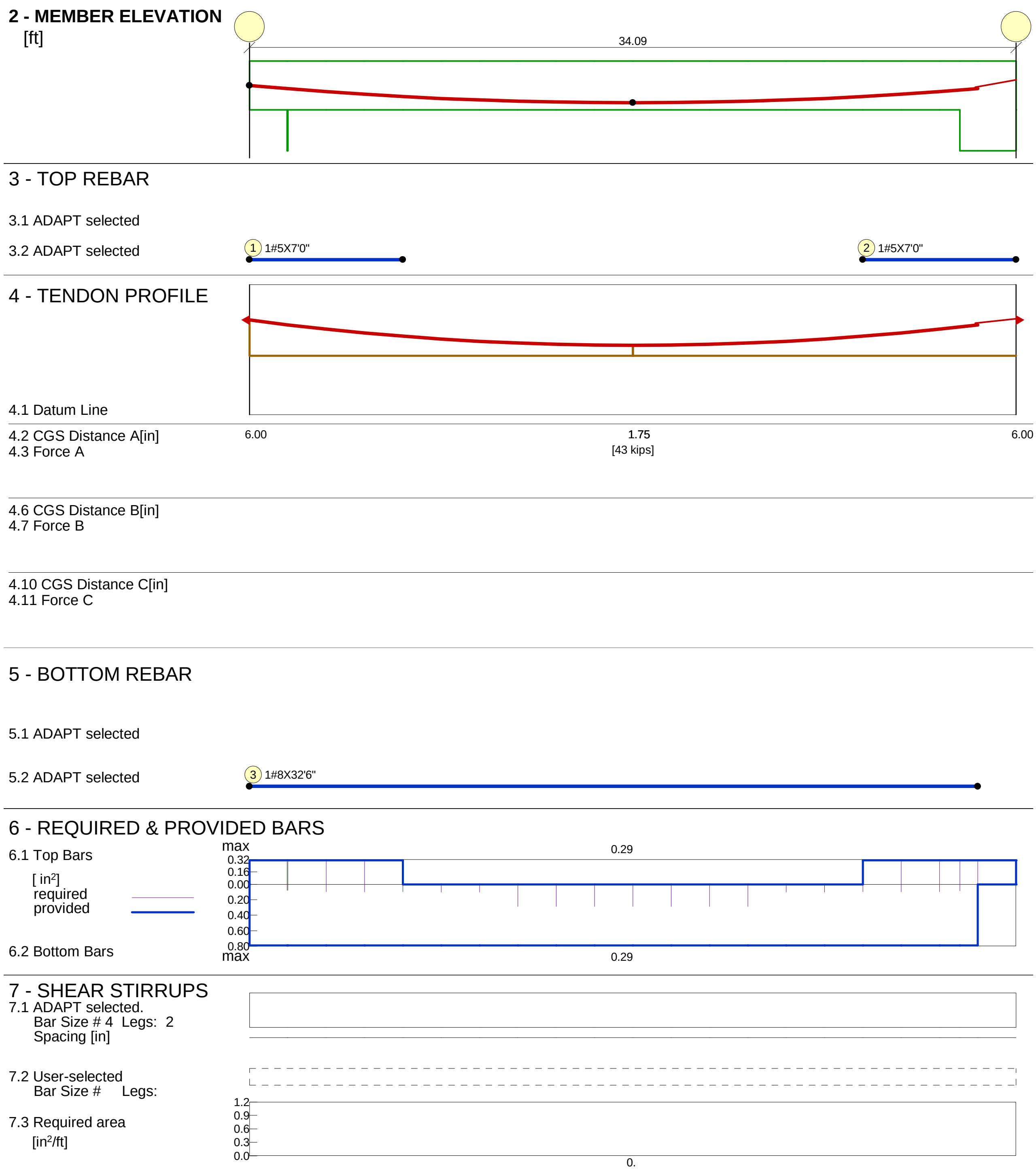
POST-TENSIONING PROFILE



DEFLECTION

Span	Class	Type	W	A	B
			k/ft2	ft	ft
1	LL	P	0.050	0.000	22.000
1	LL	P	0.082	22.000	34.090
1	SDL	U	0.015		

INPUT LOADING


2 - MEMBER ELEVATION
[ft]
34.09
3 - TOP REBAR
3.1 ADAPT selected
3.2 ADAPT selected
1 1#5X7'0"
2 1#5X7'0"
4 - TENDON PROFILE
4.1 Datum Line
4.2 CGS Distance A[in]
4.3 Force A
6.00
1.75
[43 kips]
6.00
4.6 CGS Distance B[in]
4.7 Force B
4.10 CGS Distance C[in]
4.11 Force C
5 - BOTTOM REBAR
5.1 ADAPT selected
5.2 ADAPT selected
3 1#8X32'6"
6 - REQUIRED & PROVIDED BARS
6.1 Top Bars
[in²]
required
provided
6.2 Bottom Bars
max
0.32
0.16
0.00
0.20
0.40
0.60
0.80
max
0.29
0.29
7 - SHEAR STIRRUPS
7.1 ADAPT selected.
Bar Size # 4 Legs: 2
Spacing [in]
7.2 User-selected
Bar Size # Legs:
7.3 Required area
[in²/ft]
1.2
0.9
0.6
0.3
0.0
0.

APPENDIX C

Area 1

First Floor Beams (CONCRETE BUILDING)				
Number of beams	Shape	Weight (lb/ft)	Span (ft)	Total Weight (lb)
1	18X56	1050	115	120750
1	18x40	750	115	86250
				207000

Second Floor Beams (CONCRETE BUILDING)				
Number of beams	Shape	Weight (lb/ft)	Span (ft)	Total Weight (lb)
1	20x56	1166.667	115	134166.705
1	20x40	833.333	115	95833.295
				230000

Floor Weight (CONCRETE BUILDING)				
Floor	Area (ft^2)	Weight Concrete (lb/ft^3)	Thickness Of Slab (ft)	Total Weight (lb)
2	3700	150	0.92	510600
1	4285	150	0.83	533483
				1044083

Column Weight (CONCRETE BUILDING)				
Number	Size	Weight (lb/ft)	First Floor	Second Floor
10	24x24	600	**72000**	**90000**

Other Loads					
Floor	Area	Partitions (lb/ft^2)	Finishes (lb/ft^2)	M/E/P (lb/ft^2)	Total Weight (lb)
1	4428	20	5	10	154980
2	3925	20	5	10	137375
					292355

Area 2

First Floor Beams (CONCRETE BUILDING)				
Number of beams	Shape	Weight (lb/ft)	Span (ft)	Total Weight (lb)
1	18X60	1125	121	136125
1	18x40	750	121	90750
				226875

Second Floor Beams (CONCRETE BUILDING)				
Number of beams	Shape	Weight (lb/ft)	Span (ft)	Total Weight (lb)
1	20x60	1250	121	151250
1	20x40	833.333	121	100833.293
				252083.293

Third Floor Beams (CONCRETE BUILDING)				
Number of beams	Shape	Weight (lb/ft)	Span (ft)	Total Weight (lb)
1	20x60	1250	121	151250
1	20x40	833.333	121	100833.293
				252083.293

Fourth Floor Beams (CONCRETE BUILDING)				
Number of beams	Shape	Weight (lb/ft)	Span (ft)	Total Weight (lb)
1	20x60	1250	121	151250
1	20x40	833.333	121	100833
				252083

Floor Weight (CONCRETE BUILDING)				
Floor	Area (ft^2)	Weight Concrete (lb/ft^3)	Thickness Of Slab (ft)	Total Weight (lb)
1	5055.4	150	0.83	629397
2	4868.87	150	0.92	671904
3	4868.87	150	0.92	671904
4	4785.88	150	0.92	660451
Roof	3256			130240
				2763897

Roof Beams (STEEL)				
Number of beams	Shape	Weight (lb/ft)	Span (ft)	Total Weight (lb)
7	W10x12	12	5	420
8	W10x12	12	6	576
2	W10x12	12	7.5	180
1	W10x12	12	9	108
2	W10x12	12	12	288
6	W10x12	12	13	936
10	W12x14	14	5	700
6	W12x14	14	13	1092
4	W12x14	14	14	784
4	W12x14	14	24	1344
1	W12x19	19	8.5	161.5
1	W12x19	19	13	247
1	W12x19	19	15	285
1	W12x26	26	12	312
2	W12x26	26	24	1248
1	W12x58	58	24	1392
2	W12x65	65	38	4940
1	W14x22	22	10	220
1	W16x31	31	24	744
1	W16x36	36	25	900
1	W18x35	35	37	1295
1	W18x40	40	24.5	980
1	W18x40	40	30.5	1220
3	W18x40	40	37	4440
1	W18x46	46	18.5	851
1	W21x44	44	30.5	1342
1	HSS6x6x3/8	27.41	24	657.84
2	HSS8x8x3/8	37.61	24	1805.28
				29468.62

Column Weight (STEEL BUILDING)							
Number	Size	Weight (lb/ft)	First Level	Second Level	Third Level	Fourth Level	Roof Level
12	24x24	600	**50400**	**109800**	**109800**	**109800**	**7668.0775**

Other Loads					
Floor	Area	Partitions (lb/ft^2)	Finishes (lb/ft^2)	M/E/P (lb/ft^2)	Total Weight (lb)
1	5055.4	20	5	10	176939
2	4868.87	20	5	10	170410.45
3	4868.87	20	5	10	170410.45
4	4785.88	20	5	10	167505.8
					685265.7

APPENDIX D

Area 1

Seismic Loads (ASCE 7-05)		
Occupancy Category	III	(Table 1-1)
Importance Factor(I)	1.25	(Table 11.5-1)
S_s	0.154	g
S_1	0.05	g
Site Class	C	Dense Soil/Soft Rock
F_a	1.2	(Table 11.4-1)
F_v	1.7	(Table 11.4-1)
$S_{MS}=F_a*S_s$	0.185	
$S_{M1}=F_v*S_1$	0.085	
$S_{DS}=2S_{MS}/3$	0.123	Category A
$S_{D1}=2S_{M1}/3$	0.057	Category A
T_s	0.460	
$T_a=C_th^x$	0.311	
x	0.9	(Table 12.8-2)
h	27	ft
C_t	0.016	(Table 12.8-2)
$T=C_u*T_a$	0.528	
C_u	1.7	(Table 12.8-1)
T_L	8	(Table 22-15)
$C_s=S_{D1}/(T(R/I))$	0.0268	
$S_{DS}/(R/I)$	0.0308	
R	5	(Table 12.2-1)
k	1.014	
V	51.91	kip

Area 2

Seismic Loads (ASCE 7-05)		
Occupancy Category	III	(Table 1-1)
Importance Factor(I)	1.25	(Table 11.5-1)
S_s	0.154	g
S_1	0.05	g
Site Class	C	Dense Soil/Soft Rock
F_a	1.2	(Table 11.4-1)
F_v	1.7	(Table 11.4-1)
$S_{MS}=F_a*S_s$	0.185	
$S_{M1}=F_v*S_1$	0.085	
$S_{DS}=2S_{MS}/3$	0.123	Category A
$S_{D1}=2S_{M1}/3$	0.057	Category A
T_s	0.460	
$T_a=C_t h^x$	0.311	
x	0.9	(Table 12.8-2)
h	27	ft
C_t	0.016	(Table 12.8-2)
$T=C_u*T_a$	0.528	
C_u	1.7	(Table 12.8-1)
T_L	8	(Table 22-15)
$C_s=S_{D1}/(T(R/I))$	0.0268	
$S_{DS}/(R/I)$	0.0308	
R	5	(Table 12.2-1)
k	1.014	
V	129.3	kip

APPENDIX E

Column B-2 First Floor

D	=	dead load
L	=	live load
W	=	wind load
E	=	earthquake load

Geometry

Tributary Area	24	x	20

Materials

Concrete	150	pcf
Steel	Grade	50

Roof Loads

Dead Loads:

MEP	10	psf
Roof Material	20	psf
Slab/Deck	40	psf
Beams	10	psf

Live Loads: 20 psf

Fourth Floor

Height 15.25 ft

Dead Loads:

Beams	20	x	60
Superimposed	15	psf	
Slab	12	in	
Column	24	x	24

Live Loads: 50 psf

Total Live Load Axial Load	81600	lb
Roof Axial Load	38400	lb
Fourth Floor Axial Load	118350	lb
Third Floor Axial Load	118350	lb
Second Floor Axial Load	109200	lb
Total Axial Load	384300	lb

Third Floor

Height	15.25	ft	
Dead Loads:			
Beams	20	x	60
Superimposed	15	psf	
Slab	12	in	
Column	24	x	24
Live Loads:	50	psf	

Second Floor

Height	20	ft	
Dead Loads:			
Beams	20	x	60
Superimposed	15	psf	
Slab	12	in	
Column	24	x	24
Live Loads:	50	psf	

APPENDIX F

AREA 1 First Floor Metal Deck Slab
Assumptions:
Length= 116'
Width= 40'
Thickness= 5.25"
4000psi Concrete
4 Edges Formed
Float Finish
6X6 W2.0/W2.0 Mesh

Item Code	Description	Quantity	UM	Labor $	Crew	Production	Prod. UM	Total Hours	Duration	Labor Total	Material Total	Total Cost
3150.65	SCREEDS FOR SLAB	556.8	LNFT	0.9219	C311	1,250.00	DAY	19.59936	0.44544	513.314	178.176	691.49
3220.011	6x6 W2.1/W2.1 MESH	51.04	SQS	22.008	C320	60	DAY	47.63733	0.85067	1,123.29	543.576	1,666.86
3311.7	**CONC IN SLAB OVER MTL DECK**		****									
3311.725	4000 PSI DIRECT	60.86	CUYD	14.6787	C216	60	DAY	36.51852	1.0144	893.407	3,408.40	4,301.80
3315.991	* SLAB OVER METAL DECK AREA *	4,640.00	SQFT									
3350.132	FLOAT FINISH	4,640.00	SQFT	0.2754	C276	3,000.00	DAY	49.49333	1.54667	1,277.86		1,277.86
3390.01	PROTECT & CURE	4,640.00	SQFT	0.1102	C276	7,500.00	DAY	19.79733	0.61867	511.328	89.088	600.416
5310.018	2" METAL DECK	4,640.00	SQFT	0.4445	C510	5,170.00	DAY	64.61896	0.89749	2,062.48	4,038.66	6,101.14
									5.37334	**6381.673**	**8257.891**	**14639.56**

Second Floor Concrete Slab
Assumptions:
Length= 116'
Width= 33'
Thickness= 5.25"
4000psi Concrete
4 Edges Formed
Float Finish
6X6 W2.0/W2.0 Mesh

Item Code	Description	Quantity	UM	Labor $	Crew	Production	Prod. UM	Total Hours	Duration	Labor Total	Material Total	Total Cost
3150.65	SCREEDS FOR SLAB	459.36	LNFT	0.9219	C311	1,250.00	DAY	16.16947	0.36749	423.484	146.995	570.479
3220.011	6x6 W2.1/W2.1 MESH	42.11	SQS	22.008	C320	60	DAY	39.3008	0.7018	926.713	448.45	1,375.16
3311.7	**CONC IN SLAB OVER MTL DECK**		****									
3311.73	4000 PSI W/PUMP	50.21	CUYD	12.5997	C235	120	DAY	26.78025	0.41844	632.668	2,811.93	3,709.72
3315.991	* SLAB OVER METAL DECK AREA *	3,828.00	SQFT									
3350.132	FLOAT FINISH	3,828.00	SQFT	0.2754	C276	3,000.00	DAY	40.832	1.276	1,054.23		1,054.23
3390.01	PROTECT & CURE	3,828.00	SQFT	0.1102	C276	7,500.00	DAY	16.3328	0.5104	421.846	73.498	495.343
5310.018	2" METAL DECK	3,828.00	SQFT	0.4445	C510	5,170.00	DAY	53.31064	0.74043	1,701.55	3,331.89	5,033.44
									4.01456	**5160.488**	**6812.76**	**12238.37**

AREA 1 Steel Beams

Item Code	Description	Quantity	UM	Crew	Production	Prod. UM	Total Hours	Duration	Labor Total	Material Total	Total Cost
5129.102	I BEAMS	684.45	CWT	C510	80	DAY	616.005	8.55564	19664.25	23955.75	47042.25
5129.404	SHEAR STUD, 3/4"	82	EACH	C509	400	DAY	1.40569	0.05849	44.552	58.786	127.928
								8.61413	19708.801	24014.536	47170.177

AREA 1 Steel Columns

Item Code	Description	Quantity	UM	Crew	Production	Prod. UM	Total Hours	Duration	Labor Total	Material Total	Total Cost
5129.122	I SHAPES	93.41	CWT	C510	80	DAY	84.069	1.16763	2683.669	3269.35	6420.069

AREA 1 Fireproofing

Item Code	Description	Quantity	UM	Crew	Production	Prod. UM	Total Hours	Duration	Labor Total	Material Total	Equip. Cost	Total Cost
7810.033	INTUMESCENT FIREPROOFING	1,528.92	BDFT	C917	3,000.00	DAY	6.11568	0.50964	167.875	4,442.43	122.314	4,732.62
7812.031	1/8" TOPCOAT	273.96	SQFT	C917	4,200.00	DAY	0.78274	0.06523	21.506	105.201	21.917	148.623
7810.035	TYPE A FIREPROOFING	7727.53	BDFT	C917	3,000.00	DAY	30.91012	2.57587	848.482	3,956.50	618.204	5,423.18
								3.15074	1037.863	8504.129	762.435	10304.422

AREA 1 Concrete Pilasters
Assumptions:
Depth= 24"
Width= 18"
4000psi Concrete
3 Edges Formed
Rectangular Plywood Forms
Height=12'
Reinforcing Steel= 375lb/cuyd

Item Code	Description	Quantity	UM	Crew	Production	Prod. UM	Total Hours	Duration	Labor Total	Material Total	Total Cost
3111.348	WOOD PIER FORMS	504	SQFT	C311	1,100.00	DAY	20.16	0.45818	527.99	584.892	1,112.88
3112.1	CHAMFER STRIP	288	LNFT	C311	1,700.00	DAY	7.45412	0.16941	195.235	55.296	250.531
3150.9	FORM RELEASING AGENT	504	SQFT	C311	5,500.00	DAY	4.032	0.09164	105.588	11.592	117.18
3210.155	PIER REBAR	30	CWT	C321	75	DAY	22.4	0.4	711.999	802.5	1,514.50
3310.75	**CONCRETE IN PIERS**		****								
3310.781	5000 PSI DIRECT	8	CUYD	C216	55	DAY	5.23636	0.14545	128.105	480	608.105
3350.131	POINT & PATCH	504	SQFT	C276	7,500.00	DAY	2.1504	0.0672	55.541	6.451	61.992
								1.33188	**1724.458**	**1940.731**	**3665.189**

APPENDIX G

AREA 1First Floor Concrete Slab

Assumtions:
Length= 116'
Width= 40'
Thickness= 10"
Story Height= 12'
5000psi Concrete
Standard Wood Forms
4 Edges Formed
Float Finish
Reinforcing Steel= 2.9 lbs/sqft

Item Code	Description	Quantity	UM	Labor $	Crew	Production	Prod. UM	Total Hours	Duration	Labor Total	Material Total	Total Cost
3111.612	SLAB FORM W/2.6 BM/SF	3,712.00	SQFT	2.538	C311	454.058	DAY	359.70735	8.17517	9,421.06	4,688.63	14,109.68
3111.624	SLAB EDGE FORM	260	SQFT	2.1511	C311	535.719	DAY	21.35448	0.48533	559.286	221.702	780.988
3150.65	SCREEDS FOR SLAB	556.8	LNFT	0.9219	C311	1,250.00	DAY	19.59936	0.44544	513.314	178.176	691.49
3150.9	FORM RELEASING AGENT	3,972.00	SQFT	0.2095	C311	5,500.00	DAY	31.776	0.72218	832.134	91.356	923.49
3210.13	SUPPORTED SLAB REBAR	134.56	CWT	32.3636	C321	55	DAY	137.00655	2.44655	4,354.85	3,599.48	7,954.33
3311.5	**CONC IN SUPPORTED SLAB**		****									
3311.533	5000 PSI W/CART	143.21	CUYD	14.3996	C220	105	DAY	87.28983	1.3639	2,062.17	8,592.59	10,654.76
3315.986	* SUPPORTED SLAB AREA *	4,640.00	SQFT									
3350.131	POINT & PATCH	3,972.00	SQFT	0.1102	C276	7,500.00	DAY	16.9472	0.5296	437.714	50.842	488.556
3350.132	FLOAT FINISH	4,640.00	SQFT	0.2754	C276	3,000.00	DAY	49.49333	1.54667	1,277.86		1,277.86
3390.01	PROTECT & CURE	4,640.00	SQFT	0.1102	C276	7,500.00	DAY	19.79733	0.61867	511.328	89.088	600.416
3250.01	POST TENSIONING		****									
3250.055	SUPPORTED SLABS		****									
3250.056	GREASED STRANDS	2,436.00	LBS	0.6827	C322	1,500.00	DAY	51.968	1.624	1,663.06	2,484.72	4,216.47
									17.95751	**21,632.76**	**19,996.58**	**41,698.04**

AREA 1 Second Floor Concrete Slab

Assumptions:
Length= 116'
Width= 33'
Thickness= 12"
Story Height= 15'
5000psi Concrete
Standard Wood Forms
4 Edges Formed
Float Finish
Reinforcing Steel= 2.9 lbs/sqft

Item Code	Description	Quantity	UM	Labor $	Crew	Production	Prod. UM	Total Hours	Duration	Labor Total	Material Total	Total Cost
3111.618	SLAB FORM W/2.9 BM/SF	2,900.00	SQFT	2.8245	C311	408	DAY	312.7451	7.10784	8,191.05	3,989.82	12,180.87
3111.624	SLAB EDGE FORM	298	SQFT	2.1511	C311	535.719	DAY	24.47552	0.55626	641.028	254.105	895.132
3150.65	SCREEDS FOR SLAB	459.36	LNFT	0.9219	C311	1,250.00	DAY	16.16947	0.36749	423.484	146.995	570.479
3150.9	FORM RELEASING AGENT	3,198.00	SQFT	0.2095	C311	5,500.00	DAY	25.584	0.58145	669.981	73.554	743.535
3210.13	SUPPORTED SLAB REBAR	111.01	CWT	32.3636	C321	55	DAY	113.0304	2.0184	3,592.75	2,969.57	6,562.32
3311.5	**C0NC IN SUPPORTED SLAB**		****									
3311.533	5000 PSI W/CART	141.78	CUYD	14.3996	C220	105	DAY	86.41693	1.35026	2,041.54	8,506.67	10,548.21
3315.986	* SUPPORTED SLAB AREA *	3,828.00	SQFT									
3350.131	POINT & PATCH	3,198.00	SQFT	0.1102	C276	7,500.00	DAY	13.6448	0.4264	352.42	40.934	393.354
3350.132	FLOAT FINISH	3,828.00	SQFT	0.2754	C276	3,000.00	DAY	40.832	1.276	1,054.23		1,054.23
3390.01	PROTECT & CURE	3,828.00	SQFT	0.1102	C276	7,500.00	DAY	16.3328	0.5104	421.846	73.498	495.343
3250.01	POST TENSIONING		****									
3250.055	SUPPORTED SLABS		****									
3250.056	GREASED STRANDS	2,009.70	LBS	0.6827	C322	1,500.00	DAY	42.8736	1.3398	1,372.02	2,049.89	3,478.59
									15.5343	**18,760.35**	**18,105.04**	**36,922.06**

Beam B1

Assumptions:
Width= 4.67'
Depth below slab= .67'
Length= 116'
Story Height= 12'
5000psi Concrete
Wood Soffit Forms and Shoring
Wood Side Forms

Item Code	Description	Quantity	UM	Labor $	Crew	Production	Prod. UM	Total Hours	Duration	Labor Total	Material Total	Total Cost
3111.407	BEAM SOFFIT FORMS 10'-12' HIGH	541.37	SQFT	5.6457	C311	204.112	DAY	116.70244	2.65233	3,056.42	2,021.59	5,078.02
3111.42	BEAM SIDE FORMS	154.74	SQFT	2.8709	C311	401.398	DAY	16.96256	0.38551	444.255	159.03	603.285
3111.524	Beam w/slab shoring 10'-12'	541.37	SQFT	5.6457	C311	204.112	DAY	116.70244	2.65233	3,056.42	2,021.59	5,078.02
3150.9	FORM RELEASING AGENT	696.12	SQFT	0.2095	C311	5,500.00	DAY	5.56893	0.12657	145.836	16.011	161.847
3210.901	RE-STEEL @ BEAMS W/SLAB	26.75	CWT	32.3636	C321	55	DAY	27.23411	0.48632	865.655	715.503	1,581.16
3311.1	**CONC IN BEAMS W/SLAB**		****									
3311.133	5000 PSI W/CART	13.37	CUYD	15.1196	C220	100	DAY	8.55929	0.13374	202.208	802.434	1,004.64
3315.985	* LENGTH OF BEAMS *	116	LNFT									
3350.131	POINT & PATCH	696.12	SQFT	0.1102	C276	7,500.00	DAY	2.97009	0.09282	76.712	8.91	85.622
									6.52962	**7,847.51**	**5,745.07**	**13,592.58**

Beam B2

Assumptions:
Width= 3.33'
Depth below slab= .67'
Length= 116'
Story Height= 12'
5000psi Concrete
Wood Soffit Forms and Shoring
Wood Side Forms

Item Code	Description	Quantity	UM	Labor $	Crew	Production	Prod. UM	Total Hours	Duration	Labor Total	Material Total	Total Cost
3111.407	BEAM SOFFIT FORMS 10'-12' HIGH	386.28	SQFT	5.6457	C311	204.112	DAY	83.26958	1.89249	2,180.82	1,442.45	3,623.27
3111.42	BEAM SIDE FORMS	154.74	SQFT	2.8709	C311	401.398	DAY	16.96256	0.38551	444.255	159.03	603.285
3111.524	Beam w/slab shoring 10'-12'	386.28	SQFT	5.6457	C311	204.112	DAY	83.26958	1.89249	2,180.82	1,442.45	3,623.27
3150.9	FORM RELEASING AGENT	541.02	SQFT	0.2095	C311	5,500.00	DAY	4.32819	0.09837	113.345	12.444	125.788
3210.901	RE-STEEL @ BEAMS W/SLAB	19.09	CWT	32.3636	C321	55	DAY	19.4321	0.347	617.662	510.526	1,128.19
3311.1	**CONC IN BEAMS W/SLAB**		****									
3311.133	5000 PSI W/CART	9.54	CUYD	15.1196	C220	100	DAY	6.10723	0.09543	144.279	572.553	716.832
3315.985	* LENGTH OF BEAMS *	116	LNFT									
3350.131	POINT & PATCH	541.02	SQFT	0.1102	C276	7,500.00	DAY	2.30837	0.07214	59.621	6.925	66.546
									4.78343	**5,740.80**	**4,146.37**	**9,887.18**

Beam B3

Assumptions:
Width= 4.67'
Depth below slab= .67'
Length= 116'
Story Height= 15'
5000psi Concrete
Wood Soffit Forms and Shoring
Wood Side Forms

Item Code	Description	Quantity	UM	Labor $	Crew	Production	Prod. UM	Total Hours	Duration	Labor Total	Material Total	Total Cost
3111.411	BEAM SOFFIT FORMS 14'-16' HIGH	541.37	SQFT	6.2569	C311	184.175	DAY	129.33551	2.93944	3,387.31	2,319.89	5,707.20
3111.42	BEAM SIDE FORMS	154.74	SQFT	2.8709	C311	401.398	DAY	16.96256	0.38551	444.255	159.03	603.285
3111.526	Beam w/slab shoring 14'-16'	541.37	SQFT	6.2569	C311	184.175	DAY	129.33551	2.93944	3,387.31	2,319.89	5,707.20
3150.9	FORM RELEASING AGENT	696.12	SQFT	0.2095	C311	5,500.00	DAY	5.56893	0.12657	145.836	16.011	161.847
3210.901	RE-STEEL @ BEAMS W/SLAB	26.75	CWT	32.3636	C321	55	DAY	27.23411	0.48632	865.655	715.503	1,581.16
3311.1	**CONC IN BEAMS W/SLAB**		****									
3311.133	5000 PSI W/CART	13.37	CUYD	15.1196	C220	100	DAY	8.55929	0.13374	202.208	802.434	1,004.64
3315.985	* LENGTH OF BEAMS *	116	LNFT									
3350.131	POINT & PATCH	696.12	SQFT	0.1102	C276	7,500.00	DAY	2.97009	0.09282	76.712	8.91	85.622
									7.10384	**8,432.57**	**6,332.75**	**14,765.33**

Beam B4

Assumptions:
Width= 3.33'
Depth below slab= .67'
Length= 116'
Story Height= 15'
5000psi Concrete
Wood Soffit Forms and Shoring
Wood Side Forms

Item Code	Description	Quantity	UM	Labor $	Crew	Production	Total Hours	Duration	Labor Total	Material Total	Total Cost
3111.411	BEAM SOFFIT FORMS 14'-16' HIGH	386.28	SQFT	6.2569	C311	184.175	92.28353	2.09735	2,416.92	1,655.29	4,072.20
3111.42	BEAM SIDE FORMS	154.74	SQFT	2.8709	C311	401.398	16.96256	0.38551	444.255	159.03	603.285
3111.526	Beam w/slab shoring 14'-16'	386.28	SQFT	6.2569	C311	184.175	92.28353	2.09735	2,416.92	1,655.29	4,072.20
3150.9	FORM RELEASING AGENT	541.02	SQFT	0.2095	C311	5,500.00	4.32819	0.09837	113.345	12.444	125.788
3210.901	RE-STEEL @ BEAMS W/SLAB	19.09	CWT	32.3636	C321	55	19.4321	0.347	617.662	510.526	1,128.19
3311.1	**CONC IN BEAMS W/SLAB**		****								
3311.133	5000 PSI W/CART	9.54	CUYD	15.1196	C220	100	6.10723	0.09543	144.279	572.553	716.832
3315.985	* LENGTH OF BEAMS *	116	LNFT								
3350.131	POINT & PATCH	541.02	SQFT	0.1102	C276	7,500.00	2.30837	0.07214	59.621	6.925	66.546
								5.19315	**6,212.99**	**4,572.05**	**10,785.04**

AREA 1 First Floor Columns

Assumptions:
Width= 20"
Depth=20"
Length= 11'
Chamfered Corners=4
5000psi Concrete
Plywood Forms
Reinforcing Steel= 375 lb/cuyd

Item Code	Description	Quantity	UM	Labor $	Crew	Production	Prod. UM	Total Hours	Duration	Labor Total	Material Total	Total Cost
3111.202	WOOD COLUMN FORMS, 8'-12'	733.33	SQFT	1.213	C311	950	DAY	33.96491	0.77193	889.533	844.433	1,733.97
3112.1	CHAMFER STRIP	440	LNFT	0.6779	C311	1,700.00	DAY	11.38824	0.25882	298.276	84.48	382.756
3150.9	FORM RELEASING AGENT	733.33	SQFT	0.2095	C311	5,500.00	DAY	5.86667	0.13333	153.633	16.867	170.5
3210.15	COLUMN REBAR	42.44	CWT	24.7222	C321	72	DAY	33.00754	0.58942	1,049.17	1,135.22	2,184.39
3310.65	**CONCRETE IN COLUMNS**		****									
3310.686	5000 PSI W/PUMP	11.32	CUYD	16.7996	C235	90	DAY	8.04755	0.12574	190.119	679.012	928.884
3315.984	* NO. OF COLUMNS *	10	EACH									
3350.131	POINT & PATCH	733.33	SQFT	0.1102	C276	7,500.00	DAY	3.12889	0.09778	80.813	9.387	90.2
									1.97702	**2661.541**	**2769.403**	**5490.698**

AREA 1 Second Floor Columns

Assumptions:
Width= 20"
Depth=20"
Length= 14'
Chamfered Corners=4
5000psi Concrete
Plywood Forms
Reinforcing Steel= 375 lb/cuyd

Item Code	Description	Quantity	UM	Labor $	Crew	Production	Prod. UM	Total Hours	Duration	Labor Total	Material Total	Total Cost
3111.203	WOOD COLUMN FORMS, 12'-16'	933.33	SQFT	1.1524	C311	1,000.00	DAY	41.06667	0.93333	1,075.57	1,145.01	2,220.59
3112.1	CHAMFER STRIP	560	LNFT	0.6779	C311	1,700.00	DAY	14.49412	0.32941	379.624	107.52	487.144
3150.9	FORM RELEASING AGENT	933.33	SQFT	0.2095	C311	5,500.00	DAY	7.46667	0.1697	195.533	21.467	217
3210.15	COLUMN REBAR	54.01	CWT	24.7222	C321	72	DAY	42.0096	0.75017	1,335.30	1,444.83	2,780.13
3310.65	**CONCRETE IN COLUMNS**		****									
3310.686	5000 PSI W/PUMP	14.4	CUYD	16.7996	C235	90	DAY	10.24234	0.16004	241.97	864.198	1,182.22
3315.984	* NO. OF COLUMNS *	10	EACH									
3350.131	POINT & PATCH	933.33	SQFT	0.1102	C276	7,500.00	DAY	3.98222	0.12444	102.853	11.947	114.8
									2.46709	**3,330.86**	**3,594.98**	**7,001.88**

AREA 1 Beam Post-Tensioning

Item Code	Description	Quantity	UM	Labor $	Crew	Production	Prod. UM	Total Hours	Duration	Labor Total	Material Total	Total Cost
3250.01	POST TENSIONING		****									
3250.051	BEAMS		****									
3250.052	GREASED STRANDS	3,654.00	LBS	0.6827	C322	1,500.00	DAY	77.952	**2.436**	**2,494.59**	**3,727.08**	**6,324.71**

APPENDIX H

AREA 2 First Floor Concrete Slab

Assumptions:
Length= 122'
Width= 45'
Thickness= 5.25"
4000psi Concrete
4 Edges Formed
Float Finish
6X6 W2.0/W2.0 Mesh
2" Metal Deck

Item Code	Description	Quantity	UM	Labor $	Crew	Production	Prod. UM	Total Hours	Duration	Labor Total	Material Total	Total Cost
3150.65	SCREEDS FOR SLAB	658.8	LNFT	0.9219	C311	1,250.00	DAY	23.18976	0.52704	607.348	210.816	818.164
3220.011	6x6 W2.1/W2.1 MESH	60.39	SQS	22.008	C320	60	DAY	56.364	1.0065	1,329.06	643.154	1,972.22
3311.7	**CONC IN SLAB OVER MTL DECK**		****									
3311.725	4000 PSI DIRECT	72.01	CUYD	14.6787	C216	60	DAY	43.20833	1.20023	1,057.07	4,032.78	5,089.85
3315.991	* SLAB OVER METAL DECK AREA *	5,490.00	SQFT									
3350.132	FLOAT FINISH	5,490.00	SQFT	0.2754	C276	3,000.00	DAY	58.56	1.83	1,511.95		1,511.95
3390.01	PROTECT & CURE	5,490.00	SQFT	0.1102	C276	7,500.00	DAY	23.424	0.732	604.998	105.408	710.406
5310.018	2" METAL DECK	5,490.00	SQFT	0.4445	C510	5,170.00	DAY	76.45648	1.0619	2,440.31	4,778.50	7,218.80
									6.35767	**7550.73**	**9770.652**	**17321.38**

AREA 2 Second-Fourth Floor Concrete Slab

Assumptions:
Length= 122'
Width= 38'
Thickness= 5.25"
4000psi Concrete
4 Edges Formed
Float Finish
6X6 W2.0/W2.0 Mesh
2" Metal Deck

Item Code	Description	Quantity	UM	Labor $	Crew	Production	Prod. UM	Total Hours	Duration	Labor Total	Material Total	Total Cost
3150.65	SCREEDS FOR SLAB	1,668.96	LNFT	0.9219	C311	1,250.00	DAY	58.74739	1.33517	1,538.61	534.067	2,072.68
3220.011	6x6 W2.1/W2.1 MESH	152.99	SQS	22.008	C320	60	DAY	142.7888	2.5498	3,366.96	1,629.32	4,996.28
3311.7	**CONC IN SLAB OVER MTL DECK**		****									
3311.726	4000 PSI W/CRANE	182.44	CUYD	13.942	C230	125	DAY	105.0827	1.45948	2,543.51	10,216.37	12,759.88
3315.991	* SLAB OVER METAL DECK AREA *	13,908.00	SQFT									
3350.132	FLOAT FINISH	13,908.00	SQFT	0.2754	C276	3,000.00	DAY	148.352	4.636	3,830.26		3,830.26
3390.01	PROTECT & CURE	13,908.00	SQFT	0.1102	C276	7,500.00	DAY	59.3408	1.8544	1,532.66	267.034	1,799.70
5310.018	2" METAL DECK	13,908.00	SQFT	0.4445	C510	5,170.00	DAY	193.6898	2.69014	6,182.11	12,105.52	18,287.63
									14.52499	**18994.12**	**24752.32**	**43746.43**

AREA 2 Steel Beams

Item Code	Description	Quantity	UM	Crew	Production	Prod. UM	Total Hours	Duration	Labor Total	Material Total	Total Cost
5129.102	I BEAMS	1965.12	CWT	C510	80	DAY	1768.609	24.56405	56457.92	68779.23	135062.8
5129.103	CHANNELS	17.29	CWT	C510	80	DAY	15.5601	0.21612	496.713	605.115	1240.14
5129.404	SHEAR STUD, 3/4"	254	EACH	C509	1400	DAY	4.35422	0.18126	138.012	182.076	396.282
								24.96143	**57092.65**	**69566.42**	**136699.2**

AREA 2 Steel Columns

Item Code	Description	Quantity	UM	Crew	Production	Prod. UM	Total Hours	Duration	Labor Total	Material Total	Total Cost
5129.122	I SHAPES	355.05	CWT	C510	80	DAY	319.545	4.43813	10200.59	12426.75	24402.59

AREA 2 Fire Proofing

Item Code	Description	Quantity	UM	Crew	Production	Prod. UM	Total Hours	Duration	Labor Total	Material Total	Equip. Cost	Total Cost
7810.035	TYPE A FIREPROOFING	25269.67	BDFT	C917	3000	DAY	101.0787	8.42321	2774.606	12938.08	2021.575	17734.25

AREA 2 CONCRETE PILASTERS

Assumptions:
Depth= 24"
Width= 18"
4000psi Concrete
3 Edges Formed
Rectangular Plywood Forms
Height=12'
Reinforcing Steel= 375lb/cuyd

Item Code	Description	Quantity	UM	Crew	Production	Prod. UM	Total Hours	Duration	Labor Total	Material Total	Total Cost
3111.348	WOOD PIER FORMS	588	SQFT	C311	1,100.00	DAY	23.52	0.53455	615.989	682.374	1,298.36
3112.1	CHAMFER STRIP	336	LNFT	C311	1,700.00	DAY	8.69647	0.19765	227.774	64.512	292.286
3150.9	FORM RELEASING AGENT	588	SQFT	C311	5,500.00	DAY	4.704	0.10691	123.186	13.524	136.71
3210.155	PIER REBAR	35	CWT	C321	75	DAY	26.13333	0.46667	830.666	936.25	1,766.92
3310.75	**CONCRETE IN PIERS**		****								
3310.775	4000 PSI DIRECT	9.33	CUYD	C216	55	DAY	6.10909	0.1697	149.456	522.667	672.122
3350.131	POINT & PATCH	588	SQFT	C276	7,500.00	DAY	2.5088	0.0784	64.798	7.526	72.324
								1.55388	2011.869	2226.853	4238.721

AREA 2 CONCRETE SHEAR WALLS

Item Code	Description	Quantity	UM	Crew	Production	Prod. UM	Total Hours	Duration	Labor Total	Material Total	Total Cost
3111.112	WALL FORM 14'-16' HIGH	15,600.00	SQFT	C311	346.326	DAY	1,981.95	45.04	51,905.88	22,039.68	73,945.56
3111.189	WALL FORM HARDWARE	7,800.00	SQFT							798.72	798.72
3150.9	FORM RELEASING AGENT	15,600.00	SQFT	C311	5,500.00	DAY	124.80	2.84	3,268.20	358.80	3,627.00
3210.16	WALL REBAR	909.73	CWT	C321	54	DAY	943.42	16.85	29,987.29	24,335.24	54,322.53
3310.55	**CONCRETE IN WALLS**		****								
3310.58	4000 PSI W/PUMP	255.89	CUYD	C235	105	DAY	155.97	2.44	3,684.70	14,329.78	19,365.57
3315.982	* CONCRETE WALL AREA *	7,800.00	SQFT								
3350.131	POINT & PATCH	15,600.00	SQFT	C276	7,500.00	DAY	66.56	2.08	1,719.12	199.68	1,918.80
								69.24	90,565.19	62,061.90	153,978.18

APPENDIX I

AREA 2 First Floor Concrete Slab

Assumptions:
Length= 122'
Width= 45'
Thickness= 12"
Story Height= 12'
5000psi Concrete
Standard Wood Forms
4 Edges Formed
Float Finish
Reinforcing Steel= 2.9 lbs/sqft

Item Code	Description	Quantity	UM	Labor $	Crew	Production	Prod. UM	Total Hours	Duration	Labor Total	Material Total	Total Cost
3111.616	SLAB FORM W/2.8 BM/SF	4,477.40	SQFT	2.7392	C311	420.696	DAY	468.2849	10.64284	12,264.49	5,991.66	18,256.15
3111.624	SLAB EDGE FORM	334	SQFT	2.1511	C311	535.719	DAY	27.43229	0.62346	718.467	284.802	1,003.27
3150.65	SCREEDS FOR SLAB	658.8	LNFT	0.9219	C311	1,250.00	DAY	23.18976	0.52704	607.348	210.816	818.164
3150.9	FORM RELEASING AGENT	4,811.40	SQFT	0.2095	C311	5,500.00	DAY	38.4912	0.8748	1,007.99	110.662	1,118.65
3210.13	SUPPORTED SLAB REBAR	159.21	CWT	32.3636	C321	55	DAY	162.1047	2.89473	5,152.61	4,258.87	9,411.48
3311.5	**C0NC IN SUPPORTED SLAB**		****									
3311.531	5000 PSI DIRECT	203.33	CUYD	11.7429	C216	75	DAY	97.6	2.71111	2,387.72	12,200.00	14,587.72
3315.986	* SUPPORTED SLAB AREA *	5,490.00	SQFT									
3350.131	POINT & PATCH	4,811.40	SQFT	0.1102	C276	7,500.00	DAY	20.52864	0.64152	530.216	61.586	591.802
3350.132	FLOAT FINISH	5,490.00	SQFT	0.2754	C276	3,000.00	DAY	58.56	1.83	1,511.95		1,511.95
3390.01	PROTECT & CURE	5,490.00	SQFT	0.1102	C276	7,500.00	DAY	23.424	0.732	604.998	105.408	710.406
3250.01	POST TENSIONING		****									
3250.056	GREASED STRANDS	2,882.25	LBS	0.6827	C322	1,500.00	DAY	61.488	1.9215	1,967.71	2,939.90	4,988.89
									23.399	26753.5	26163.69	52998.48

AREA 2 Second - Fourth Floor Concrete Slab

Assumptions:
Length= 122'
Width= 38'
Thickness= 12"
Story Height= 15'
5000psi Concrete
Standard Wood Forms
4 Edges Formed
Float Finish
Reinforcing Steel= 2.9 lbs/sqft

Item Code	Description	Quantity	UM	Labor $	Crew	Production	Prod. UM	Total Hours	Duration	Labor Total	Material Total	Total Cost
3111.618	SLAB FORM W/2.9 BM/SF	10,870.20	SQFT	2.8245	C311	408	DAY	1,172.28	26.64265	30,702.88	14,955.22	45,658.10
3111.624	SLAB EDGE FORM	960	SQFT	2.1511	C311	535.719	DAY	78.84731	1.79198	2,065.06	818.592	2,883.65
3150.65	SCREEDS FOR SLAB	1,668.96	LNFT	0.9219	C311	1,250.00	DAY	58.74739	1.33517	1,538.61	534.067	2,072.68
3150.9	FORM RELEASING AGENT	11,830.20	SQFT	0.2095	C311	5,500.00	DAY	94.6416	2.15095	2,478.43	272.095	2,750.52
3210.13	SUPPORTED SLAB REBAR	403.33	CWT	32.3636	C321	55	DAY	410.6653	7.33331	13,053.28	10,789.13	23,842.41
3311.5	**C0NC IN SUPPORTED SLAB**		****									
3311.532	5000 PSI W/CRANE	515.11	CUYD	13.942	C230	125	DAY	296.704	4.12089	7,181.68	30,906.67	38,088.35
3315.986	* SUPPORTED SLAB AREA *	13,908.00	SQFT									
3350.131	POINT & PATCH	11,830.20	SQFT	0.1102	C276	7,500.00	DAY	50.47552	1.57736	1,303.69	151.427	1,455.12
3350.132	FLOAT FINISH	13,908.00	SQFT	0.2754	C276	3,000.00	DAY	148.352	4.636	3,830.26		3,830.26
3390.01	PROTECT & CURE	13,908.00	SQFT	0.1102	C276	7,500.00	DAY	59.3408	1.8544	1,532.66	267.034	1,799.70
3250.01	POST TENSIONING		****									
3250.056	GREASED STRANDS	7,301.70	LBS	0.6827	C322	1,500.00	DAY	155.7696	4.8678	4,984.87	7,447.73	12,638.51
									56.31051	**68671.42**	**66141.97**	**135,019.29**

AREA 2 Concrete Columns

Assumptions:
Width= 24"
Depth=24"
Chamfered Corners=4
5000psi Concrete
Plywood Forms
Reinforcing Steel= 375 lb/cuyd

Item Code	Description	Quantity	UM	Crew	Production	Prod. UM	Total Hours	Duration	Labor Total	Material Total	Total Cost
3111.203	WOOD COLUMN FORMS, 12'-16'	5,376.00	SQFT	C311	1,000.00	DAY	229.0779	5.20632	5,999.69	7,107.98	13,107.67
3112.1	CHAMFER STRIP	2,688.00	LNFT	C311	1,700.00	DAY	69.57177	1.58117	1,822.20	516.10	2,338.29
3150.9	FORM RELEASING AGENT	5,376.00	SQFT	C311	5,500.00	DAY	43.008	0.97746	1,126.27	123.65	1,249.92
3210.15	COLUMN REBAR	373.33	CWT	C321	72	DAY	290.3704	5.18519	9,229.62	9,986.67	19,216.29
3310.65	**CONCRETE IN COLUMNS**		****								
3310.686	5000 PSI W/PUMP	99.56	CUYD	C235	90	DAY	70.79507	1.10617	1,672.49	5,973.33	8,171.48
3315.984	* NO. OF COLUMNS *	42.00	EACH								
3350.131	POINT & PATCH	5,376.00	SQFT	C276	7,500.00	DAY	22.9376	0.7168	592.44	68.81	661.25
								14.77311	**20442.7**	**23776.54**	**44744.90**

Beam B5

Assumptions:
Width= 5'
Depth below slab= .67'
Length= 62'
Story Height= 12'
5000psi Concrete
Wood Soffit Forms and Shoring
Wood Side Forms

Item Code	Description	Quantity	UM	Labor $	Crew	Production	Prod. UM	Total Hours	Duration	Labor Total	Material Total	Total Cost
3111.407	BEAM SOFFIT FORMS 10'-12' HIGH	310	SQFT	5.6457	C311	204.112	DAY	66.82606	1.51877	1,750.17	1,157.60	2,907.77
3111.42	BEAM SIDE FORMS	83.08	SQFT	2.8709	C311	401.398	DAY	9.10697	0.20698	238.514	85.381	323.896
3111.524	Beam w/slab shoring 10'-12'	310	SQFT	5.6457	C311	204.112	DAY	66.82606	1.51877	1,750.17	1,157.60	2,907.77
3150.9	FORM RELEASING AGENT	393.08	SQFT	0.2095	C311	5,500.00	DAY	3.14464	0.07147	82.35	9.041	91.391
3210.901	RE-STEEL @ BEAMS W/SLAB	15.39	CWT	32.3636	C321	55	DAY	15.66492	0.27973	497.92	411.554	909.474
3311.1	**CONC IN BEAMS W/SLAB**		****									
3311.136	5000 PSI W/PUMP	7.69	CUYD	15.1196	C235	100	DAY	4.92326	0.07693	116.309	461.556	618.481
3315.985	* LENGTH OF BEAMS *	62	LNFT									
3350.131	POINT & PATCH	393.08	SQFT	0.1102	C276	7,500.00	DAY	1.67714	0.05241	43.317	5.031	48.349
									3.72506	**4478.744**	**3287.767**	**7807.129**

Beam B6

Assumptions:
Width= 3.33'
Depth below slab= .67'
Length= 62'
Story Height= 12'
5000psi Concrete
Wood Soffit Forms and Shoring
Wood Side Forms

Item Code	Description	Quantity	UM	Labor $	Crew	Production	Prod. UM	Total Hours	Duration	Labor Total	Material Total	Total Cost
3111.407	BEAM SOFFIT FORMS 10'-12' HIGH	206.46	SQFT	5.6457	C311	204.112	DAY	44.50615	1.0115	1,165.61	770.963	1,936.57
3111.42	BEAM SIDE FORMS	83.08	SQFT	2.8709	C311	401.398	DAY	9.10697	0.20698	238.514	85.381	323.896
3111.524	Beam w/slab shoring 10'-12'	206.46	SQFT	5.6457	C311	204.112	DAY	44.50615	1.0115	1,165.61	770.963	1,936.57
3150.9	FORM RELEASING AGENT	289.54	SQFT	0.2095	C311	5,500.00	DAY	2.31632	0.05264	60.659	6.659	67.318
3210.901	RE-STEEL @ BEAMS W/SLAB	10.25	CWT	32.3636	C321	55	DAY	10.43283	0.1863	331.615	274.095	605.709
3311.1	**CONC IN BEAMS W/SLAB**		****									
3311.136	5000 PSI W/PUMP	5.12	CUYD	15.1196	C235	100	DAY	3.27889	0.05123	77.462	307.396	411.909
3315.985	* LENGTH OF BEAMS *	62	LNFT									
3350.131	POINT & PATCH	289.54	SQFT	0.1102	C276	7,500.00	DAY	1.23537	0.03861	31.907	3.706	35.613
									2.55876	**3071.379**	**2219.163**	**5317.593**

Beam B7

Assumptions:
Width= 5'
Depth below slab= .67'
Length= 52'
Story Height= 7'
5000psi Concrete
Wood Soffit Forms and Shoring
Wood Side Forms

Item Code	Description	Quantity	UM	Labor $	Crew	Production	Prod. UM	Total Hours	Duration	Labor Total	Material Total	Total Cost
3111.403	BEAM SOFFIT FORMS 4'-8' HIGH	260	SQFT	5.0733	C311	227.143	DAY	50.36475	1.14465	1,319.06	779.74	2,098.80
3111.42	BEAM SIDE FORMS	69.68	SQFT	2.8709	C311	401.398	DAY	7.6381	0.17359	200.044	71.61	271.654
3111.522	Beam w/slab shoring 4'-8'	260	SQFT	5.0733	C311	227.143	DAY	50.36475	1.14465	1,319.06	779.74	2,098.80
3150.9	FORM RELEASING AGENT	329.68	SQFT	0.2095	C311	5,500.00	DAY	2.63744	0.05994	69.068	7.583	76.651
3210.901	RE-STEEL @ BEAMS W/SLAB	12.9	CWT	32.3636	C321	55	DAY	13.13832	0.23461	417.61	345.174	762.784
3311.1	**CONC IN BEAMS W/SLAB**		****									
3311.136	5000 PSI W/PUMP	6.45	CUYD	15.1196	C235	100	DAY	4.12919	0.06452	97.549	387.111	518.726
3315.985	* LENGTH OF BEAMS *	52	LNFT									
3350.131	POINT & PATCH	329.68	SQFT	0.1102	C276	7,500.00	DAY	1.40663	0.04396	36.331	4.22	40.551
									2.86592	**3458.718**	**2375.178**	**5867.962**

Beam B8

Assumptions:
Width= 3.33'
Depth below slab= .67'
Length= 52'
Story Height= 7'
5000psi Concrete
Wood Soffit Forms and Shoring
Wood Side Forms

Item Code	Description	Quantity	UM	Labor $	Crew	Production	Prod. UM	Total Hours	Duration	Labor Total	Material Total	Total Cost
3111.403	BEAM SOFFIT FORMS 4'-8' HIGH	173.16	SQFT	5.0733	C311	227.143	DAY	33.54292	0.76234	878.493	519.307	1,397.80
3111.42	BEAM SIDE FORMS	69.68	SQFT	2.8709	C311	401.398	DAY	7.6381	0.17359	200.044	71.61	271.654
3111.522	Beam w/slab shoring 4'-8'	173.16	SQFT	5.0733	C311	227.143	DAY	33.54292	0.76234	878.493	519.307	1,397.80
3150.9	FORM RELEASING AGENT	242.84	SQFT	0.2095	C311	5,500.00	DAY	1.94272	0.04415	50.875	5.585	56.46
3210.901	RE-STEEL @ BEAMS W/SLAB	8.59	CWT	32.3636	C321	55	DAY	8.75012	0.15625	278.128	229.886	508.014
3311.1	**CONC IN BEAMS W/SLAB**		****									
3311.131	5000 PSI DIRECT	4.3	CUYD	14.6787	C216	60	DAY	2.57816	0.07162	63.073	257.816	320.889
3315.985	* LENGTH OF BEAMS *	52	LNFT									
3350.131	POINT & PATCH	242.84	SQFT	0.1102	C276	7,500.00	DAY	1.03612	0.03238	26.761	3.108	29.869
									2.00267	**2375.867**	**1606.619**	**3982.484**

Beam B9

Assumptions:
Width= 5'
Depth below slab= .67'
Length= 122'
Story Height= 15'
5000psi Concrete
Wood Soffit Forms and Shoring
Wood Side Forms

Item Code	Description	Quantity	UM	Labor $	Crew	Production	Prod. UM	Total Hours	Duration	Labor Total	Material Total	Total Cost
3111.411	BEAM SOFFIT FORMS 14'-16' HIGH	1,830.00	SQFT	6.2569	C311	184.175	DAY	437.1929	9.9362	11,450.13	7,841.92	19,292.04
3111.42	BEAM SIDE FORMS	490.44	SQFT	2.8709	C311	401.398	DAY	53.76051	1.22183	1,408.00	504.025	1,912.03
3111.526	Beam w/slab shoring 14'-16'	1,830.00	SQFT	6.2569	C311	184.175	DAY	437.1929	9.9362	11,450.13	7,841.92	19,292.04
3150.9	FORM RELEASING AGENT	2,320.44	SQFT	0.2095	C311	5,500.00	DAY	18.56352	0.4219	486.132	53.37	539.502
3210.901	RE-STEEL @ BEAMS W/SLAB	90.82	CWT	32.3636	C321	55	DAY	92.47354	1.65131	2,939.33	2,429.49	5,368.83
3311.1	**CONC IN BEAMS W/SLAB**		****									
3311.136	5000 PSI W/PUMP	45.41	CUYD	15.1196	C235	100	DAY	29.06311	0.45411	686.598	2,724.67	3,651.04
3315.985	* LENGTH OF BEAMS *	366	LNFT									
3350.131	POINT & PATCH	2,320.44	SQFT	0.1102	C276	7,500.00	DAY	9.90054	0.30939	255.712	29.702	285.414
									23.93094	28676.03	21425.09	50340.895

Beam B10

Assumptions:
Width= 3.33'
Depth below slab= .67'
Length= 122'
Story Height= 15'
5000psi Concrete
Wood Soffit Forms and Shoring
Wood Side Forms

Item Code	Description	Quantity	UM	Labor $	Crew	Production	Prod. UM	Total Hours	Duration	Labor Total	Material Total	Total Cost
3111.411	BEAM SOFFIT FORMS 14'-16' HIGH	1,218.78	SQFT	6.2569	C311	184.175	DAY	291.1705	6.61751	7,625.79	5,222.72	12,848.50
3111.42	BEAM SIDE FORMS	490.44	SQFT	2.8709	C311	401.398	DAY	53.76051	1.22183	1,408.00	504.025	1,912.03
3111.526	Beam w/slab shoring 14'-16'	1,218.78	SQFT	6.2569	C311	184.175	DAY	291.1705	6.61751	7,625.79	5,222.72	12,848.50
3150.9	FORM RELEASING AGENT	1,709.22	SQFT	0.2095	C311	5,500.00	DAY	13.67376	0.31077	358.082	39.312	397.394
3210.901	RE-STEEL @ BEAMS W/SLAB	60.49	CWT	32.3636	C321	55	DAY	61.58737	1.09977	1,957.60	1,618.04	3,575.64
3311.1	**CONC IN BEAMS W/SLAB**		****									
3311.136	5000 PSI W/PUMP	30.24	CUYD	15.1196	C235	100	DAY	19.35603	0.30244	457.274	1,814.63	2,431.59
3315.985	* LENGTH OF BEAMS *	366	LNFT									
3350.131	POINT & PATCH	1,709.22	SQFT	0.1102	C276	7,500.00	DAY	7.29267	0.2279	188.356	21.878	210.234
									16.39773	19620.88	14443.32	34223.888

Beam Post-Tensioning

Item Code	Description	Quantity	UM	Crew	Production	Prod. UM	Total Hours	Duration	Labor Total	Material Total	Total Cost
3250.01	POST TENSIONING		****								
3250.051	BEAMS		****								
3250.052	GREASED STRANDS	7,686.00	LBS	C322	1,500.00	DAY	163.968	5.124	5,247.23	7,839.72	13,303.70