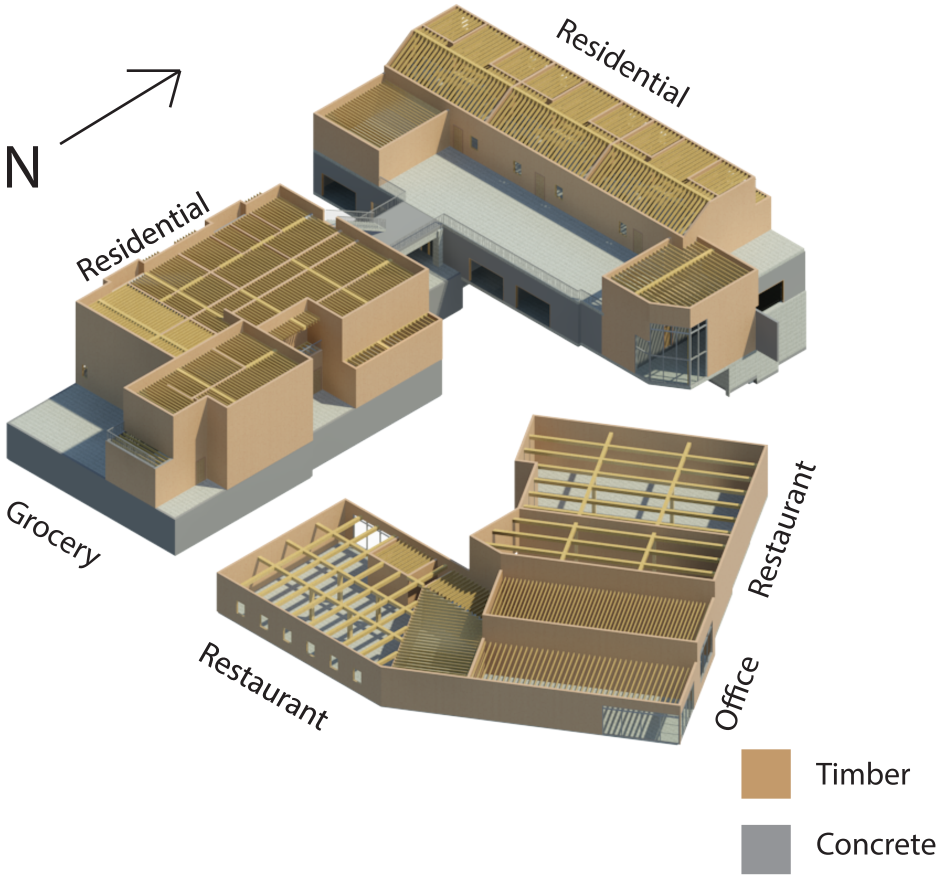
GRAVITY SYSTEM DESCRIPTION



The gravity framing system of the restaurants, Southeast building offices, and residential sections of the building site will consist of almost entirely timber framing.

The grocery, parking, and Northern building offices will consist of concrete construction due to span lengths and wall heights.

The floor system for the residential areas will consist of a thin layer of concrete sitting on plywood sheathing atop 11 3/4" TJIs that feed into bearing walls (Picture A). These deeper joists will allow for extra insulation to be placed inside the diaphragm and allow for added thermal and acoustic insulation between space uses.

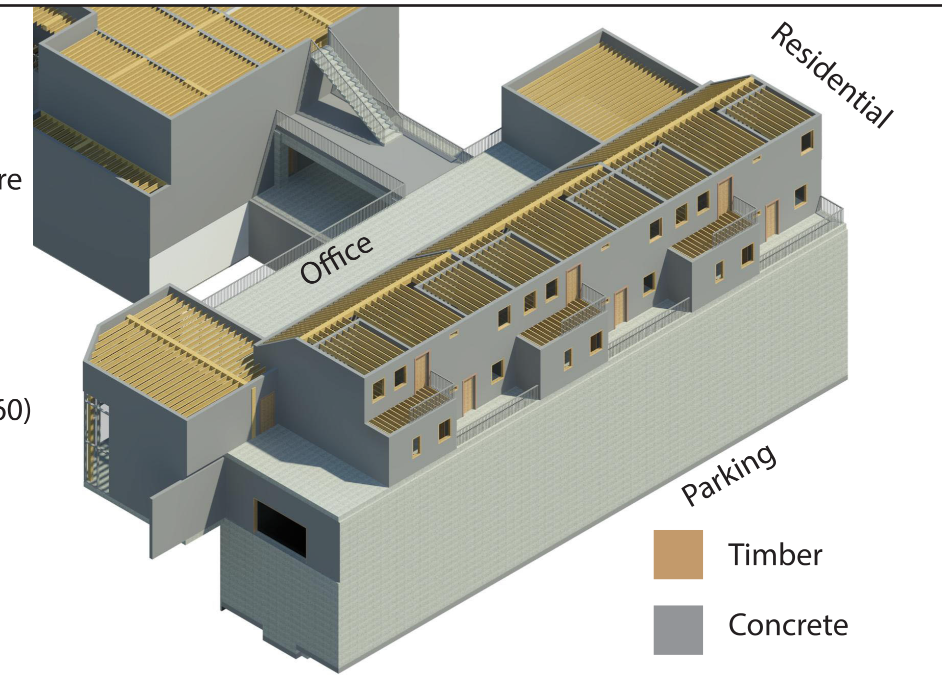
The roof system of the Western building will house multiple planters as well as solar panels. In order to support these additional weights a higher grade of TJI (360) will be required.

The roof system of the Northern Structure that houses the multi story residences above the parking garage will also be built up of engineered joists feeding into glulams that are carried down via timber bearing walls and columns to the structural two way slab that covers the parking and offices.

The roof system of the Southeast structure that houses the offices and restaurants consist of an exposed 2x6 plank system that is supported by glulam beams (Picture B). These beams feed into larger glulam girders that are held up by either columns or bearing walls.

The automated parking garage's gravity system will consist of cast in place concrete shear/bearng walls (Picture C) that support the two way slab above. Seeing as there is no human occupancy in the area, aesthetics were not as important as acoustic insulation and vibration prevention. Being that most of the bearing walls will be below grade to hide the automated parking, the walls will have to be relatively thick and thus will supply sufficient acoustic insulation to the sides.

The grocery's and parking's gravity system will consist of a two-way slab (Pictures D&E) in order to better resist the irregular bearing wall placements of the floors above.



(E) WWW.EVSTUDIO.COM

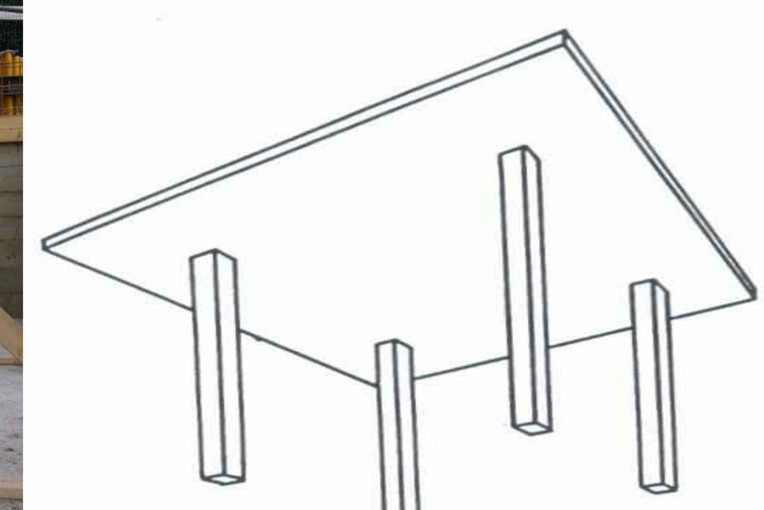
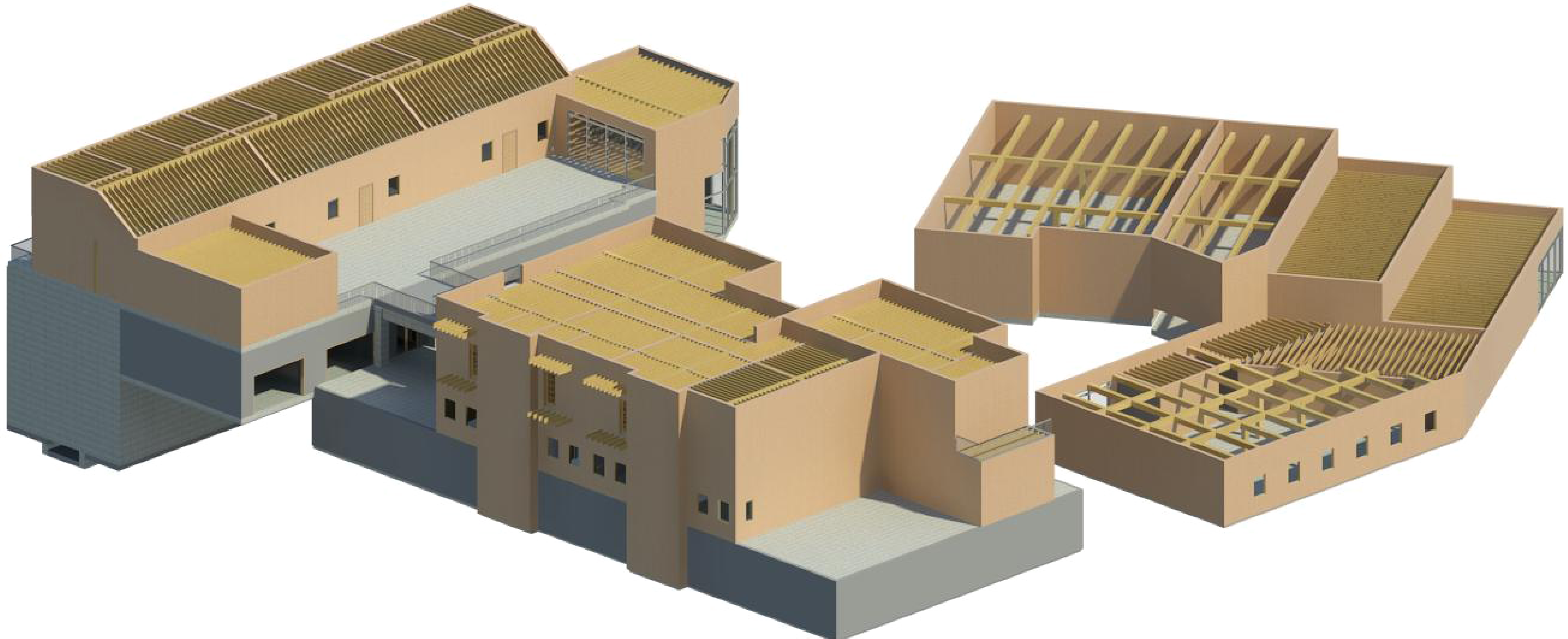


PHOTO SOURCES: (A) WWW.NACHI.ORG (B) WWW.APAWOOD.ORG (C) WWW.BASEMENTEXPO.CO.UK (D) WWW.STUDYBLUE.COM

LATERAL SYSTEM DESCRIPTION



TIMBER SHEAR WALLS

CONCRETE SHEAR WALLS

The lateral systems of the building site combines two different systems; concrete shear walls (Picture B), and timber shear walls (Picture A). The structures on the North and West borders of the site will feature a hybrid system of timber construction on the upper floors, and concrete into the lower floors. The Southeastern corner structure however will feature a solely timber shear wall system.

The timber shear wall lateral system will be made up of a diaphragm consisting of engineered joists, glulam beams for longer spans and collectors, and plywood sheathing. This is a typical wooden framed diaphragm system that will feature continuity ties and sufficient lateral connection hardware to create a complete load path to the timber shear walls. The residential units of the North and Western buildings will feature sufficient wall lengths to resist all found lateral forces. In the Northern building that features apartments with multiple levels, additional shear walls will be required to support the sub diaphragms created.

The Northern and Western Buildings will feature shear walls with plywood sheathing located primarily on the exterior of individual housing units to take advantage of the long straight walls void of openings. For interior walls separating living spaces there are thicker walls featuring two rows of 2x4's with a 3/4" airspace to provide an acoustic barrier. This means the shear walls will have sheathing on the exterior of both these rows. Once the lateral loads have been resisted by the timber shear walls, they need to be brought down to the ground. For the Northern and Western buildings the transition needs to be made into a concrete structural system. In order for this transition to happen the timber shear walls must be sufficiently attached to a two way slab (Picture C). This slab must be thick enough to take all of the forces from the above stories and transfer those into the concrete shear walls below.

For the Southeastern building the loads will be relatively light and the building will feature numerous walls that will be sufficient for resisting all the necessary forces. The main difference of this structure compared to the rest of the site is that roof diaphragm will be made up of plywood sheathing attached to 2x6 planks laid flat on glulams spanning the full roof.

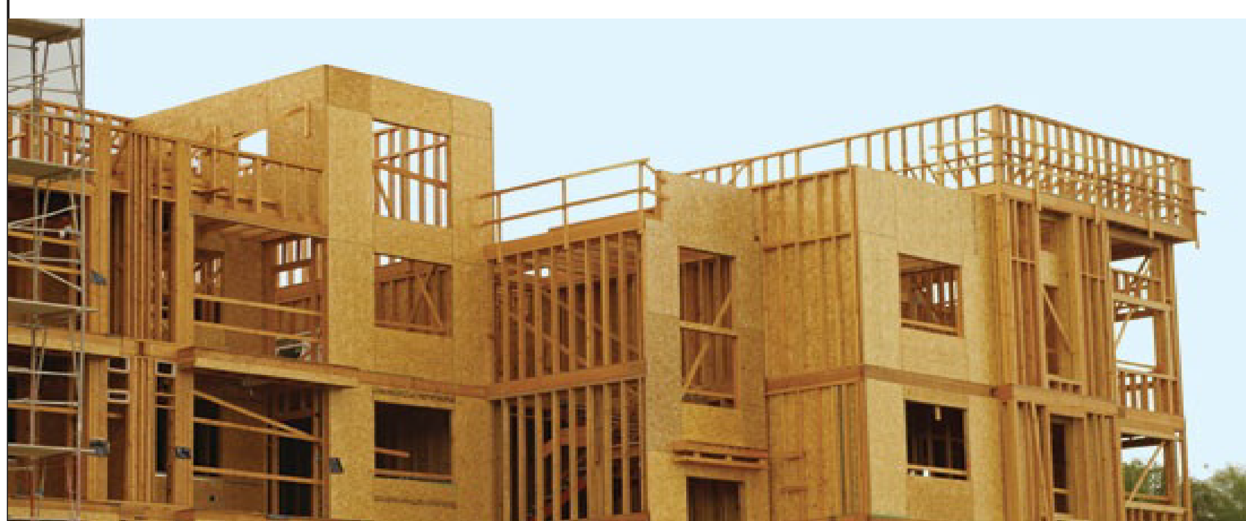


PHOTO SOURCES: (A) WWW.MCGRAWIMAGES.BUILDINGMEDIA.COM (B) WWW.IZOTEX.COM (C) WWW.EVSTUDIO.COM

FOUNDATION SYSTEM DESCRIPTION

The foundation system will be relatively challenging as there will be several height changes as well as structural material changes throughout the site.

Northern Building: The Northern Building will feature the most complicated foundation on the entire site. This structure will house the automated parking system about 2 stories below grade, several offices, and residences on the upper levels.

For the area that houses the parking structure that is the northern most part of the site, a specialized foundation system has been defined by the parking system manufacturer, Automotion. However, due to poor soil conditions, it is possible that the suggested foundation dimensions will need to be overhauled and redesigned to span a wider area and possibly deeper. Being that this foundation steps so far down from the adjacent foundation, a step foundation will have to be installed to prevent differential settlement problems.

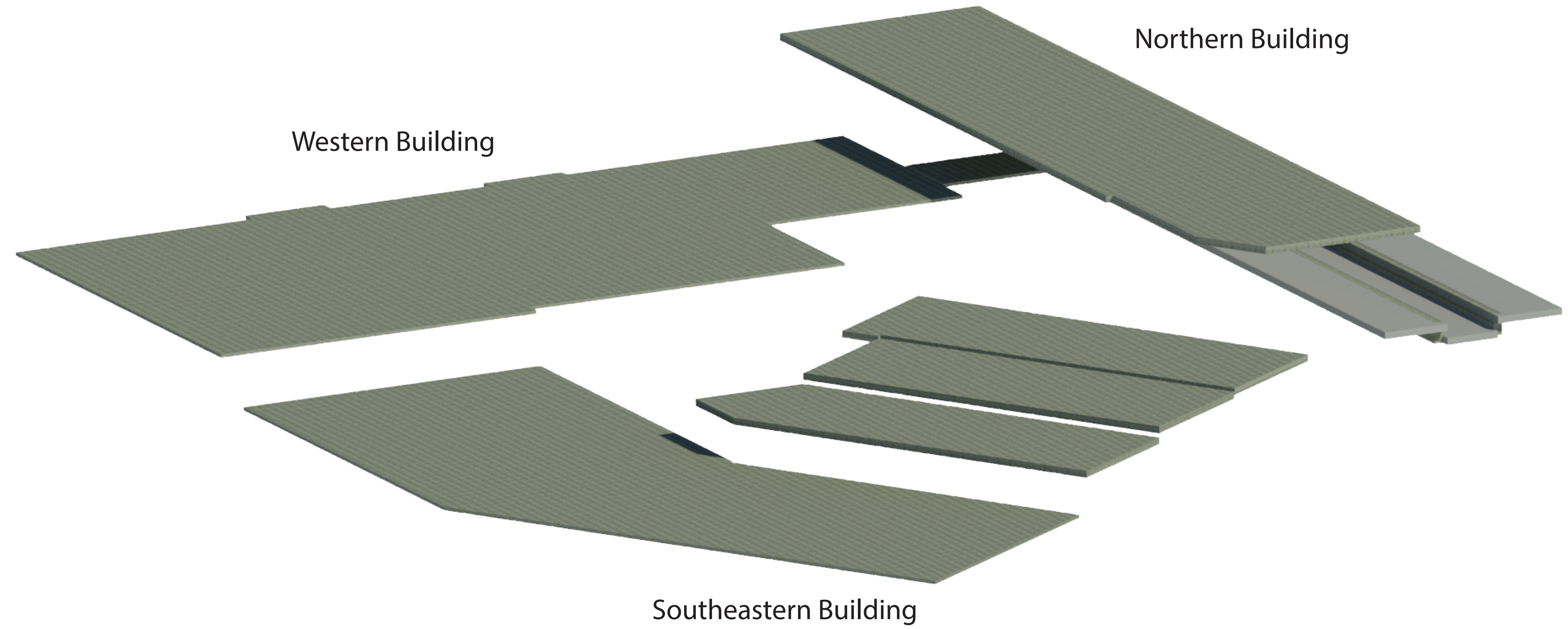
Another provision that will be taken is the mat foundation for the southern half of the Northern Building will have to be connected to the retaining wall of the parking structure in order to prevent any sort of pounding damage that may occur.

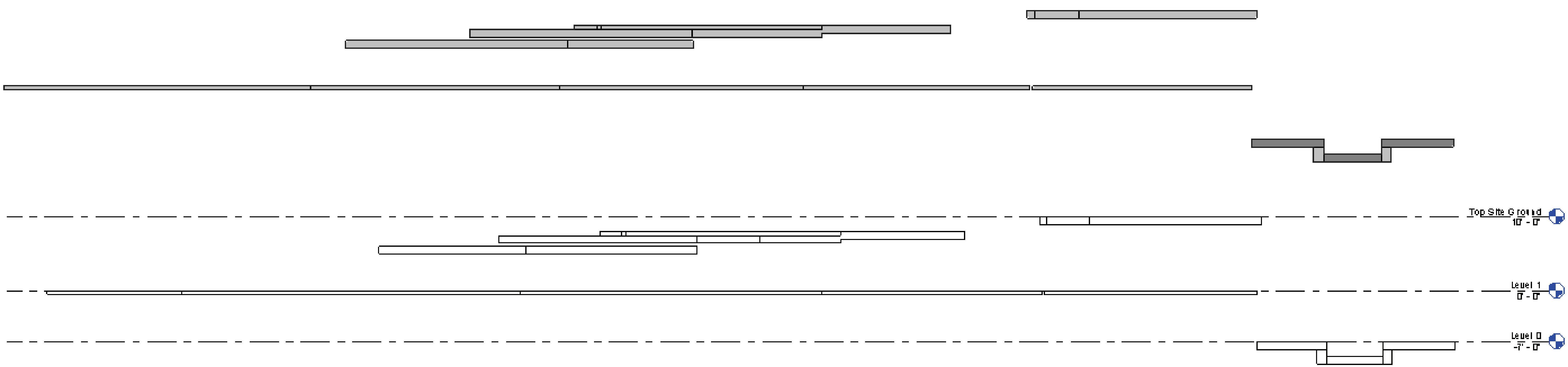
Western Building

The Western Building will utilize a simple mat foundation. The mat will not change heights and will be 16" thick and will be the simplest of the three.

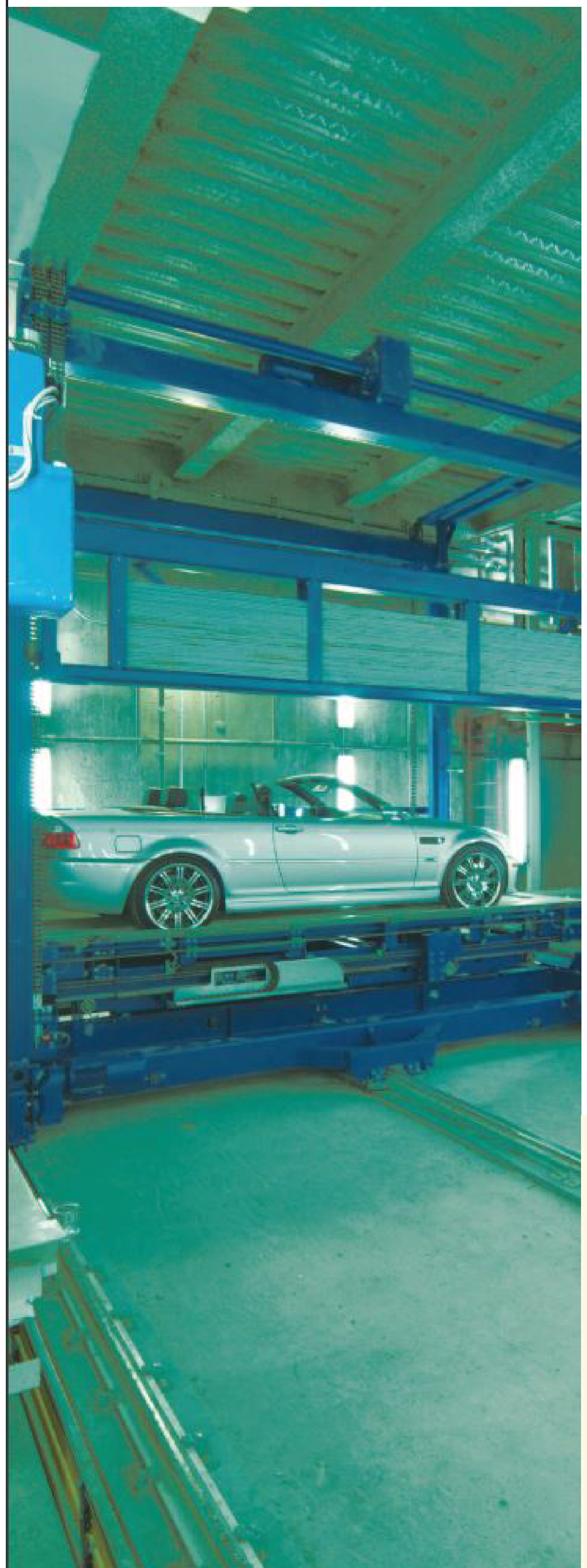
Southeastern Building

The Southeastern Building will also be a mat foundation but will step up at different sections of the structure. The further North the building is, the higher the foundation goes to better match the slope of the site. However, each of the seperate foundations will be 12"





PARKING SYSTEM DESCRIPTION

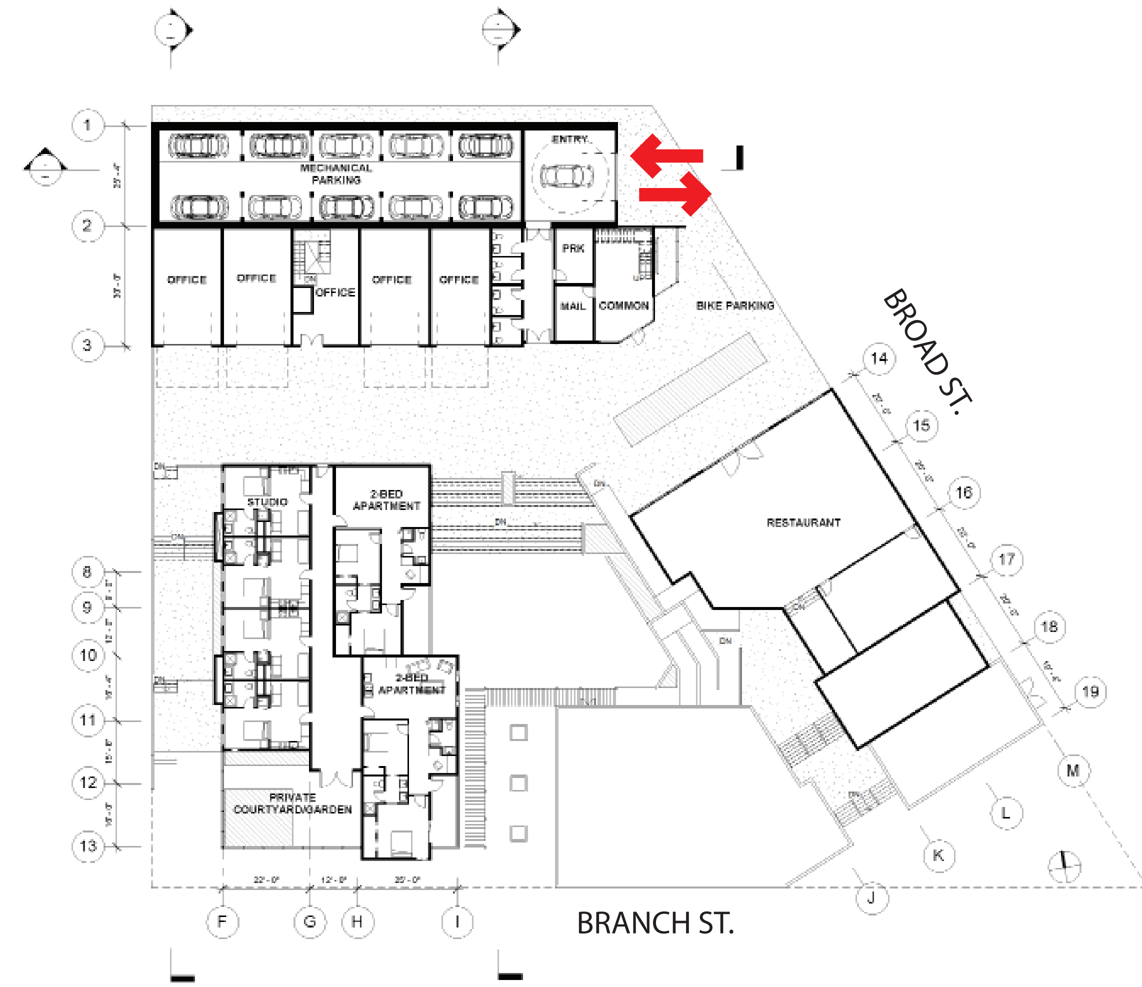


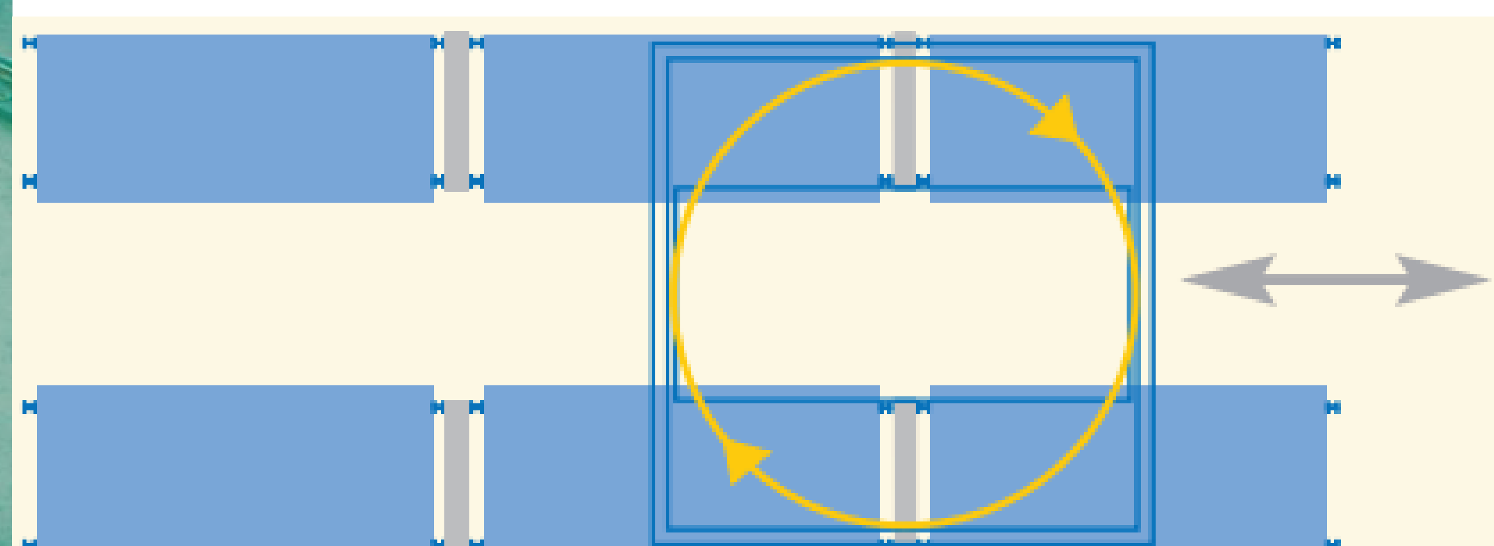
The system: The automated parking system for the site will utilize the LPM Parking System by Automotion Parking (TM). This system utilizes 3 below grade rows (Picture C) and 1 above grade row to house and store 48 cars safely and out of sight.

How the system works: Patrons will drive onto the on ramp from Broad St. into an entry area. When prompted, they will drive into the car receptacle, remove all necessary items and walk out. Once activated, the car will rotate 180 degrees (Picture B) and the platform is lowered into the storage area. The car will be transferred onto a center track system which will find an empty space and slide the car into that space. When the car is needed again, the patron will activate the system to retrieve the car. The platform is then picked up again by the center track system and lifted back up into the car receptacle.

How it will be supported: The system will be encased in a reinforced concrete structure. This system will not only fully support the impeding horizontal forces from the soil on both sides, but will assist in preventing vibration and noise pollution into the adjacent buildings. The actual parking system will need to be supported by a mat foundation as specified by the manufacturer Automotion. Due to poor soil conditions a mat foundation with additional support may be required.

Features of the system:
Single entry access point
Mostly below grade
saves space
Hides unslightly system and allows for architectural facade.
48 Spaces





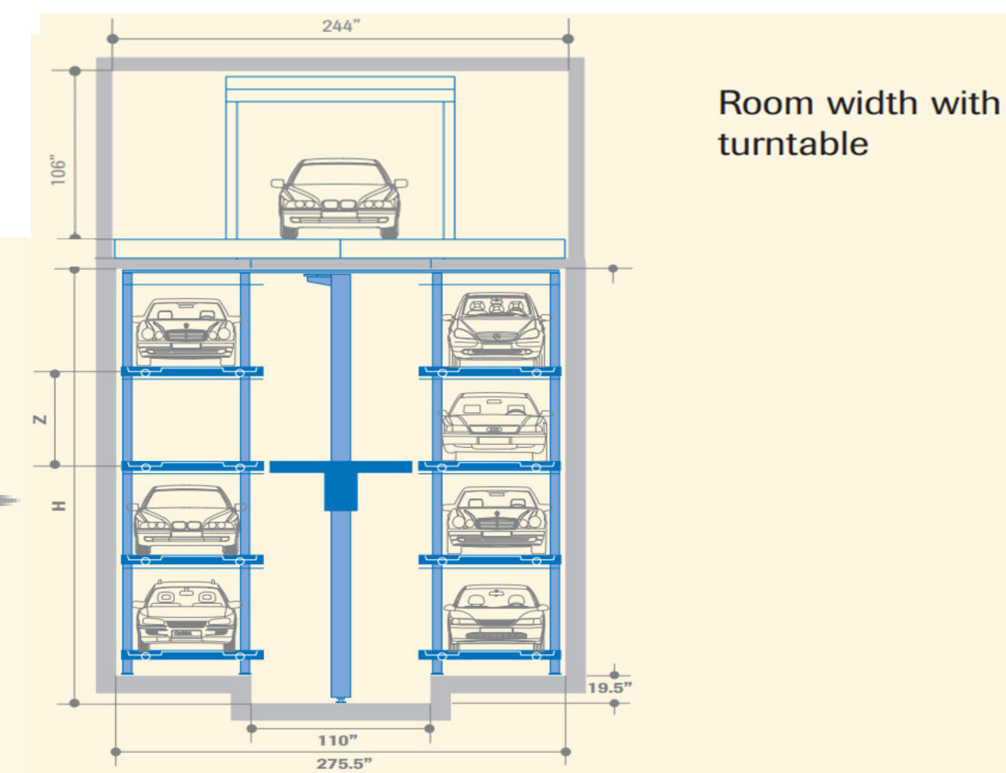


PHOTO SOURCES: (A) WWW.AUTOMOTIONPARKING.COM (B) (C)

GRAVITY SYSTEM SELECTION

The selection of the gravity system is the result of a collaboration of many different facets and considerations that have guided the project.

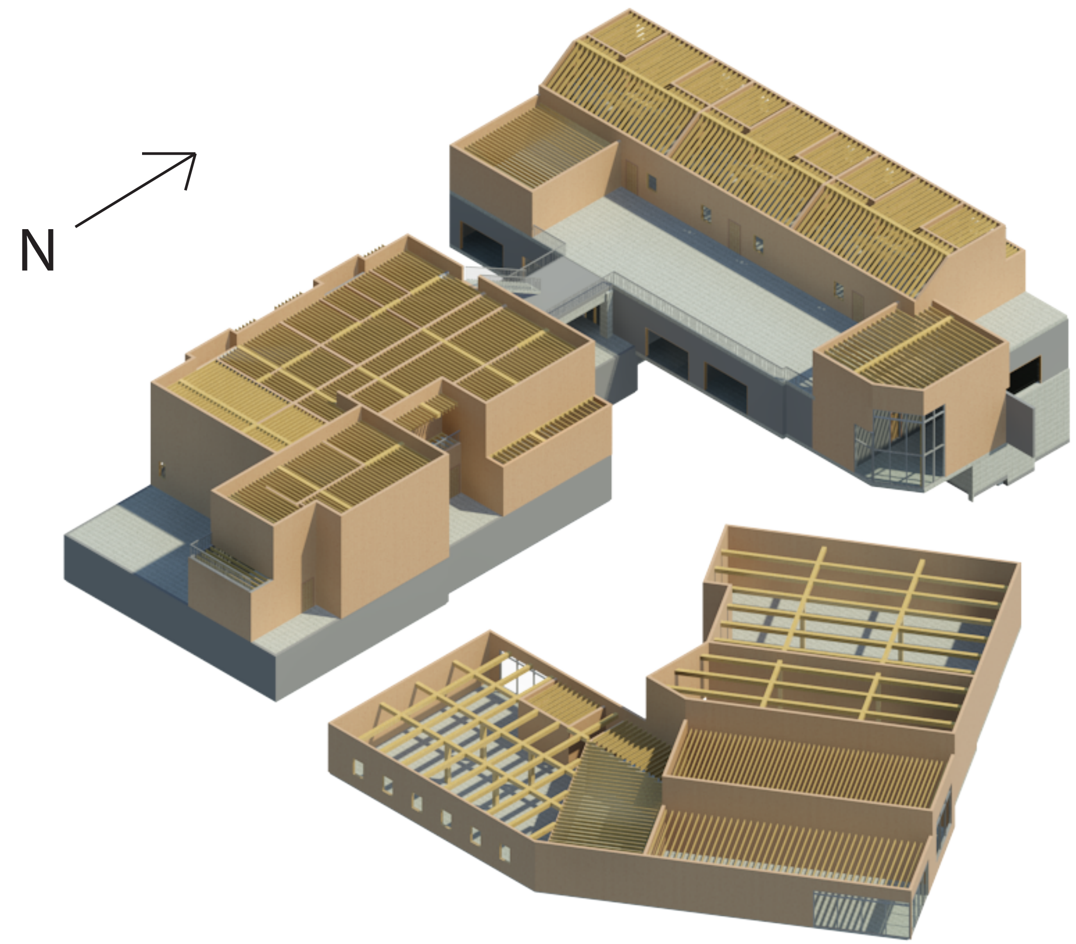
Building Program

Of these deciding factors none is more important than the bulding program. The goal of the site is to create a mixed use collaborative live, work, shop, and dine complex that will cater to the Railroad District of San Luis Obispo. In doing so the building materials should reflect it's goals as well as it's surroundings.
The layout of the different building uses have guided the materials used for the structures. For the residential areas the shorter building spans allow for timber framing to be used as the numerous intermediate walls will supply sufficient support. For the grocery store in the Western building, higher ceilings and longer spans will require a different building material than timber, therefore a concrete two way slab will be used to meet these requirements.
The concrete slabs that encompass the parking structure serve as not only flooring

Aesthetics

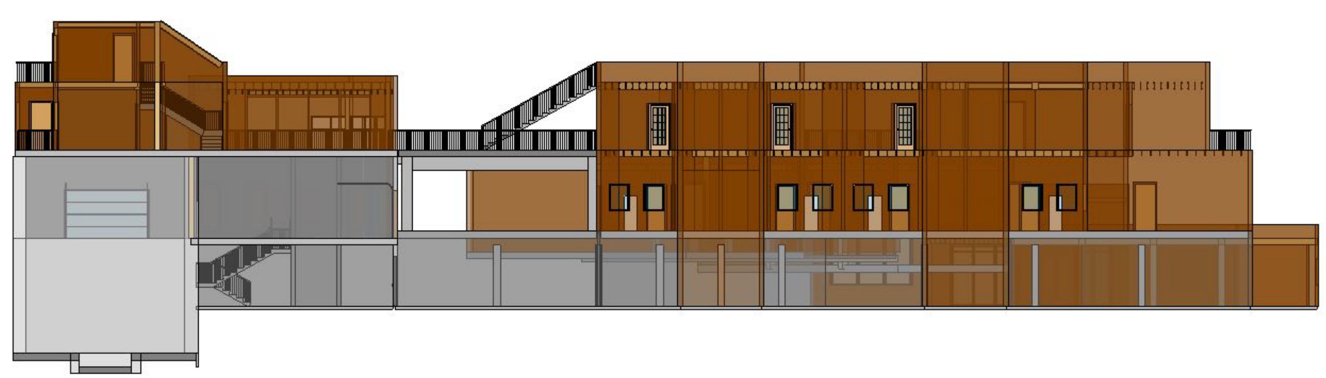
For the Southeastern building the architect has requested an exposed timber ceiling that will employ an industrial aesthetic. Because of this a plank and beam system will be used. The rest of the site will utilize designed wall and ceiling coverings such as gypsum board.
The flat concrete slab over the Northern Building offices and the grocery will allow for a consistently higher floor to ceiling height which is considered to be more aesthetically pleasing.

Fire Resistance
When there are many different building occupancies adjoined together, proper fire resistance will be required. For primary fire protection of the structural components, the entire building will utilize a sprinkler system. This will allow for lower hour partitions to be required for the structure.
All flooring systems in the multi story buildings will feature at least a thin layer of non combustible concrete which will assist in preventing the spreading of fire from floor to floor.



Timber

Concrete



Sustainability

Timber framing has become more and more sustainable with the introduction of engineered lumber. The use of TJI's means the wood being used will be more strcucturally efficient than typical dimensional lumber. Trussjoist also manufactures many different grades of TJI that will allow for different strengths to be used for similar sized members. The concrete two way slabs use significantly less formwork and will therefore use less resources to construct than a typical beam and slab system.

Constructibility

A driving concern of any project is how well and efficient and cheap the actual project will actually be built. Some of the benefits of having a concrete and timber hybrid sight is that there are only 2 professions need to be hired to build the complex, and they can be building in tandem. The concrete workers can come in first to lay the foundations and retaining walls for the parking system. Then, while the parking system is installed the foundations can be laid for the rest of the site.
The surrounding neighborhood will be a tight fit for most construction equipment so having the individual material contractors work one at a time will be necessary, and this design inhibits this.

Cost

An additional benefit to timber construction is also that it is significantly cheaper than a full concrete or steel construction building. Engineered lumber proves to be a great way to get the most strength for the amount of money used.
The concrete two way slabs may use more concrete than its beam and girder counterpart, but the form work needed for the construction costs so much less that it is actually a cheaper solution.

Summary
A hybrid timber and concrete structure will best meet the building program. This system gives the architect a lot of freedom to create an ever developing design before construction begins with sufficient flexibility.

LATERAL SYSTEM SELECTION

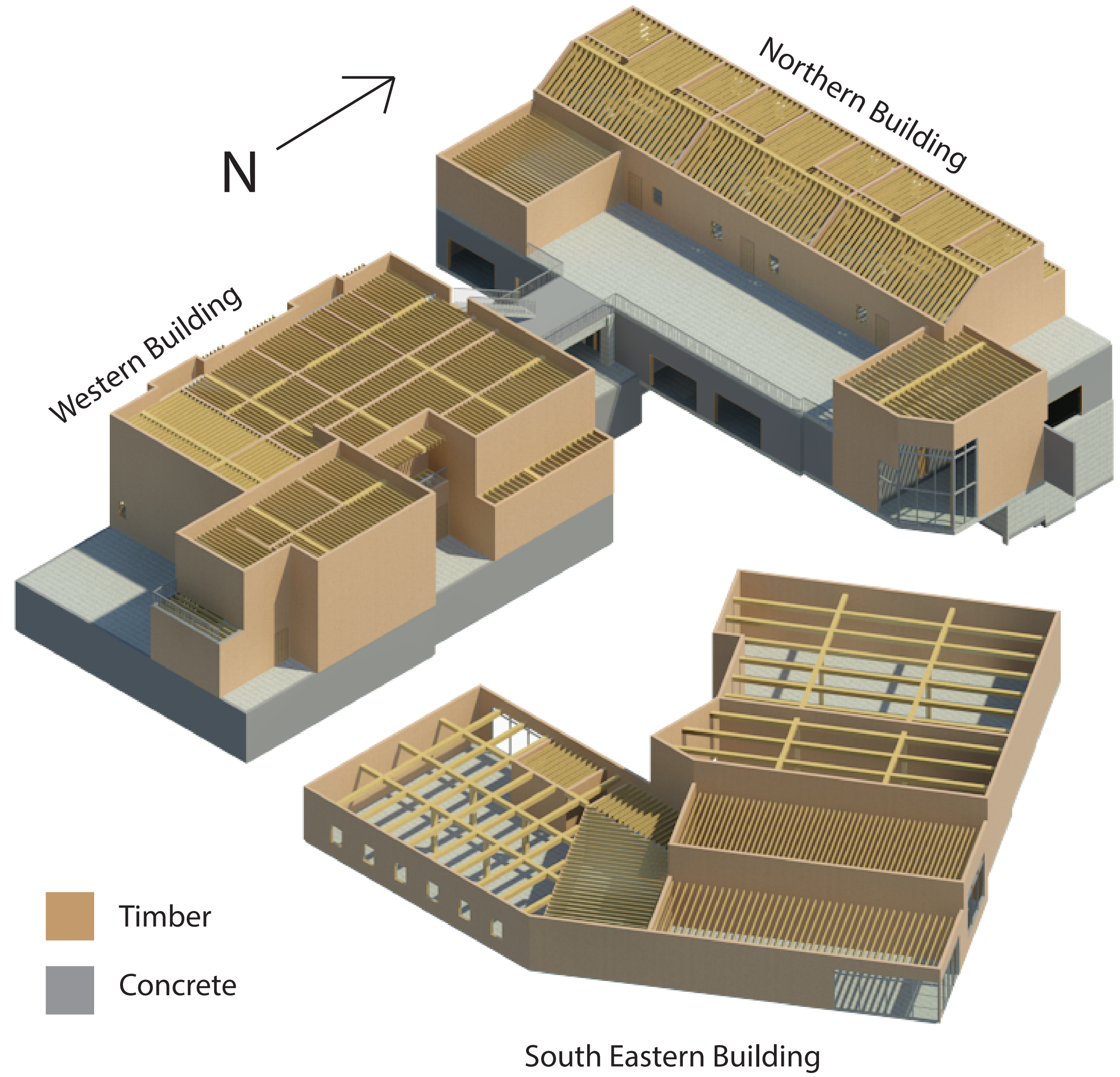
When selecting the lateral system of a structure the most prominent deciding factor of which system to use is the building material itself.

Building Program

The building program works in favor of a timber concrete hybrid system very greatly. The lower levels of the Northern and Western Buildings will supply more than enough exterior walls to meet the lateral requirements of the site. Only 10' of concrete walls are needed for the Western Building and only 15' of concrete shear walls are required for the Northern Building. This will allow the architect more flexibility in wall placement when a final design iteration will occur.
As for the timber shear wall residential areas in the multi story buildings, as well as the Southeastern Builings, many partition walls will be supplied to provide nearly double the necessary wall lengths. Again, because of this, wall openings will have more flexibility while the desgin develops.

Seismic Performance

According to ASCE-7-10 the buildings on this site have certain requirements when the site is of seismic design category D. Being that the desired height is 42' the seismic force-resisting system have to be checked for code compliance. Being that timber shear walls under seismic codesign category D can only reach 65', the timber shear wall system is more than sufficient. The concrete shear wall system is required to be made of special reinforced concrete shear walls as no other concrete walls will meet ASCE 7-10 Table 12.2-1 compliance.



Compatibility with Gravity System

For the majority of the building that is of timber construction the clear choice is to have the lateral force resisting system consist of timber shear walls. Seeing as the floor to floor heights are fairly typical and not 20 to 30 feet high, utilizing heavy timber framing with braced frames would be an unnecssarily costly method.
However, timber shear walls will not satisfy the entirety of the site as the two areas that a concrete two way slab will make up the gravity system for will require stronger support in that of concrete shear walls.

Cost

Shear walls are considered one of the the cheaper options when it comes to choosing between braced frames and moment frames. Being that braced frames and moment frames are not able to be built of timber and adding another material to the roject would lead to more issues, timber shear walls would be the correct choice.
For the concrete lateral system, shear walls are a better choice than moment frames due to how much cheaper it would be as well as sufficient lengths of exterior walls.

Summary

The lateral force resisting systems should be made entirely of shear walls due to the building program supplying sufficient wall lengths in every direction needed to be a code compliant lateral system.

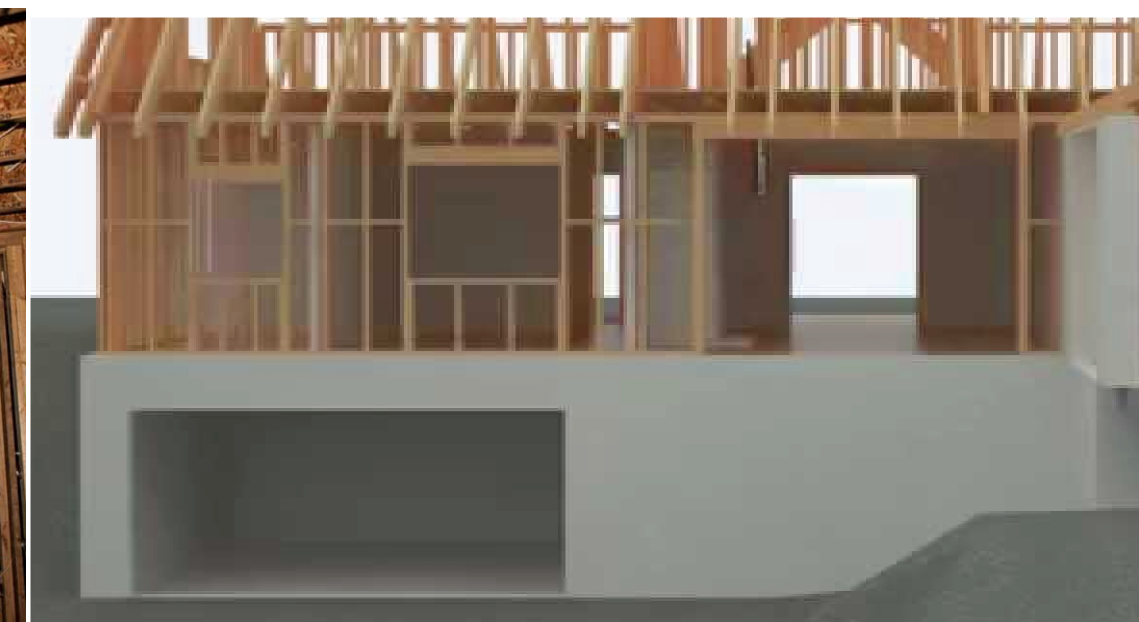
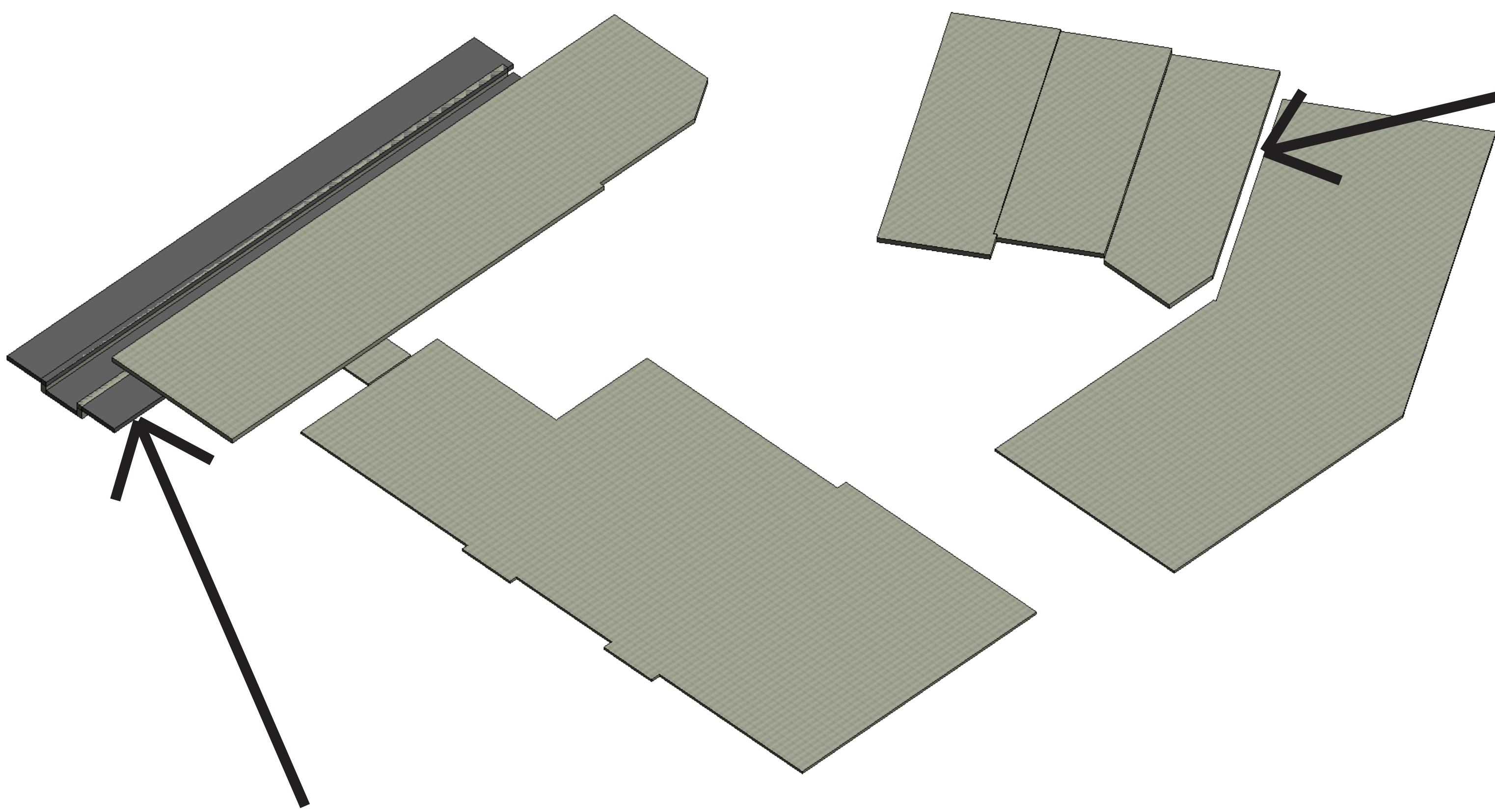


PHOTO SOURCES: WWW.MCGRAWIMAGES.BUILDINGMEDIA.COM (A) WWW.CONSTRUCTIONCANADA.NET (B) WWW.I.YTIMG.COM (C)

FOUNDATION SYSTEM SELECTION



Primary Foundation
The primary foundation system of the site will be a mat foundation. The reason for this is mainly to compensate for the poor soil conditions. The site is made up of a very expansive clay which would require significant soil replacement to require a less excessive foundation system.

Parking Foundation
The foundation for the automated parking system is a customized mat footing that will conform to Automotion's specifications. In addition, a step foundation (Picture A) will be necessary to connect the the very deep foundation to the surface. Due to such an excessive dramatic drop in height, diagonal and straight braces will be needed to be placed in between the sides of the excavation during construction

Excavation

The site will require a lot of soil to be excavated, and most likely with further calculations new soil will need to be replaced to improve bearing capacity. The site sits on incredibly expansive soil with a high water table running through it so a mat foundation is a great way to assist with preventing of differential settlements.

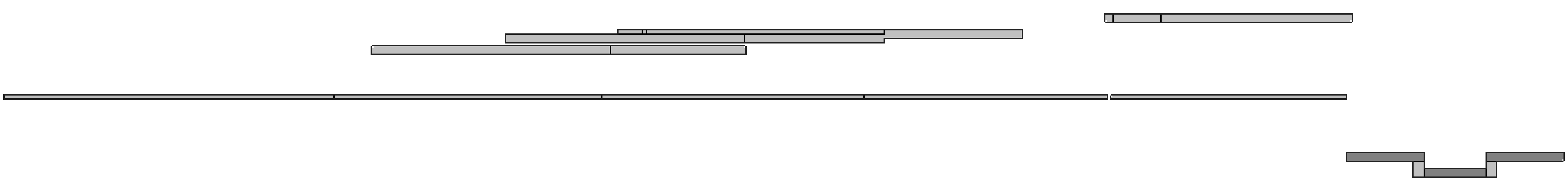
The excavation for the Northern building will require a pile and lagging temporary retaining wall in order to take out 20+ feet of soil from such a narrow area. A similar excavation would probably also be required for the northern half of the Western Building.

Environment

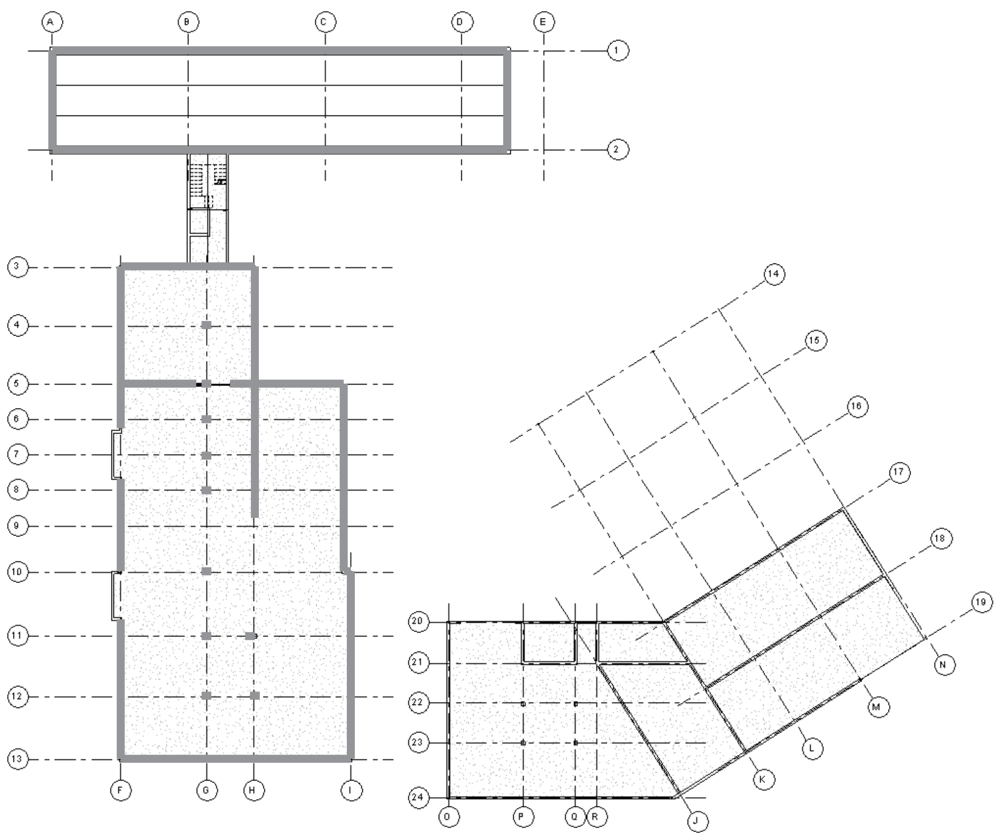
The site is located in a very quiet residential/retail area. The intrduction of a deep foundation system will most likely cause a lot of noise, vibration, and utilize large, noisy machinery that would disturb the neighbors. In order to prevent these disturbances that would cause locals to contest the construction of the complex, which would also hurt the architect's bid to push the height limit of the site.

Summary

A mat foundation will be used for the entirety of the site due to pour soil conditions. However, the parking structure will require a specialized foundation to support the automated parking that is at the specs of manufacturer.



GRAVITY SYSTEM CONFIGURATION



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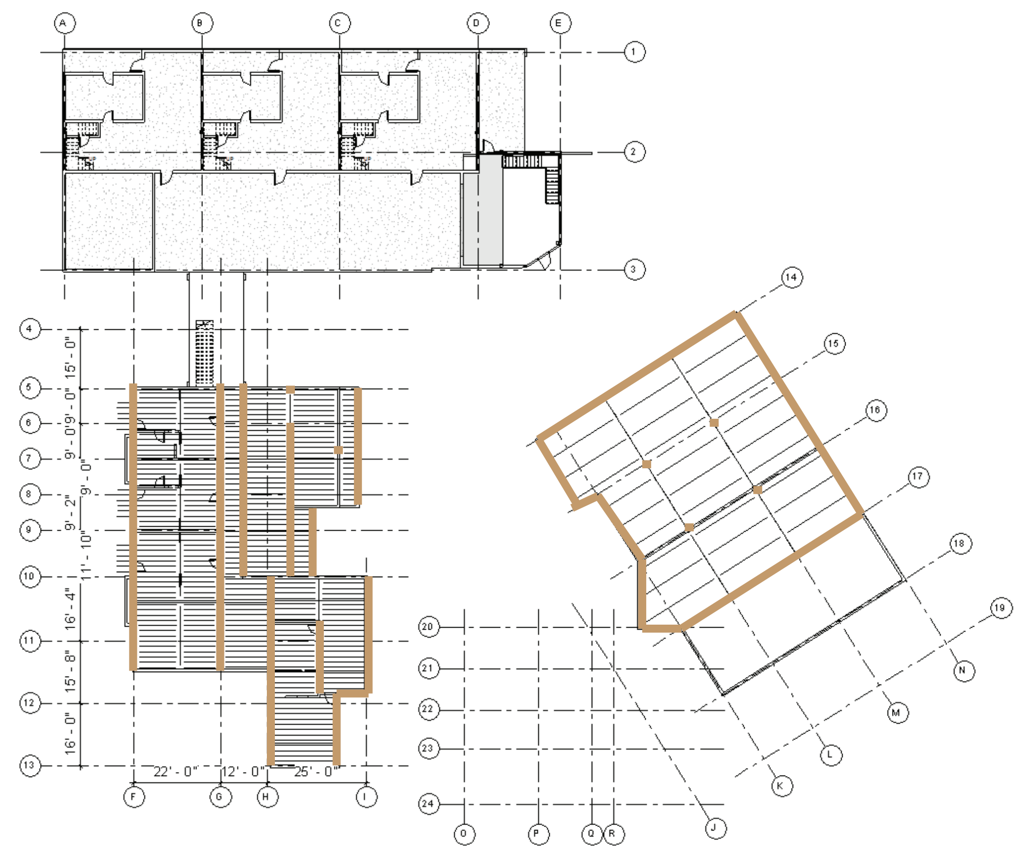

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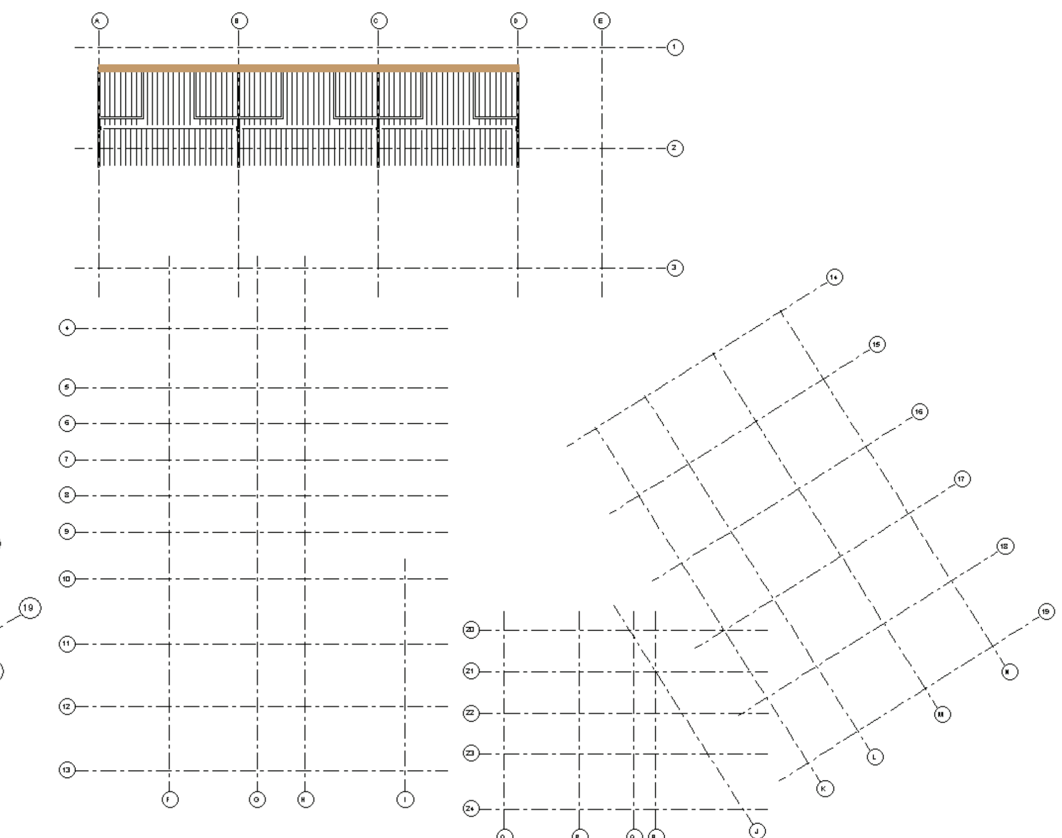
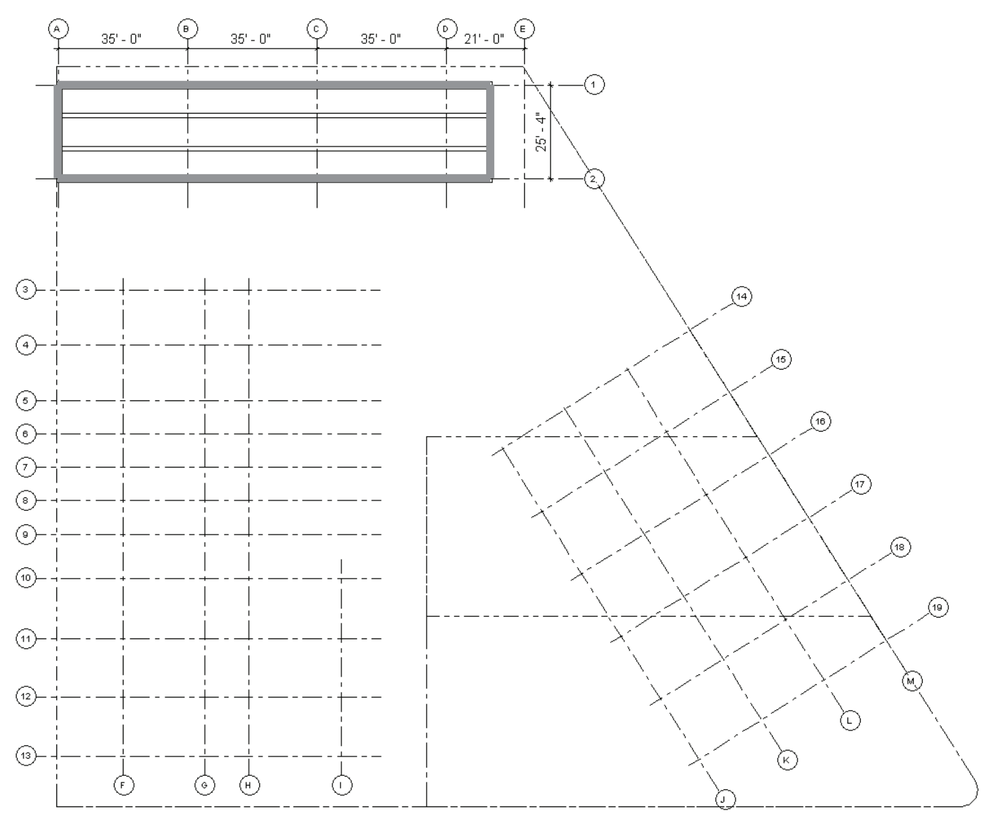


Height Limit

- Timber Bearing Wall
- Concrete Bearing Wall
- Concrete Column
- Timber Column



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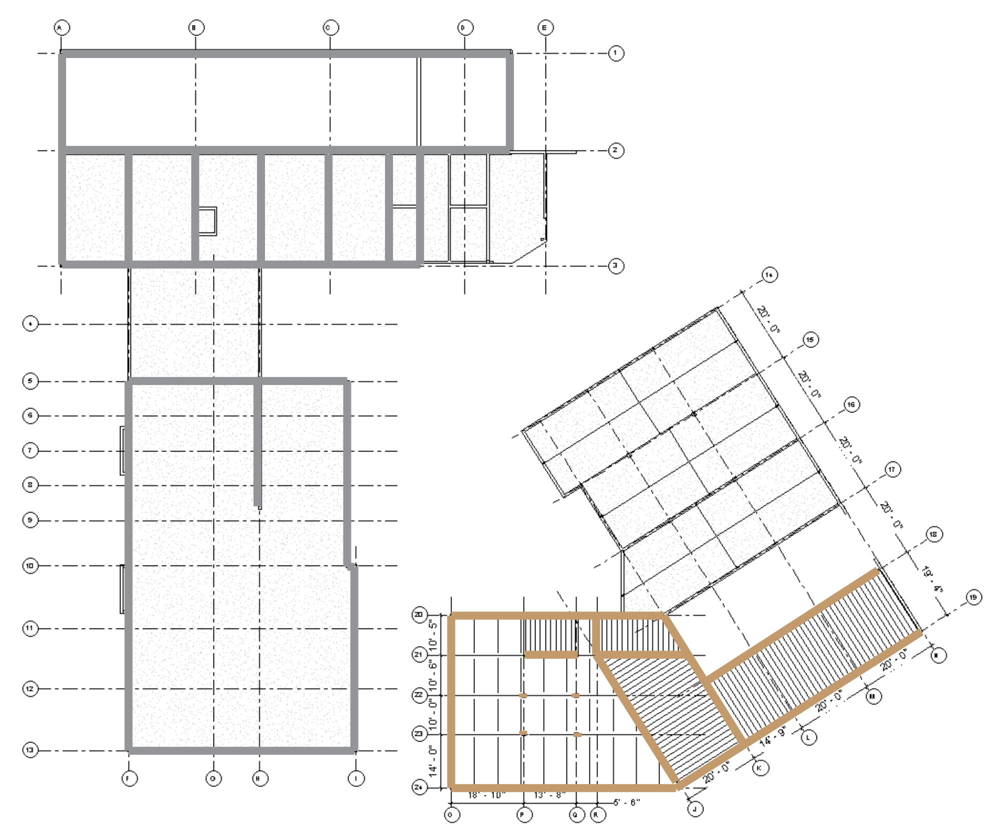
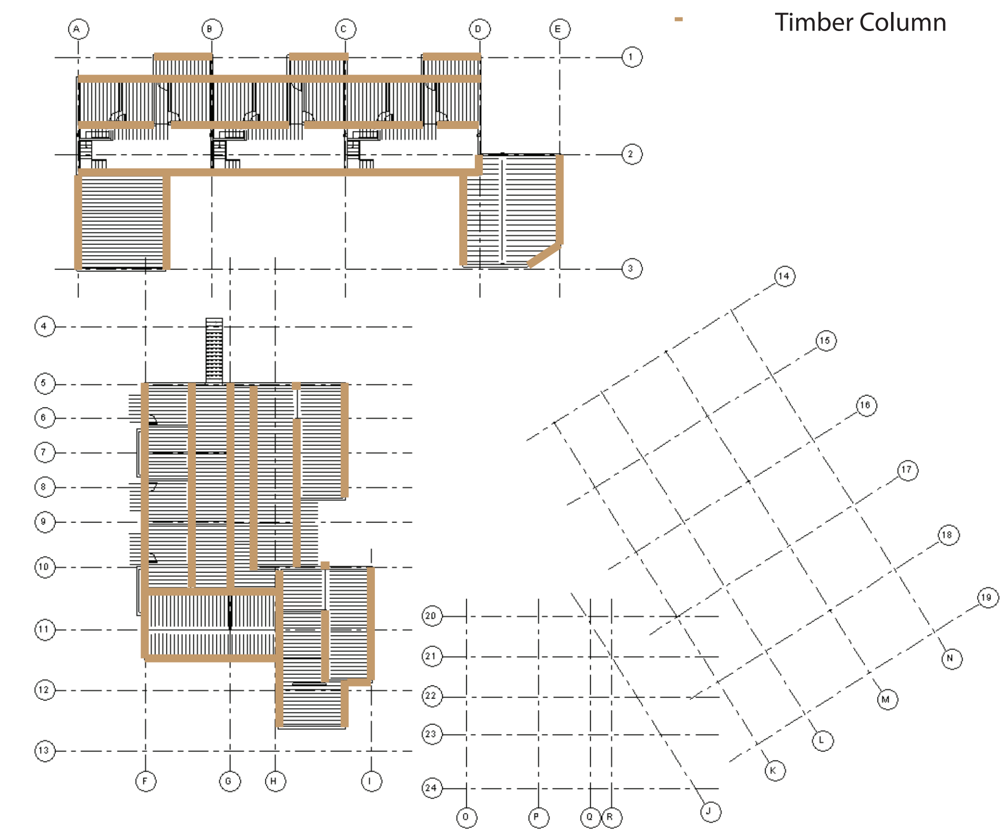
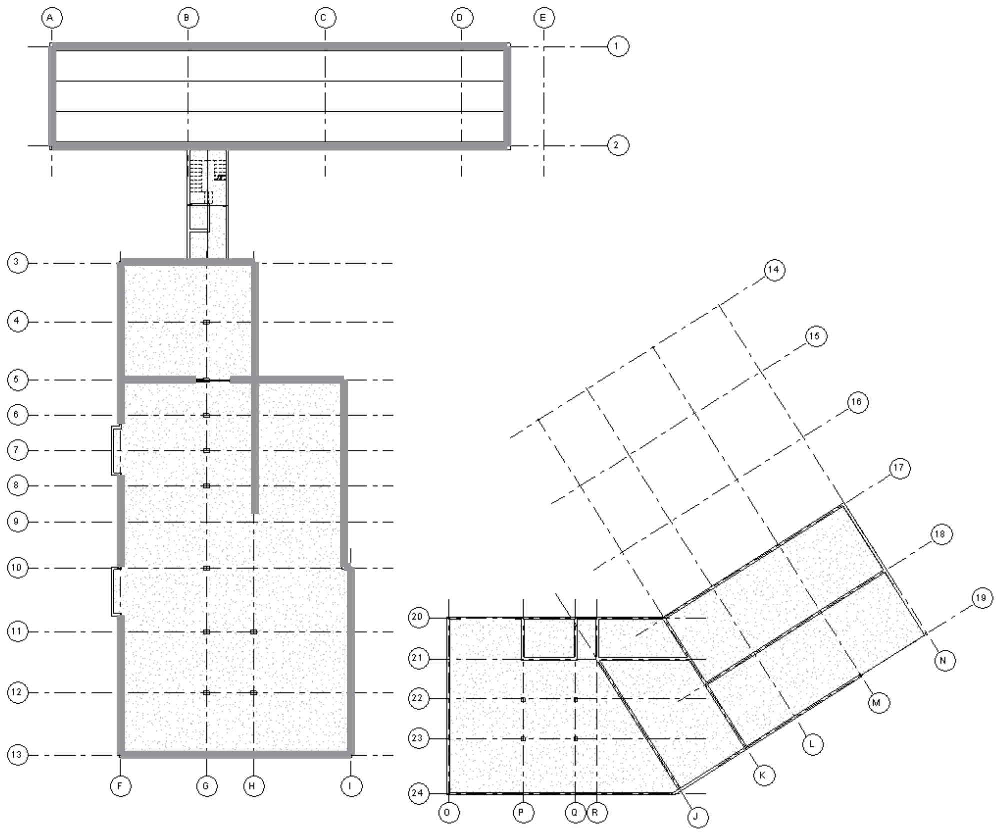


Level 2



Level 4

LATERAL SYSTEM CONFIGURATION



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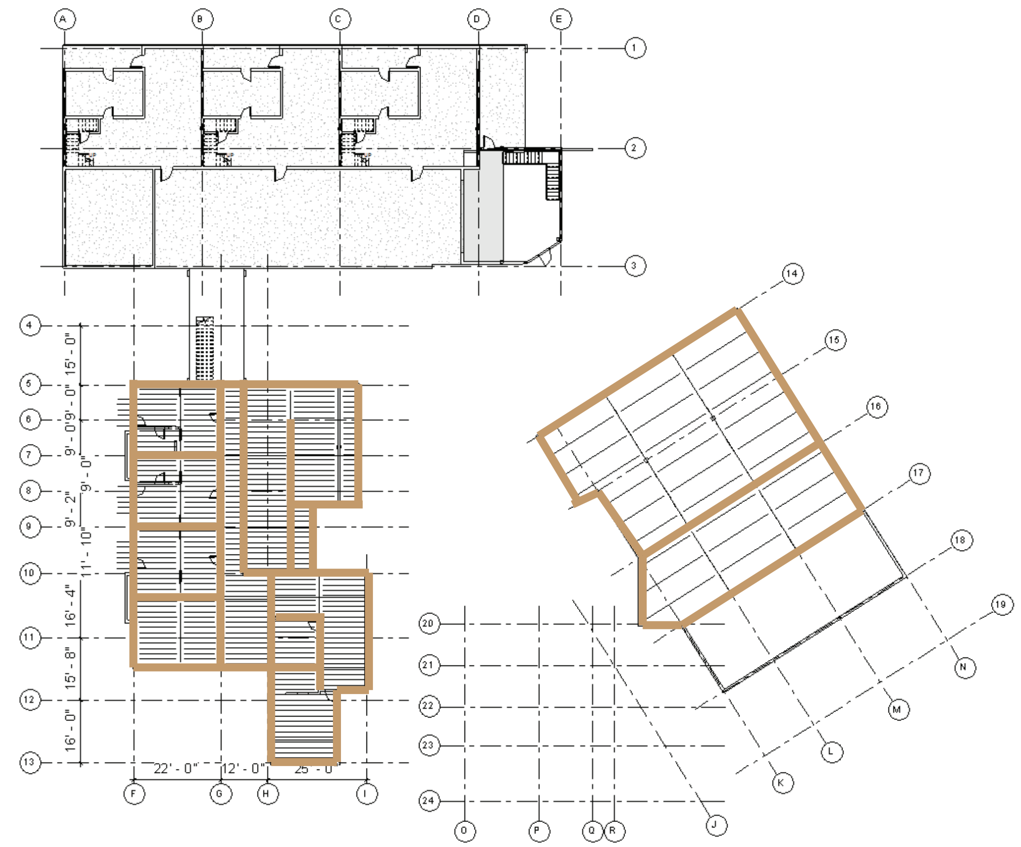

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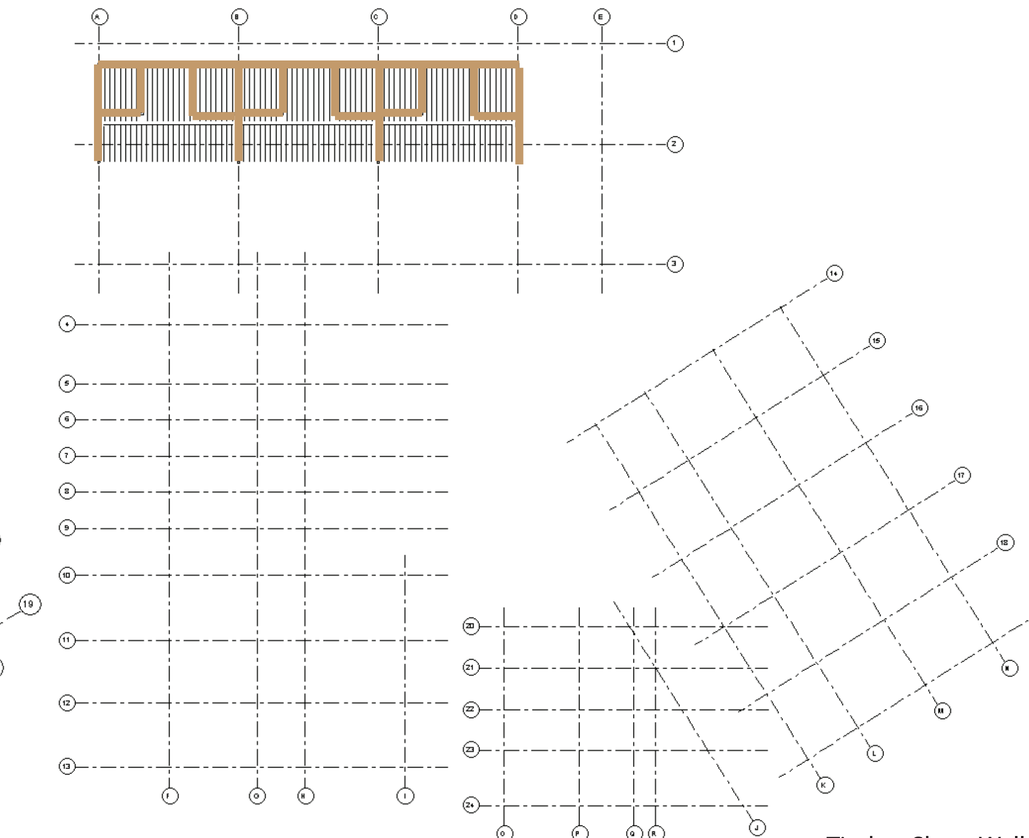
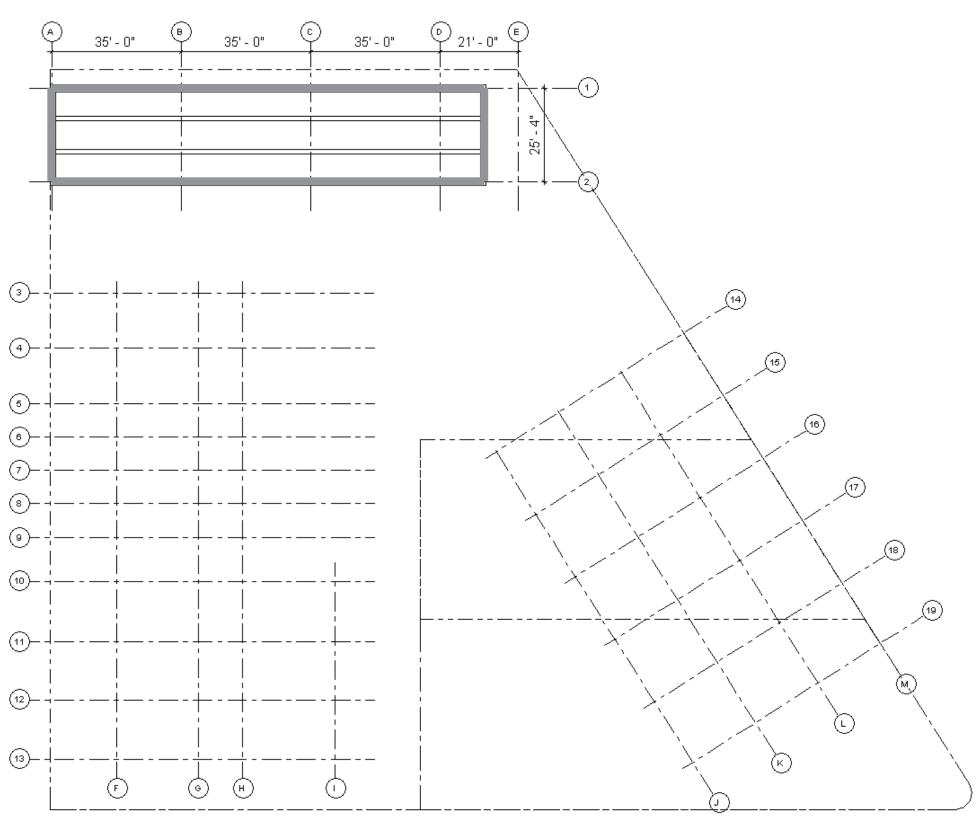


Height Limit

Timber Shear Wall

Concrete Shear Wall

Disclaimer: Due to unfinished design, the lines on these diagrams simply state where the shear walls can be placed, after wall openings are designed.



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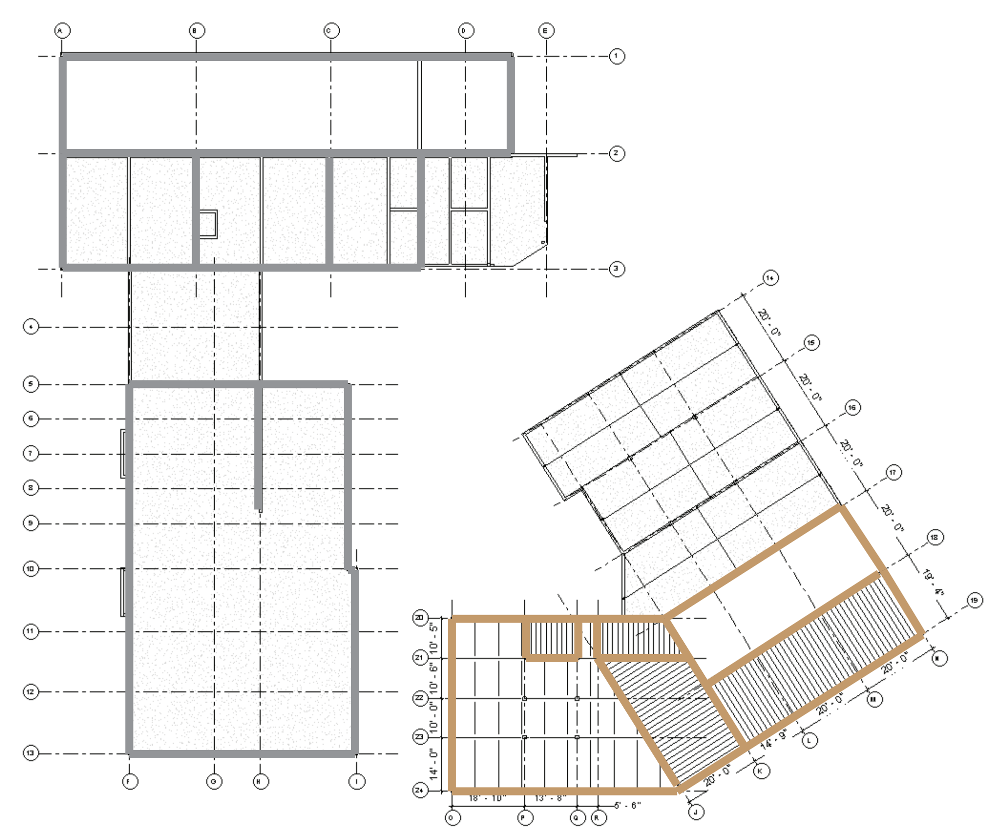

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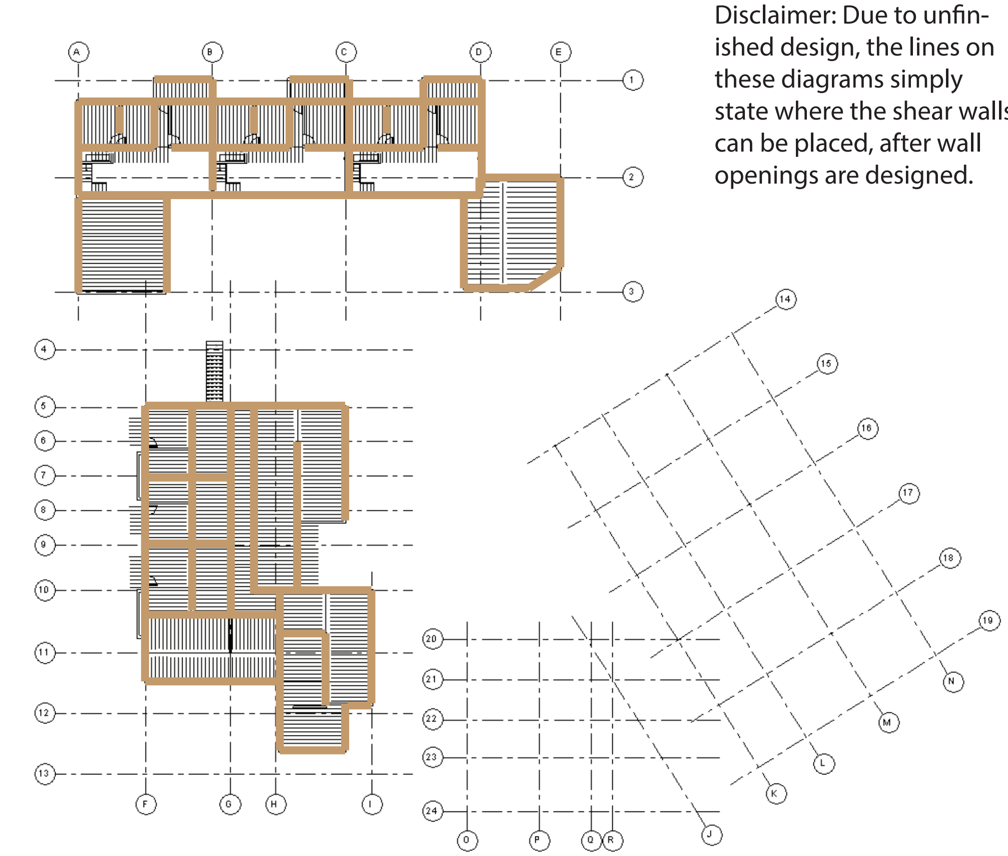
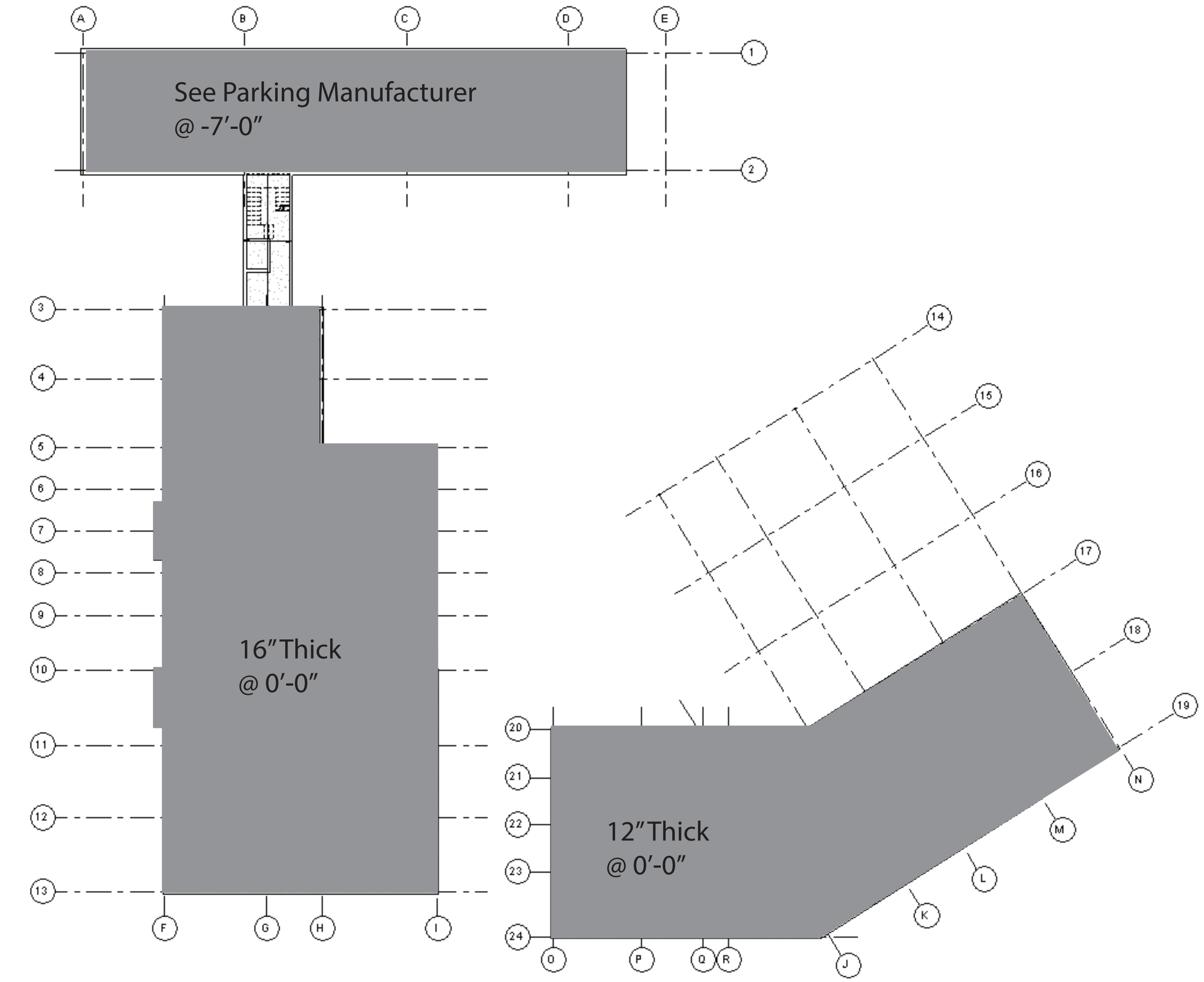
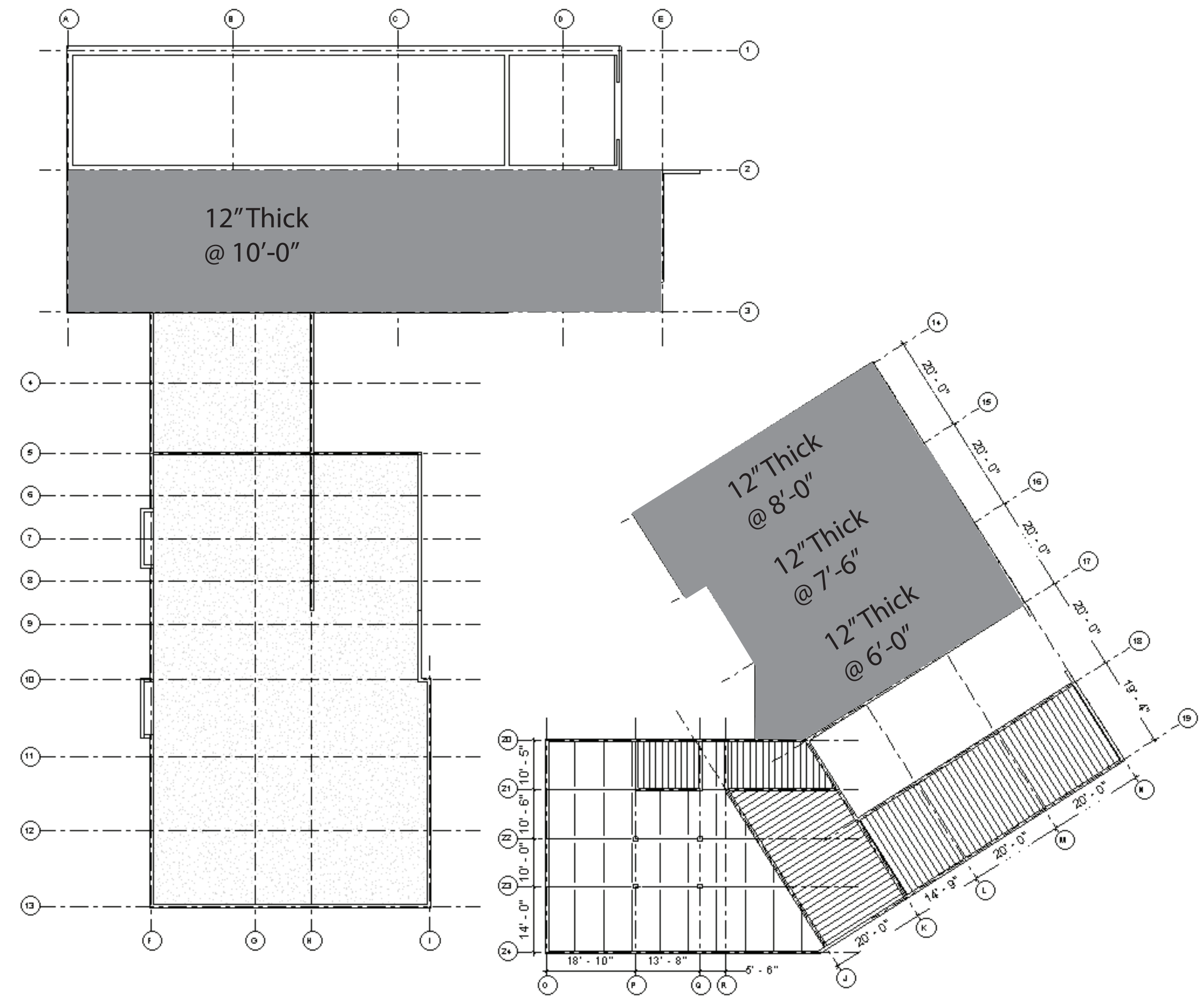
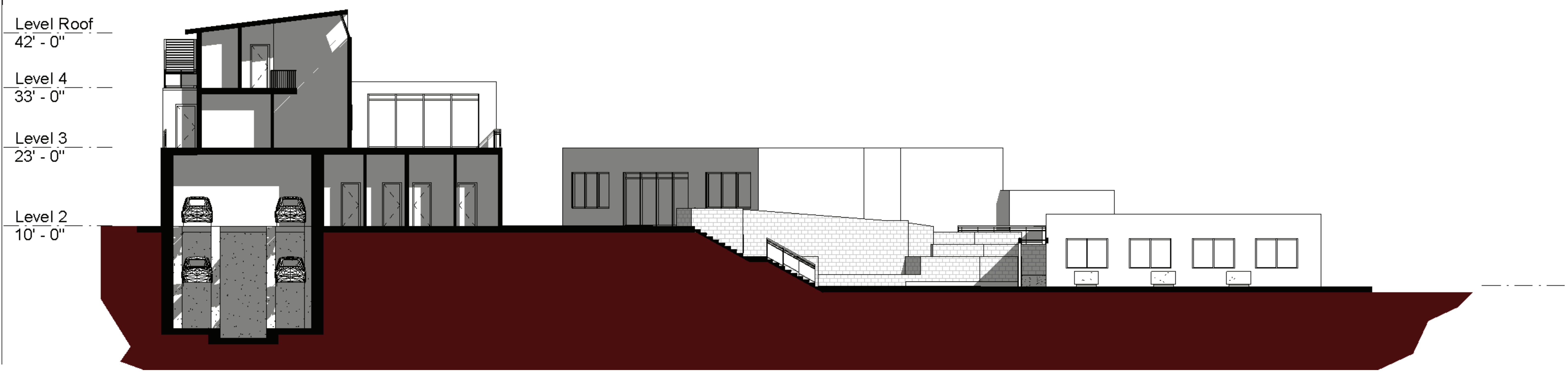


Level 4

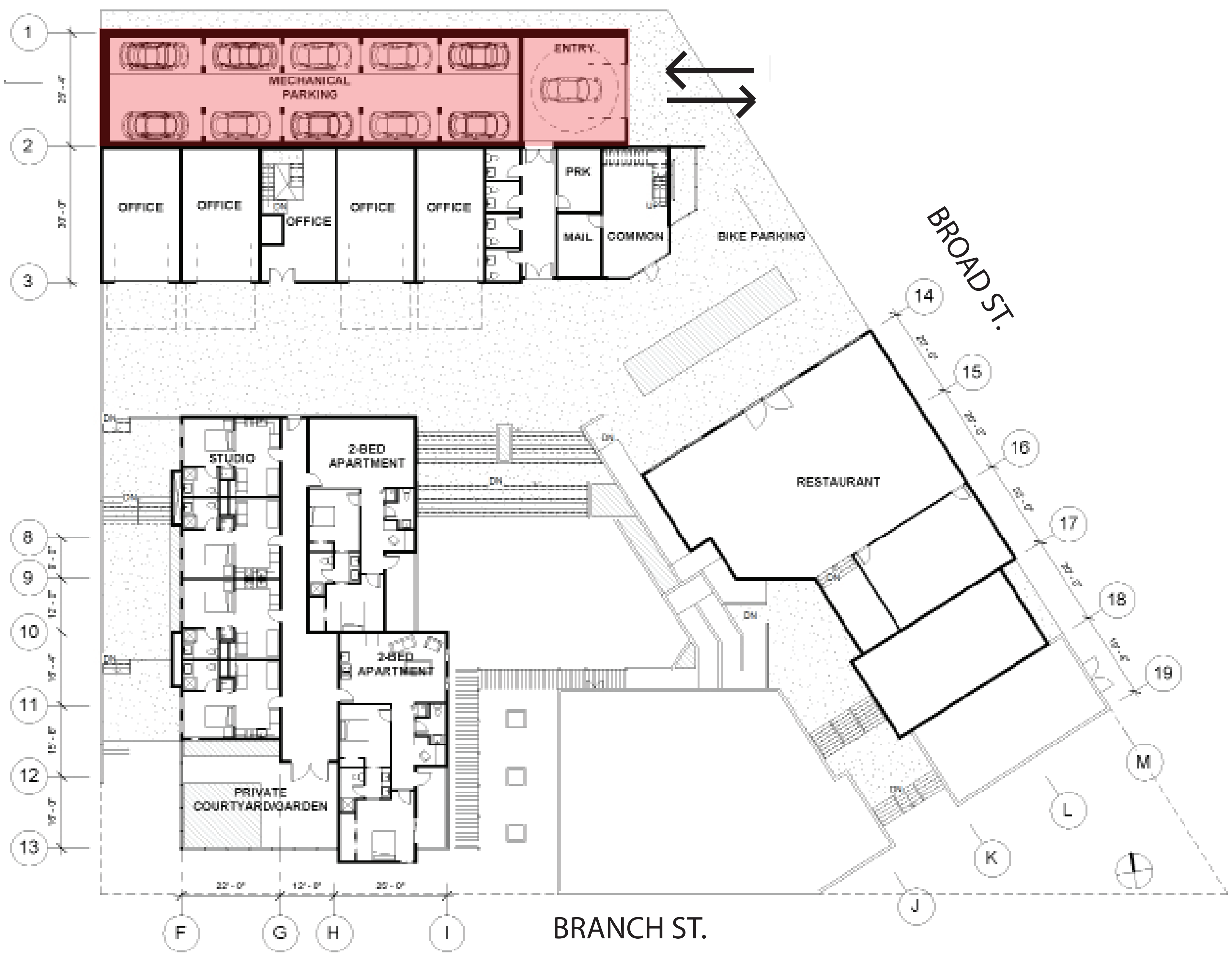
FOUNDATION SYSTEM CONFIGURATION

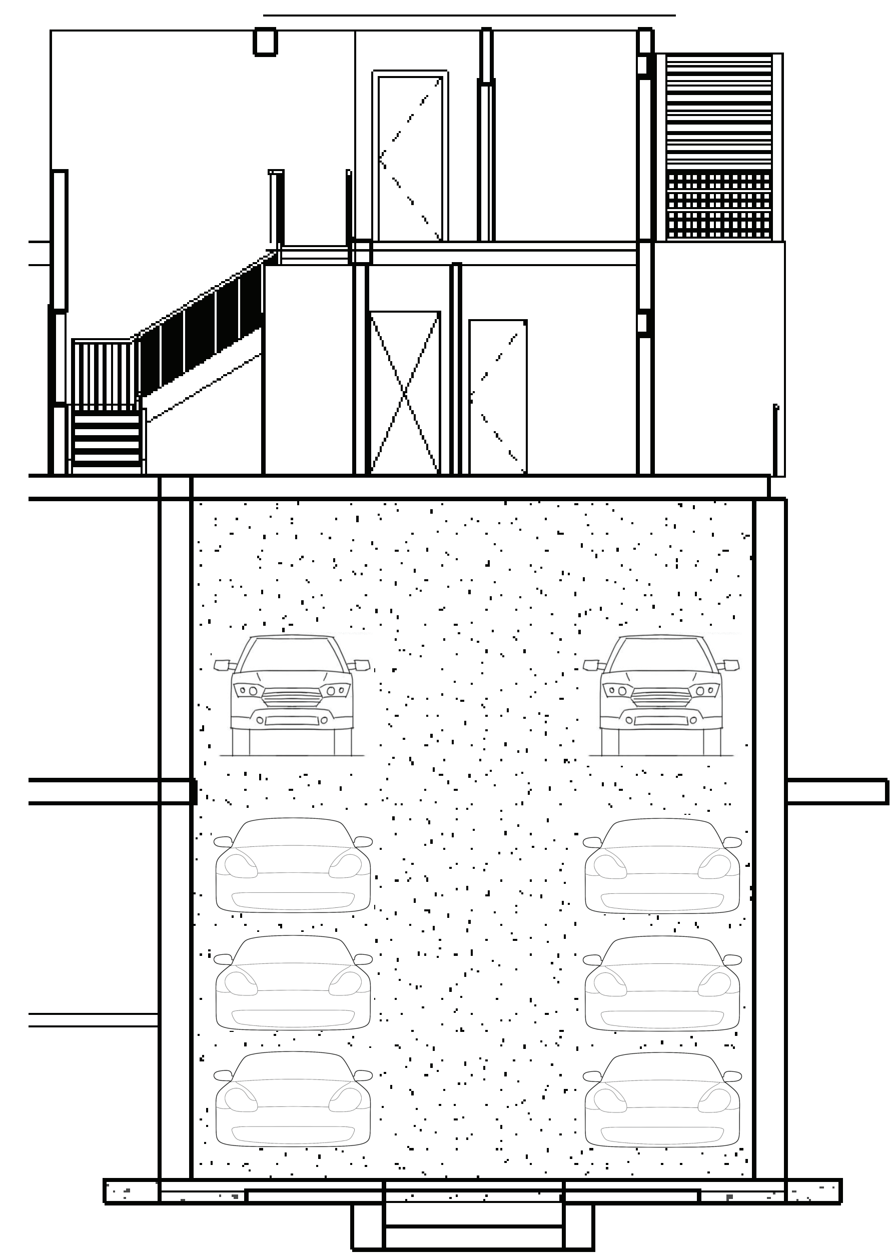






PARKING SYSTEM CONFIGURATION





The Mechanical Parking will feature an Automotion LPM System that will house 48 cars.
Drivers will enter from Broad Street and enter the platform.
The platform will rotate the car and place it into the parking system below for storage.
When the car is qeued to leave the parking system will pick up the platform and send it back into the turntable.

Additional parking for the site will be located across Broad Street as a park share with the bank.

GRAVITY SYSTEM CALCULATIONS

Western Building Weights			
Roof Weights		Square Footage (ft^2)	4200
Layer	Weight (psf)	Wall Length (ft)	915
Green Roof	10.25	Tributary Height (ft)	5
Typical Dead Load	19.75	Typ. Wall Weight (psf)	8
Total	30	Wall Weight (lb)	36600
Live Load	100	Roof Weight (lb)	126000
		Total Roof Weight (k)	162.6
Third Floor Weights		Square Footage (ft^2)	4200
Layer	Weight (psf)	Wall Length (ft)	915
		Tributary Height (ft)	11.5
Typical Dead Load	20	Typ. Wall Weight (psf)	8
Total	20	Wall Weight (lb)	84180
Live Load	40	3rd Floor Weight (lb)	84000
		Total Roof Weight (k)	168.18
Second Floor Weights		Square Footage (ft^2)	5328
Layer	Weight (psf)	Timber Walls	
Typical Dead Load	20	Wall Length (ft)	915
12" Concrete Floor	150	Tributary Height (ft)	6.5
Total	170	Typ. Wall Weight (psf)	8
Concrete Walls		Wall Weight (lb)	269580
Wall Length (ft)	444	Roof Weight (lb)	905760
Tributary Height (ft)	5	2nd Floor Weight (k)	1175.34
Typ. Wall Weight (psf)	100	Live Load	40

Concrete Two Way Slab Depth Estimation

Minimum Thickness of Two way slab $\frac{l_n}{30}$ ACI Table 9.5(c)

Longest Span = 24.5'

$\frac{24.5'}{30} = 9.8''$ (Assume 12" For Conservative Guess)

Depth	TJI®	Basic Properties: Joist Weight (lbs/ft)	Basic Properties: Maximum Resistive Moment(1) (ft-lbs)	Basic Properties: Joist Only EI x 10⁶ (in.²-lbs)	Basic Properties: Maximum Vertical Shear (lbs)	Reaction Properties: 1¾" End Reaction (lbs)	Reaction Properties: 3½" End Reaction (lbs)	3½" Intermediate Reaction (lbs): No Web Stiffeners	3½" Intermediate Reaction (lbs): With Web Stiffeners(2)	5¼" Intermediate Reaction (lbs): No Web Stiffeners	5¼" Intermediate Reaction (lbs): With Web Stiffeners(2)
9½"	110	2.3	2,500	157	1,220	910	1,220	1,935	N.A.	2,350	N.A.
	210	2.6	3,000	186	1,330	1,005	1,330	2,145	N.A.	2,565	N.A.
	230	2.7	3,330	206	1,330	1,060	1,330	2,410	N.A.	2,790	N.A.
11⅞"	110	2.5	3,160	267	1,560	910	1,375	1,935	2,295	2,350	2,705
	210	2.8	3,795	315	1,655	1,005	1,460	2,145	2,505	2,565	2,925
	230	3.0	4,215	347	1,655	1,060	1,485	2,410	2,765	2,790	3,150
	360	3.0	6,180	419	1,705	1,080	1,505	2,460	2,815	3,000	3,360
	560	4.0	9,500	636	2,050	1,265	1,725	3,000	3,475	3,455	3,930
14"	110	2.8	3,740	392	1,860	910	1,375	1,935	2,295	2,350	2,705
	210	3.1	4,490	462	1,945	1,005	1,460	2,145	2,505	2,565	2,925
	230	3.3	4,990	509	1,945	1,060	1,485	2,410	2,765	2,790	3,150
	360	3.3	7,335	612	1,955	1,080	1,505	2,460	2,815	3,000	3,360
	560	4.2	11,275	926	2,390	1,265	1,725	3,000	3,475	3,455	3,930
16"	110	3.0	4,280	535	2,145	910	1,375	1,935	2,295	2,350	2,705
	210	3.3	5,140	629	2,190	1,005	1,460	2,145	2,505	2,565	2,925
	230	3.5	5,710	691	2,190	1,060	1,485	2,410	2,765	2,790	3,150
	360	3.5	8,405	830	2,190	1,080	1,505	2,460	2,815	3,000	3,360
	560	4.5	12,925	1,252	2,710	1,265	1,725	3,000	3,475	3,455	3,930

Worst Case Joist To Confirm 11⅞" Joist Possible

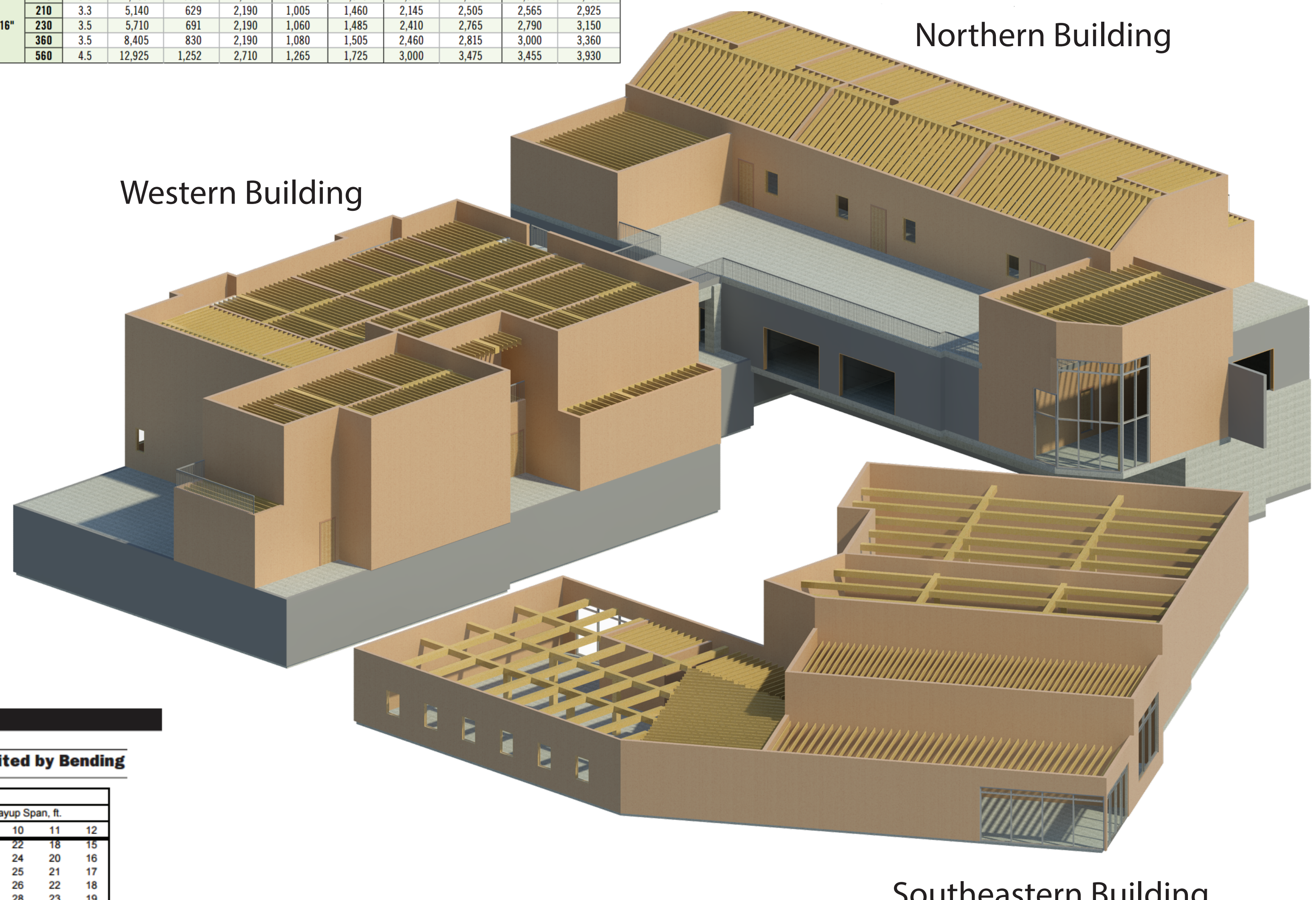
17' : Longest Span in Western Building

Dead Load = 30 psf
Live Load = 100 psf

@ 12" Spacing

Max Moment = $\frac{130\,psf(1')(17')^2}{8} = 4696.25$ ft·lb

Use 11⅞" Grade 360
@ 1' Spacing



Northern Building Weights			
Roof Weights		Square Footage (ft^2)	2600
Layer	Weight (psf)	Wall Length (ft)	552.5
		Tributary Height (ft)	5
Typical Dead Load	20	Typ. Wall Weight (psf)	8
Total	20	Wall Weight (lb)	22100
		Roof Weight (lb)	52000
Live Load	20	Total Roof Weight (k)	74.1
Third Floor Weights		Square Footage (ft^2)	2980
Layer	Weight (psf)	Wall Length (ft)	508
Concrete Overlay	13.75	Tributary Height (ft)	10
Typical Dead Load	16.25	Typ. Wall Weight (psf)	8
Total	30	Wall Weight (lb)	40640
		3rd Floor Weight (lb)	89400
Live Load	40	Total Roof Weight (k)	130.04
Second Floor Weights		Square Footage (ft^2)	5415
Layer	Weight (psf)	Timber Walls	
Typical Dead Load	20	Wall Length (ft)	508
12" Concrete Floor	150	Tributary Height (ft)	5
Total	170	Typ. Wall Weight (psf)	8
Concrete Walls		Wall Weight (lb)	1504270
Wall Length (ft)	286	2nd Floor Weight (lb)	920550
Tributary Height (ft)	15	2nd Floor Weight (k)	2424.82
Typ. Wall Weight (psf)	300	Live Load	40
Other Concrete Walls			
Wall Length (ft)	303		
Tributary Height (ft)	6.5		
Typ. Wall Weight (psf)	100		

Glulam Calcs

Longest Span = 20'

Tributary Width = 20'

Loading = 45 psf

$\frac{wl^2}{8} = \frac{(45\,psf)(20')(20')^2}{8} = 45000$ #ft

$f_b = 2400$ psi 24F-V8

$\frac{45000\ \#ft \cdot (12''/ft)}{2400\ psi} = S_{req}$

$S_{req} = 225$ Use 16½ × 5⅛ 24F-V8

8 TONGUE AND GROOVE ROOF DECKING

Table 1. Two Inch Nominal Thickness – Allowable Roof Load Limited by Bending

Bending Stress, psi	Simple Span, ft. 6	7	8	9	10	11	12	Controlled Random Layup Span, ft. 6	7	8	9	10	11	12
	Allowable Uniformly Distributed Total Roof Load[1,2,3,4,5], psf													
875	73	54	41	32	26	22	18	61	45	34	27	22	18	15
950	79	58	45	35	29	24	20	66	48	37	29	24	20	16
1000	83	61	47	37	30	25	21	69	51	39	31	25	21	17
1050	88	64	49	39	32	26	22	73	54	41	32	26	22	18
1100	92	67	52	41	33	27	23	76	56	43	34	28	23	19
1150	96	70	54	43	35	29	24	80	59	45	35	29	24	20
1200	100	73	56	44	36	30	25	83	61	47	37	30	25	21
1250	104	77	59	46	38	31	26	87	64	49	39	31	26	22
1300	108	80	61	48	39	32	27	90	66	51	40	33	27	23
1350	113	83	63	50	41	33	28	94	69	53	42	34	28	23
1400	117	86	66	52	42	35	29	97	71	55	43	35	29	24
1450	121	89	68	54	44	36	30	101	74	57	45	36	30	25
1500	125	92	70	56	45	37	31	104	77	59	46	38	31	26
1550	129	95	73	57	47	38	32	108	79	61	48	39	32	27
1600	133	98	75	59	48	40	33	111	82	63	49	40	33	28
1650	138	101	77	61	50	41	34	115	84	64	51	41	34	29
1700	142	104	80	63	51	42	35	118	87	66	52	43	35	30
1750	146	107	82	65	53	43	36	122	89	68	54	44	36	30
1900	158	116	89	70	57	47	40	132	97	74	59	48	39	33
2000	167	122	94	74	60	50	42	139	102	78	62	50	41	35

1 Tabulated values are based on 1-1/2 in. net thickness. For 1-7/16 in. decking multiply the tabulated allowable loads by 0.918

2 To determine allowable uniformly distributed loads for other span conditions, use simple span load values for combination simple and two-span continuous, and two span continuous layups; and use controlled random layup load values for cantilevered pieces intermixed layup.

3 Duration of Load, C_D = 1.0 used in this table. For other load durations, adjust by the appropriate factor.

4 No increase for size effect has been applied, (C_F = 1.00).

5 Dry conditions of use.

South Eastern Building Toungе And Groove Plank System

8' Span, Assume Simple Span Configuration

Dead Load = 25 psf
Live Load = 20 psf

From ASD Table 1, Bending Stress Required 1000 psf
Assume 1200 needed
Use Douglas Fir-Larch No.1 & Better

Southeastern Building Weights			
Roof Weights		Square Footage (ft^2)	8760
Layer	Weight (psf)	Wall Length (ft)	786
		Tributary Height (ft)	6
Typical Dead Load	25	Typ. Wall Weight (psf)	8
Total	25	Wall Weight (lb)	37728
		Roof Weight (lb)	219000
Live Load	20	Total Roof Weight (k)	256.728

LATERAL SYSTEM CALCULATIONS

Western Building Weights

Floor	Weight (k)		
Roof	162.60	R	6.00
3rd Floor	168.18	Ie	1.00
2nd Floor	1175.34	Cs	0.12
Total	1506.12	V (k)	175.97

Sds 0.70

Floor	w*h	Height
Roof	5365.8	33
3rd Floor	3868.14	23
2nd Floor	11753.4	10
Total	20987.34	

	Shear Force	Sum	Typical Wall Strength (k/ft)	
Roof	44.99	44.99	Timber	0.49
3rd Floor	32.43	77.42	Concrete	20.028
2nd Floor	98.54	175.97		
Total	175.97			

Wall Length Required	
Roof	92
3rd Floor	158
2nd Floor	9

USGS Design Maps Summary Report

User–Specified Input

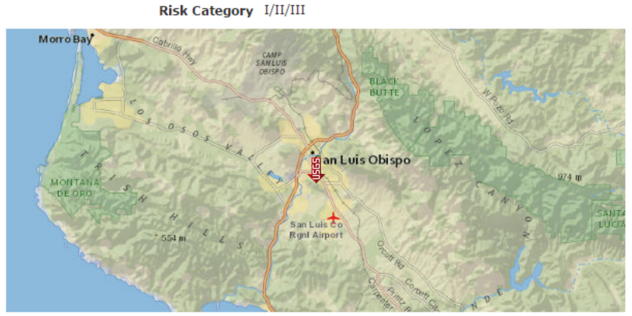
Report Title Broad Street Mixed Use
Thu June 9, 2016 04:51:09 UTC

Building Code Reference Document ASCE 7-10 Standard
(which utilizes USGS hazard data available in 2008)

Site Coordinates 35.27045°N, 120.65718°W

Site Soil Classification Site Class E – "Soft Clay Soil"

Risk Category I/II/III

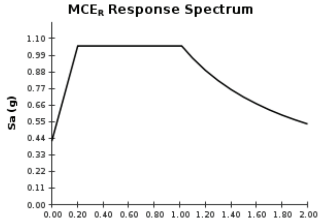


USGS–Provided Output

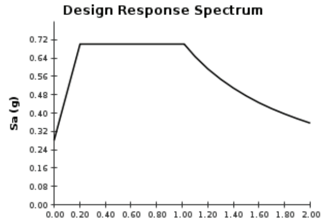
S_S = 1.168 g S_{MS} = 1.051 g S_{DS} = 0.701 g
S_1 = 0.445 g S_{M1} = 1.068 g S_{D1} = 0.712 g

For information on how the SS and S1 values above have been calculated from probabilistic (risk-targeted) and deterministic ground motions in the direction of maximum horizontal response, please return to the application and select the "2009 NEHRP" building code reference document.

MCE_R Response Spectrum



Design Response Spectrum



For PGA_M, T_L, C_{RS}, and C_{R1} values, please view the detailed report.

Concrete Shear Wall Strength

$$V_c = 3.3\,\lambda\sqrt{f'c}\cdot b\cdot d$$

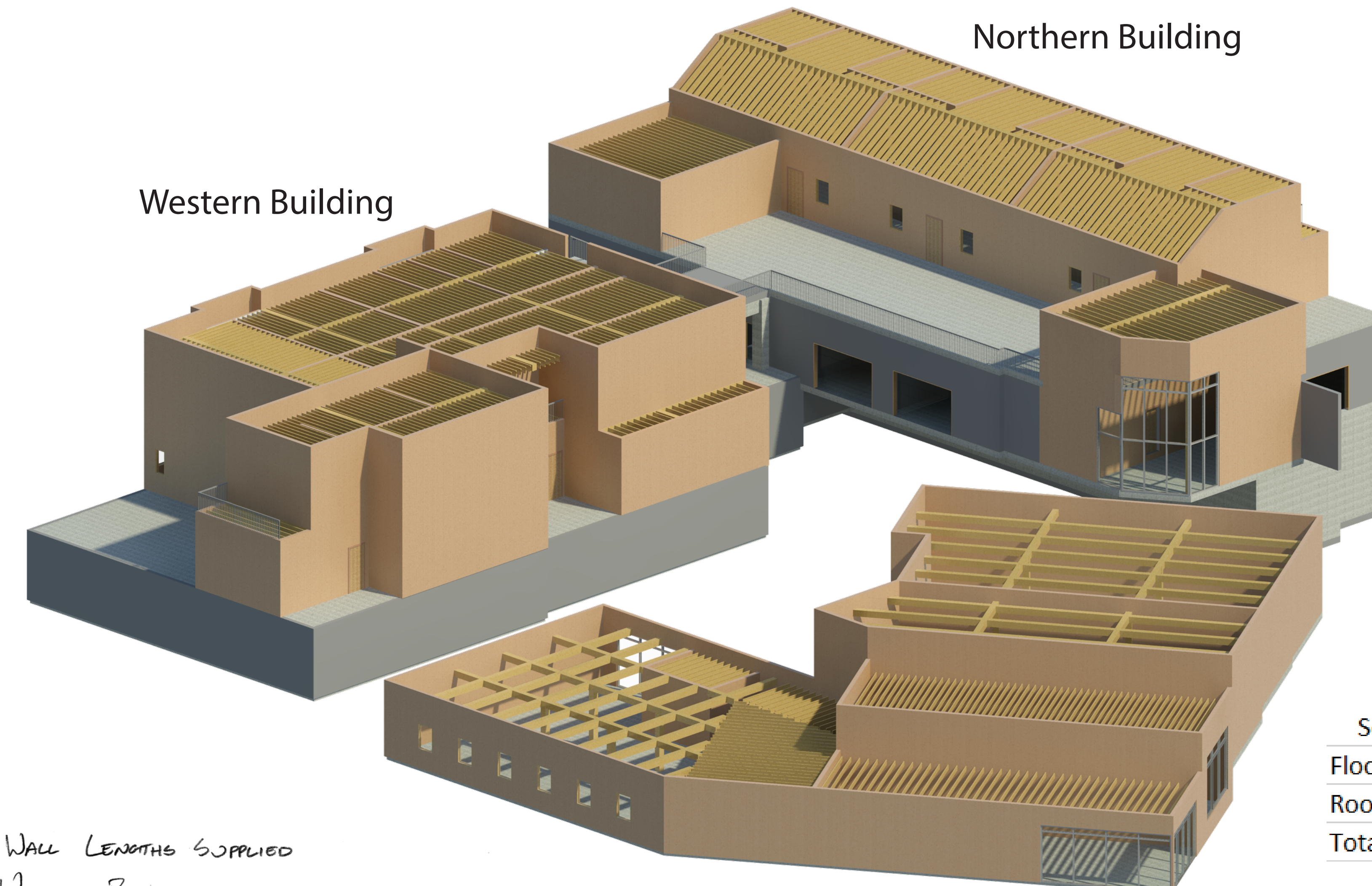
$$= 3.3(1.0)\sqrt{4000\,psi}\cdot 8''\cdot d$$

$$= 1669\ \#/in = 20.036\ k/ft$$

Table 4.3A Nominal Unit Shear Capacities for Wood-Frame Shear Walls[1,3,6,7]

Wood-based Panels[4]

Sheathing Material	Minimum Nominal Panel Thickness (in.)	Minimum Fastener Penetration in Framing Member or Blocking (in.)	Fastener Type & Size	A SEISMIC: 6 v_s (plf)	6 G_a (kips/in.) OSB	6 G_a PLY	4 v_s (plf)	4 G_a OSB	4 G_a PLY	3 v_s (plf)	3 G_a OSB	3 G_a PLY	2 v_s (plf)	2 G_a OSB	2 G_a PLY	B WIND: 6 v_w (plf)	4 v_w (plf)	3 v_w (plf)	2 v_w (plf)
Wood Structural Panels - Structural I[4,5]	5/16	1-1/4	Nail (common or galvanized box) 6d	400	13	10	600	18	13	780	23	16	1020	35	22	560	840	1090	1430
	3/8[2]	1-3/8	8d	460	19	14	720	24	17	920	30	20	1220	43	24	645	1010	1290	1710
	7/16[2]			510	16	13	790	21	16	1010	27	19	1340	40	24	715	1105	1415	1875
	15/32			560	14	11	860	18	14	1100	24	17	1460	37	23	785	1205	1540	2045
	15/32	1-1/2	10d	680	22	16	1020	29	20	1330	36	22	1740	51	28	950	1430	1860	2435
Wood Structural Panels – Sheathing[4,5]	5/16	1-1/4	6d	360	13	9.5	540	18	12	700	24	14	900	37	18	505	755	980	1260
	3/8			400	11	8.5	600	15	11	780	20	13	1020	32	17	560	840	1090	1430
	3/8[2]	1-3/8	8d	440	17	12	640	25	15	820	31	17	1060	45	20	615	895	1150	1485
	7/16[2]			480	15	11	700	22	14	900	28	17	1170	42	21	670	980	1260	1640
	15/32			520	13	10	760	19	13	980	25	15	1280	39	20	730	1065	1370	1790
	15/32	1-1/2	10d	620	22	14	920	30	17	1200	37	19	1540	52	23	870	1290	1680	2155
	19/32			680	19	13	1020	26	16	1330	33	18	1740	48	22	950	1430	1860	2435
Plywood Siding	5/16	1-1/4	Nail (galvanized casing) 6d	280	13		420	16		550	17		720	21		390	590	770	1010
	3/8	1-3/8	8d	320	16		480	18		620	20		820	22		450	670	870	1150
Particleboard Sheathing - (M-S "Exterior Glue" and M-2 "Exterior Glue")	3/8		Nail (common or galvanized box) 6d	240	15		360	17		460	19		600	22		335	505	645	840
	3/8		8d	260	18		380	20		480	21		630	23		365	530	670	880
	1/2			280	18		420	20		540	22		700	24		390	590	755	980
	1/2		10d	370	21		550	23		720	24		920	25		520	770	1010	1290
	5/8			400	21		610	23		790	24		1040	26		560	855	1105	1455
Structural Fiberboard Sheathing	1/2		Nail (galvanized roofing) 11 ga. galv. roofing nail (0.120" x 1-1/2" long x 7/16" head)				340	4.0		460	5.0		520	5.5			475	645	730
	25/32		11 ga. galv. roofing nail (0.120" x 1-3/4" long x 3/8" head)				340	4.0		460	5.0		520	5.5			475	645	730



Wall Lengths Supplied

Western Building

Floor	N/S	E/W	
Roof	≈ 460	≈ 460	Timber
3rd	≈ 460	≈ 460	Timber
2nd	≈ 220	≈ 220	Concrete

Northern Building

Floor	N/S	E/W	
Roof	≈ 225	≈ 225	Timber
3rd	≈ 250	≈ 250	Timber
2nd	≈ 280	≈ 300	Concrete

Southeastern Building

Floor	N/S	E/W	
Roof	≈ 380	≈ 380	Timber

Northern Building Weights

Floor	Weight (k)	Sds	0.70
Roof	74.10	R	6.00
3rd Floor	130.04	Ie	1.00
2nd Floor	2424.82	Cs	0.12
Total	2628.96	V (k)	307.15

Floor	w*h	Height
Roof	2445.3	33
3rd Floor	2990.92	23
2nd Floor	24248.2	10
Total	29684.42	

	Shear Force	Sum	Typical Wall Strength (k/ft)	
Roof	25.30	25.30	Timber	0.49
3rd Floor	30.95	56.25	Concrete	20.028
2nd Floor	250.90	307.15		
Total	307.15			

Wall Length Required	
Roof	52
3rd Floor	115
2nd Floor	15

Southeastern Building Weights

Floor	Weight (k)	Sds	0.70
Roof	256.73	R	6.00
Total	256.73	Ie	1.00
		Cs	0.12
		V (k)	29.99

Floor	w*h	Height
Roof	3337.464	13
Total	3337.464	

	Shear Force	Sum	Typical Wall Strength (k/ft)	
Roof	29.99	29.99		
Total	29.99		Timber	0.49

Wall Length Required	
Roof	61

FOUNDATION SYSTEM CALCULATIONS

PUNCHING SHEAR CALCS

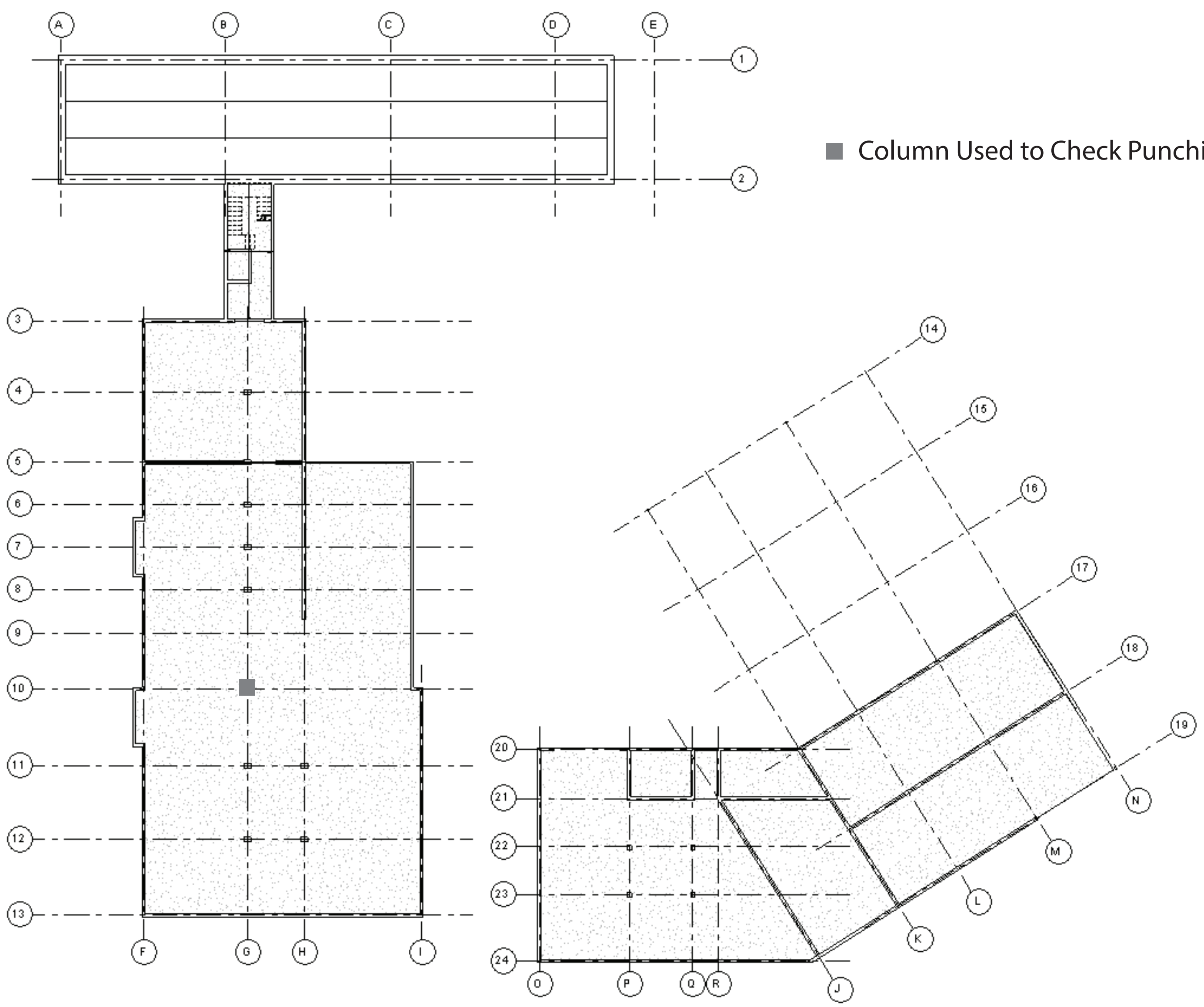
WESTERN BUILDING $V_u = 4\lambda\sqrt{f'_c} \cdot b_o \cdot d$

$b_o = 4d_{col} + 4d = (48'' + 2d)$

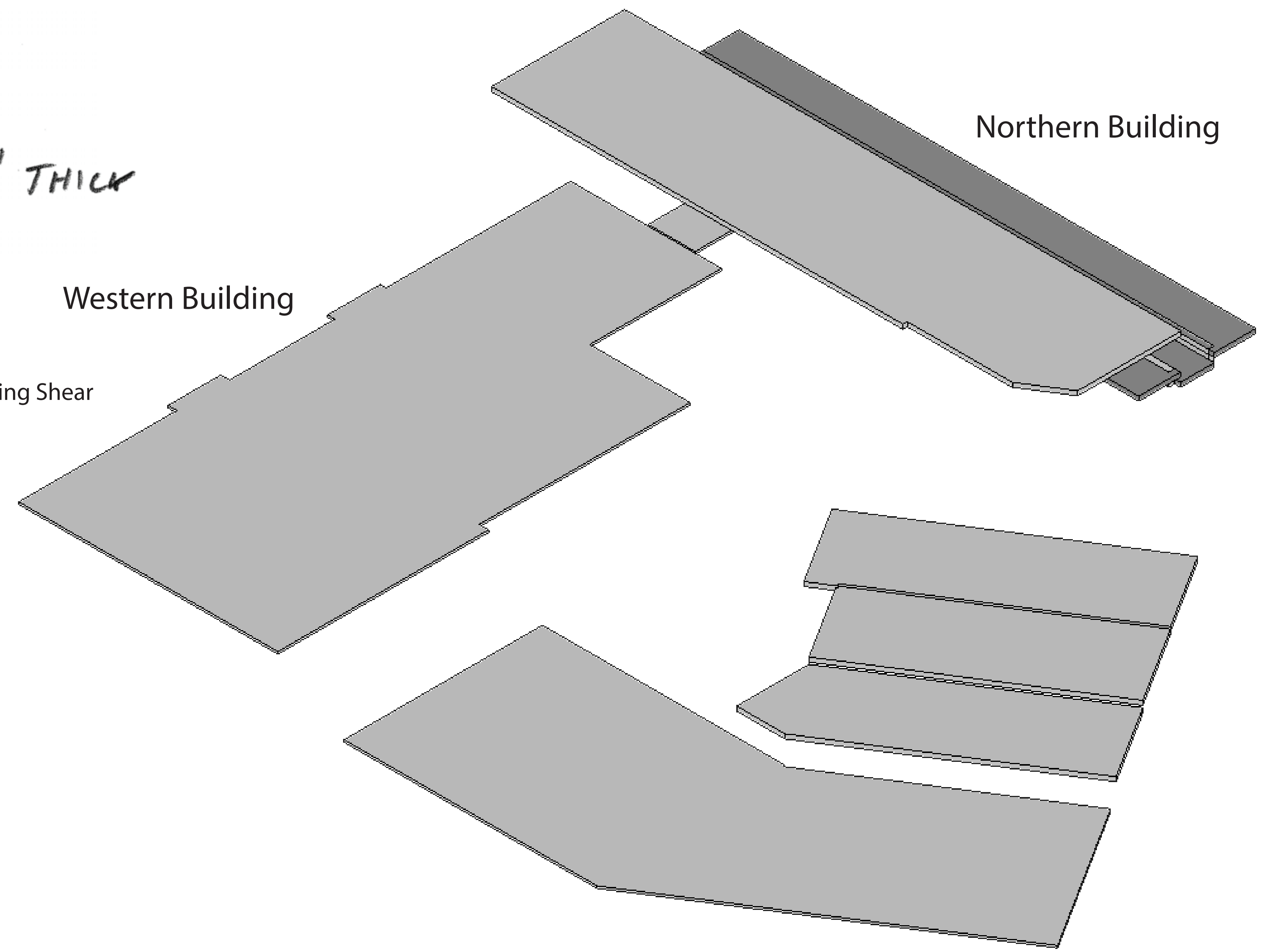
ASSUME 12" φ COLUMN $V_{u_{MAX}} = 150k$

$150000\# = 4\sqrt{4000} \cdot 96d + 2d^2$

d = 9" + 3" COVER + 4" ASSUMPTION = 16" THICK



■ Column Used to Check Punching Shear



Punching Shear will be considerably less for the Southern half of the Northern building and the Southeastern building.
A 12" slab is used as an estimation point to provide wiggle room as the project develops.