

Technical Report 3

Existing System Spot
Checks /Alternate
Systems Study



Image courtesy of Cannon Design

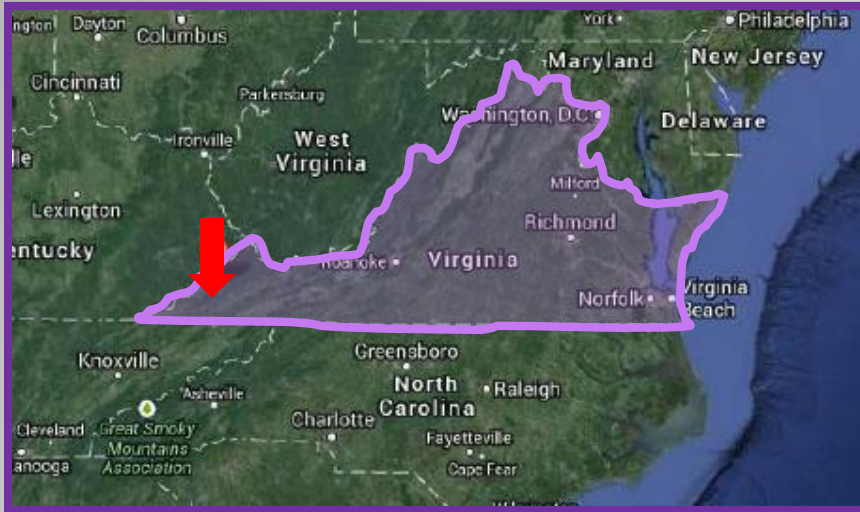
University of Virginia's College at Wise -New Library-

Macenzie Ceglar

Structural Option

Advisor: Heather Sustersic

Site Plan and Location



Location:
Wise, Virginia



General Building Description

- Owner: University of Virginia' College at Wise
- Location: Wise, VA
- Number of Stories: 6
- Size: 68,000 GSF
- Construction: Aug. 2012 - Aug. 2015
- Structural Engineer and Architect: Cannon Design

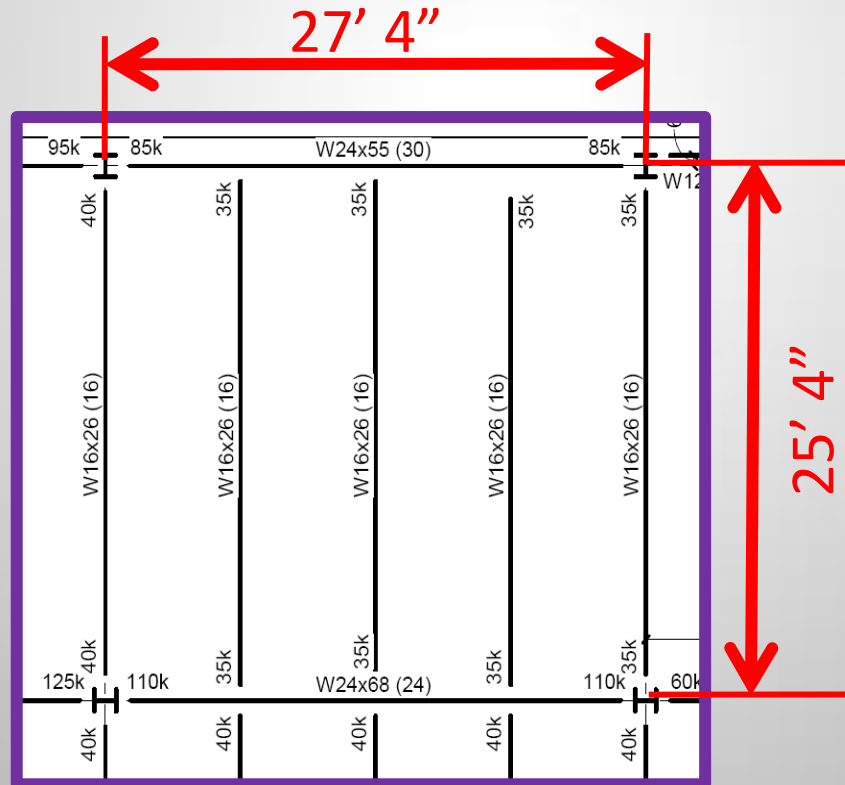
- Unique Feature: Built into 60FT hillside

Existing Structural System

- Steel Framing
 - Composite Metal Deck
 - Composite Steel Wide Flange Beams and Girders
 - Steel Wide Flange Columns
- Lateral System
 - Ordinary Reinforced Concrete Shear Walls
- Soil Retention System
 - Temporary Leave in Place Soil Retention System
 - Foundation Walls

Typical Bay

- 6 ½” Composite Deck
- W16x26 Composite Beams
- W24x68 & W24x55 Composite Girders
- W12 Columns



Gravity Spot Checks

⊙ Decking

- SDI Max - May be unshored for 3+ span condition
- Deflection
 - 95psf < 400psf → PASSED

⊙ Beams

- Strength
 - 304ft-k > 135.9ft-k → PASSED!
- Wet Concrete Deflection
 - 0.528" < 1.267" → PASSED!
- Live Load Deflections
 - 0.210" < 0.844" → PASSED!

Gravity Spot Checks

○ Girders

○ Strength

➤ 1060ft-k > 587.6ft-k → PASSED!

○ Wet Concrete Deflection

➤ 0.435" < 1.367" → PASSED!

○ Live Load Deflections

➤ 0.229" < 0.911" → PASSED!

Gravity Spot Checks

◎ Columns

- Interior - Strength

 - 1620ft-k > 1041.2ft-k → PASSED!

- Exterior - Strength

 - 640ft-k < 478.2ft-k → PASSED!

◎ Note:

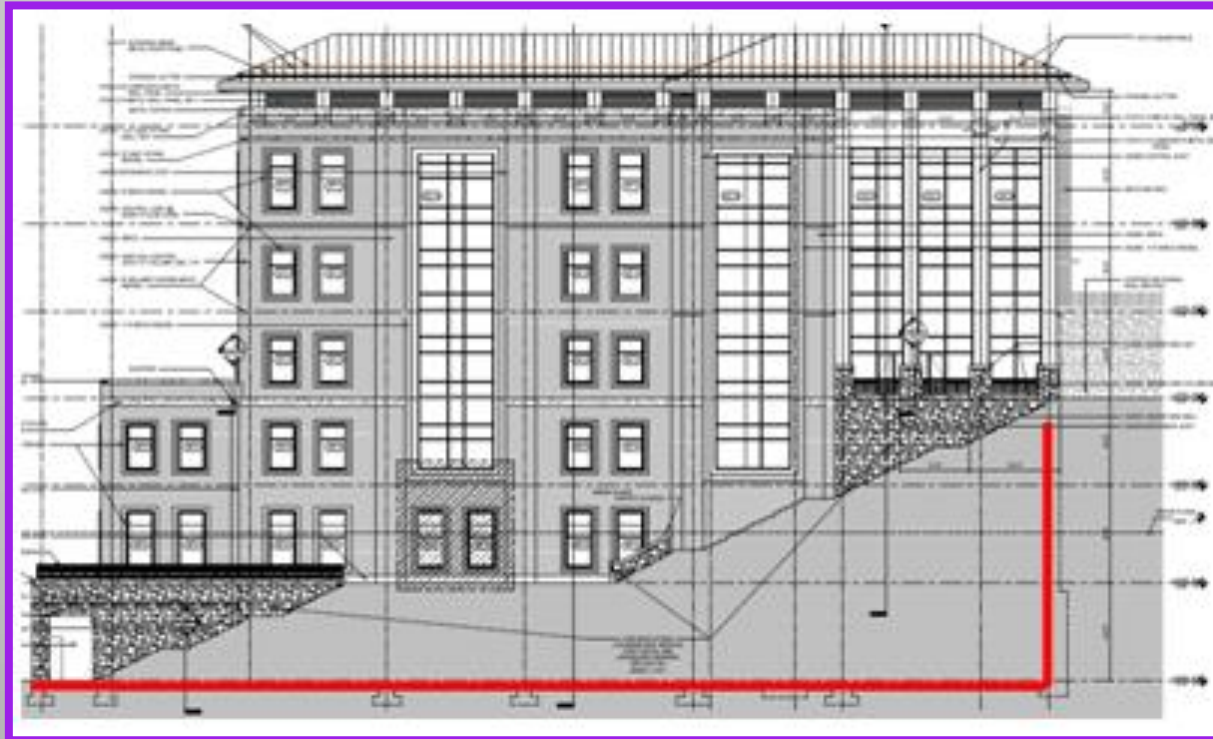
- Existing system gravity checked done using 80PSF office loading, but also passes using 150 PSF general collections loading.

Alternate Floor Systems

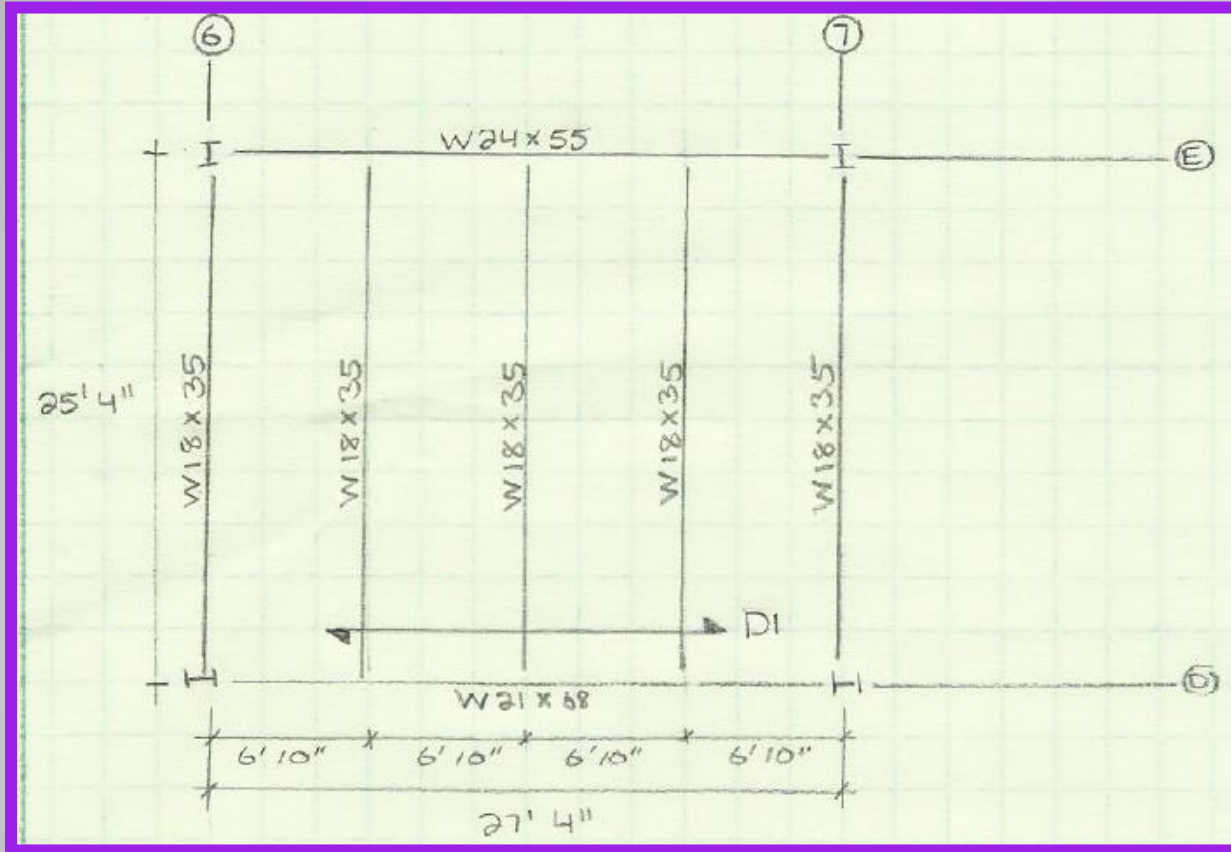
- High live loading due to general collections was important in picking alternate systems
1. Non-Composite Steel → Plausible
 2. One-Way Slab with Beam → Plausible
 3. Two-Way Slab with Drop Panels → Plausible
 4. Steel Joists → NOT Plausible
 5. Wood Framing → NOT Plausible

Considerations

- No restriction of floor-to-floor heights
- Concrete shear walls aid in foundation system
- Limit column size



Non-Composite Steel



Notes

- Existing framing layout used
- D1: 6 ½" NWC Composite Deck (4 ½" Slab)
- $f'c = 4000$ psi

Non-Composite Steel

- Cost: **Increased**

- \$28.74/SF < \$22.05/SF

- Weight: **Increased**

- 80.3 PSF > 78.6 PSF

- Depth: **No Change**

- 30.5" = 30.5"

- Lateral Systems

- Concrete Shear Walls

- Fire Protection

- Additional Fire Proofing Required

- 2hr fire rating provided by 4.5" NWC

- Durability

- Acceptable

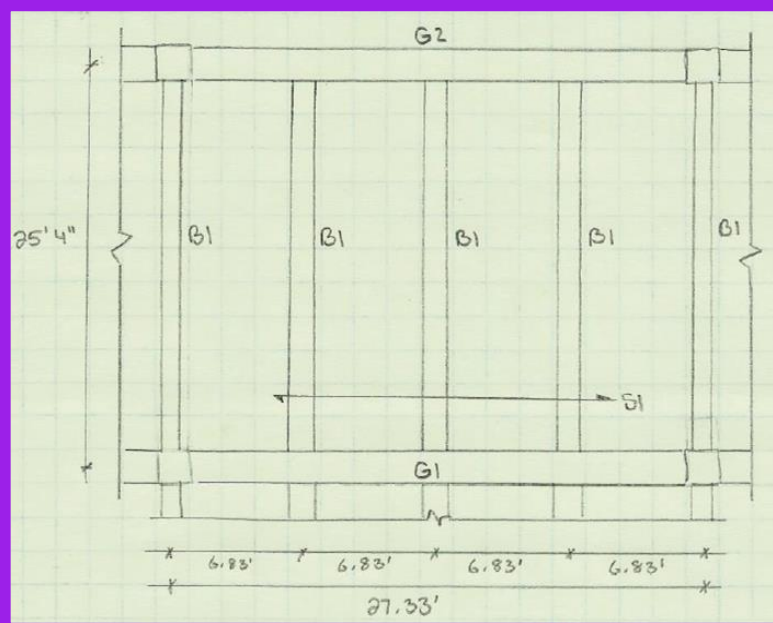
- CONCLUSION

- Pros: Average Depth

- Cons: Increase cost and weight, fire proof required, vibration concerns

→ **NOT PLAUSIBLE!**

One-Way Slab with Beams



SLAB	THICKNESS	E-W DIRECTION		N-S DIRECTION
		TOP	BOTTOM	
S1	8.5"	#4 @ 12"	#4 @ 12"	#4" @ 12" For temperature & shrinkage

BEAM	SIZE	CONCRETE	f'c	REINFORCEMENT	
				LONGITUDINAL	TRANSVERSE
B1	13" x 22"	NWC	4000 psi	(4) #8	(13) #3 x M @ 9"

GIRDER	SIZE	CONCRETE	f'c	REINFORCEMENT	
				LONGITUDINAL	TRANSVERSE
G1	21" x 36"	NWC	4000 psi	(6) #11	(35) #4 x M Evenly spaced
G2	20" x 32"	NWC	4000 psi	(5) #11	(10) #4 x M @ 14"

Notes

- Existing framing layout used
- $f'c = 4000$ psi
- $F_y = F_{yt} = 60,000$ psi
- NWC

One-Way Slab with Beams

- Cost: **Decreased**

- \$17.23/SF < \$22.05/SF

- Weight: **Increased**

- 218.2 PSF > 78.6 PSF

- Depth: **Increased**

- 36" > 30.5"

- Lateral Systems

- Concrete Shear Walls
- Concrete Moment Frames

- Fire Protection

- No additional fire proofing required
- 2hr fire rating provided by 8.5" NWC

- Durability

- Acceptable

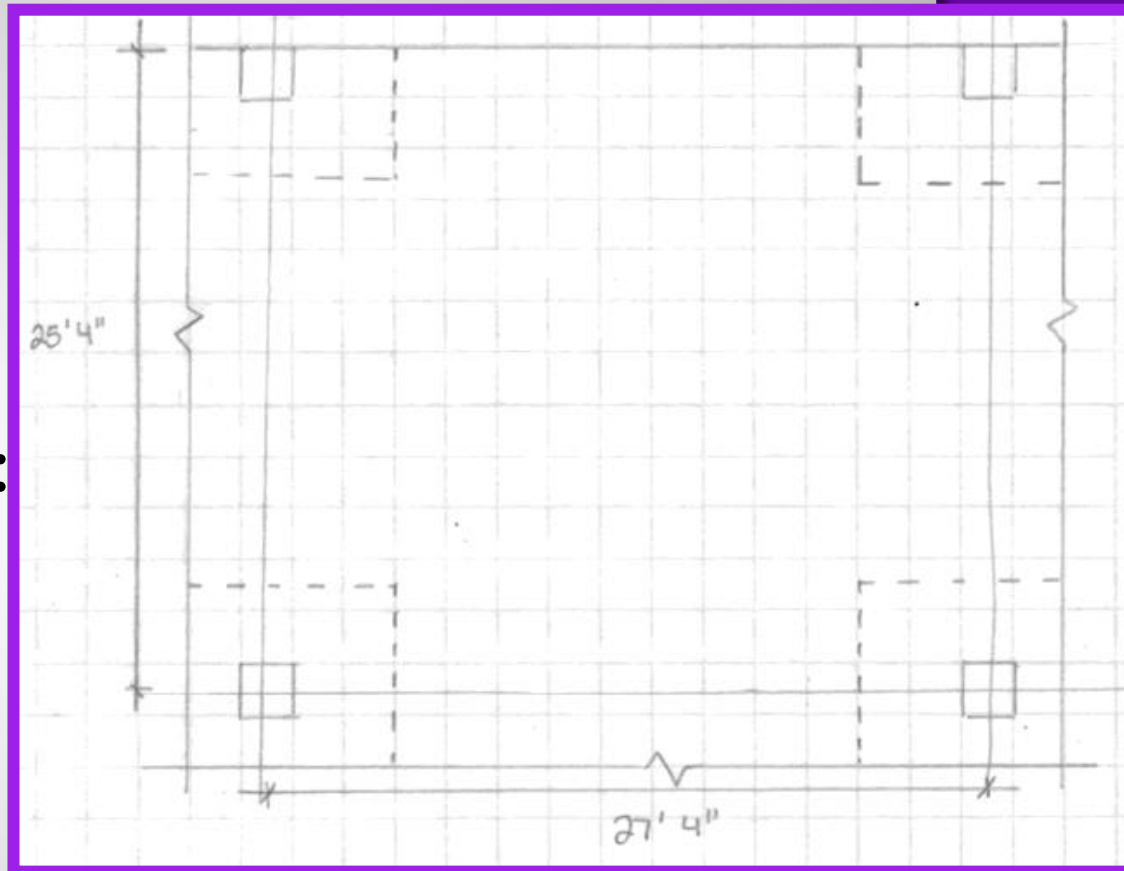
- CONCLUSION

- Pros: Decreased cost per SF, no additional fire proofing required
- Cons: Increase weight and depth

→ **REDESIGN PLAUSIBLE**

Two-Way Slab with Drop Panels

- 10" Slab
- 3" Drop Panels
- Interior Drop Panels:
117" x 102"
- Exterior Drop Panels:
117" x 63"



○ Notes

- $f'_c = 4000$ psi
- $F_y = F_{yt} = 60,000$ psi
- NWC

Two-Way Slab with Drop Panels

- Decreased Cost

- \$14.93/SF < \$22.05/SF

- Increased Weight

- 185.2 PSF > 78.6 PSF

- Decreased Depth

- 13" < 30.5"

- Lateral Systems

- Concrete Shear Walls
- Concrete Moment Frames

- Fire Protection

- No additional fire proofing required
- 2hr fire rating provided by 10" Slab

- Durability

- Acceptable

- CONCLUSION

- Pros: Decreased cost and depth, no additional fire proofing required, decreased cost per SF
- Cons: Increased weight

→ **REDESIGN PLAUSIBLE!**

Final Comparison

Criteria	Floor System Designs			
	Composite Steel	Non-composite Steel	One-Way Slab with Beams	Two-Way Slab with Drop Panels
System Statistics				
Cost	\$22.05/SF	\$28.74/SF	\$17.23/SF	\$14.90/SF
Weight	78.6 PSF	80.3 PSF	218.2 PSF	185.2 PSF
Architectural				
Maximum Depth	30.5"	30.5"	36"	13"
Additional Fire Proofing Required	YES	YES	NO	NO
Fire Rating	2 HR	2 HR	2 HR	2 HR
Servicability				
Vibrations	Likely	Likely	Minimal	Minimal
Future Considerations				
Lateral Systems	Concrete Shear Wall	Concrete Shear Wall	Concrete Shear Wall, Concrete Moment Frame	Concrete Shear Wall, Concrete Moment Frame
Durability	Acceptable	Acceptable	Acceptable	Acceptable
Feasible for Redesigning	N/A	NO	YES	YES

Thank You! Any Questions?

