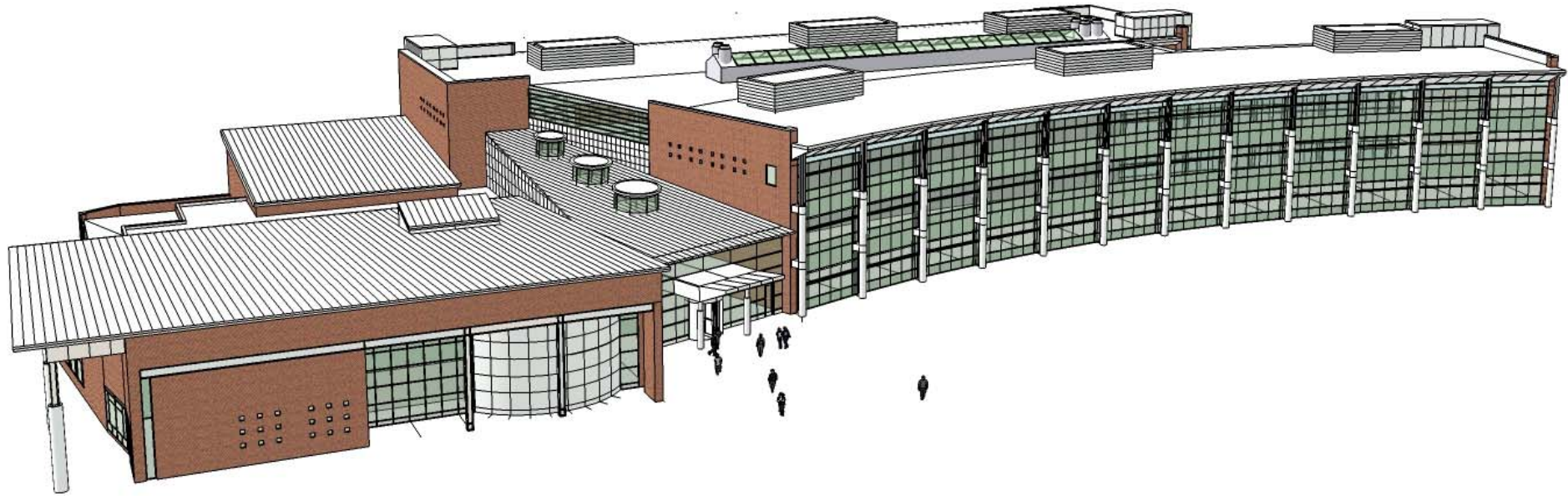


The Pennsylvania State University  
Department of Architectural Engineering  
Senior Thesis



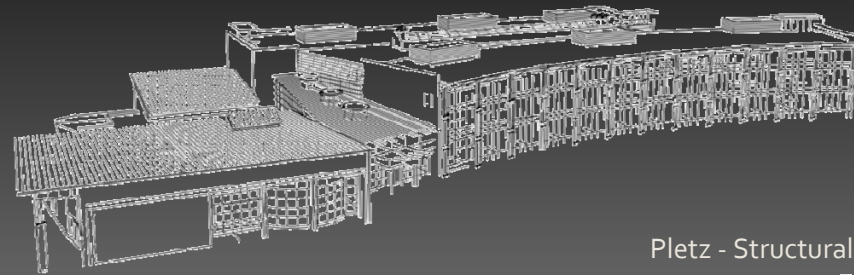
# THE EDWARD L KELLY LEADERSHIP CENTER

Ryan Pletz  
Structural  
Dr. Hanagan

April 14, 2008

# Project Team

- Owner: Prince William County Schools
- Architect: Jim Pociluyko, Moseley Architects
- Structural Engineer: Jeff O'beirne, Moseley Architects
- Mechanical Engineer: Jim Miller , Moseley Architects
- Electrical Engineer: Russell Roundy , Moseley Architects
- Plumbing Engineer: Jeffry Mortensen , Moseley Architects
- Civil Engineer: Ross, France, Ratliff, Ltd.
- Construction: V.F. Pavone



# Where We're Going...

- Existing Conditions
- Problem / Proposal
- Research Goals
- Architectural Study
- Structural Study
- Conclusions

# Where We're Going...

- **Existing Conditions**
- Problem / Proposal
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- Conclusions

# Existing Conditions

- Location: Manassas, Virginia



# Existing Conditions

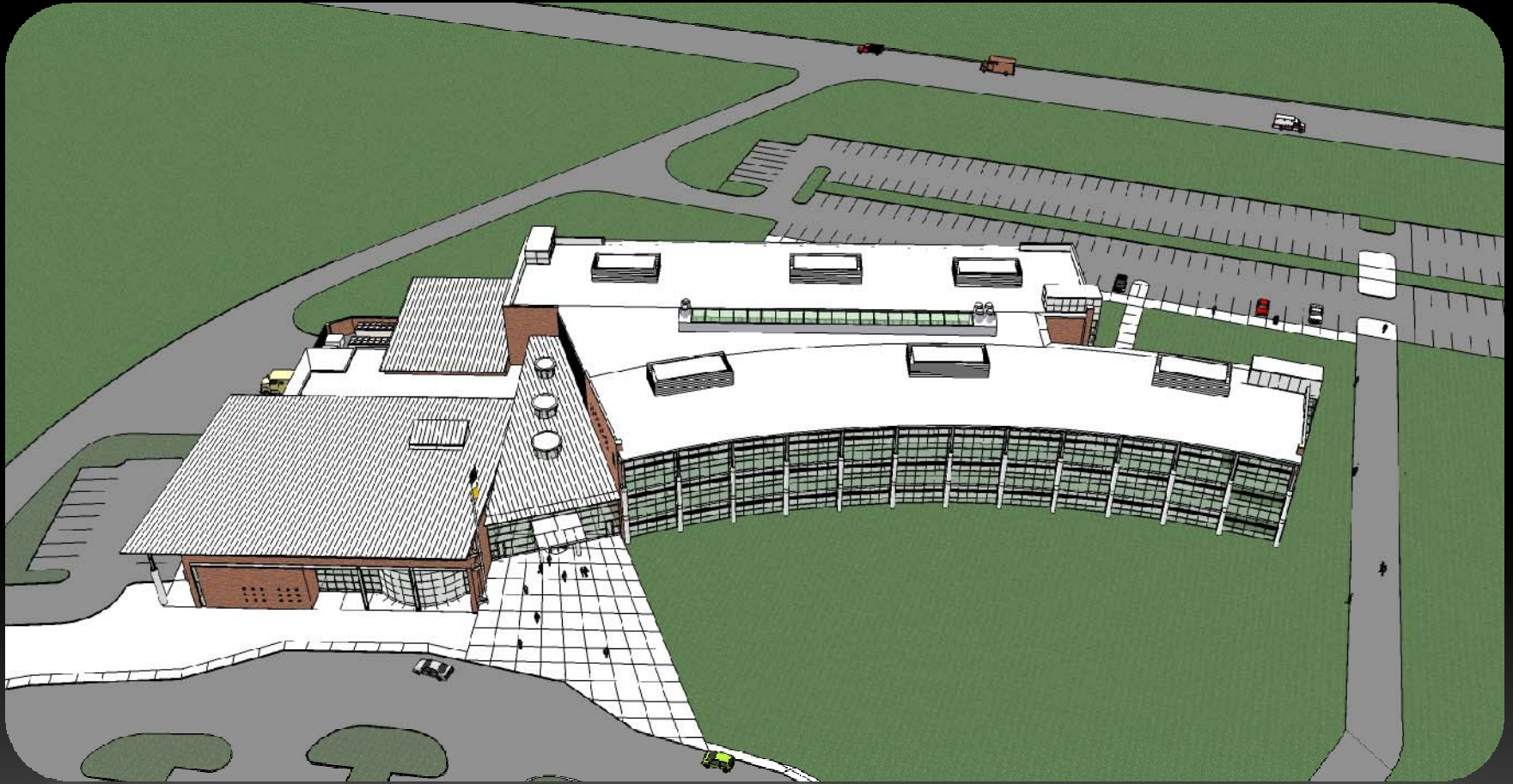
- Location: Manassas, Virginia
- Administration building for Prince William County Schools
- 150,000 square feet
- One 1-story wing, two 3-story wings
- Original building height: 46'-0"

# Existing Conditions

- Location: Manassas, Virginia

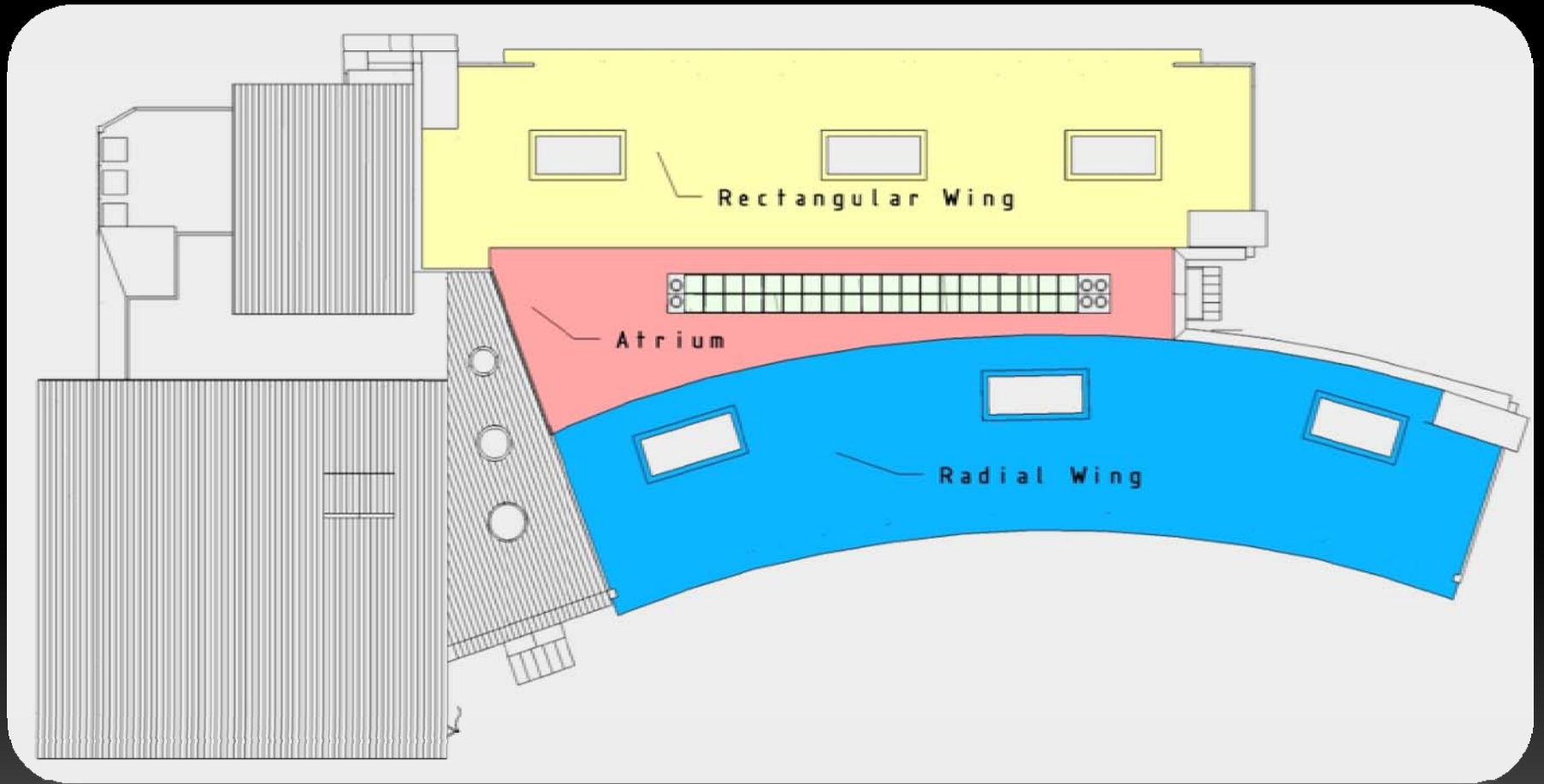


# Existing Conditions





# Existing Conditions



# Where We're Going...

- Existing Conditions
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# Problem / Proposal

- Owner wants more building space
  - Where to expand?
- Impact on the existing structural system
  - Foundations
  - Gravity Columns
  - Lateral System
- Alternative and possibly more efficient system
  - Gravity
  - Lateral

# Where We're Going...

- Existing Conditions
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# Research Goals

- Add additional space and maintain good aesthetics throughout
- Create more efficient structural system
- Save money and scheduling time

# Where We're Going...

- Existing Conditions
- Problem / Proposal
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- **Architectural Study**
- Structural Study
- Conclusions

# Architectural Study

- 2 preliminary options
  - Expand Outward
  - Expand Upward

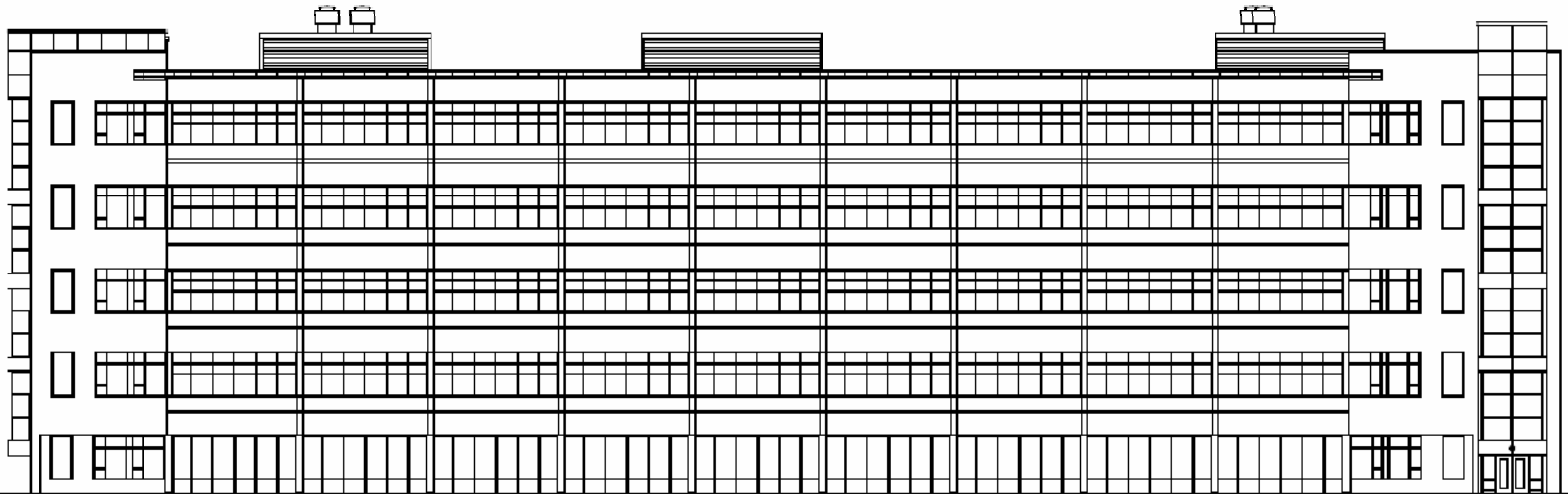


# Architectural Study

- 2 options
  - ~~Expand Outward~~
  - Expand Upward
    - Minimize site impact
    - Increase site usable space (Parking, ...)
    - One construction sequence



# Architectural Study



# Architectural Study



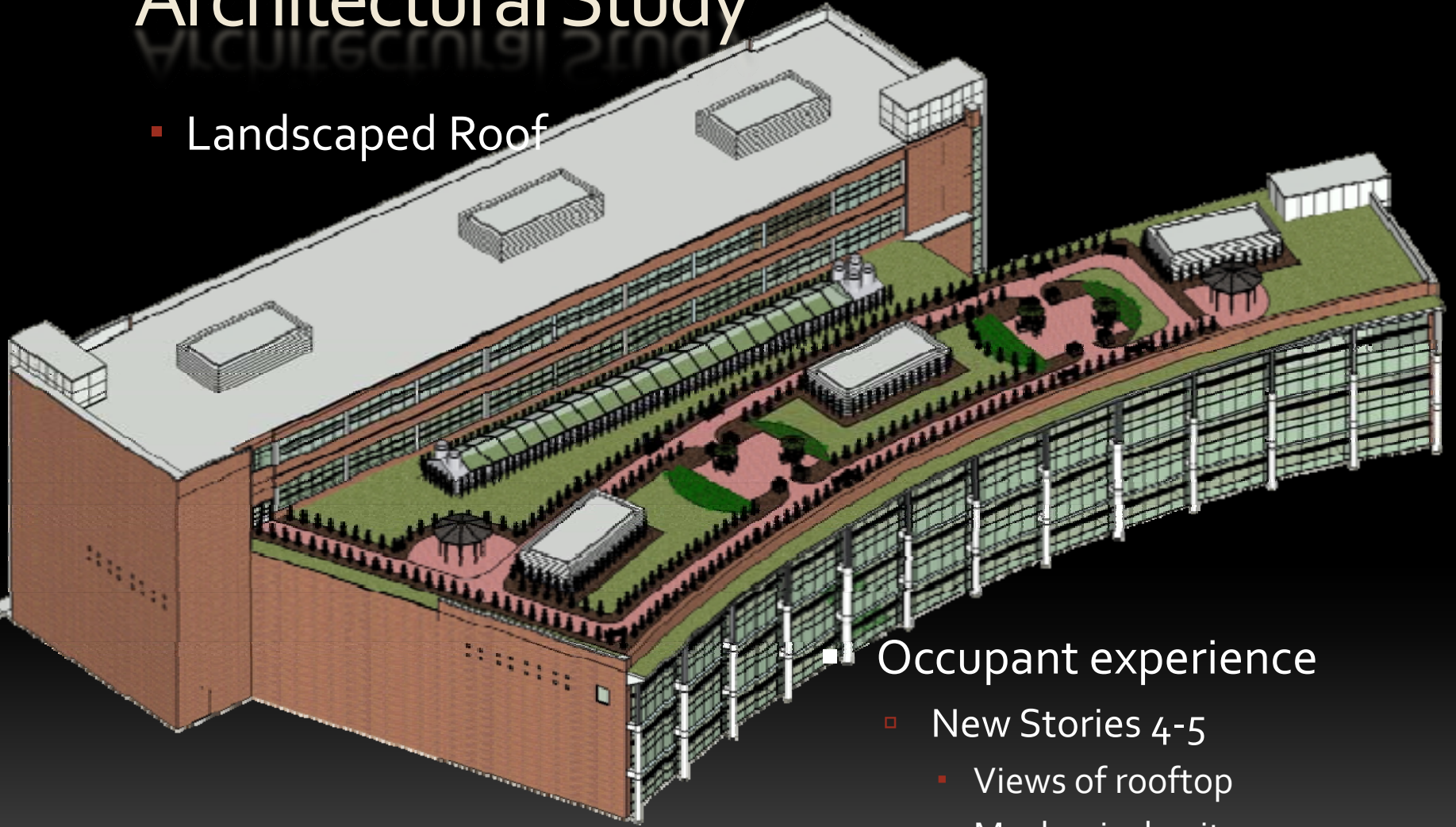
# Architectural Study



- Additional 2 stories (15'-4" story height)
- New Height: 76'-8"
- 37,770 additional square feet
- 116 additional open workstations
- 36 additional private offices

# Architectural Study

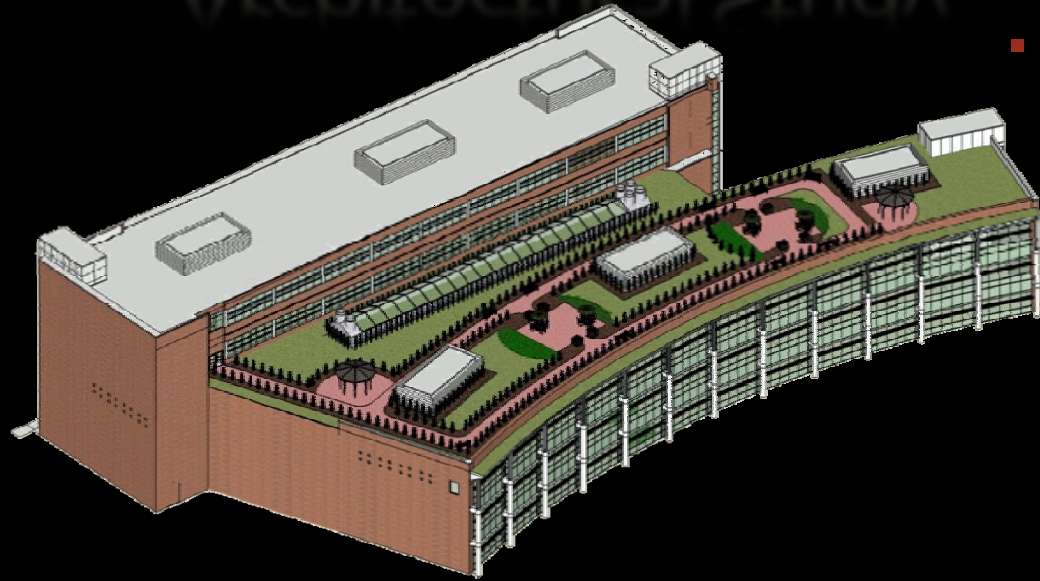
- Landscaped Roof



- Occupant experience

- New Stories 4-5
  - Views of rooftop
  - Mechanical units
- Greater aesthetics
- Connect the occupant to outside

# Architectural Study



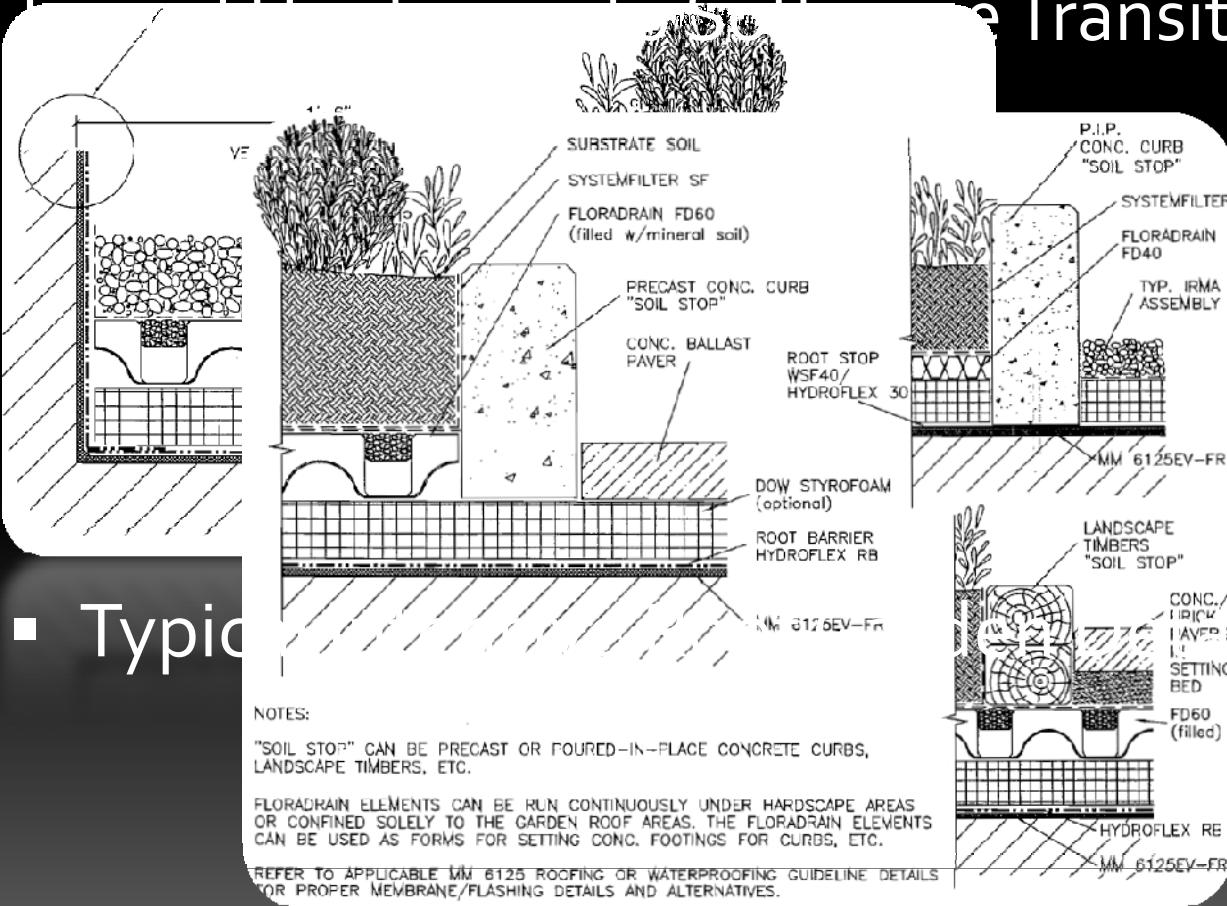
- Landscaped Roof

- 30,000 square feet
- Intensive-type
- Aesthetic and psychological benefits
- Ecological and economic benefits

# Architectural Study

- Landscaped Roof

## Typical Details for a Green Roof Surface Transition



- Typical

ils



# Where We're Going...

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# Structural Study

- Existing System
  - Non-Composite
  - Steel W-shape main beams and girders
    - 24'-0" width, 31'-0" length
  - OWSJ bay fillers
    - 6 per bay, 4'-0" on center
  - Spread footing foundation

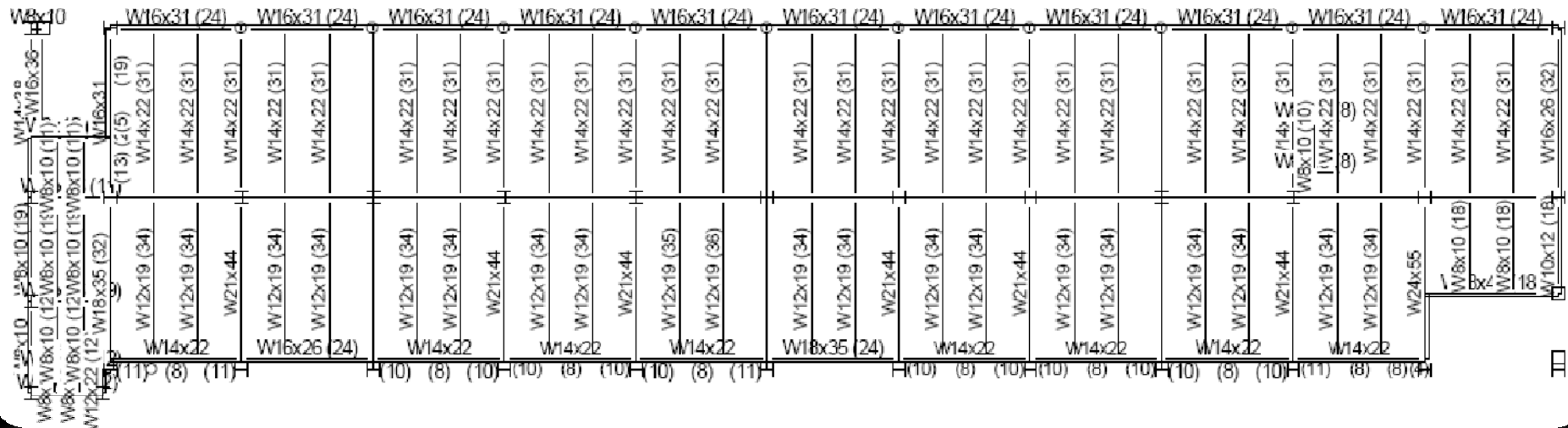


# Structural Study

- New System
  - Composite
    - Steel W-shapes at 3 per bay, 8'-0" on center
  - No joists
  - 4" Composite concrete slab



# Structural Study



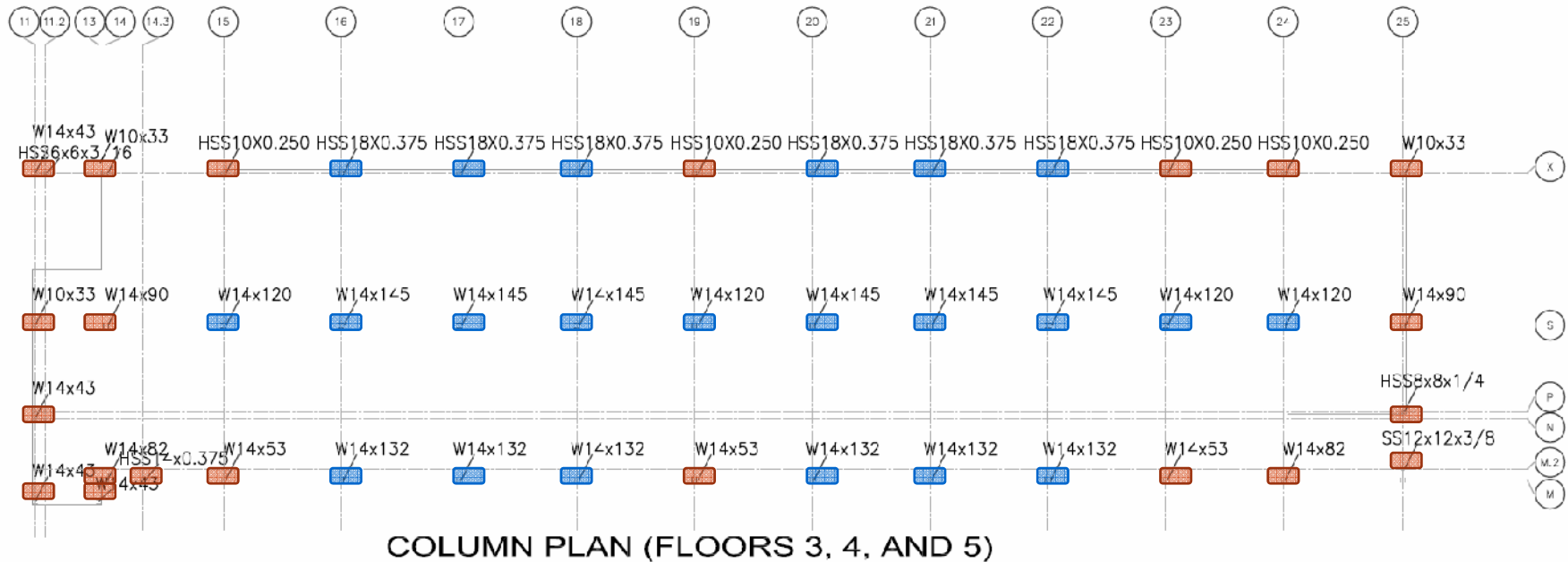
- Floor Framing
- Typical Sizes: W<sub>14</sub>x<sub>22</sub>, W<sub>12</sub>x<sub>19</sub>, and W<sub>21</sub>x<sub>44</sub>
- Original Design: 28K8
- 50-57% reduction in depth

# Structural Study

- Column Redesign for Floors 3, 4, and 5
  - Size spliced at second story

Gravity

Lateral

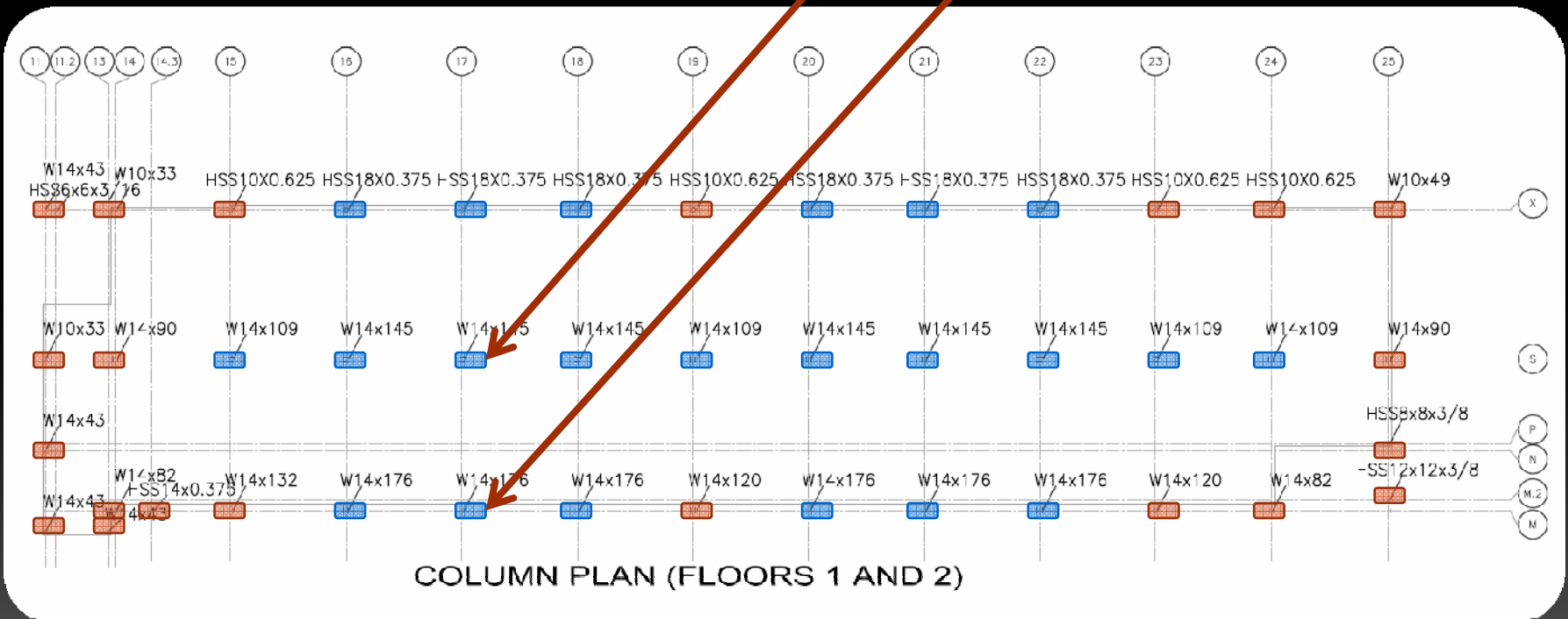


# Structural Study

- Foundation Redesign

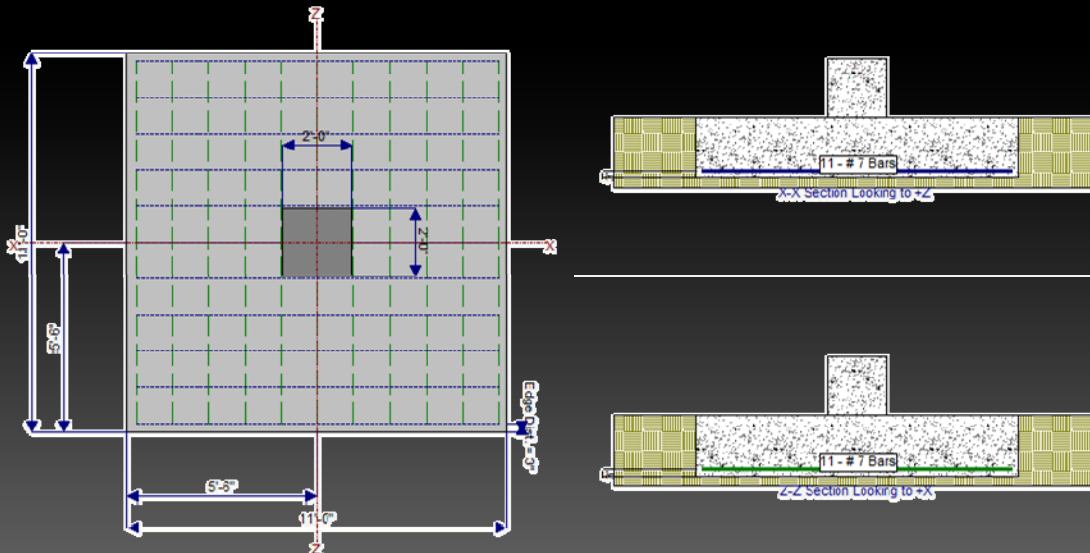
Column S-17  
(Highest Axial Load)

Column M-17  
(Highest Moment)



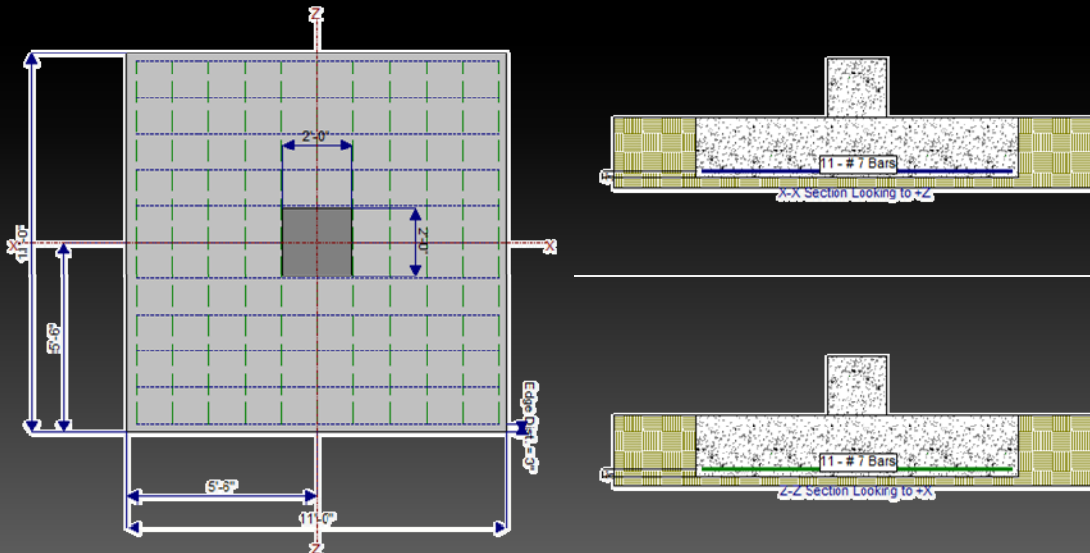
# Structural Study

- Foundation Redesign
- Footing M-17
- $P = 228.3$  kips (106.5 Dead, 121.8 Live)
- $M = 291$  ft-kips



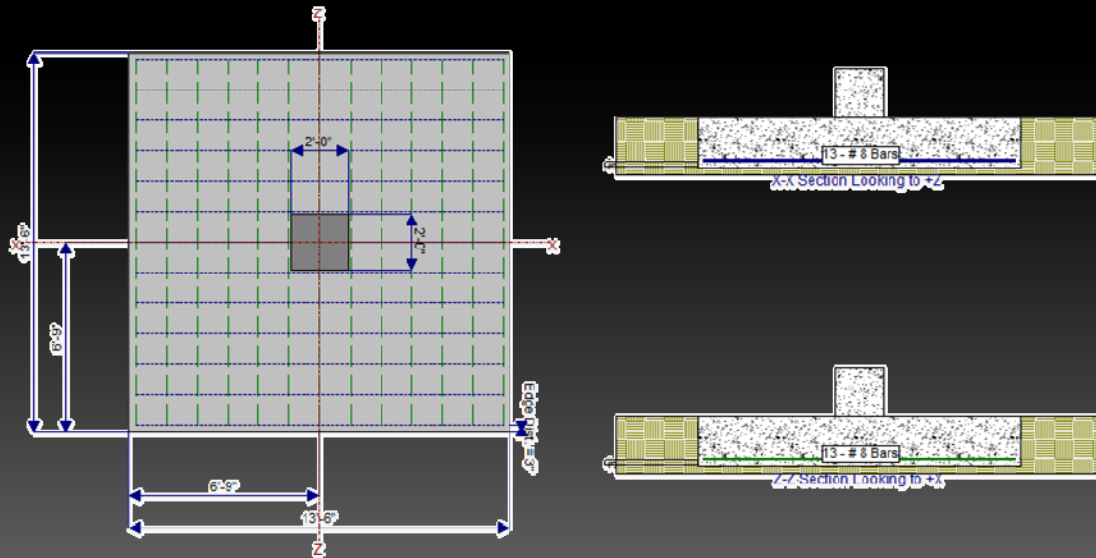
# Structural Study

- Foundation Redesign
  - Footing M-17
  - 11'-0" x 11'-0" (49% larger)
  - 25" thick
  - (11)#7 bars each way
- Original Redesign
  - Footing M-17
  - 9'-0" x 9'-0"
  - 25" thick
  - (10)#7 bars each way



# Structural Study

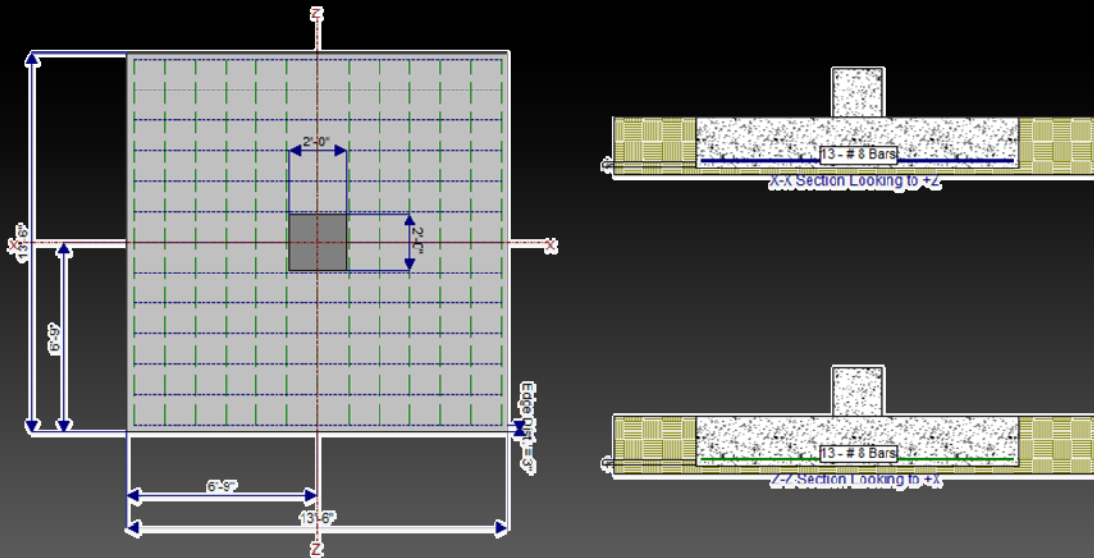
- Foundation Redesign
- Footing S-17
- $P = 475.6$  kips (212.4 Dead, 258.2 Live)
- $M = 255.2$ ft-kips





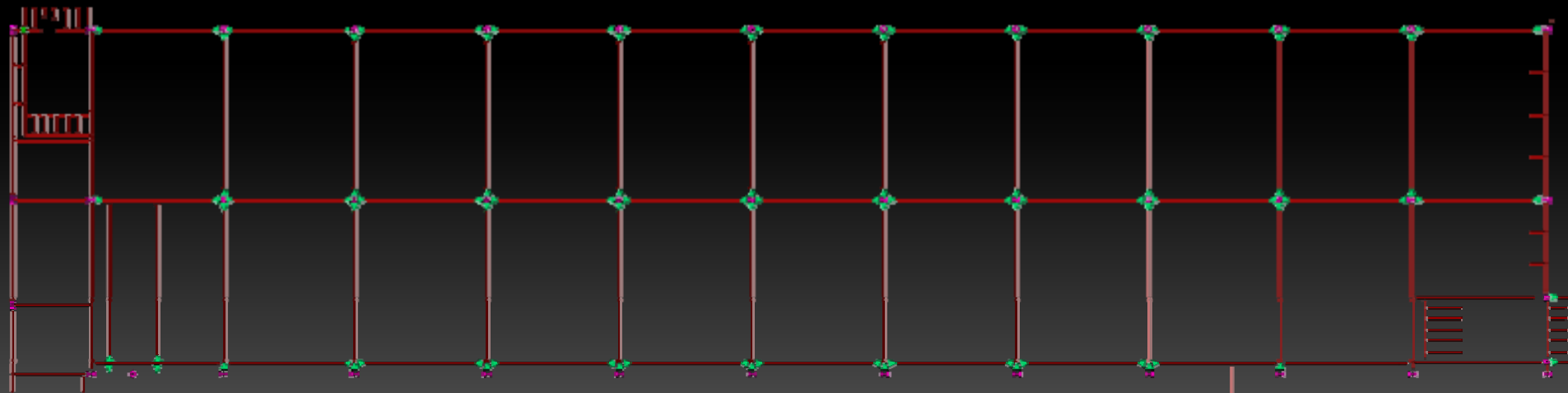
# Structural Study

- Foundation Redesign
- Footing S-17
- 13'-6" x 13'-6" (65% increase)
- 25" thick
- (13)#8 bars each way
- Original Design
- Footing S-17
- 10'-6" x 10'-6"
- 25" thick
- (10)#7 bars each way



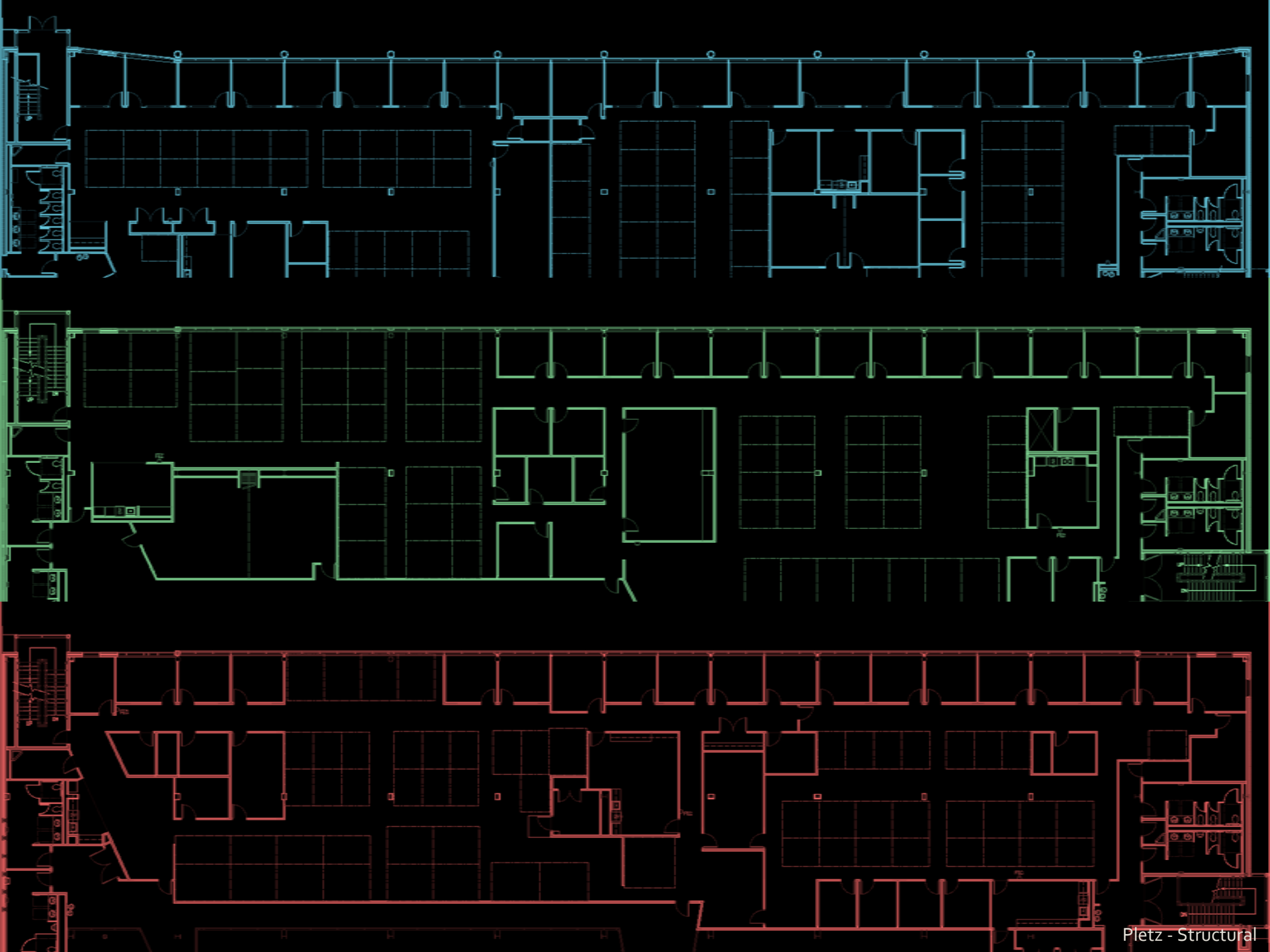
# Structural Study

- Existing Lateral System
  - Moment Frames
    - 11 in N-S Direction
    - 3 in E-W Direction
  - 102 fixed connections framing level

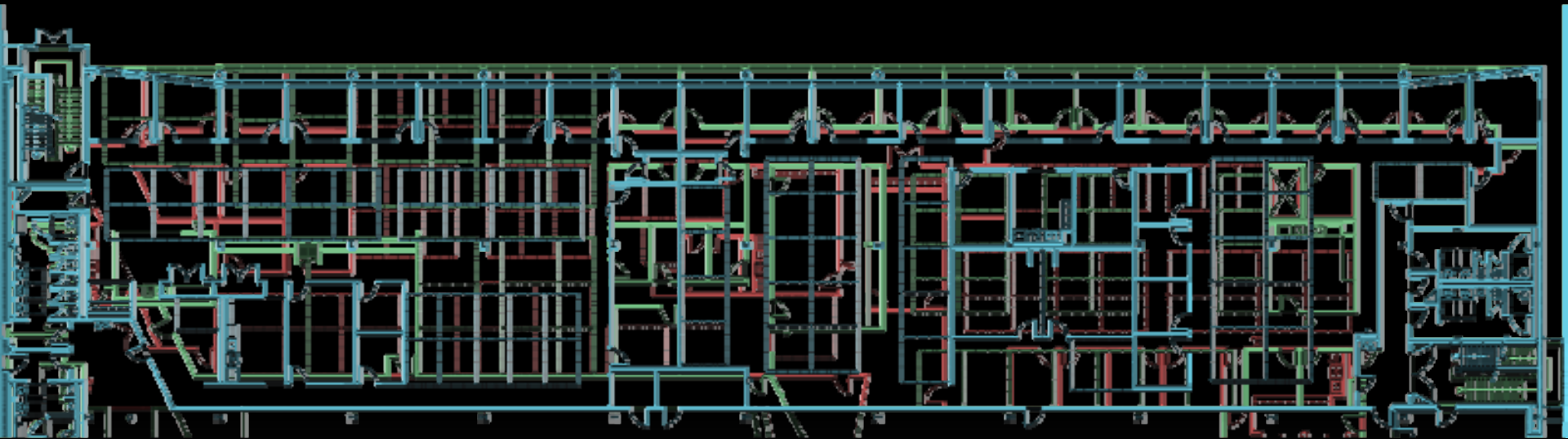


# Structural Study

- Redesign possibilities
  - Braced Framing
  - Shear Walls
  - Dual System
  - Reduction in Moment Frames



# Structural Study

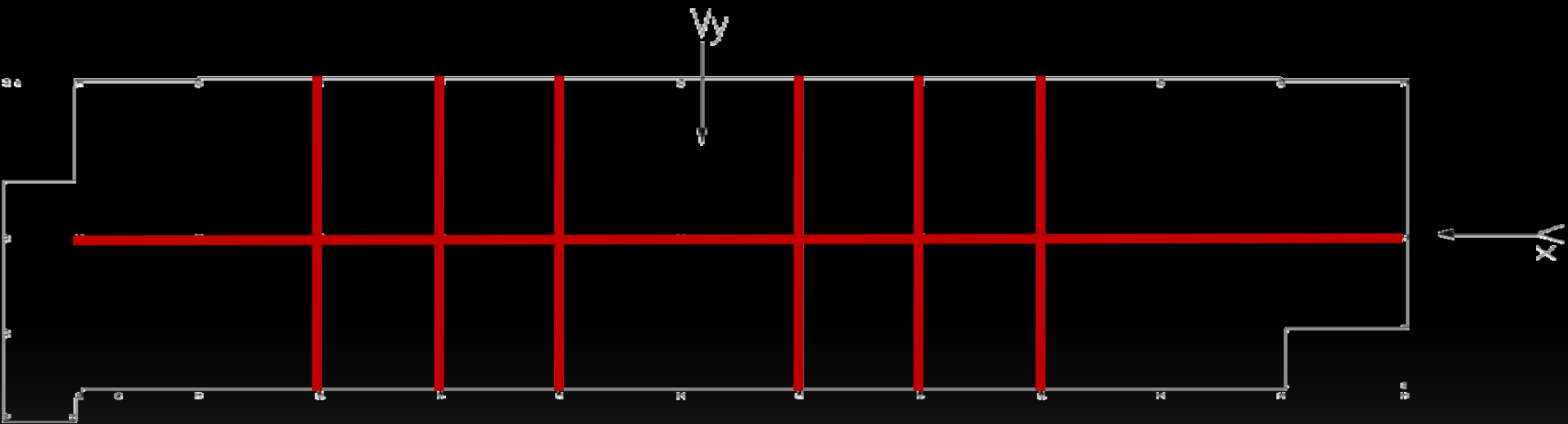


# Structural Study

- Redesign possibilities
  - ~~Braced Framing~~
  - ~~Shear Walls~~
  - Reduction in Moment Frames
    - ~~3 north-south frames~~
      - 6 north-south frames
    - 1 east-west frame

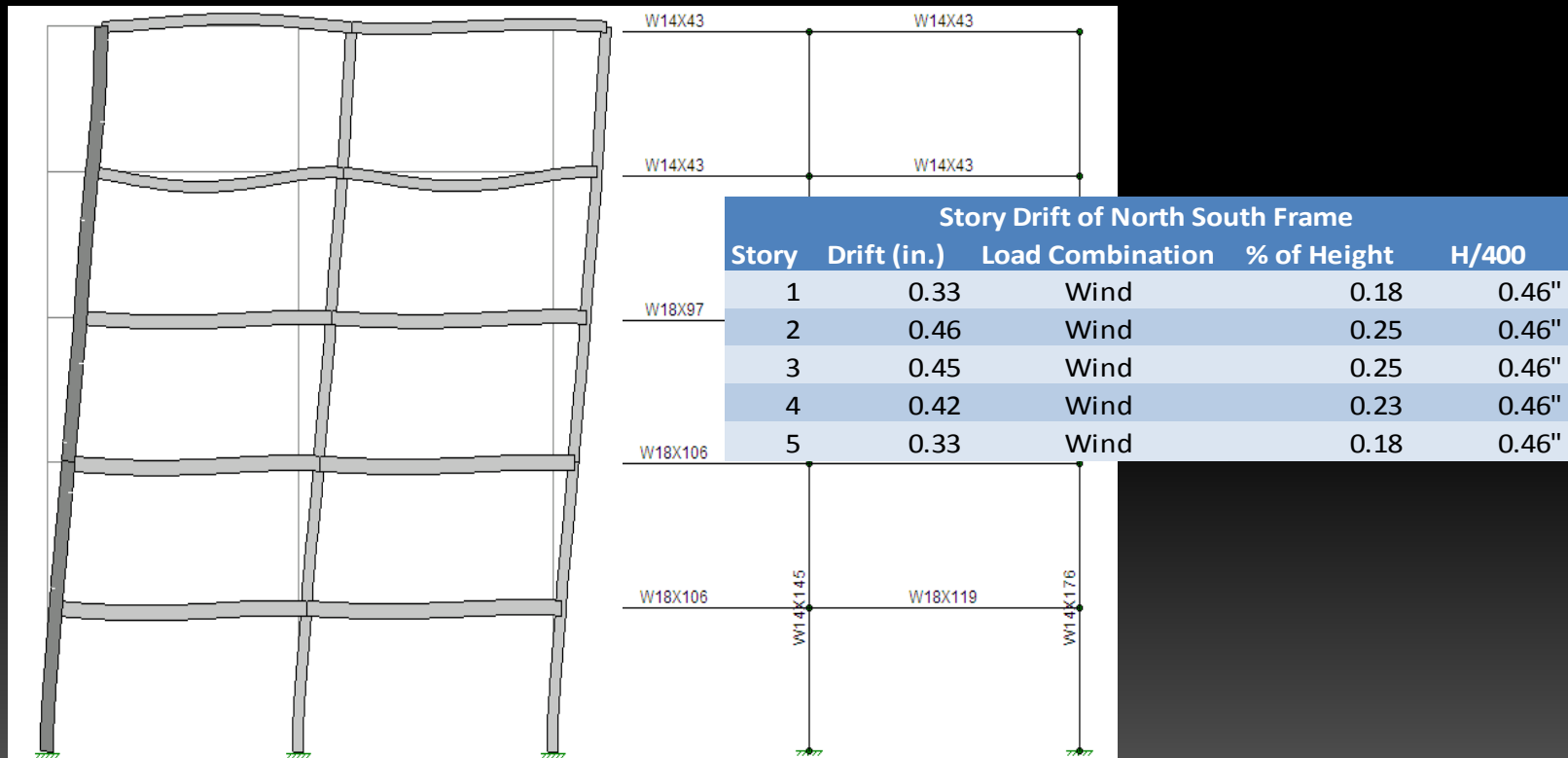
# Structural Study

- Redesigned Moment Frame Plan



# Structural Study

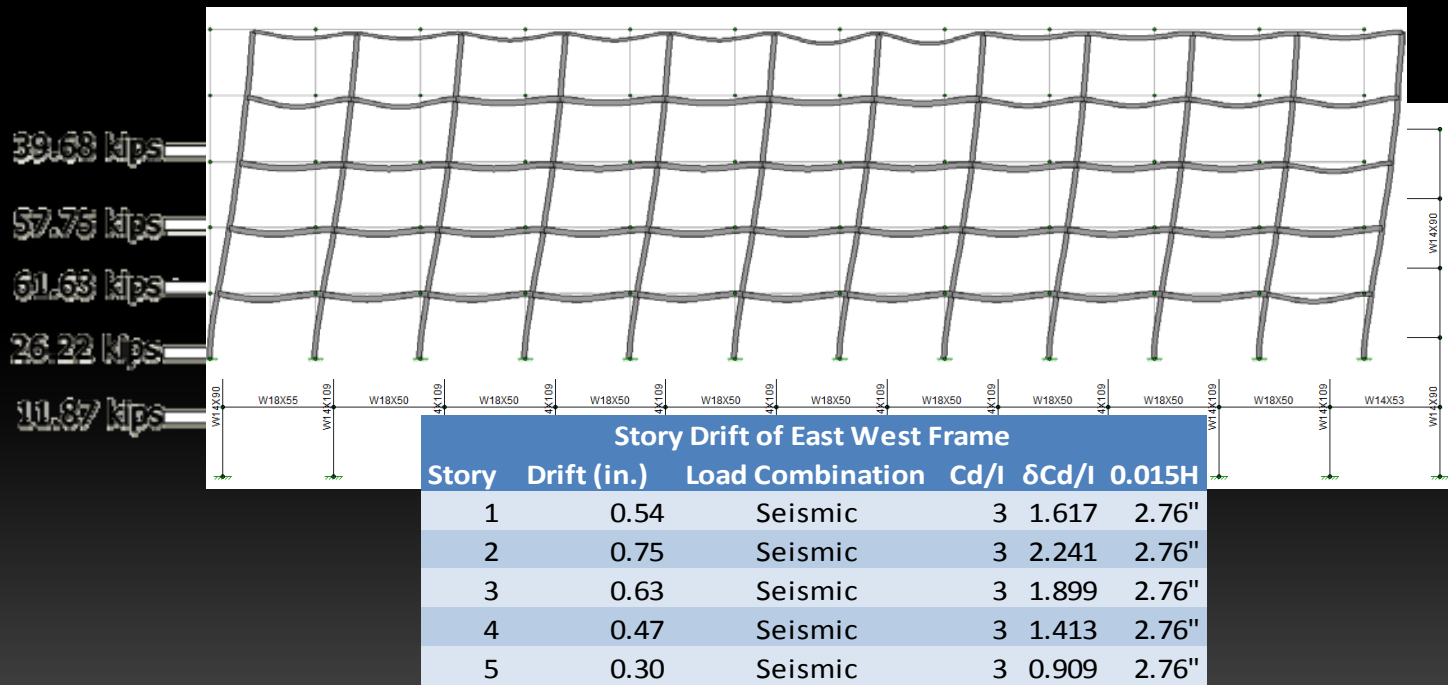
- Wind
  - Controlling Lateral Load for North-South Frames





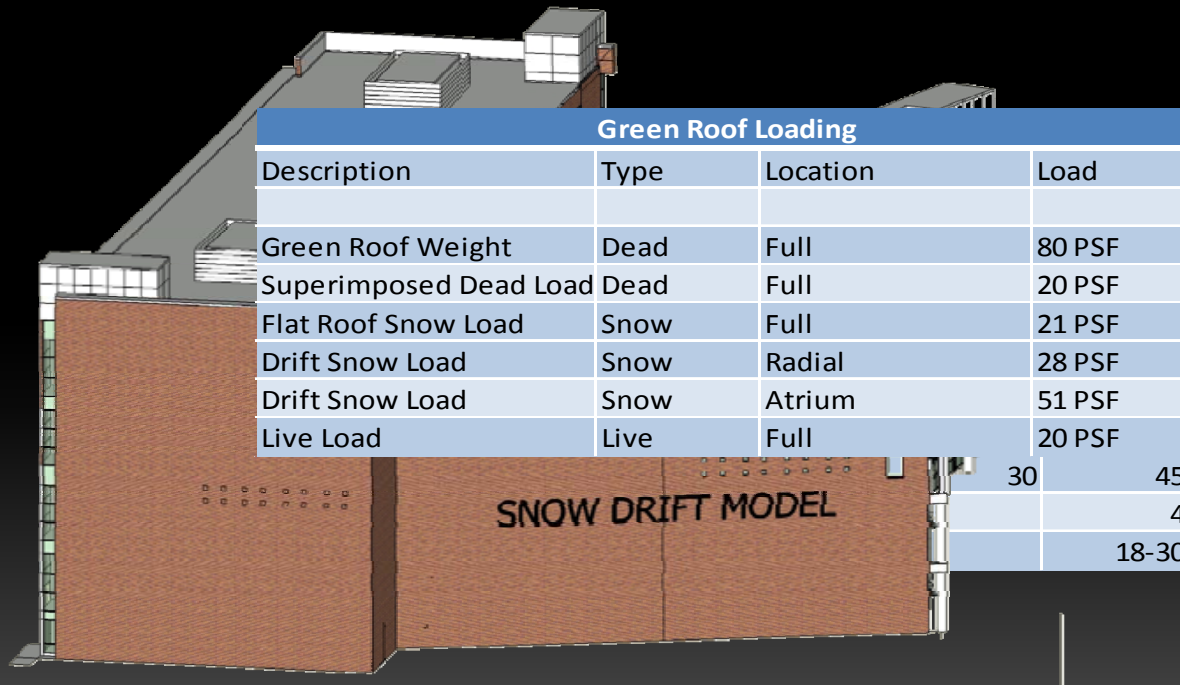
# Structural Study

- Seismic
  - Controlling Lateral Load for East-West Frame



# Structural Study

- ▣ Green Roof Framing
  - ▣ Loading







# Where We're Going...

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# Conclusions

- New Architecture provides needed additional space requirements for future growth
- Green Roof aesthetically pleasing and provides potential economic benefits
- Structural floor framing more efficient than original
- Decreased number of lateral frames
  - Frames much bigger than original
  - Original design still adequate
- Construction costs very close to original

# Acknowledgments

- **Prince William County Schools** for permission
- **Moseley Architects** for sponsorship
- **American Hydrotech** for all the green information that I could want
- **V.F. Pavone Construction** for multiple site visits
- **Dr. Hanagan and the structural faculty** for everything you have taught me
- **Professor Holland and all the consultants and mentors** for all the guidance through this research
- **All 2008 AE students** for always being around to help
- **Friends and family** for support, inspiration, and encouragement

**Thank you for your attention**

**Questions?**