UNIVERSITY HEALTH BUILDING
LOCATED IN THE MID-ATLANTIC REGION

THESIS FINAL PRESENTATION
EVAN LANDIS || STRUCTURAL OPTION
ADVISOR || HEATHER SUSTERISIC
**PROJECT INFO**

- Cost: $56 Million
- Size: 161,000 SF
- Floors: 7

**STRUCTURAL OVERVIEW**

**FOUNDATION**
- Spread footings
- Grade beam tie ins for basement retaining walls

**FLOOR SLABS**
- Two-way post tensioned slabs
  - $f'c = 6-8ksi$

**LATERAL SYSTEM**
- Concrete Moment Frames
- One Shear wall

**ROOF SYSTEM**
- Green roof on post tensioned slab
- White PVC membrane on post tensioned concrete slab

**OUTLINE**

- Introduction
- Structural Overview
- Proposal
- Lateral System Redesign
- Lateral System Cost
- Foundation Redesign
- Foundation Cost/Schedule
- Building Envelope
- Conclusion
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Thesis Proposal

Structural Depth
- Owners want to open a branch campus in Orlando, Florida

Scope
- Lateral System Analysis
- Foundations check

Cost/Schedule Analysis Breadth
- To determine the cost associated with the changes to the lateral and foundation systems
- Determine the increase to the building schedule due to changes

Building Envelope Analysis
- Determine the condensation point in a typical wall section
- Determine if the R-Value meets minimum standards for new location

MAE Requirements
- AE 530 Computer Modeling of Building Structures
- AE 542 Building Enclosure Science and Design
Structural Depth

**ETABS Model**
- All structural elements were modeled
- Modulus of Elasticity was halved to allow for the inelastic response of concrete members
- Live Loads and Superimposed Dead Loads were placed on the model
- Floor Slabs modeled as rigid diaphragms
- Shear walls modeled as membrane elements
**OUTLINE**

Introduction
Structural Overview
Thesis Proposal
Lateral System Redesign
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Conclusion

**ORIGINAL LATERAL SYSTEM**
- Designed for seismic loading
- Very few moment frames due to column discontinuities

**STORY FORCES**

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**Foundation**

- 48,000 ft
- $650,000

**BUILDING ENVELOPE**

Legend:
- NS Moment Frames
- EW Moment Frames
- EW Shear Wall
LATERAL SYSTEM ADDITIONS
- Designed for wind velocity of 145mph (Orlando Building Code)
- Addition of (7) 12” thick shear walls of varying lengths
- Alterations to existing shear wall
- h/400 = 3.3”

STORY FORCES

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<thead>
<tr>
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<th>Force</th>
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113,000ft - 2000k

Building Envelope

Conclusion
STRUCTURAL DEPTH

LATERAL SYSTEM ADDITIONS
- Designed for wind velocity of 145mph (Orlando Building Code)
- Addition of (7) 12” thick shear walls of varying lengths
- Alterations to existing shear wall
- \( h/400 = 3.3" \)

<table>
<thead>
<tr>
<th>Original System</th>
<th>New System</th>
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<td>South</td>
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<tr>
<td>West</td>
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STORY FORCES

EAST-WEST

Foundation Redesign
Foundation Cost/Schedule
Building Envelope
Conclusion
**SHEAR WALL DESIGN**
- Designed with boundary elements
- Walls of same length designed with same rebar configuration for ease of construction
- Typ. (6) or (8) #9’s or #10’s in boundary element
- #5’s @ 12” Vertical
- #5’s @ 12” Horizontal

**Boundary Element**
Temperature/Shrinkage and Shear Reinforcing
SHEAR WALL PLACEMENT
- Main goal was to not disrupt the architectural flow of the building
- Could not be avoided entirely
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COST/SCHEDULE BREADTH

SHEAR WALL COST INCLUDES
- 4-10ksi concrete
- Rebar
- Formwork
- Pumping

SHEAR WALL SCHEDULE: Negligible

<table>
<thead>
<tr>
<th>Wall</th>
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<th>Thickness (ft)</th>
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119,000

OUTLINE

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STRUCTURAL DEPTH

ORIGINAL FOUNDATION
- Spread footings
- Soil Bearing Capacity: 30ksf bedrock
- Typical sizes: 6x6, 5x4, 9x9
- $f'_c = 5$ksi

GOALS
- Design new spread footings for single shear walls and typ. column
- To determine percent increase to size
STRUCTURAL DEPTH

FOUNDATION DESIGN
- Trial 1: Spread footings on soil: 2-3ksf
  - Not suitable for loading
- Trial 2: Spread footings on structural fill: 8ksf
  - Typ. Column: 12x12
  - Typ. Shear Wall: no good
- Trial 3: 50ft Caissons: 20ksf bedrock

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<th>Caisson Foundation</th>
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<td>Column</td>
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Sandy Soil

Structural Fill

Bedrock
COST/SCHEDULE BREADTH

FUNDAMENTAL COST INCIHDES
- 3ksi concrete caisson
- 5ksi concrete cap
- Casing and Pumping
- Excavation
- Mobilization
- Haul excess excavation
- Inspection
- Equipment

FOUNDATION SCHEDULE
- 1 caisson per column
- 2 caissons per shear wall
- Original number of spread footings

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<th>Amount</th>
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<th>Days Needed</th>
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Cost/Schedule Breadth

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BUILDING ENVELOPE BREADTH

CONDENSATION ANALYSIS

To determine if typical wall section will work in the humid Orlando Climate
Building Envelope Breadth

R-Value Analysis
- ASHRAE 90.1 Energy Standard for Buildings
- R-Value does not include Terra Cotta

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<th>Location</th>
<th>Climate Zone</th>
<th>Required R-value (h<em>ft^2</em>F/BTU)</th>
<th>R-value of wall assembly (h<em>ft^2</em>F/BTU)</th>
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R-Values
CONCLUSION

LATERAL SYSTEM
- 7 new shear walls
- 1 updated shear wall

FOUNDATION
- Change from spread footings to caissons

BUILDING ENVELOPE
- No changes necessary

COST
- Shear Walls $119,000
- Foundations $571,000
  Total $690,000
QUESTIONS?

Special Thanks to the ones that made this possible:

PENN STATE
ae
WT
PAYETTE
## Appendix

### West Wall

<table>
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<tr>
<th>Story</th>
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<th>Thr. Height</th>
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### Wind Drift: North-West

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# APPENDIX

## Appendix 1

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[Diagram of a garden bed layout](image)