LOYOLA INTERCOLLEGIATE ATHLETIC COMPLEX

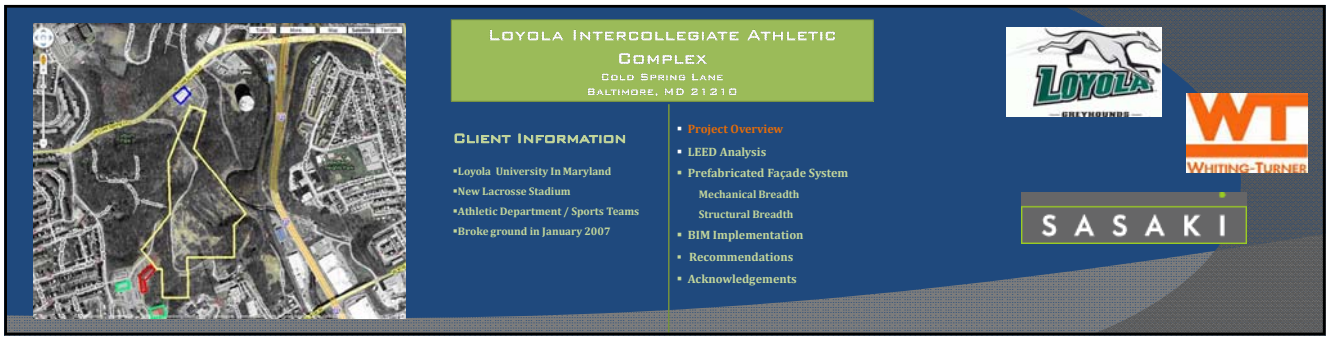
AE Senior Thesis 2010
Steven Rogers
Construction Management

Loyola Intercollegiate Athletic Complex

Cold Spring Lane
Baltimore, MD 21210

Outline

- Project Overview
- LEED Analysis
- Prefabricated Façade System
  - Mechanical Breadth
  - Structural Breadth
- BIM Implementation
- Recommendations
- Acknowledgements


LOYOLA INTERCOLLEGIATE ATHLETIC COMPLEX
COLD SPRING LANE
BALTIMORE, MD 21210
CLIENT INFORMATION
•Loyola University In Maryland
•New Lacrosse Stadium
•Athletic Department / Sports Teams
•Broke ground in January 2007
▪ Project Overview
▪ LEED Analysis
▪ Prefabricated Façade System
Mechanical Breadth
Structural Breadth
▪ BIM Implementation
▪ Recommendations
▪ Acknowledgements
LOYOLA
WHITING-TURNER
SASAKI


LOYOLA INTERCOLLEGIATE ATHLETIC COMPLEX
COLD SPRING LANE
BALTIMORE, MD 21210
PROJECT INFORMATION
•Gross Area: 41, 520 Square Feet
•Upper and Lower Grandstands:5, 966 people
•4 Stories: 2 locker rooms & Offices, Concession Level, Presidential Suite & Press Boxes
•2 Artificial Grass Fields & 1 Grass field
•5 VRSS Slopes : 60- 110 ft Tall
▪ Project Overview
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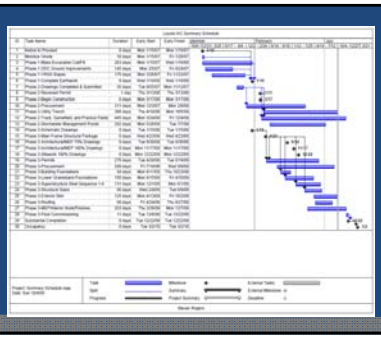
ARTIFICIAL GRASS FIELDS
VRSS-3



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Schedule & Cost

(3) Year Project

$ 54 million

- Project Overview
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Loyola IAC: Costs			
	Cost	Total SF	Cost/SF
Construction Cost	$20,237,252	41,520	$487.41
Building Cost	$28,189,112	41,520	$678.93
Total Project Cost	$53,872,347	41,520	$1297.50

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Analysis 1
LEED

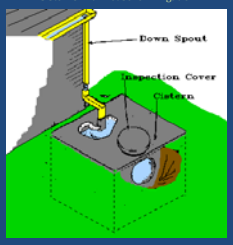
Overall Problem Statement

Loyola IAC is not seeking any LEED rating from the US Green Build Council (USGBC).

Goal

Demonstrate that LEED could have been achieved on this project.

Cisterns with Reuse for Irrigation



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Interview Results

- Loyola
  - LEED Future
- Schedule
- Cost
  - Example: Four Pipe System vs. PTAC
- Manpower
- Recycled Material
- Local Materials (500 mile radius)

Recycled Rubber for track and field infill

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- Almost Half Points Came From Sustainable Sites and Water Efficiency
- 49 Total Points – LEED Certified
- 58 Points Possible – LEED Silver

LEED v3.0

- Project Overview
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LEED Conclusion

- Interviews
- Research
- Recommendations
- LEED Certified

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West & East Elevations

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Analysis 2
Precast Concrete System

Overall Problem Statement

The hand laid brick takes a considerable amount of time to construct, takes up room with the scaffolding, and leaves room for error between trades

Goal

To shorten the schedule, determine the added costs, calculate the added structural load, and to analyze the mechanical properties.

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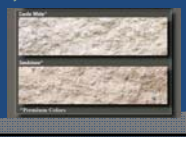
System Selection

- Old Wall System
- High Concrete
- System Color



- Project Overview
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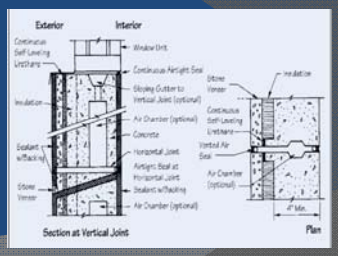

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Erection Time?	21 days	49 days
Lead Time?	30 days	45 days

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Schedule

- Original Duration
  - 49 days
- New Duration
  - 21 days
- Time Savings
  - 4 Weeks
- General Conditions Savings
  - $58, 912

- Project Overview
- LEED Analysis
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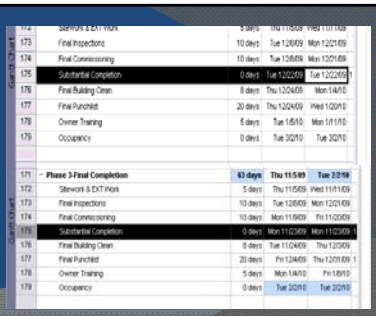

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Cost of system?	$45.64/SF, which includes material, crane costs, and installation costs.	$17.22, which includes split face CMU and labor.

Cost

- 27,713 SF of Facade
- Cost Comparison
- Savings
- Cost Summary

System Type	Cost/SF	Total Cost
Prefabricated System	$45.64	$1,264,821
Hand Laid Brick	$17.22 (From Contract)	$477,250
$ Difference		$787,571
% Difference of Building Facade		165.7 %
% Difference of Total Project Cost		1.4 %

Summary	
Total Added Cost of system	$787,571
Total of Credits and General Conditions	$99, 677
Total Cost	$687,894
Total % Difference of Building Facade	144 %
Total % Difference of Total Project Cost	1.27 %

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Mechanical Breadth Introduction

- Goal
- U-Value
  - Parallel Material Calculation Method
  - R-Value
- Heat Transfer

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Original Layers	R-Value ((hr x ft² x °F)/BTU)
Exterior Air Film	.17
4" Face Brick	.8
1.5" Air Space	.93
2" Rigid Insulation	10
5/8" Gypsum Board	.56
Framing Cavity	9
½" Gypsum Board	.45
Interior Air Film	.68
Total	22.59
U-Value	.044

R & U-Values

- Original
- Precast Concrete System

- Project Overview
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Precast Concrete Layers	R-Value ((hr x ft² x °F)/BTU)
Exterior Air Film	.17
12" Concrete	.96
2" Batt Insulation	12
Interior Air Film	.68
5/8" Gypsum Board	.56
Framing Cavity	9
½" Gypsum Board	.45
Total	23.82
U-Value	.042

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Estimated Heat Gain (Summer)	U-Value (BTU/hr*SF*°F)	Area (SF)	ΔT (°F)	Heat Loss (BTU/hr)
Prefabricated Split Face System	.042	10,296	22	9513.5
Original Spit Face Façade	.044	10,296	22	9966.5
			Difference	453
			Reduction in Heat Gain	4.5%

Estimated Heat Loss (Winter)	U-Value (BTU/hr*SF*°F)	Area (SF)	ΔT (°F)	Heat Loss (BTU/hr)
Prefabricated Split Face System	.042	10,296	60	25945.9
Original Spit Face Façade	.044	10,296	60	27181.4
			Difference	1235.5
			Reduction in Heat Loss	4.5%

Comparisons

- Heat Gain
  - H = A x U x ΔT
- Heat Loss
  - H = A x U x ΔT
- Overall Reduction

*Different ΔT for heat gain and heat loss

- Project Overview
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Summer Temperatures	°F
T_o	93 (99.6%)
T_i	71
ΔT	22

Winter Temperatures	°F
T_o	11 (99.6%)
T_i	71
ΔT	60

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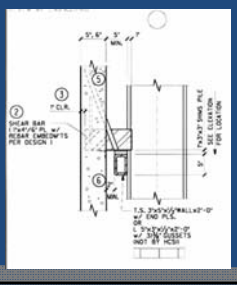

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Structural Breadth Introduction

- Goal
- Existing Loads
- Connection Details
- Hand Calculations
- Redesign

- Project Overview
- LEED Analysis
- Prefabricated Façade System
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  - Structural Breadth
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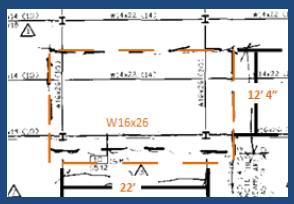

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Exterior Beam Calculation

- Design
  - ΦMn >Mu
- Total Design Load
  - Mu
  - Mtotal
- Redesign
- Hand Calculations

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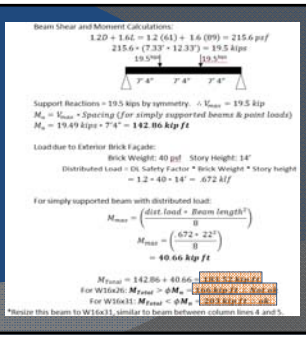

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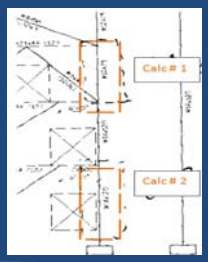

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Exterior Column Calculation

- Design
  - ΦcPu >Pu
- Total Design Load
  - Pu
  - ΦcPu
- Hand Calculations

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Exterior Column:

$KL = 1 * 14 = 14$ *(column sizing from AISC manual)*

Live Load Reduction for Calculation 1:

$$LL_r = LL\left(.25 + \left(\frac{15}{\sqrt{K_{LL} \times A_T}}\right)\right)$$

$$LL_r = 180\left(.25 + \left(\frac{15}{\sqrt{4 \times 271 \times 3}}\right)\right)$$

$LL_r = 180 * .51$ $(.51 > .4 \therefore ok$

$LL_r = \mathbf{92.3\ psf}$

Axial Loading Calculations for W12x79:

$1.2D + 1.6L = 1.2\,(61) + 1.6\,(92.3) = 220.88\ psf$

*Axial Load = Tributary Area * Load*

$$Axial\ Load = \left(271\ sf * 3\ floors\right) * 220.88\ psf$$

$= \mathbf{179.6\ kips}$ *(excluding the facade)*

$$Axial\ Load_{facade} = \left(293.3\ sf * 3 floors\right) * 70 psf$$

$= \mathbf{61.6\ kips}$

Total Axial Load $= 241.2$ kips

$\therefore P_u = 836$ kips > 241.2 kips $= P_u$ $\therefore ok$

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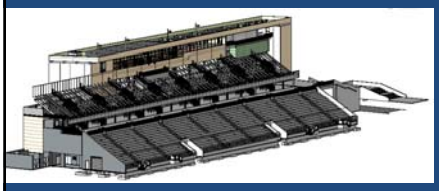
Precast Concrete Conclusion

- Cost & Schedule
- Mechanical Properties
- Structural Implications
- Recommendations



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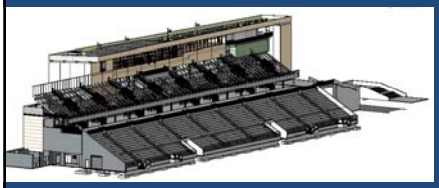
Analysis 3
BIM Analysis

Overall Problem Statement

Building Information Modeling (BIM) was only used on the MEP section of the project.

Goal

To identify different programs that could be used in the BIM process, create a 4D model in Synchro, create a Virtual Design and Construction Plan, and analyze some basic upfront cost impacts.



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Baltimore, MD 21210

Introduction

- Virtual Design and Construction Plan
- Synchro
- Costs

- Project Overview
- LEED Analysis
- Prefabricated Façade System
  - Mechanical Breadth
  - Structural Breadth
- BIM Implementation
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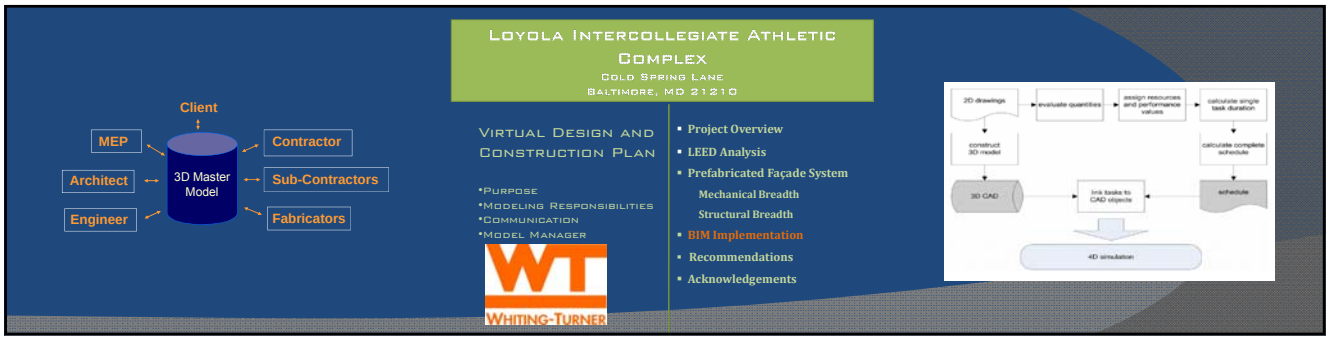
Client
MEP
Architect
Engineer
3D Master Model
Contractor
Sub-Contractors
Fabricators
Loyola Intercollegiate Athletic Complex
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Virtual Design and Construction Plan
•Purpose
•Modeling Responsibilities
•Communication
•Model Manager
WHITING-TURNER
▪ Project Overview
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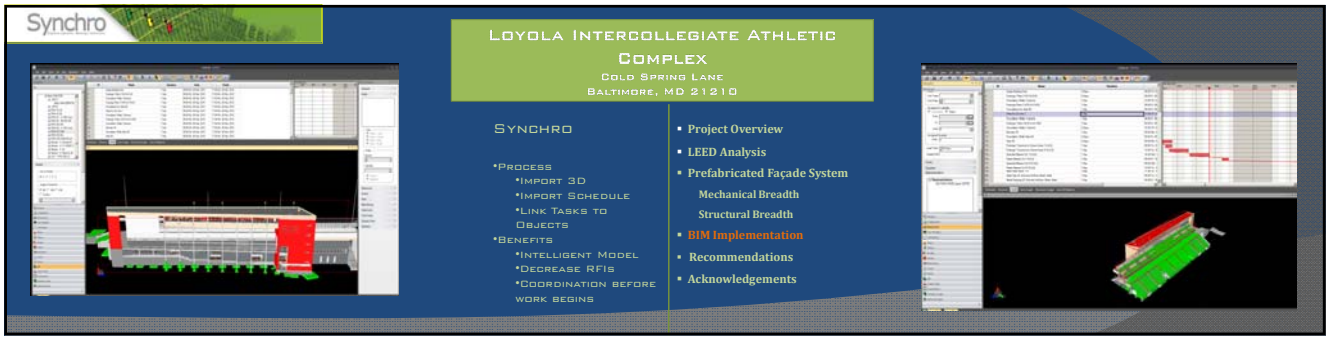
2D drawings
evaluate quantities
assign resources and performance values
calculate single task duration
construct 3D model
calculate complete schedule
3D CAD
link tasks to CAD objects
schedule
4D simulation


Synchro
Loyola Intercollegiate Athletic Complex
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Synchro
•Process
•Import 3D
•Import Schedule
•Link Tasks to Objects
•Benefits
•Intelligent Model
•Decrease RFIs
•Coordination before work begins
▪ Project Overview
▪ LEED Analysis
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Mechanical Breadth
Structural Breadth
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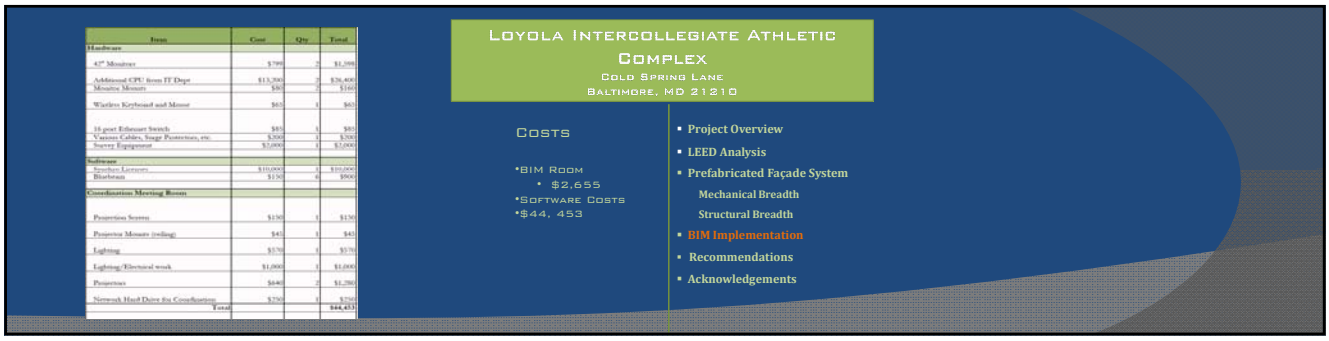
Item
Cost
Qty
Total
Hardware
42" Monitor
$799
2
$1,598
Additional CPU from IT Dept
$13,200
2
$26,400
Monitor Mounts
$80
2
$160
Wireless Keyboard and Mouse
$65
1
$65
16 port Ethernet Switch
$85
1
$85
Various Cables, Stage Pointerines, etc.
$300
1
$300
Survey Equipment
$3,000
1
$3,000
Software
Autodesk Licenses
$10,000
1
$10,000
Bluebeam
$130
4
$506
Coordination Meeting Room
Projection Screen
$130
1
$130
Projector Mounts (ceiling)
$45
1
$45
Lighting
$570
1
$570
Lighting/Electrical work
$1,000
1
$1,000
Projectors
$640
2
$1,280
Network Hard Drive for Coordination
$750
1
$750
Total
$44,453
Loyola Intercollegiate Athletic Complex
Cold Spring Lane
Baltimore, MD 21210
Costs
•BIM Room
• $2,655
•Software Costs
•$44, 453
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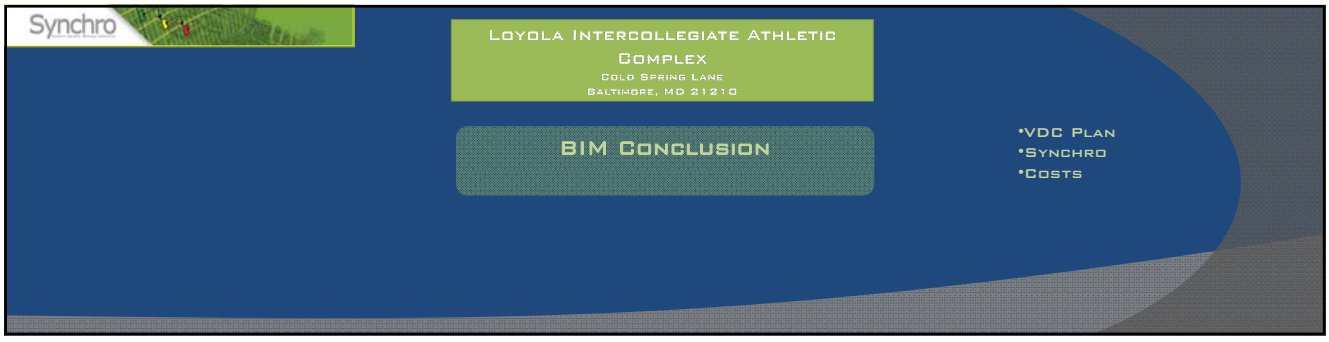
Synchro
Loyola Intercollegiate Athletic Complex
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BIM Conclusion
•VDC Plan
•Synchro
•Costs

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Overall Conclusion & Recommendations

- LEED Analysis
- Prefabricated Façade
- BIM Analysis

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Acknowledgements

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- Mr. Les Pely

RVA Architects
- Mr. Emmett VanRiper

All my family and friends for their continued support, especially Mom, Dad, and my Uncle Garret.

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Questions?