

CARDINAL WUERL NORTH CATHOLIC HIGH SCHOOL



ALEC HANLEY
CONSTRUCTION MANAGEMENT
CRANBERRY TOWNSHIP, PA
ADVISOR : RAY SOWERS

PROJECT OVERVIEW | Building Statistics

Project Overview

Prefabricated Masonry Panels

Breadths – Arch & Structural

Lifetime Costs of VE Finishes

Efficient/Effective FM Info Turnover

Alternative Roof Systems Analysis

Final Recommendations

Acknowledgements



Vatican Reviewed/Approved Design

SIZE | 177,129 SF

PROJECT COST | \$72.5 million

CONTRACT TYPE | GMP

DELIVERY METHOD | Design-Bid-Build, Multiple Prime, GC Lead with CM Agency

SCHEDULE | June 2012 – June 2014

OWNER | Catholic Diocese of Pittsburgh

GENERAL CONTRACTOR | Mascaro Construction Company

CM AGENCY | Campayno Consulting Services

ARCHITECT | Astorino

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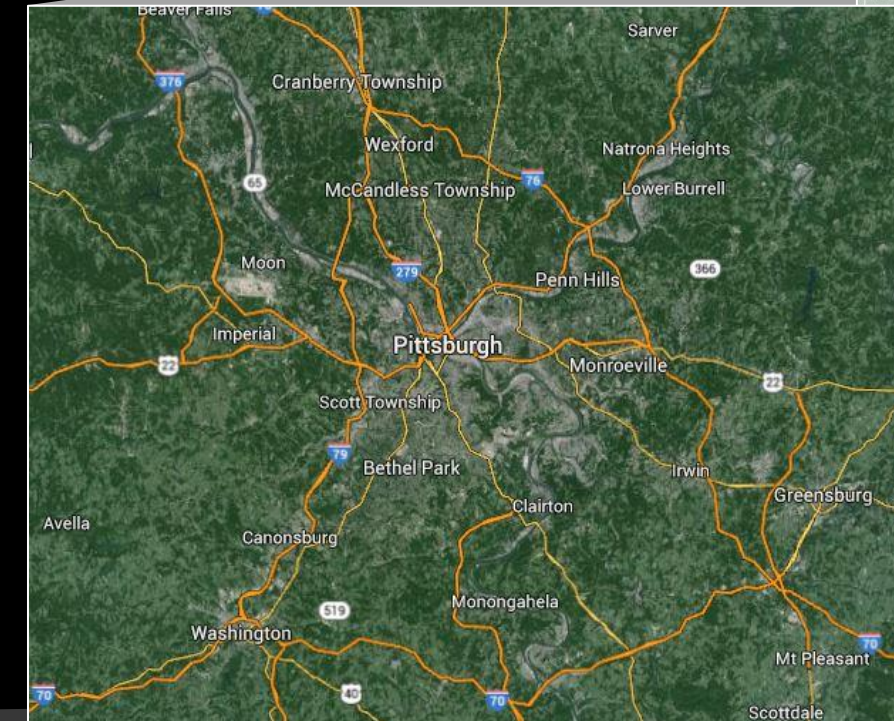
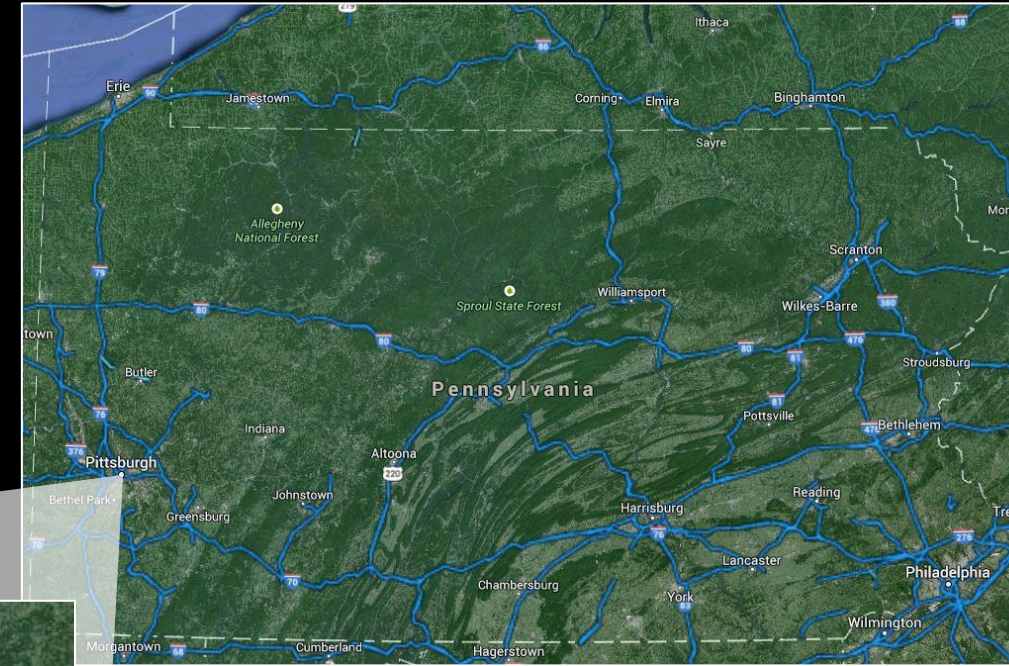
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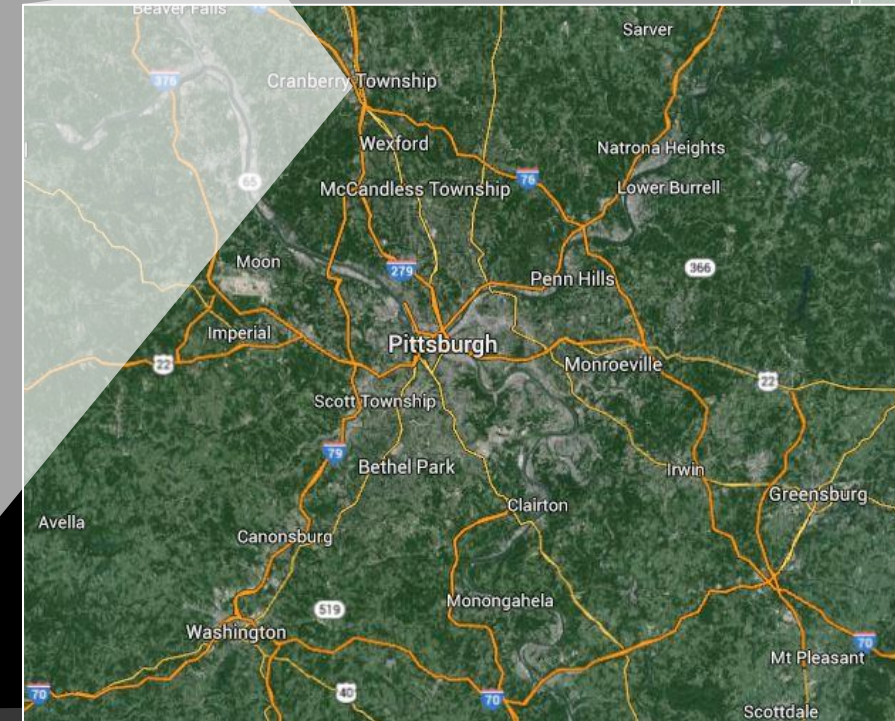
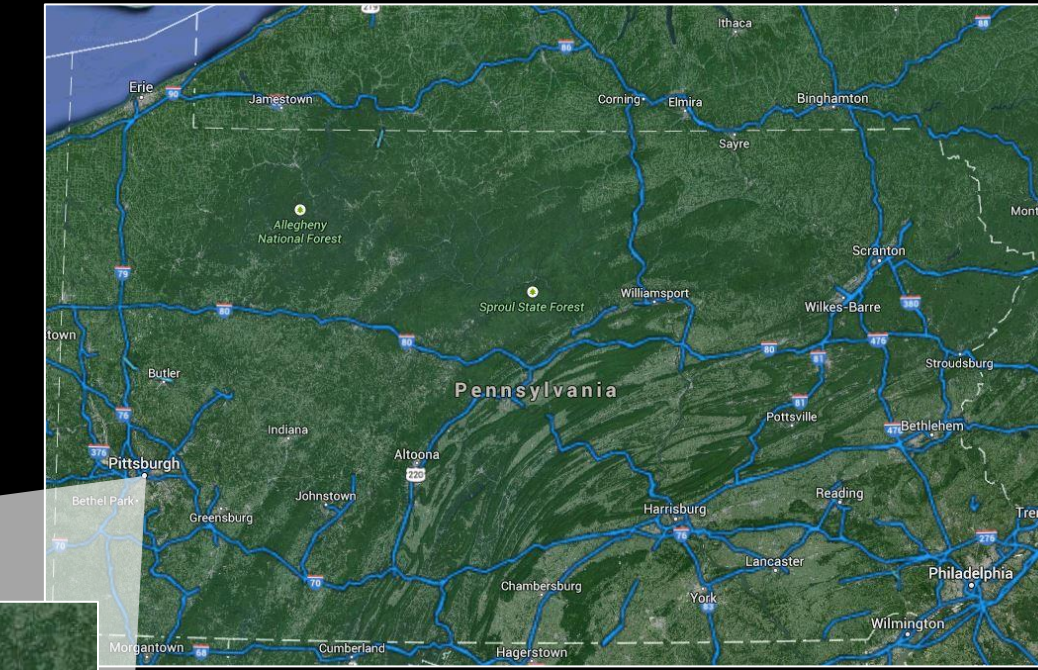
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PREFAB PANELS | Problem Identification

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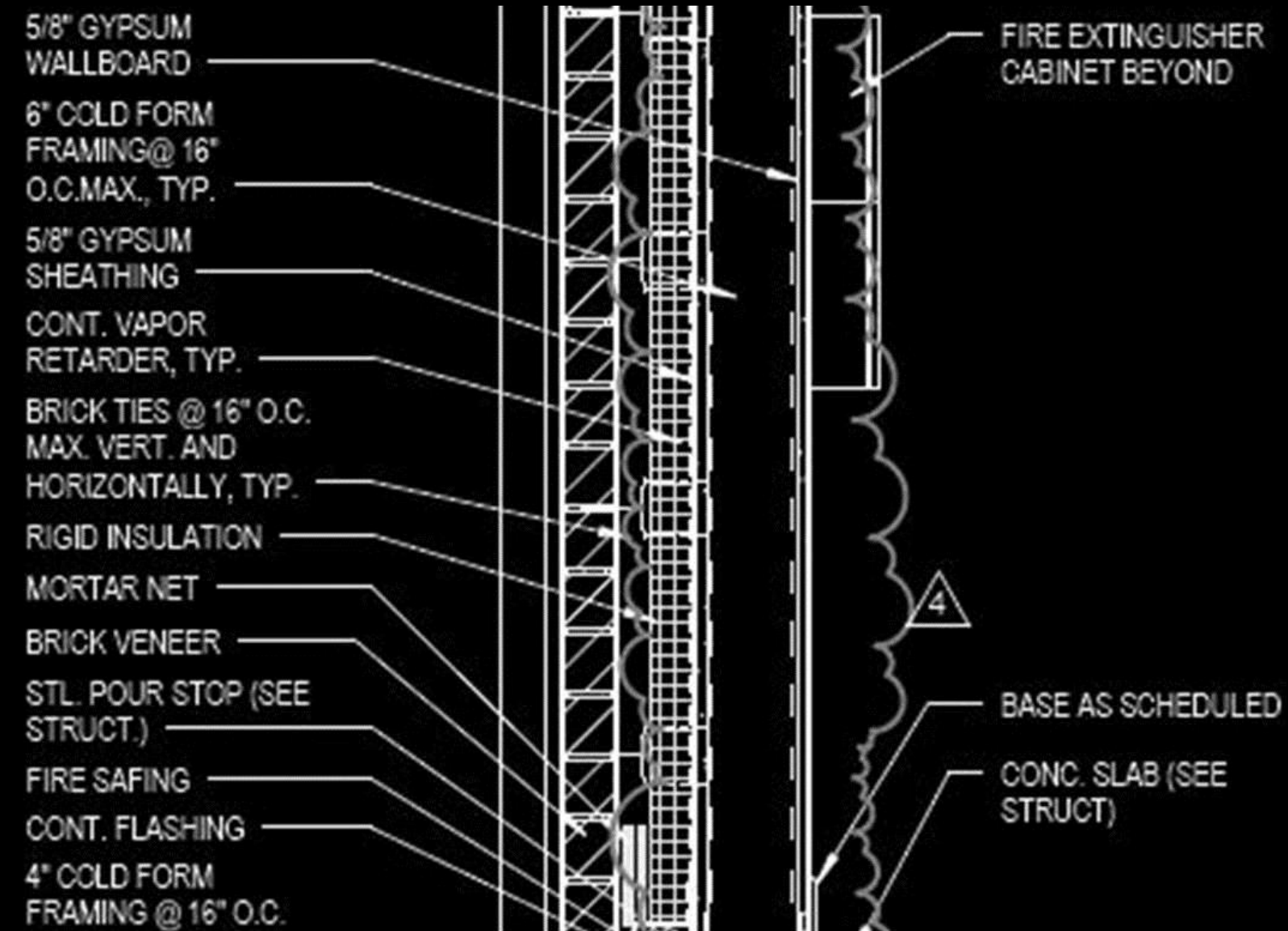
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Typical Wall Section

EXISTING SYSTEM

Stick-built cold-formed metal framing with sheathing, continuous vapor barrier, insulation and brick veneer

Congested building perimeter

- Scaffolding
- Equipment
- Manpower

\$1,516,000 to complete

Critical path item for 62 days

Safety Issues/QC Intensive

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Scaffolding Congestion – Area E North Elevation

EXISTING SYSTEM

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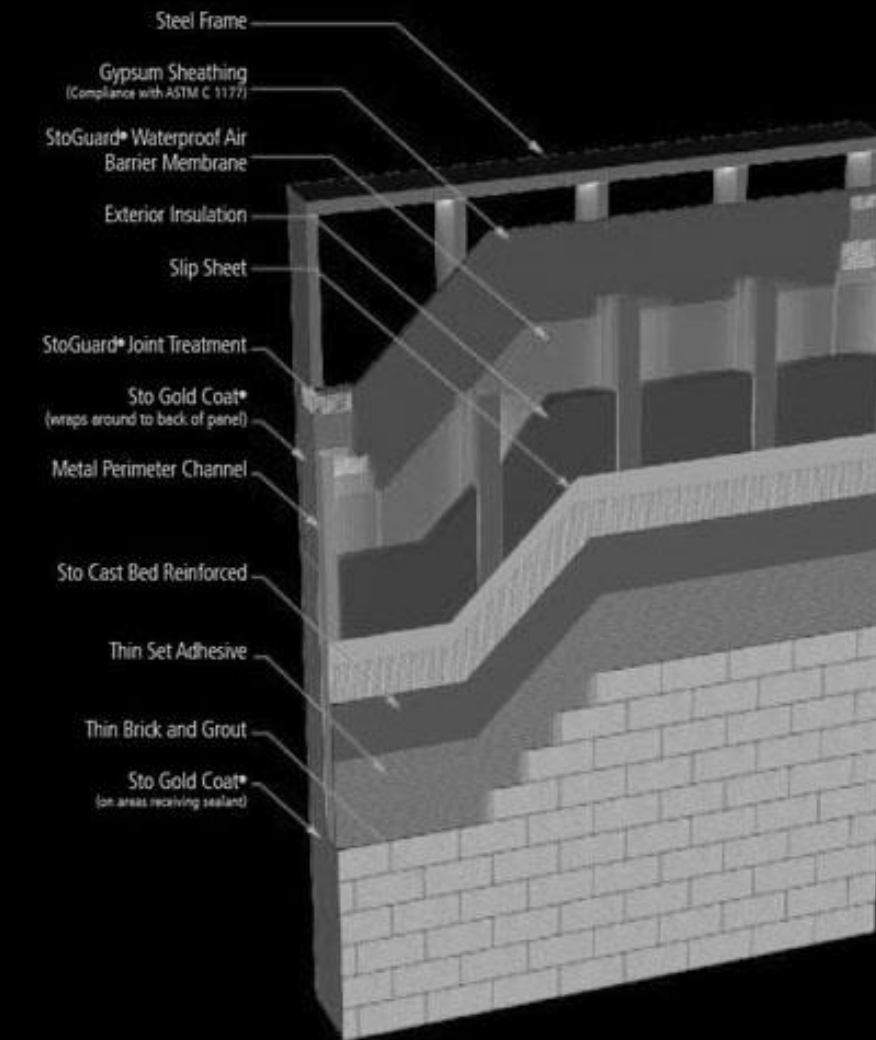
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Sto Panel Brick Insulated System



PREFABRICATED MASONRY PANELS

ADVANTAGES

Site Congestion Alleviated

Quick Installation Time = Schedule Reduction

Quality Control

Lightweight/Energy-Efficient

Finish Options

DISADVANTAGE

High Cost of Prefabrication

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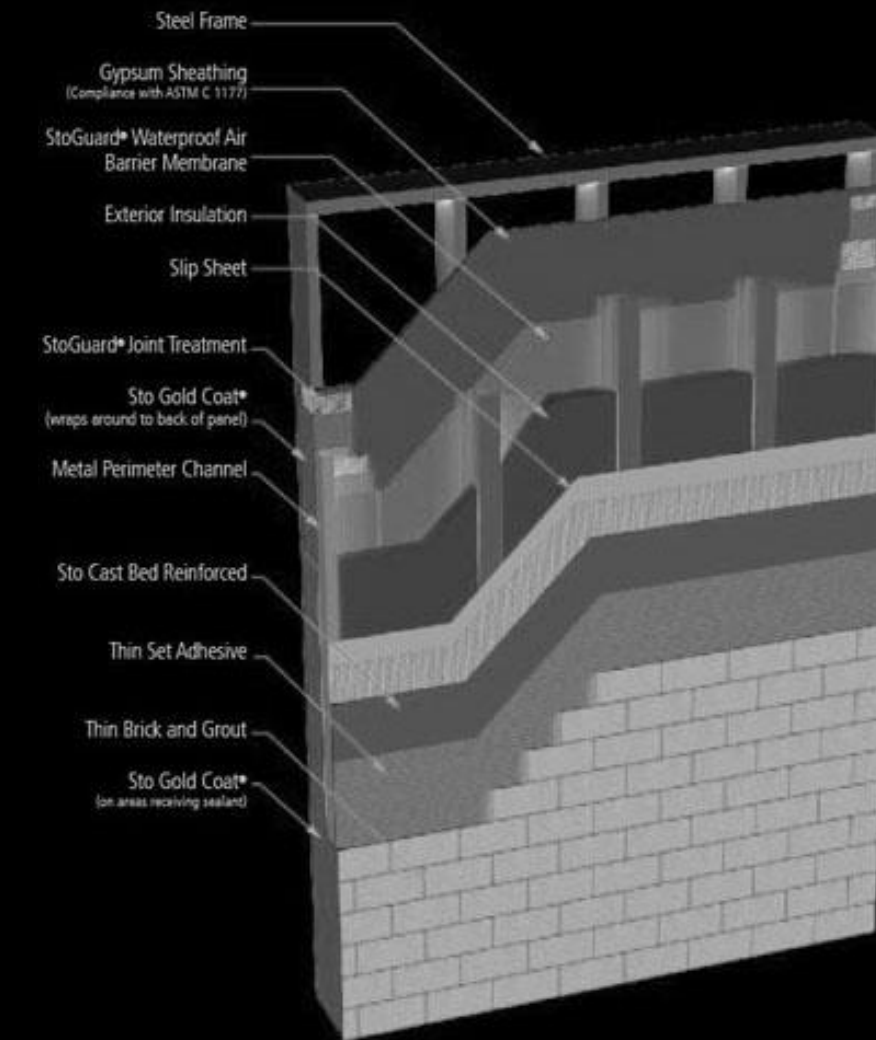
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Sto Panel Brick Insulated System



SYSTEM CONSIDERATIONS

Mechanical – Match R-Value

Architectural – Waterproofing & Air Barrier
• *Breadth #1 Topic*

Structural – Brick Veneer → Curtain Wall
• *Breadth #2 Topic*

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R-Value

ORIGINAL ASSEMBLY R-VALUE	
1. Exterior Air Film	0.17
2. 3-5/8" Brick	0.44
3. 1" Air Space	1.00
4. Thermax 3" Rigid Insulation	19.00
5. Continuous Air Barrier	-
6. Glass Mat Exterior Gypsum Wall Sheathing	0.57
7. 1/2" Interior GWB	0.45
8. Interior Air Space	1.62
TOTAL	23.25

Sto Panel Brick Insulated = R-30

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PREFAB PANELS | Architectural Breadth

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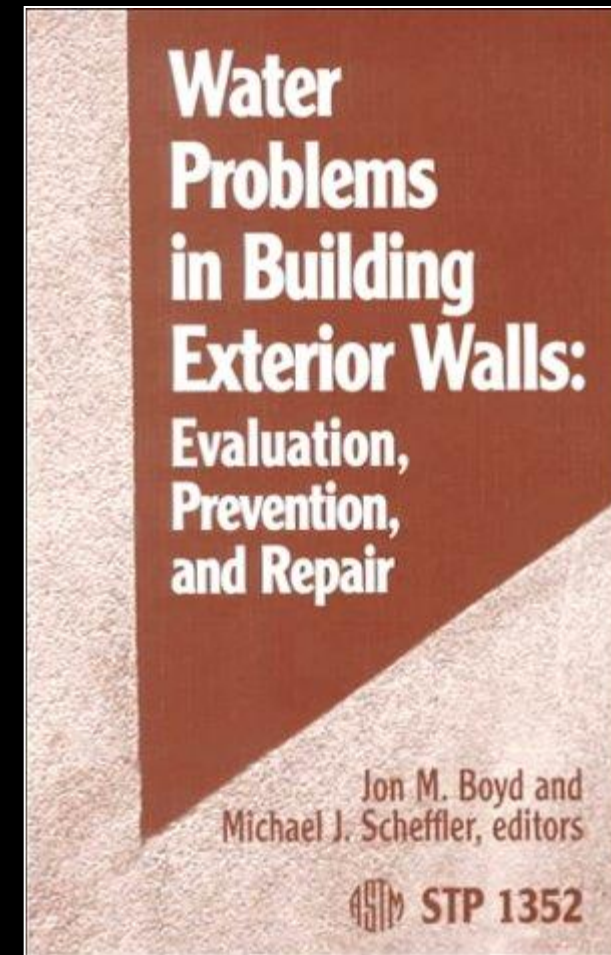
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Final Recommendations

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Waterproofing



FULLY DEVELOP DETAILS

- MEP Coordination
- Transitions & Corners

CONSIDER ALL FORCES OF WATER PENETRATION IN MASONRY CONSTRUCTION

PANEL-TO-PANEL JOINTS

SYSTEM CONSIDERATIONS

Mechanical – Match R-Value

Architectural – Waterproofing & Air Barrier

- *Breadth #1 Topic*

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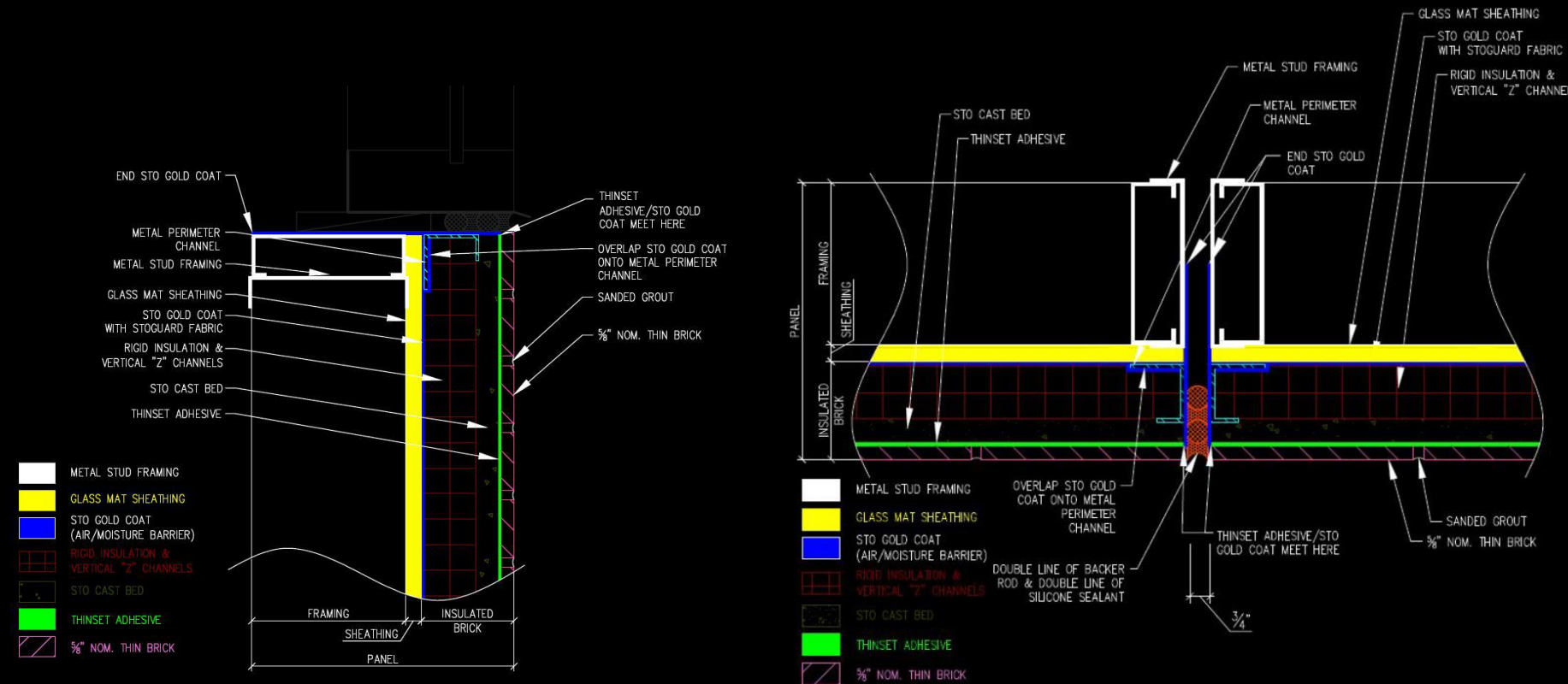
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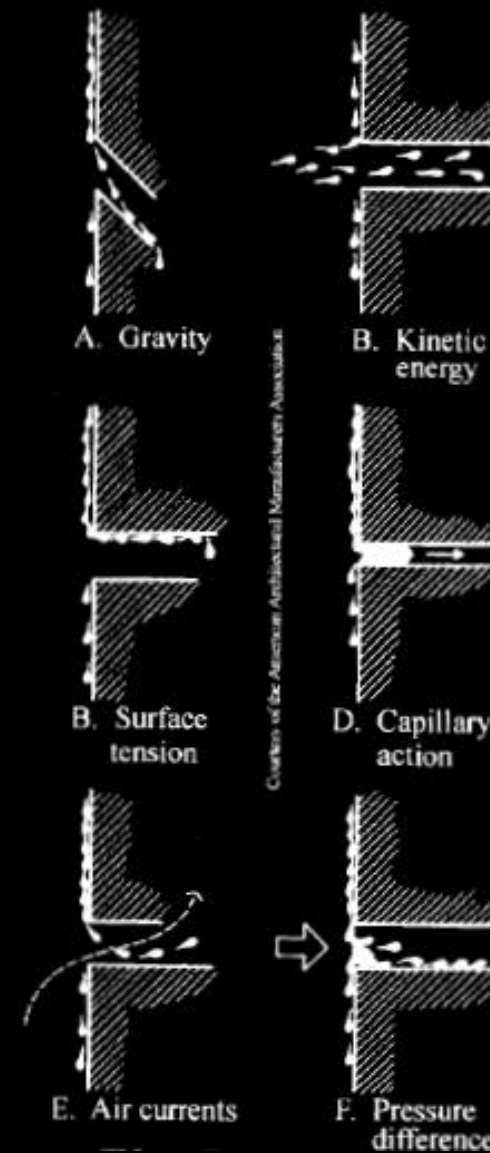


ASTORINO

Waterproofing



Sto Panel Details



- GRAVITY
- KINETIC ENERGY
- SURFACE TENSION
- CAPILLARY ACTION
- AIR CURRENTS
- PRESSURE DIFFERENCE

PREFAB PANELS | Architectural Breadth

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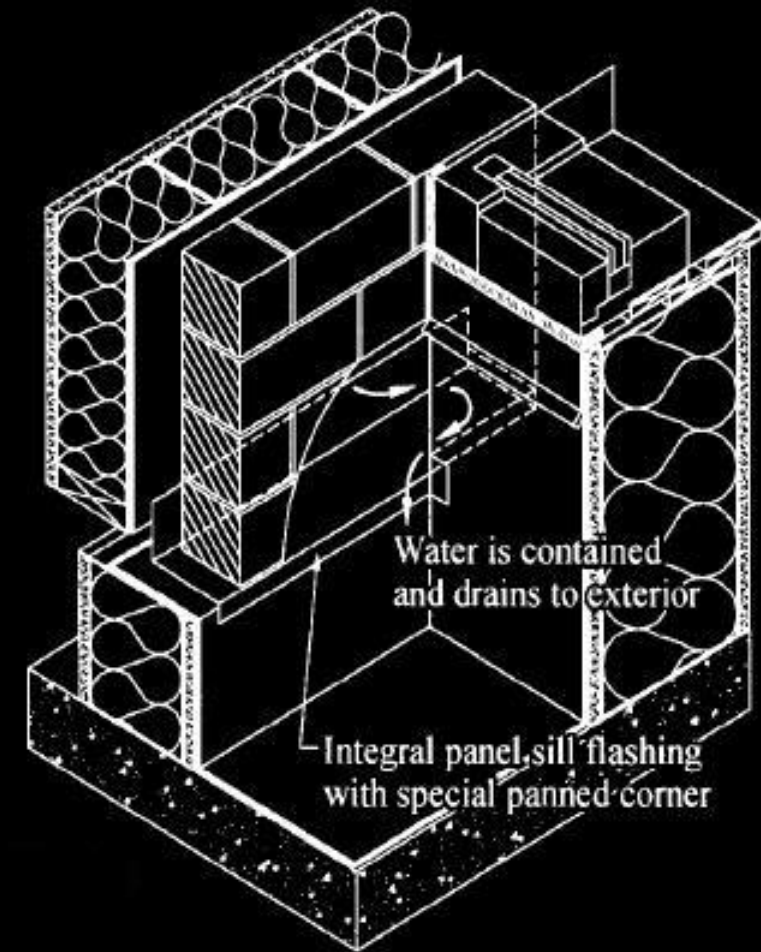
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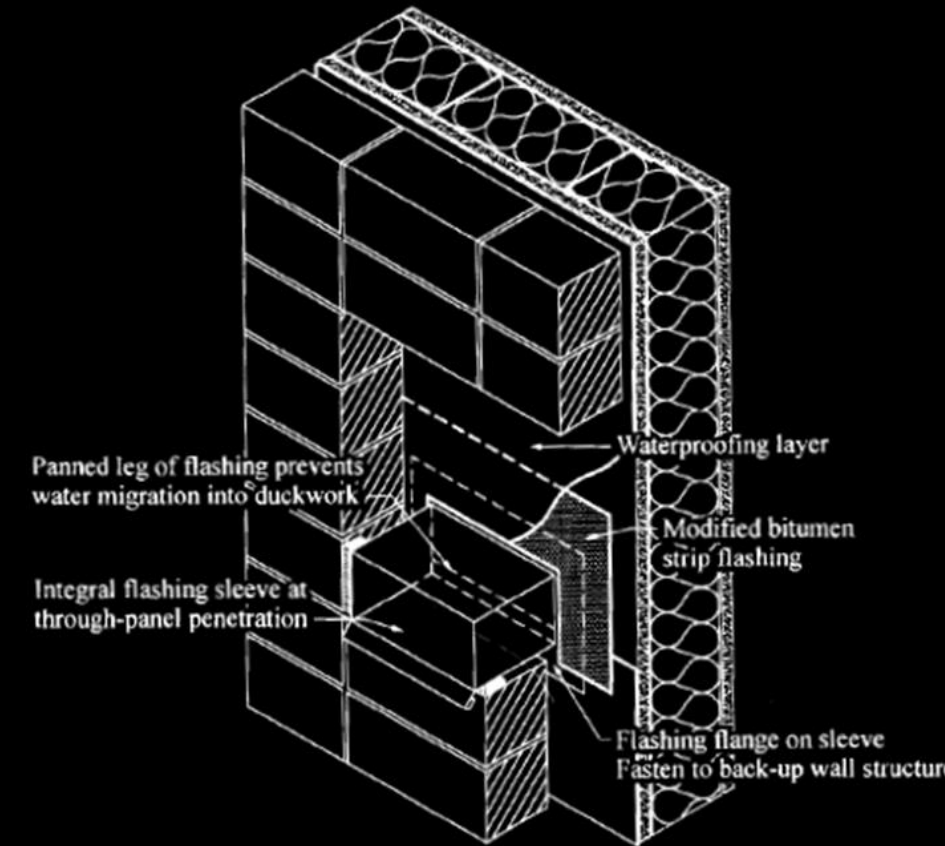
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Sill Flashing



MEP Penetration

Suggestions

Sto Gold Waterproof/Air Barrier Membrane

MEP Coordination

Sill Flashing at Corners

PREFAB PANELS | Structural Breadth

Project Overview

Prefabricated Masonry Panels

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Lifetime Costs of VE Finishes

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Alternative Roof Systems Analysis

Final Recommendations

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LOAD TRANSFER



SYSTEM CONSIDERATIONS

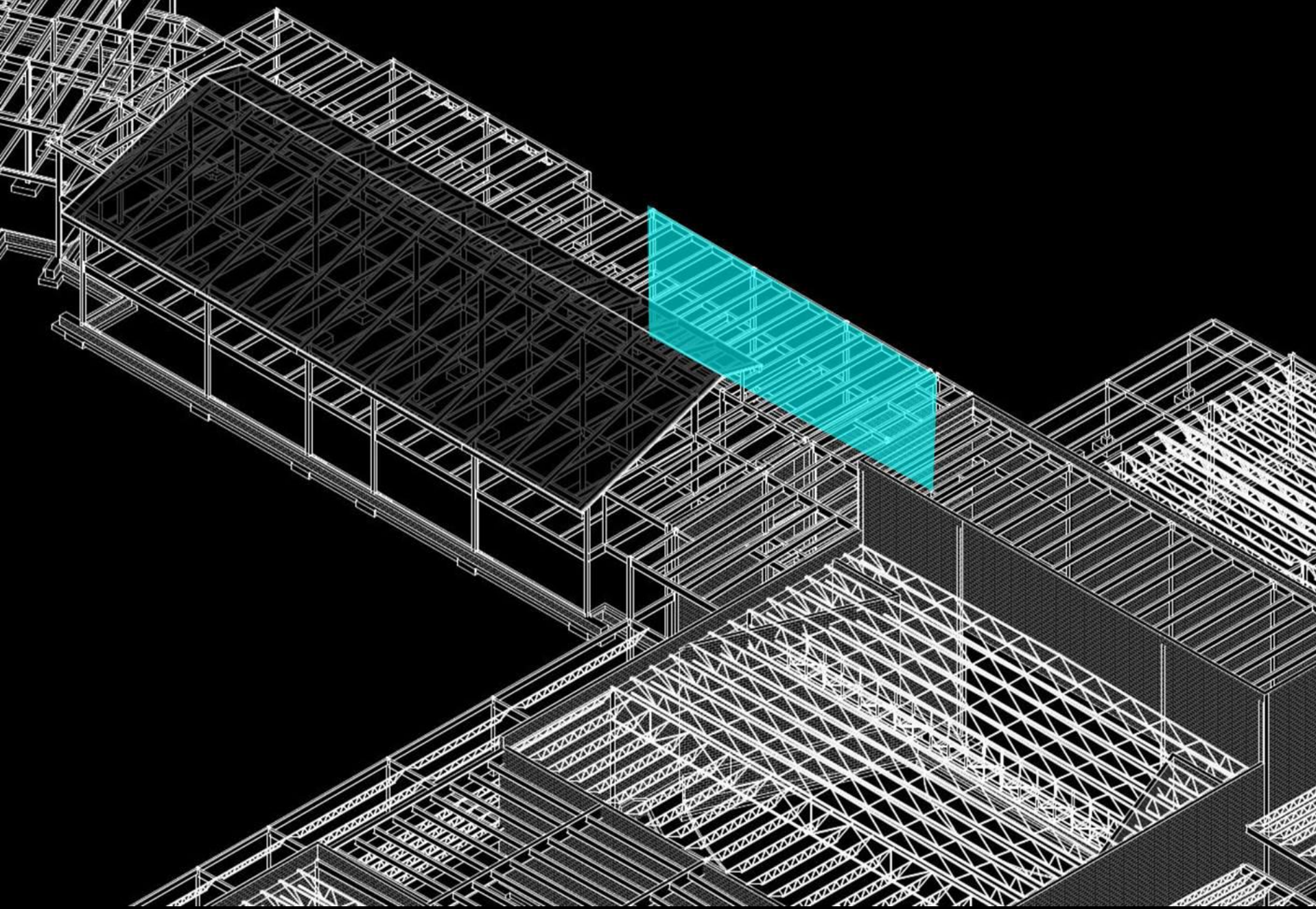
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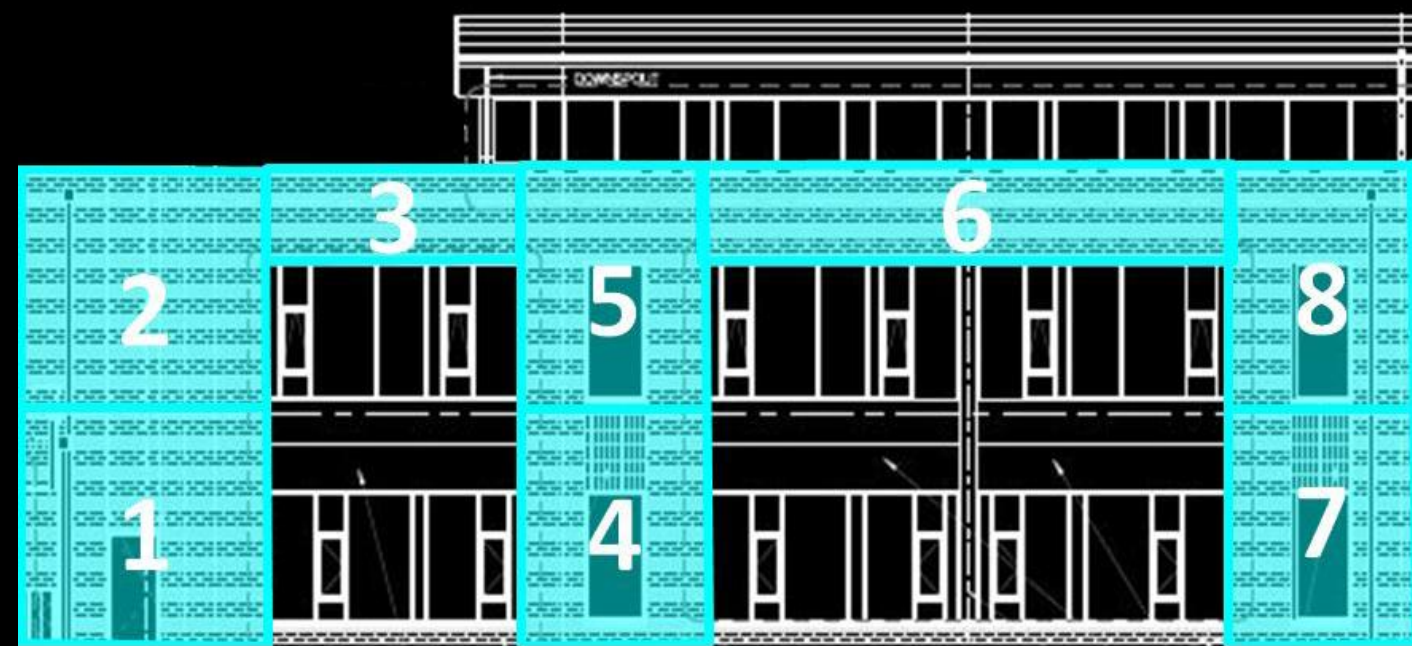
- Breadth #1 Topic

Structural – Brick Veneer → Curtain Wall

- Breadth #2 Topic



LOAD TRANSFER



SYSTEM CONSIDERATIONS

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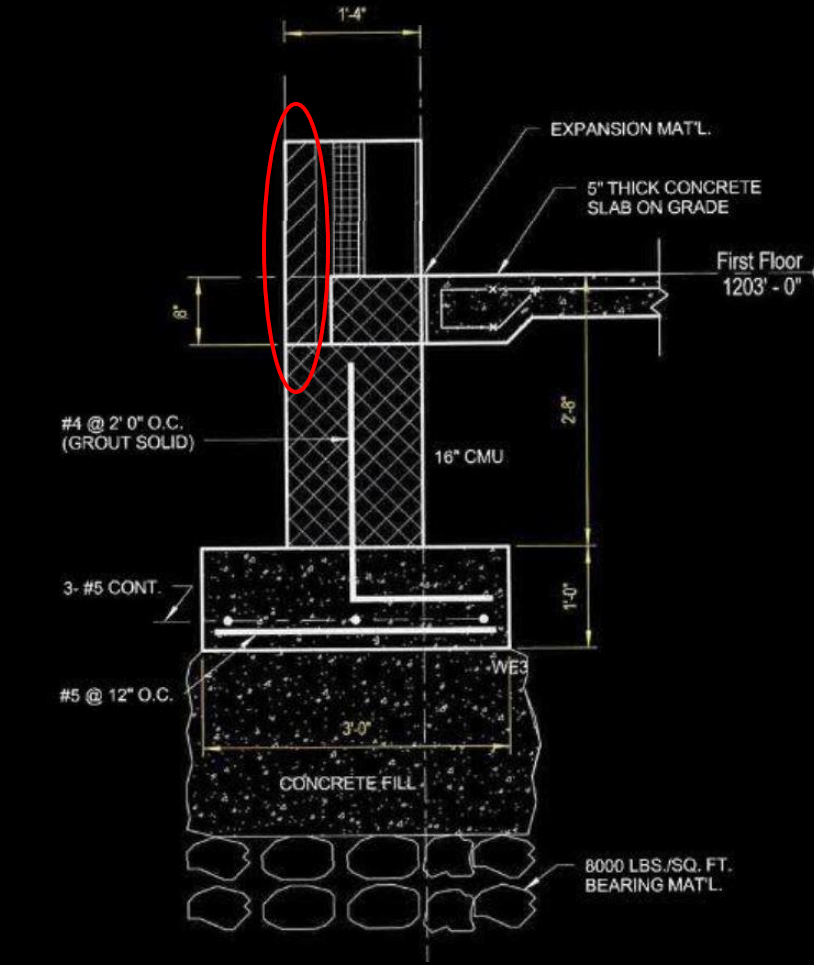
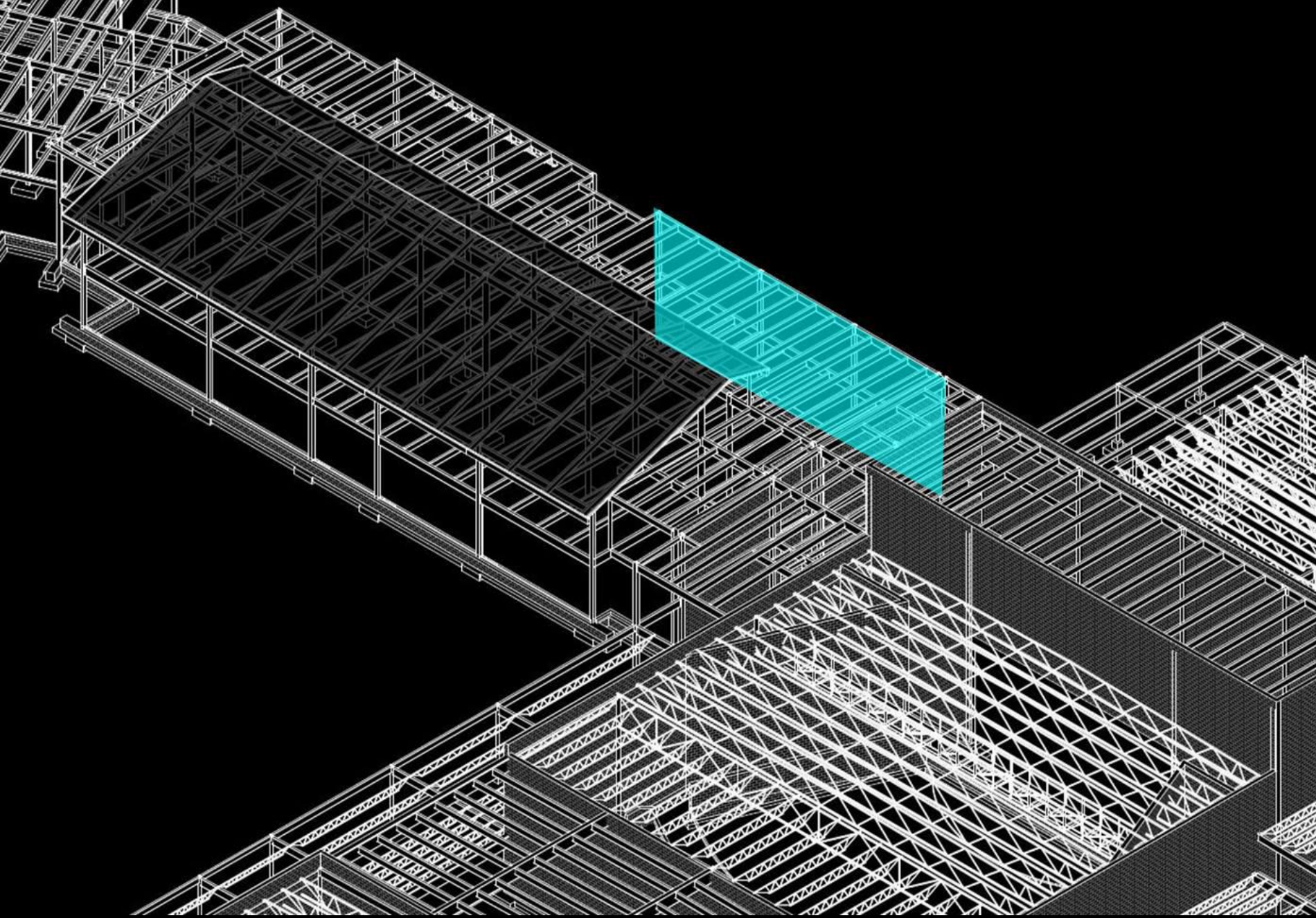
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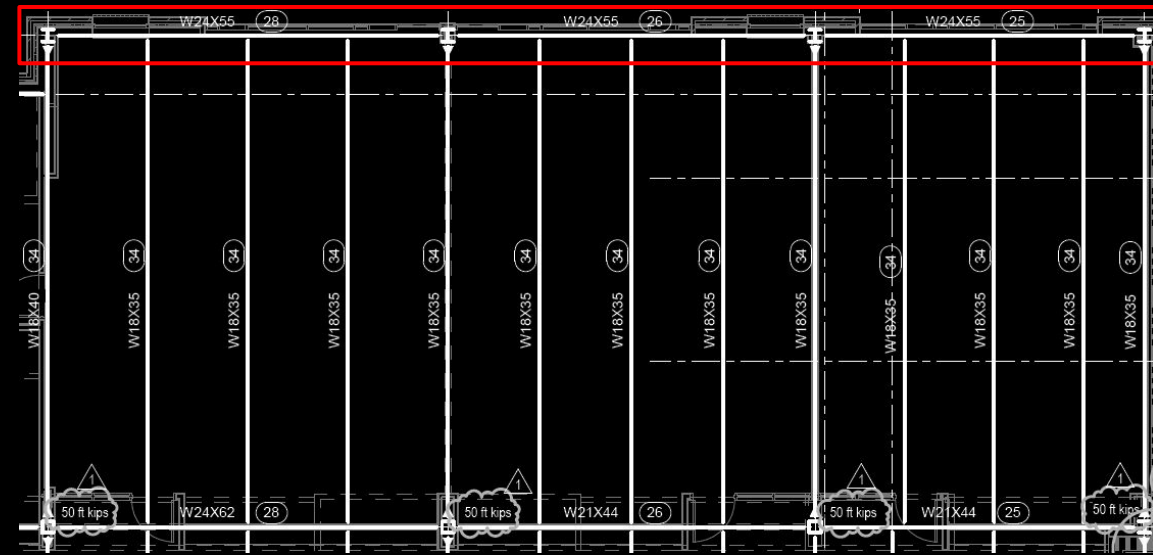
- Breadth #2 Topic

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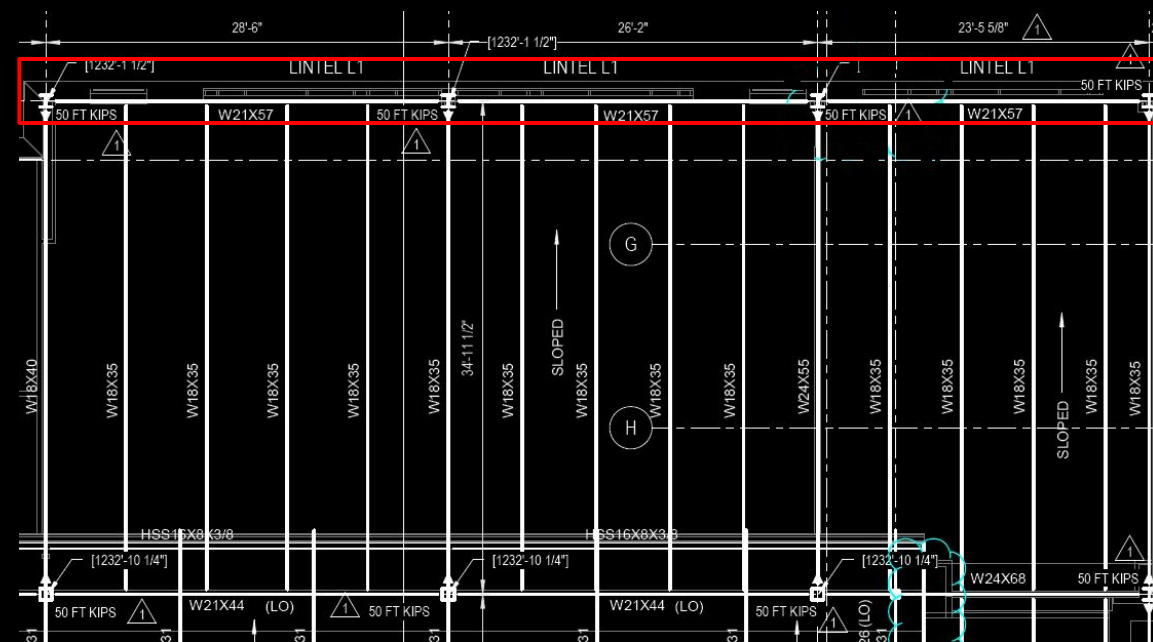


Original Brick Veneer = 50 PSF

Sto Panel Brick Insulated = 20 PSF

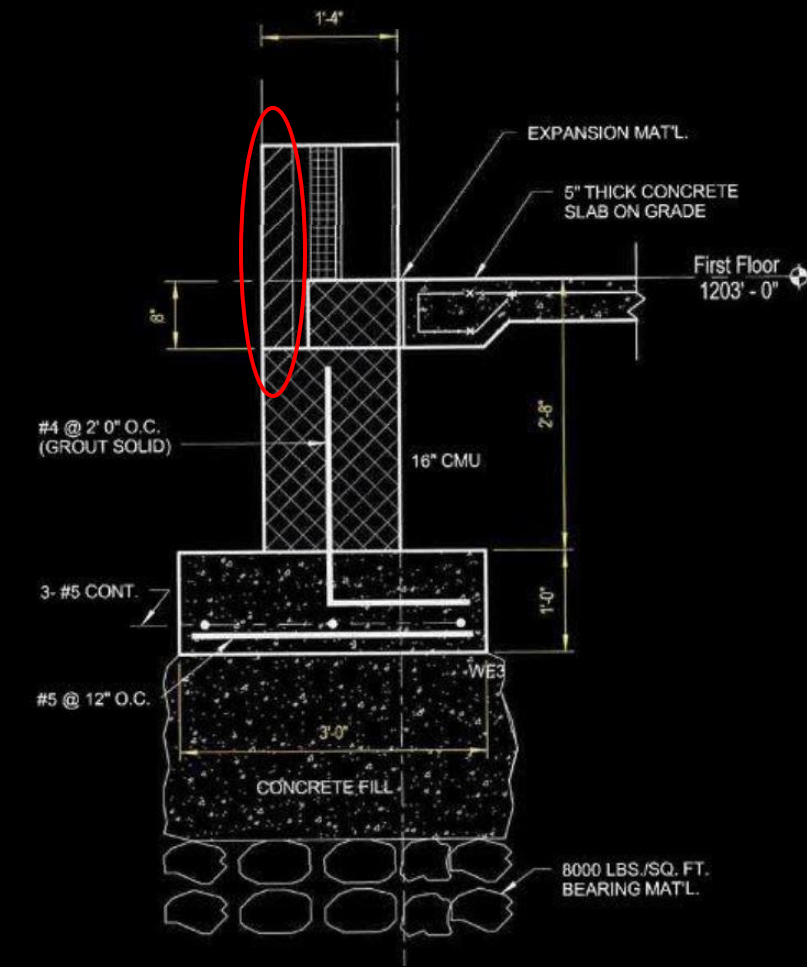


1st Floor



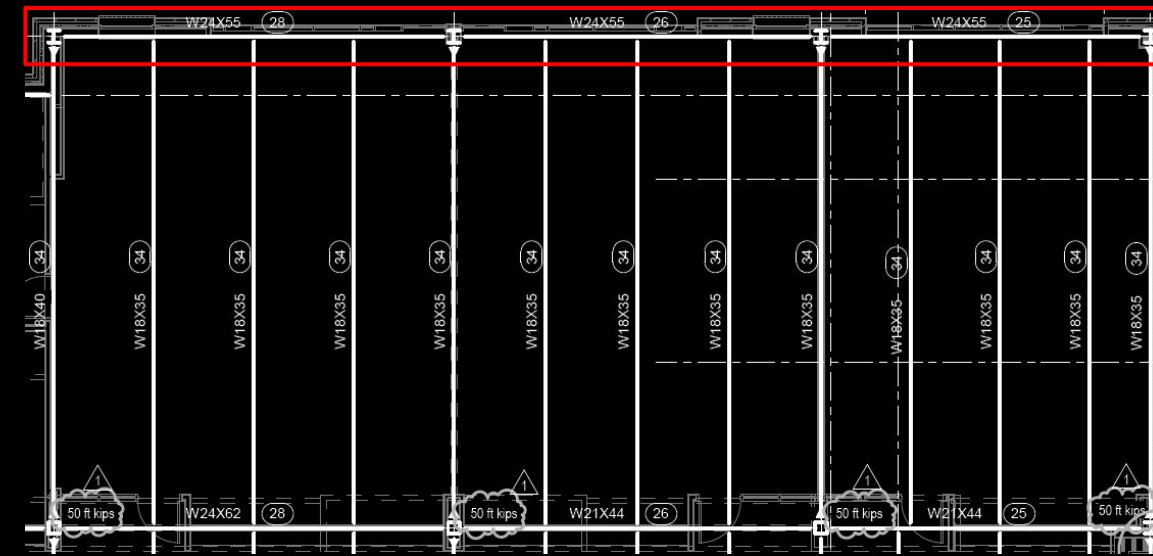
Roof

LOAD TRANSFER

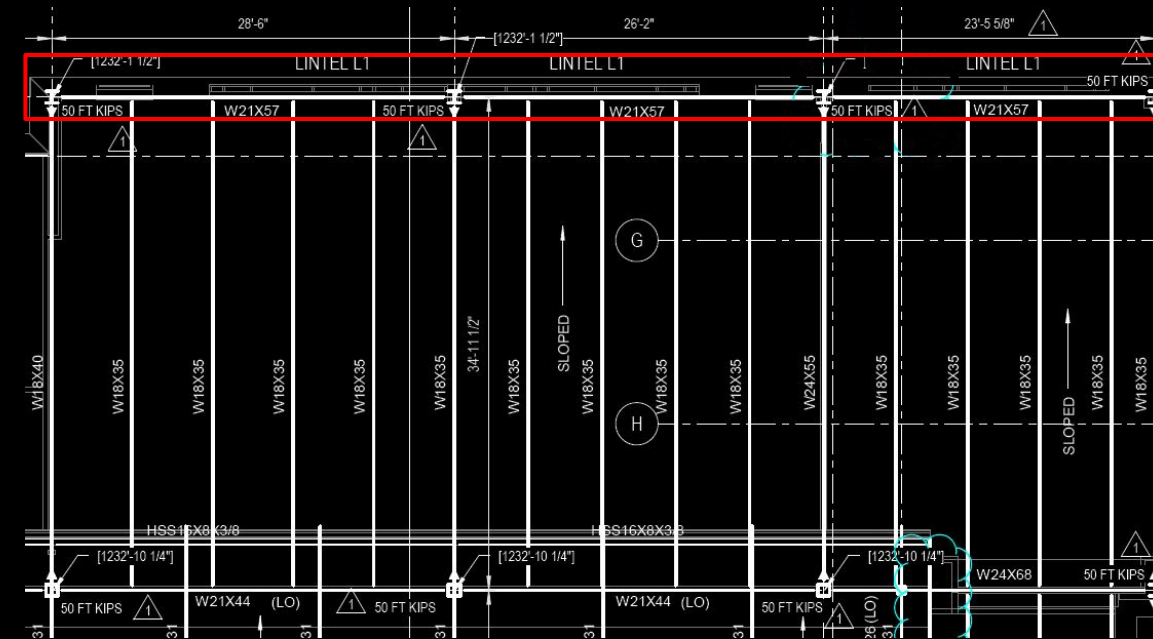


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Sto Panel Brick Insulated = 20 PSF



1st Floor



Roof

LOAD TRANSFER

SUPERSTRUCTURE

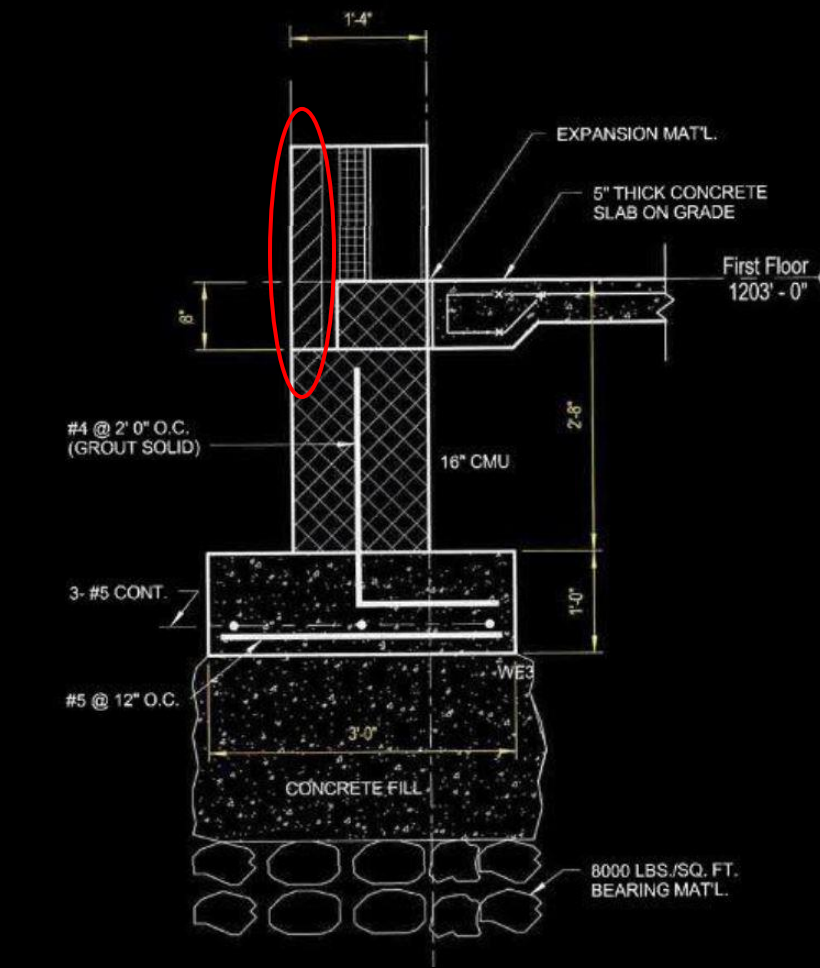
W10x49 Columns can support additional 20 PSF Wall Load

- No additional costs
- Assumed over entire structure

FOUNDATION

Footing Depth reduced by 4"

- Assumed over entire perimeter WF3 Footing
- \$28,340.14 Cost Reduction



Original Brick Veneer = 50 PSF

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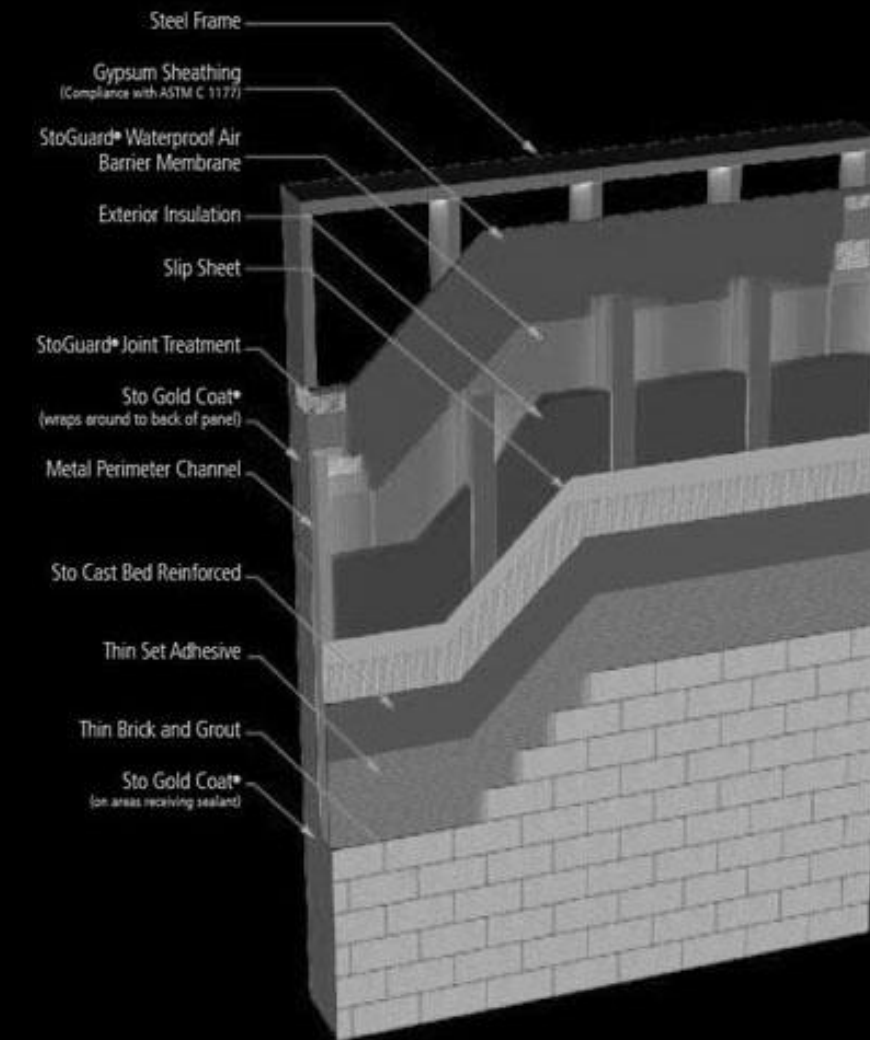
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Sto Panel Brick Insulated System



SYSTEM CONSIDERATIONS

Mechanical – Match R-Value ✓

Architectural – Waterproofing & Air Barrier ✓
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Structural – Brick Veneer → Curtain Wall ✓
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PREFAB PANELS | Site & Logistics

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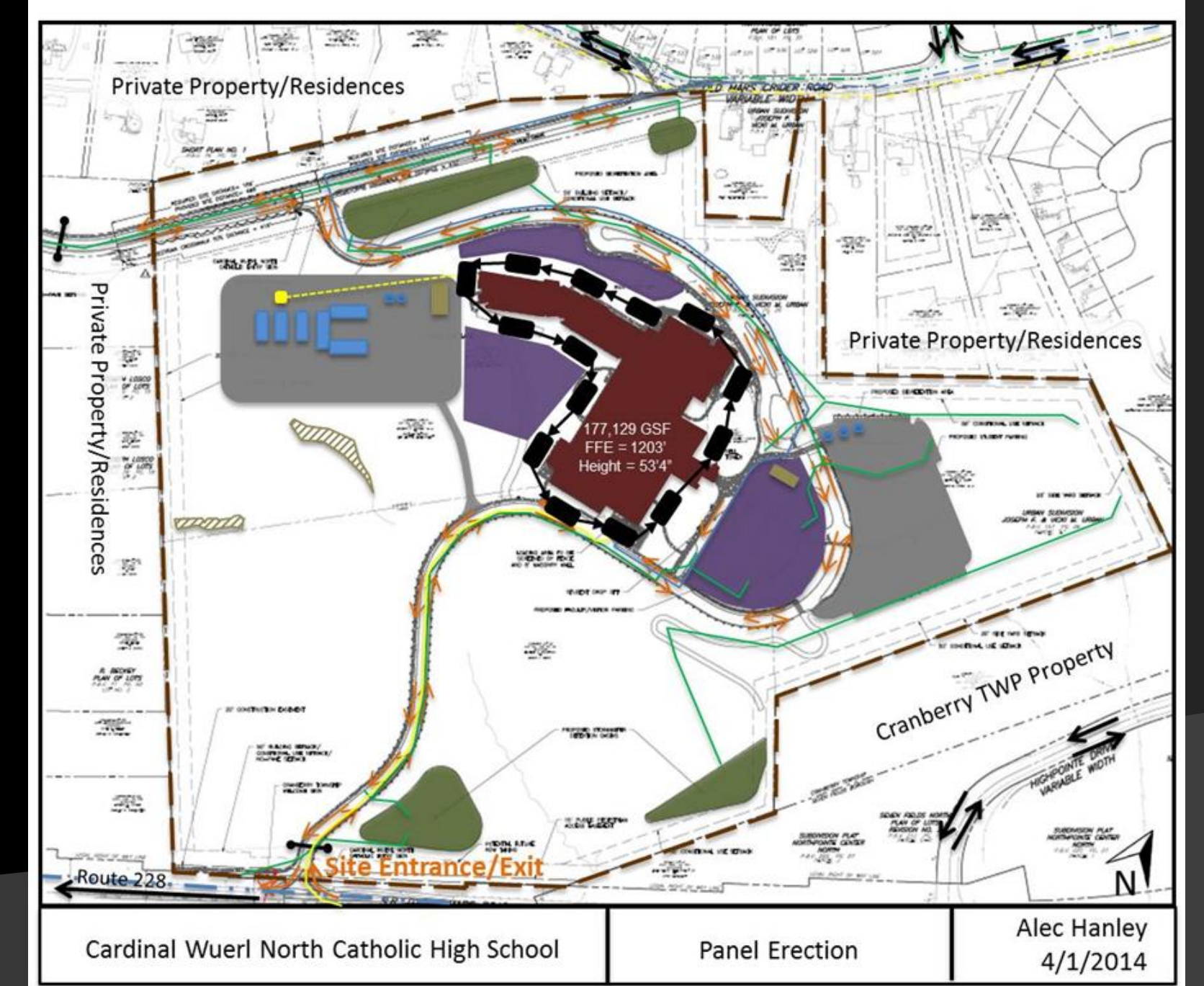
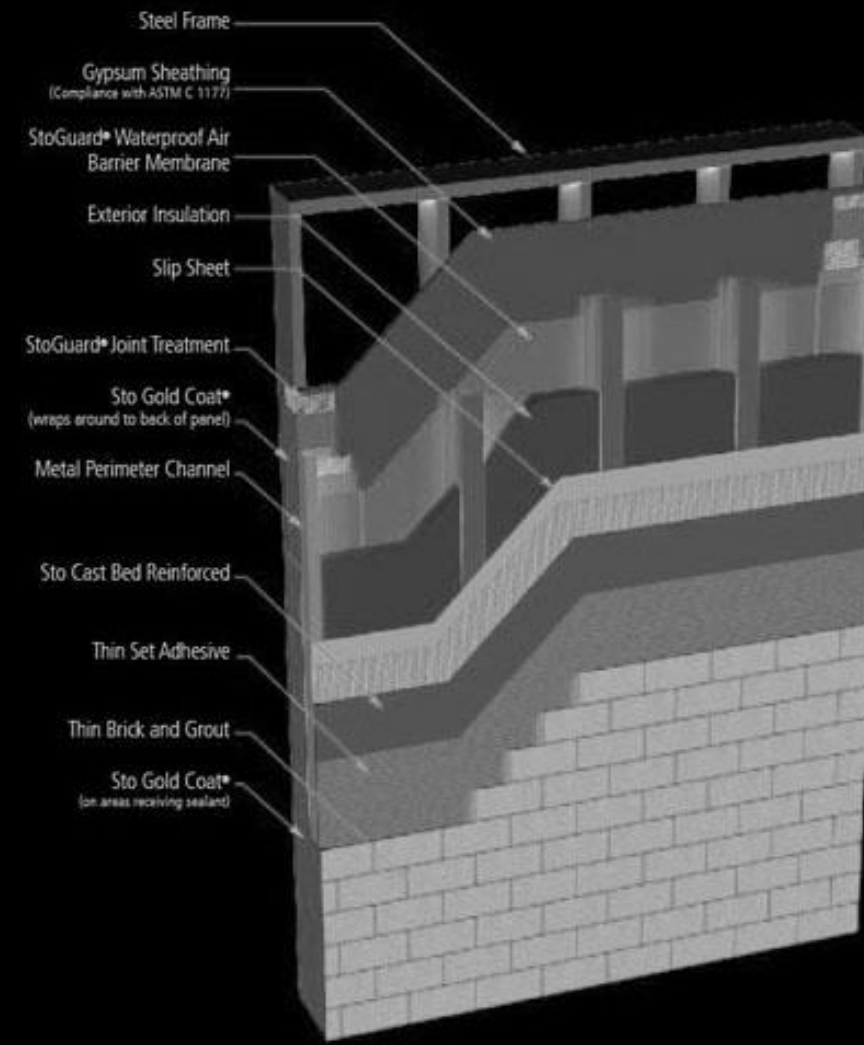
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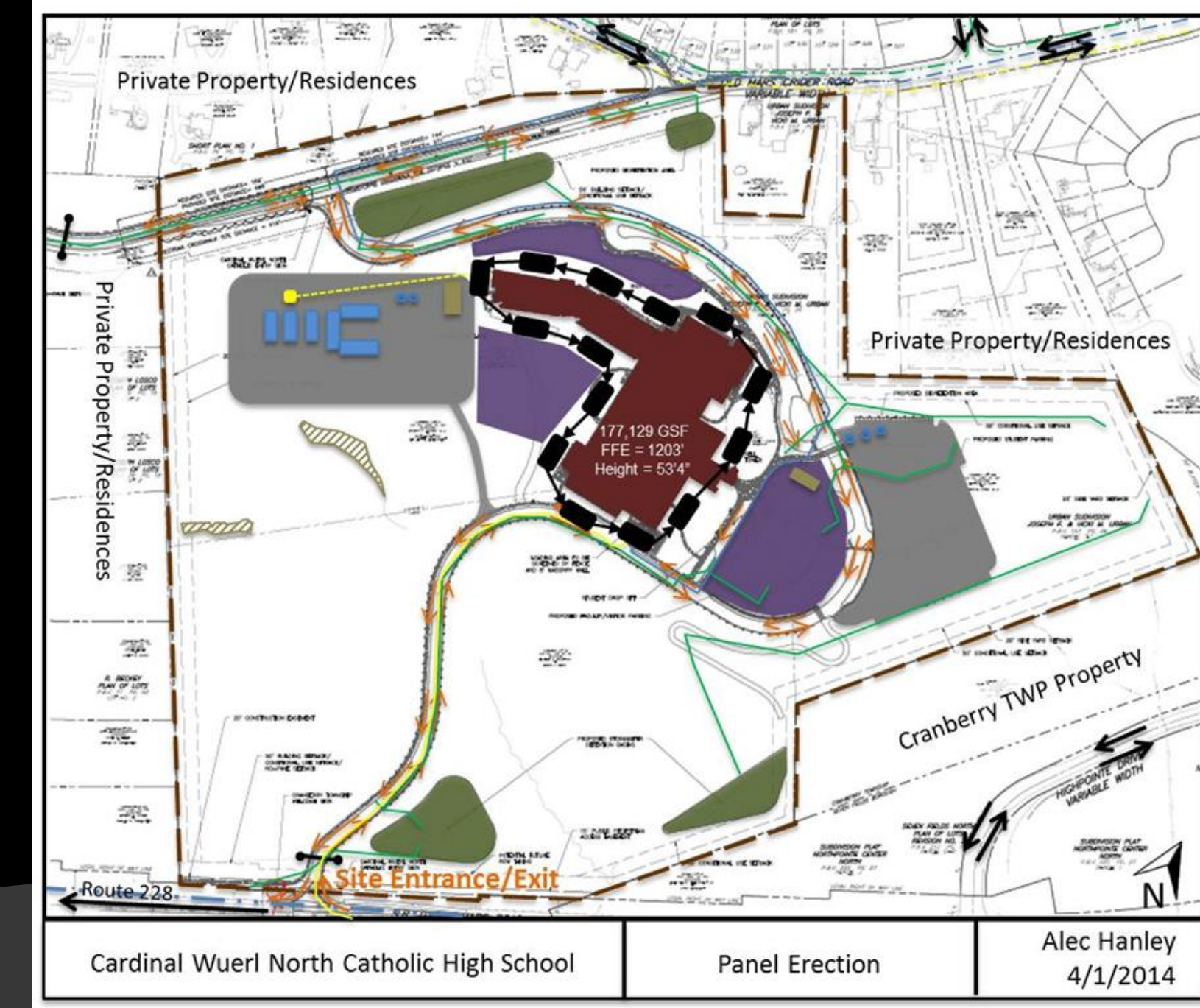
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Final Recommendations

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Terex T560-1 at CWNCHS



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Terex T560-1 at CWNCHS

LOAD CHART - MAIN BOOM

T 560-1

Outriggers Fully Extended (100%)

16,500 lb 100% 360° 35-110 ft Standard ASME B30.5

ft	Boom Length (ft)						ft
	35	50	65	80	95	110	
10	120,000	80,000					10
12	100,700	80,000					12
15	82,800	78,400	61,900				15
20	62,500	63,300	54,800	46,200			20
25	49,600	49,600	49,100	40,700	35,300		25
30	38,600	38,600	39,100	30,800	31,100	27,500	30
35	36,700	29,100	29,700	30,000	24,000	24,800	35
40		22,700	23,400	23,000	22,000	22,000	40
45		18,100	19,000	19,300	19,600	19,600	45
50			15,600	16,000	16,200	16,300	50
55			12,900	13,400	13,600	13,700	55
60			10,700	11,300	11,500	11,700	60
65				9,600	9,800	10,000	65
70				8,100	8,400	8,600	70
75				6,800	7,200	7,400	75
80					6,200	6,400	80
85					5,200	5,500	85
90					4,400	4,700	90
95						4,000	95
100						3,300	100
105						2,700	105

PREFAB PANELS | Schedule & Cost

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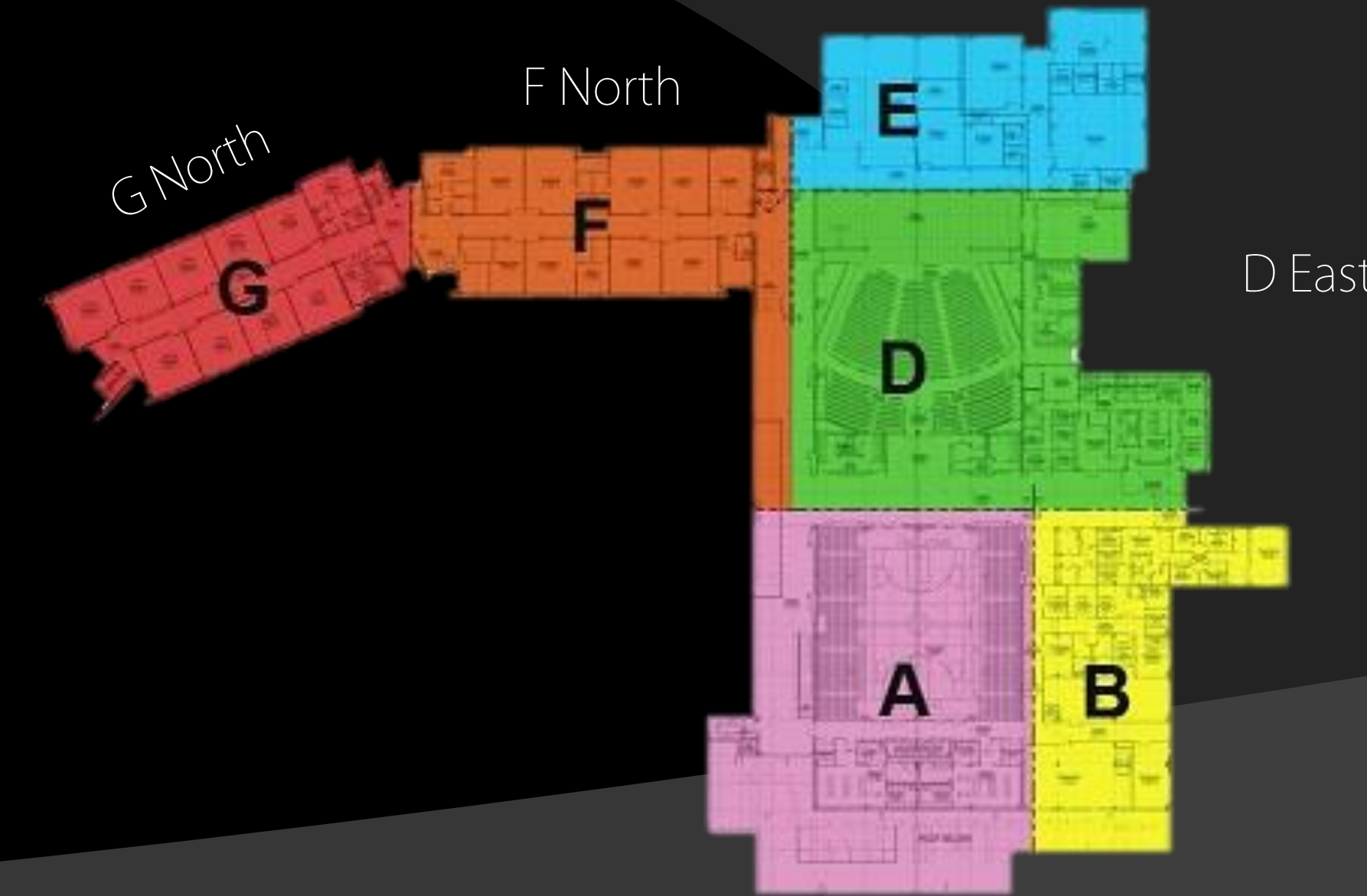
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Final Recommendations

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Current Critical Path Activities	
Area F - North Elevation (Feb 5th - Feb 25th)	
Cold-Formed Metal Studs	10 days
Exterior Sheathing	10 days
Area G - North Elevation (Feb 26th - March 15th)	
Cold-Formed Metal Studs	14 days
Area D - East Elevation (May 15th - June 20th)	
Cold-Formed Metal Studs	5 days
Exterior Sheathing	10 days
Spray-Applied Air Barrier	3 days
Brick Veneer	10 days
TOTAL CP DURATION	62



PREFAB PANELS | Schedule & Cost

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Prefabricated Masonry Panels
Breaths – Arch & Structural

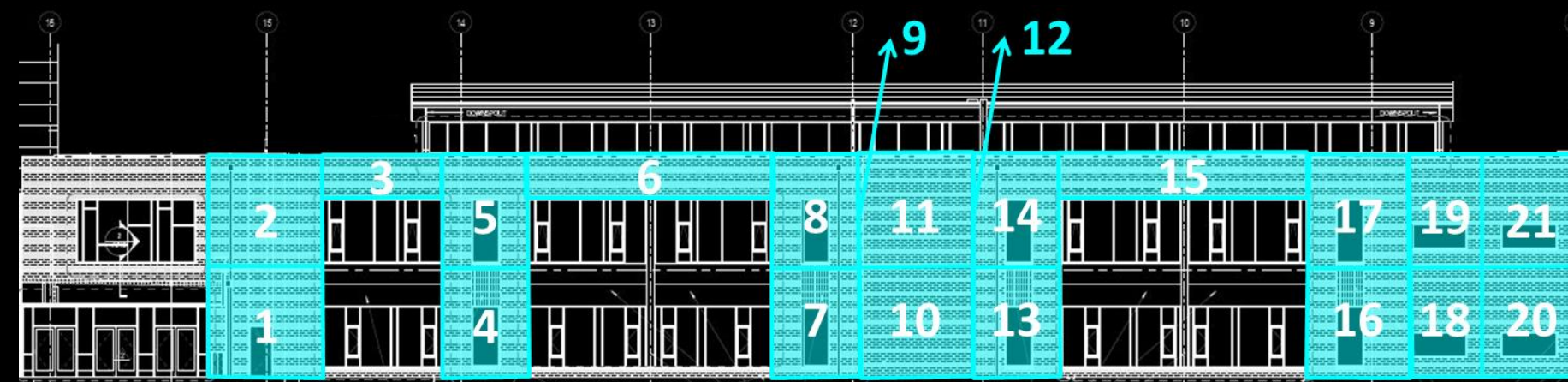
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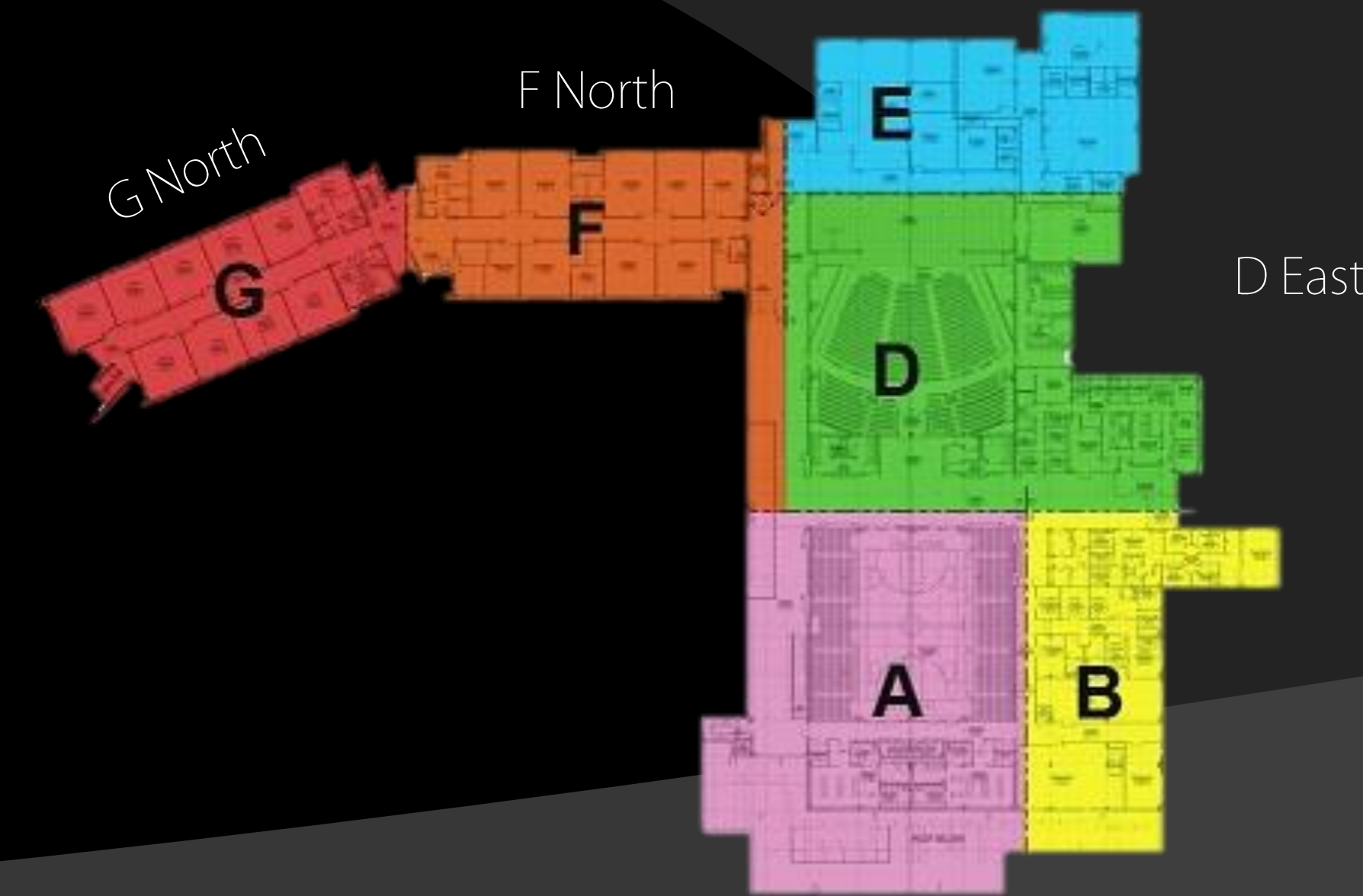
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F NORTH Elevation



G NORTH Elevation



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Project Overview

Prefabricated Masonry Panels

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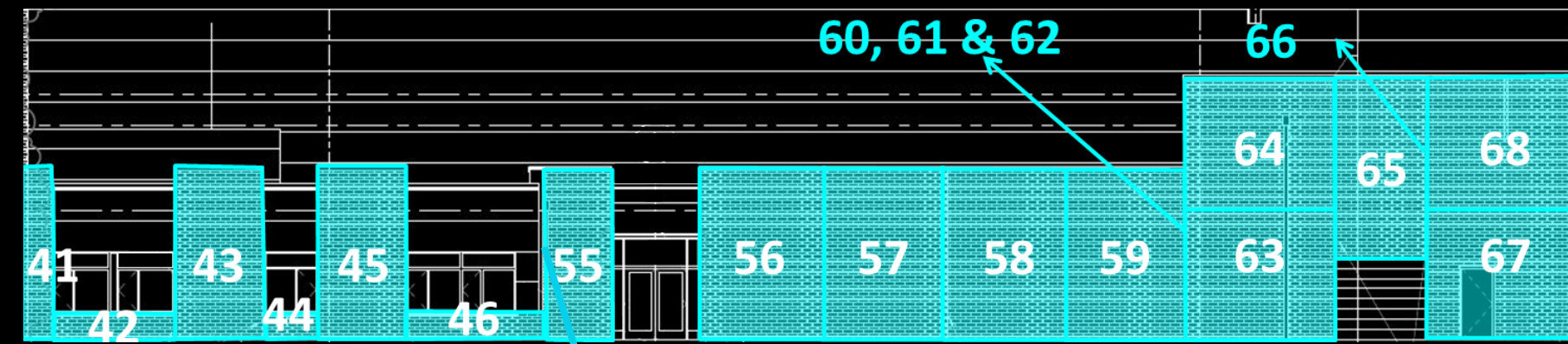
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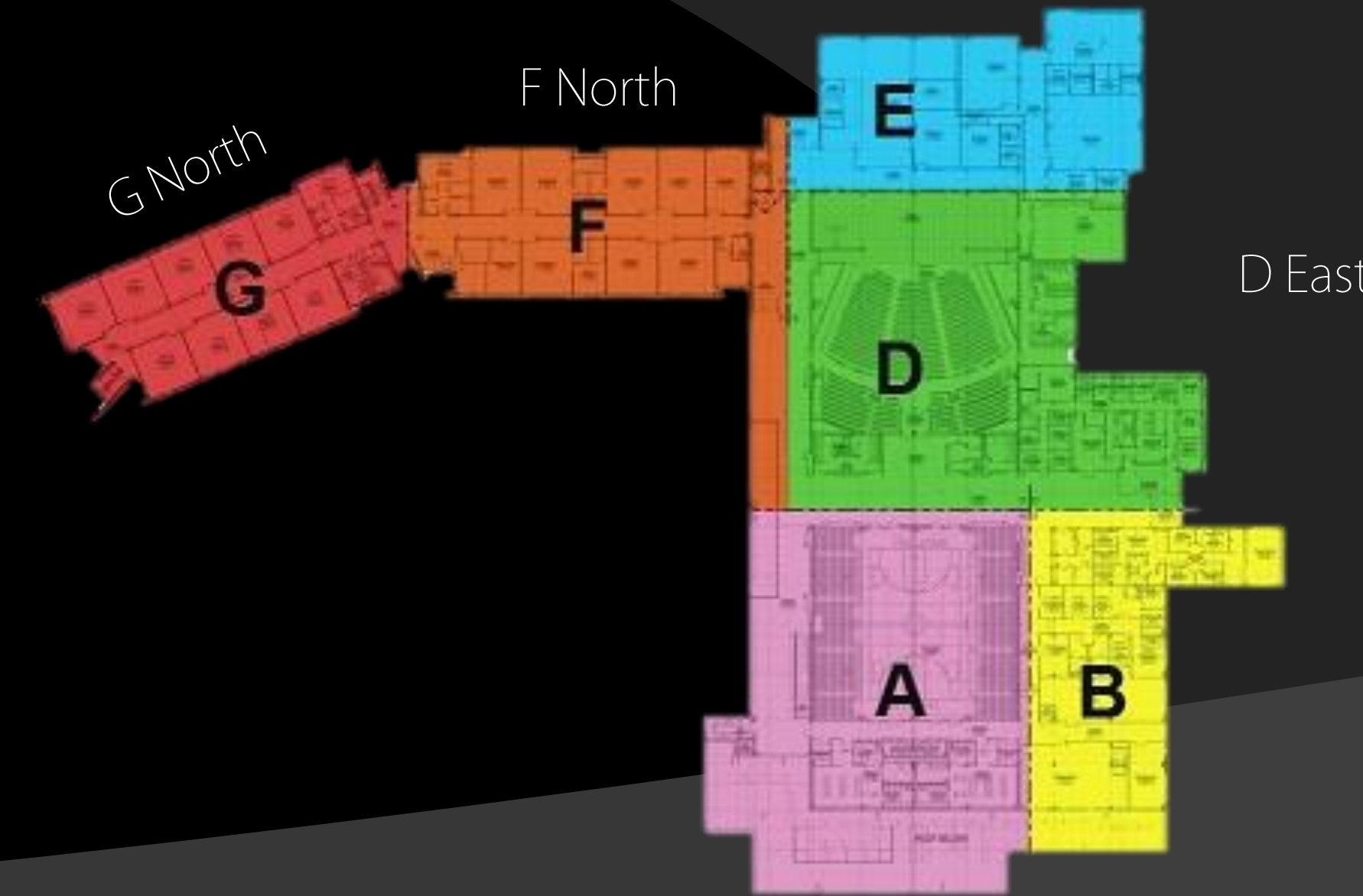
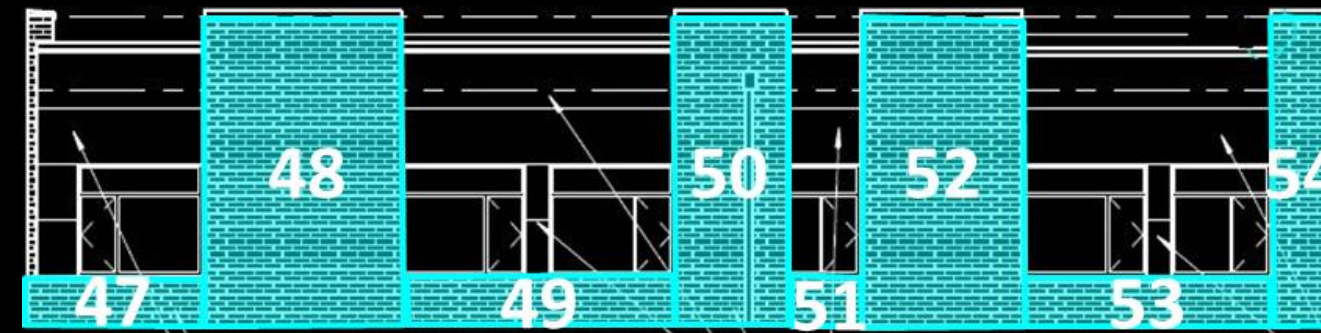
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Final Recommendations

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D East Elevation



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Project Overview

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Breaths – Arch & Structural

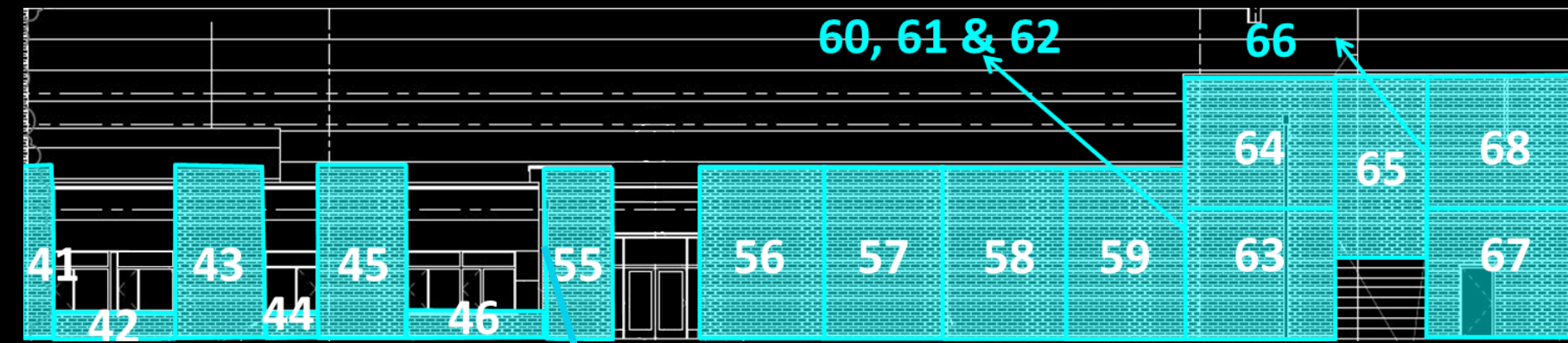
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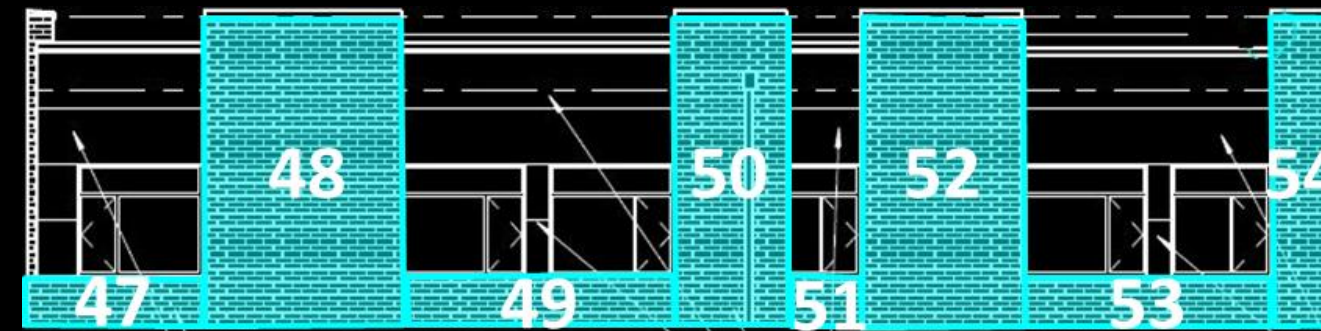
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Final Recommendations

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D East Elevation



Start at F North → Work Counterclockwise

10 picks/day

- Laydown
- Erecting
- Caulking/Detailing

Design panels at 200-300 SQ FT

- (20 PSF)(200) = 4,000 lbs.
- (20 PSF)(300) = 6,000 lbs.
 - Critical for Crane loading

Estimated 260 Panels = 26 days for erection

- Reduced from 6 months → 5 weeks

PREFAB PANELS | Schedule & Cost

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Final Recommendations

Acknowledgements



PREFABRICATED EXTERIOR MASONRY PANELS ESTIMATE	
Stick-Built Construction Costs	\$ 1,516,000.00
Cost/SF of Prefabricated Panels	\$ 62.00
Gross Square Feet of Panel Area	44,657
Estimated Cost of Prefabrication	\$ 2,768,734.00
Current Façade Critical Path Duration (days) 62	
Prefabrication Critical Path Duration (days) 2	
Critical Path Reduction (days) 60	
General Conditions Cost/Day	\$ 6,835.00
General Conditions Savings	\$ 410,100.00
Structural Redesign Costs	
Footing Redesign Difference	\$ 28,340.14
Column Redesign Difference	\$ -
TOTAL COST OF PREFABRICATED PANELS	\$ 2,330,293.86
STICK BUILT vs. PREFAB COST DIFFERENCE	\$ (814,293.86)

Start at F North → Work Counterclockwise

10 picks/day

- Laydown
- Erecting
- Caulking/Detailing

Design panels at 200-300 SQ FT

- (20 PSF)(200) = 4,000 lbs.
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PREFAB PANELS | Recommendation

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STICK BUILT vs. PREFAB COST DIFFERENCE	\$ (814,293.86)

FINAL RECOMMENDATION

DO NOT use Prefabricated Masonry Panels at CWNCHS

Too expensive, despite benefits

Better for buildings with regular geometry

With GC savings, break even is \$43/SF

Use original method; schedule reduction not of great importance

~\$815,000 loss associated with panels



VE FINISHES | Problem Identification

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Final Recommendations

Acknowledgements



Main Corridor Looking East

PROBLEM

Diocese will own & operate the facility post-construction

Initial savings are misleading & may be ineffective for of analysis

Present Value Life-Cycle Cost (LCC) analysis is more realistic

Large cost savings reported in Division 9: Finishes

- Total VE = \$2,740,000
- Reported from Finishes; = \$540,000
- LCC Analysis = \$328,275

VE FINISHES | Problem Identification

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Cardinal Wuerl North Catholic High School			
Description	Cost	Analyze	Disregard
1 Delete Level 5 Finish on All Drywall Walls & Ceilings	\$ 140,000.00		x
2 Reduce Ceramic Wall Tile Scope by 1/2 for Paint	\$ 152,275.00	x	
3 Reduce Material Price of Tile from \$17.80/SF to \$12.00/SF	\$ 52,571.00		x
4 Use Polished Concrete in-lieu of linoleum	\$ 16,000.00	x	
5 Use a Standard Rubber Base in-lieu of Custom Rubber Base (take half)	\$ 17,000.00		x
6 Use VCT in-lieu of Carpet Under Auditorium Seating rather than carpet	\$ 33,000.00	x	
7 Use a different rubber athletic flooring manufacturer	\$ 3,000.00		x
8 Use Armstrong School Zone Fine Fissured in-lieu of the Ultima Ceiling Tile	\$ 54,000.00	x	
9 Use a curved drywall ceiling in-lieu of the Wood Linear Ceiling in the 2nd Floor Corridors	\$ 72,000.00	x	

Reported VE Cost Reductions

PROBLEM

Diocese will own & operate the facility post-construction

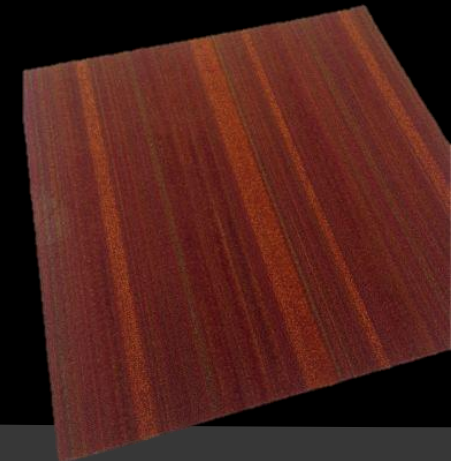
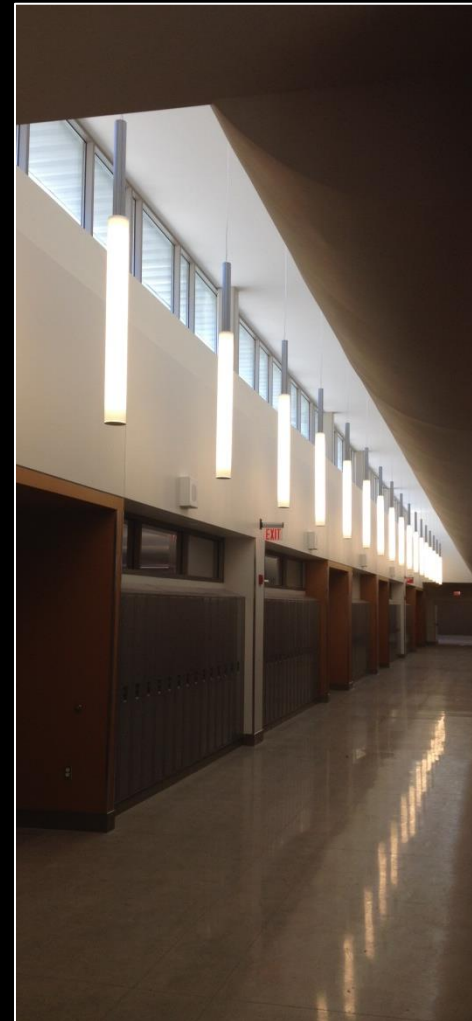
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2 Reduce Ceramic Wall Tile Scope by 1/2 for Paint	\$ 152,275.00	x	
3 Reduce Material Price of Tile from \$17.80/SF to \$12.00/SF	\$ 52,571.00		x
4 Use Polished Concrete in-lieu of linoleum	\$ 16,000.00	x	
5 Use a Standard Rubber Base in-lieu of Custom Rubber Base (take half)	\$ 17,000.00		x
6 Use VCT in-lieu of Carpet Under Auditorium Seating rather than carpet	\$ 33,000.00	x	
7 Use a different rubber athletic flooring manufacturer	\$ 3,000.00		x
8 Use Armstrong School Zone Fine Fissured in-lieu of the Ultima Ceiling Tile	\$ 54,000.00	x	
9 Use a curved drywall ceiling in-lieu of the Wood Linear Ceiling in the 2nd Floor Corridors	\$ 72,000.00	x	

Reported VE Cost Reductions

PROBLEM

Diocese will own & operate the facility post-construction

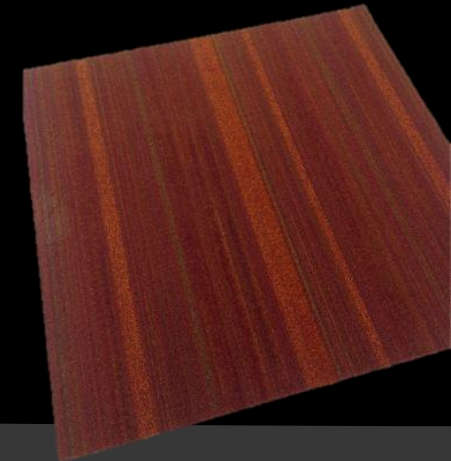
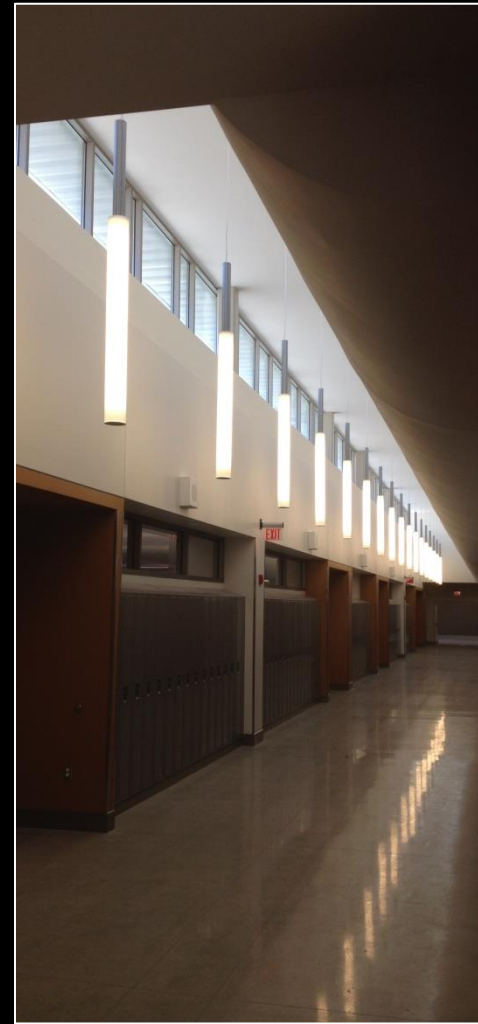
Initial savings are misleading & may be ineffective for of analysis

Present Value Life-Cycle Cost (LCC) analysis is more realistic

Large cost savings reported in Division 9: Finishes

- Total VE = \$2,740,000
- Reported from Finishes; = \$540,000
- LCC Analysis = \$328,275

VE FINISHES | Analysis



ANALYSIS

Determine if the reported savings are realistic over 50 years

Present Value used to show value of dollar is lost over time

- ASTM E 833 – Terminology of Building Economics
- ASTM E 917 – Practice for Measuring Life Cycle Costs of Buildings & Building Systems
- ASTM E 1185 – Guide for Selecting Economic Methods for Evaluating Investments in Buildings and Building Systems

Cardinal Wuerl North Catholic High School			
Description	Cost	Analyze	Disregard
1 Delete Level 5 Finish on All Drywall Walls & Ceilings	\$ 140,000.00		x
2 Reduce Ceramic Wall Tile Scope by 1/2 for Paint	\$ 152,275.00	x	
3 Reduce Material Price of Tile from \$17.80/SF to \$12.00/SF	\$ 52,571.00		x
4 Use Polished Concrete in-lieu of linoleum	\$ 16,000.00	x	
5 Use a Standard Rubber Base in-lieu of Custom Rubber Base (take half)	\$ 17,000.00		x
6 Use VCT in-lieu of Carpet Under Auditorium Seating rather than carpet	\$ 33,000.00	x	
7 Use a different rubber athletic flooring manufacturer	\$ 3,000.00		x
8 Use Armstrong School Zone Fine Fissured in-lieu of the Ultima Ceiling Tile	\$ 54,000.00	x	
9 Use a curved drywall ceiling in-lieu of the Wood Linear Ceiling in the 2nd Floor Corridors	\$ 72,000.00	x	

Reported VE Cost Reductions

$$P = F \left(\frac{1}{(1+i)^n} \right)$$

Where:

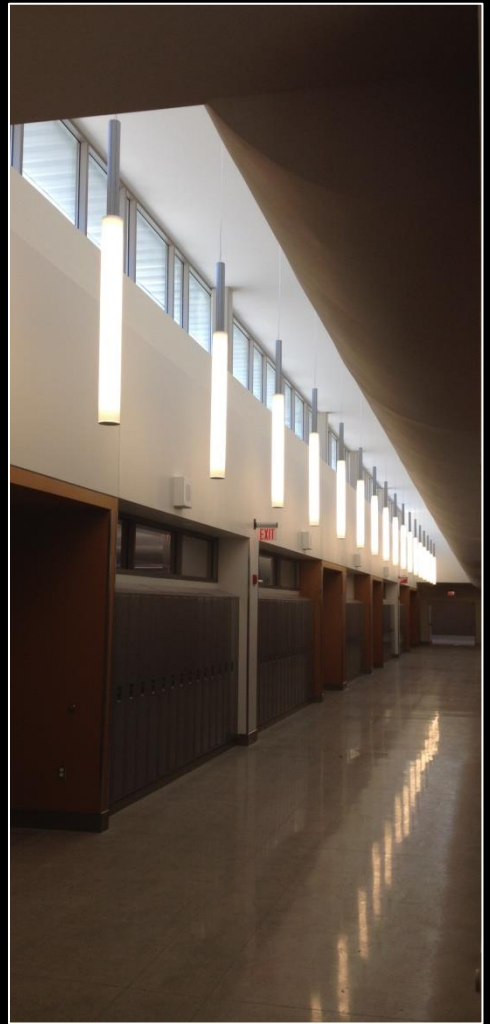
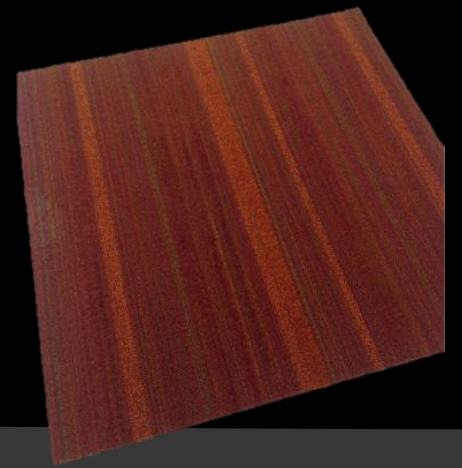
P = Present Value

F = Future Value

i = compounding interest rate (10%)

n = # of years

VE FINISHES | Results



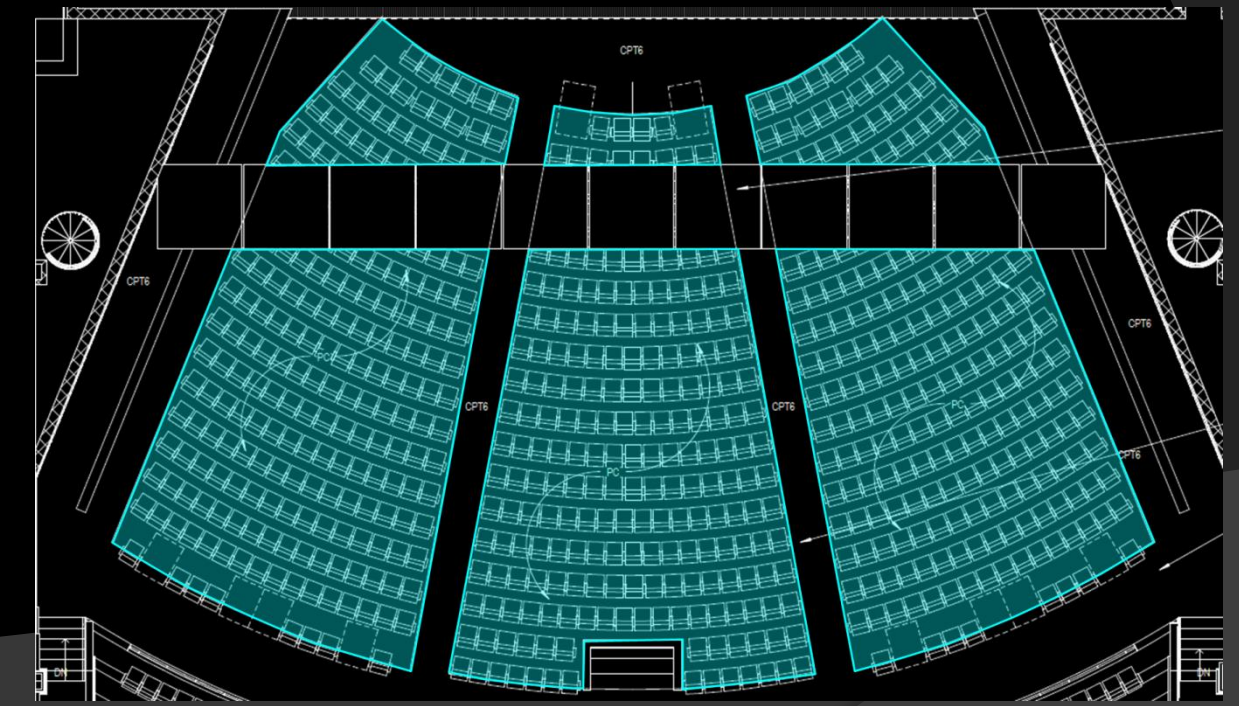
Materials	Original VE	Present Value LCC
Ceramic Tile vs. Paint	\$ 152,275.00	\$ 40,523.21
VCT vs. Carpet	\$ 16,000.00	\$ 15,968.62
School Zone vs. Ultima	\$ 34,000.00	\$ (19,758.83)
Curved Drywall vs. Linear Wood	\$ 54,000.00	\$ 57,695.50
Polished Concrete vs. Linoleum	\$ 72,000.00	\$ 39,479.61
TOTAL COST REDUCTION	\$ 328,275.00	\$ 133,908.11
% Difference	59%	

Final VE vs. LCC

RESULTS

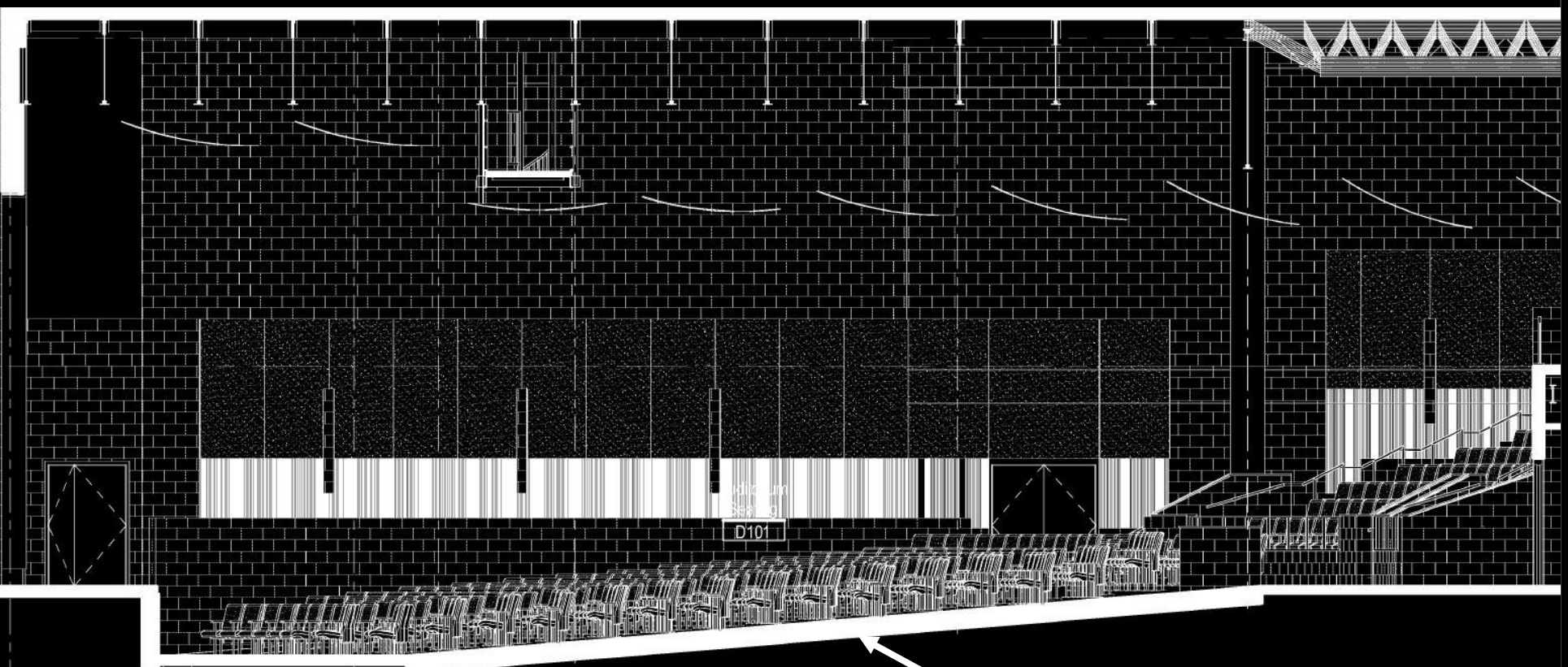
Auditorium Seating → Change from VCT to Carpet
 • \$20,000 Loss in PV when using VCT compared to Carpet

59% Difference → PV LCC savings lower than VE deductions



Auditorium Seating

VE FINISHES | Results



Slope is not maintenance friendly with VCT

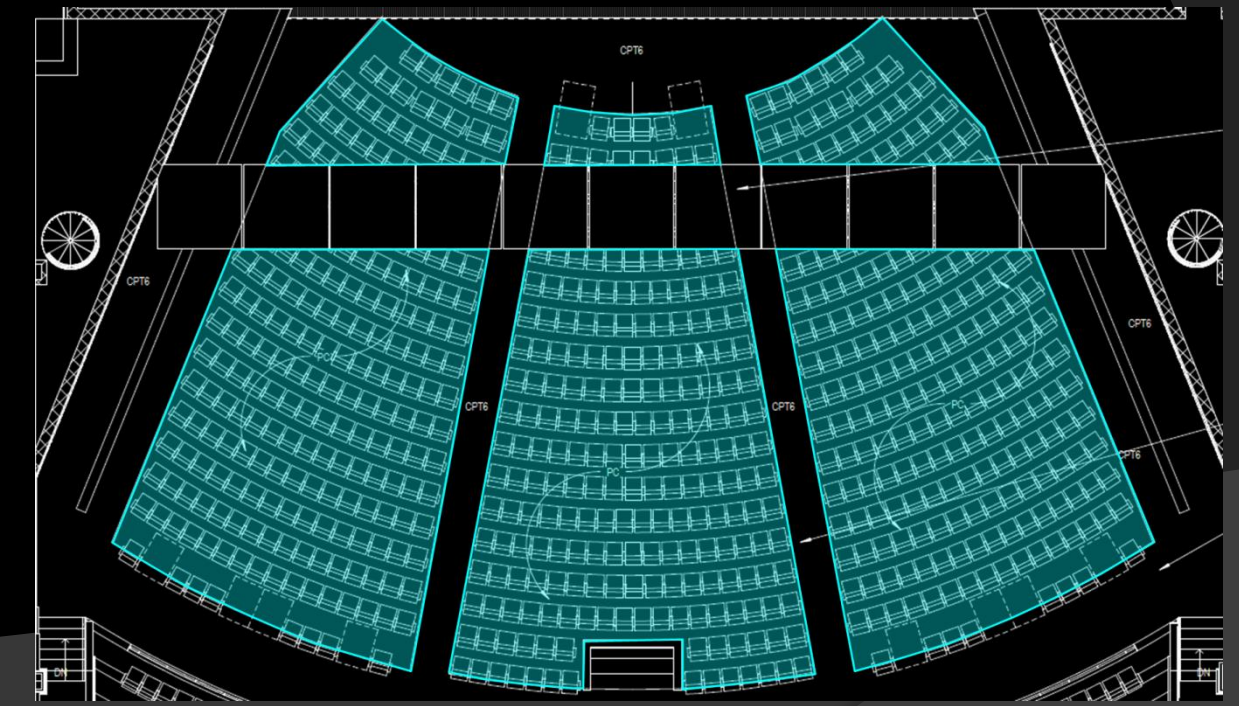
Materials	Original VE	Present Value LCC
Ceramic Tile vs. Paint	\$ 152,275.00	\$ 40,523.21
VCT vs. Carpet	\$ 16,000.00	\$ 15,968.62
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Final VE vs. LCC

RESULTS

Auditorium Seating → Change from VCT to Carpet
 • \$20,000 Loss in PV when using VCT compared to Carpet

59% Difference → PV LCC savings lower than VE deductions



Auditorium Seating

VE FINISHES | Recommendations

Use PV LCC with finishes when owner operates building post-construction

- Obtain accurate information from manufacturers for:
 - Repairs
 - Cleaning
 - Refinishing

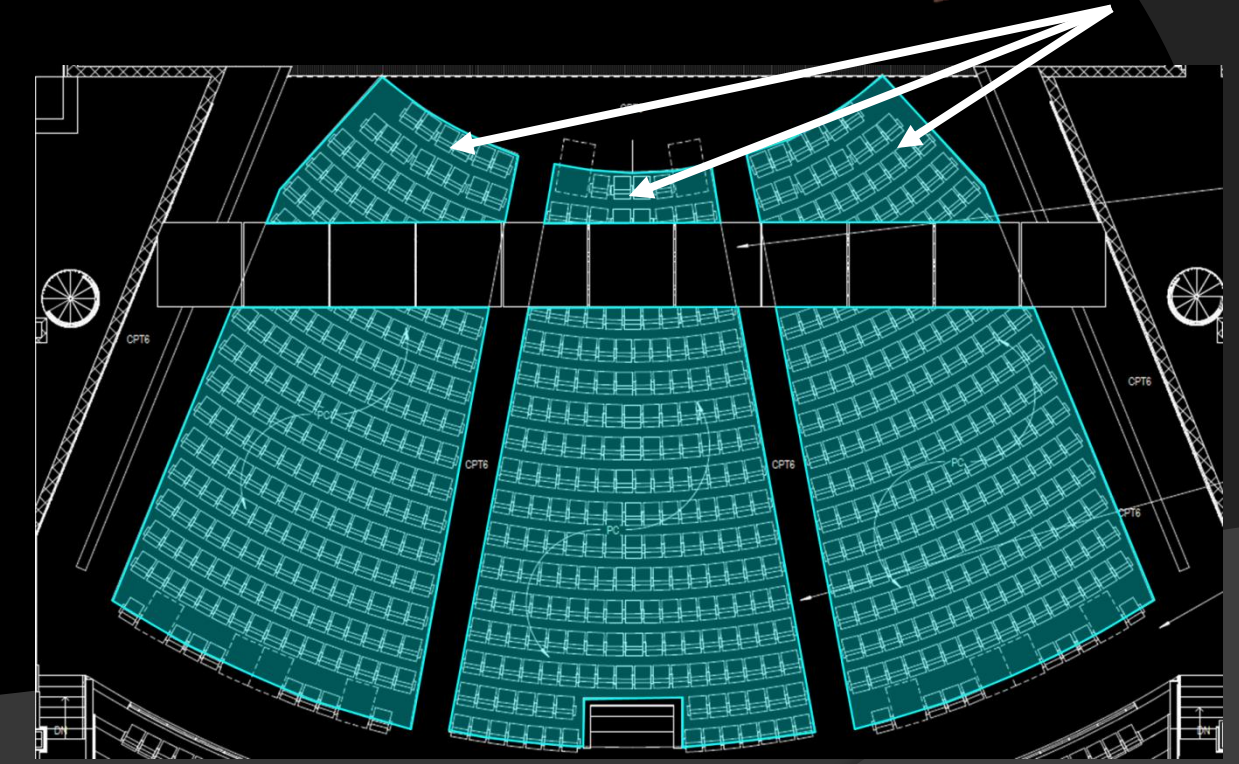
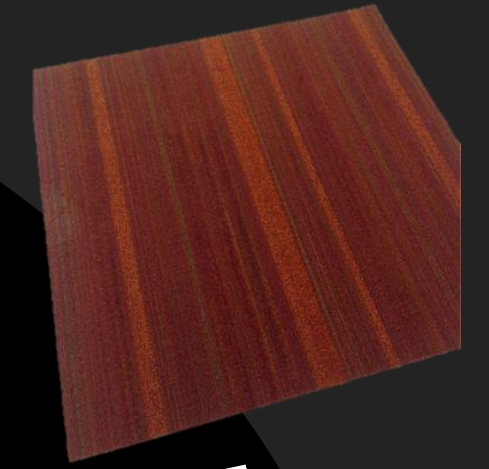
Use Carpet in place of VCT to save \$54,000 in present value

Analysis was not used to disprove all VE; only to provide more realistic data



Materials	Original VE	Present Value LCC
Ceramic Tile vs. Paint	\$ 152,275.00	\$ 40,523.21
VCT vs. Carpet	\$ 16,000.00	\$ 15,968.62
School Zone vs. Ultima	\$ 34,000.00	\$ (19,758.83)
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Final VE vs. LCC



Auditorium Seating

FM INFO TURNOVER | Problem Identification

Project Overview

Prefabricated Masonry Panels
Breaths – Arch & Structural

Lifetime Costs of VE Finishes

Efficient/Effective FM Info Turnover

Alternative Roof Systems Analysis

Final Recommendations

Acknowledgements



Planning → 10 months

Design → 8 months

Construction → 2 years

Facility Management → 50 years!

CRITICAL INDUSTRY RESEARCH

Presented at PACE Conference – November 2013

CWNCHS BIM Focus = Record Modeling

Avoid “paper dump” – EFFICIENCY!

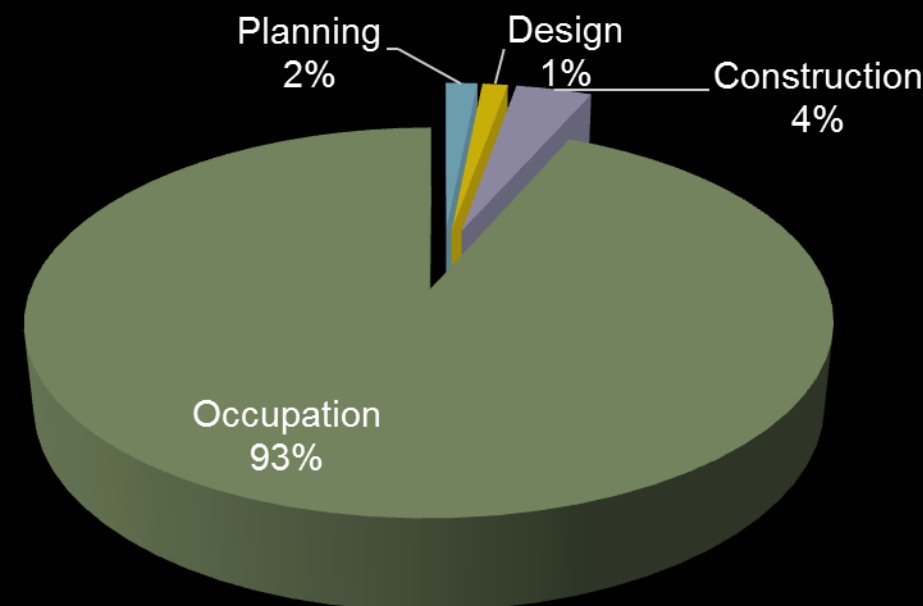
Interviews conducted for industry consensus

Make process more user friendly for FM

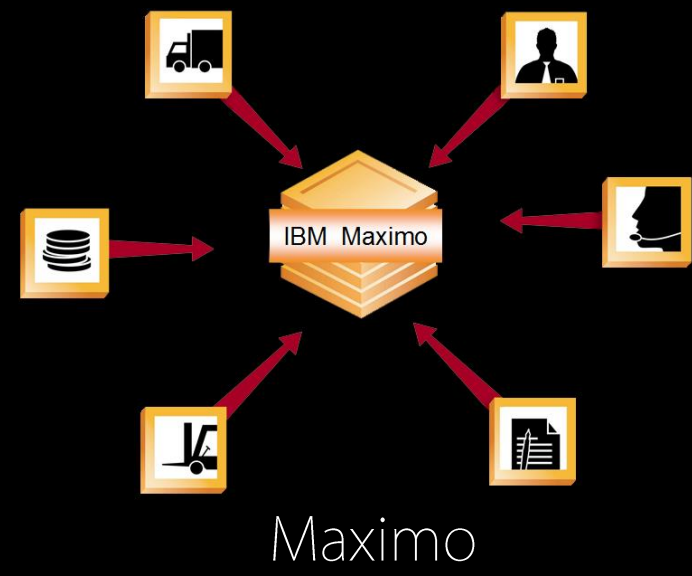
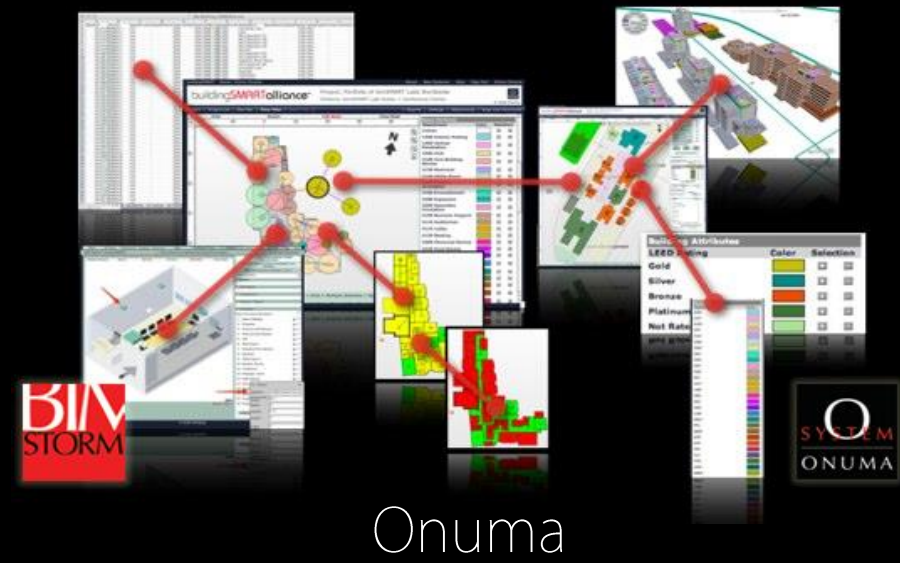
What is the best way to go about this?



FM INFO TURNOVER | Analysis



Plan, Design & Construct to make occupation more efficient/effective!



CMMS SOFTWARE

Four cloud-based software programs analyzed

Chosen based off of weighted matrix

- FM: Systems disregarded prior to this point

	Onuma	Maximo	Evolve FM
Strengths	AM, SM, Mobile, BIM, BAS, Cost, Funct., Flex., Help	AM, Mobile, BIM, Funct., BAS, Flex., Help	AM, SM, Function, Flexibility
Weaknesses	None	Cost, SM	Mobile, BIM, BAS, Cost, Help

FM INFO TURNOVER | Analysis



Evolve FM



FM: Systems

CMMS SOFTWARE

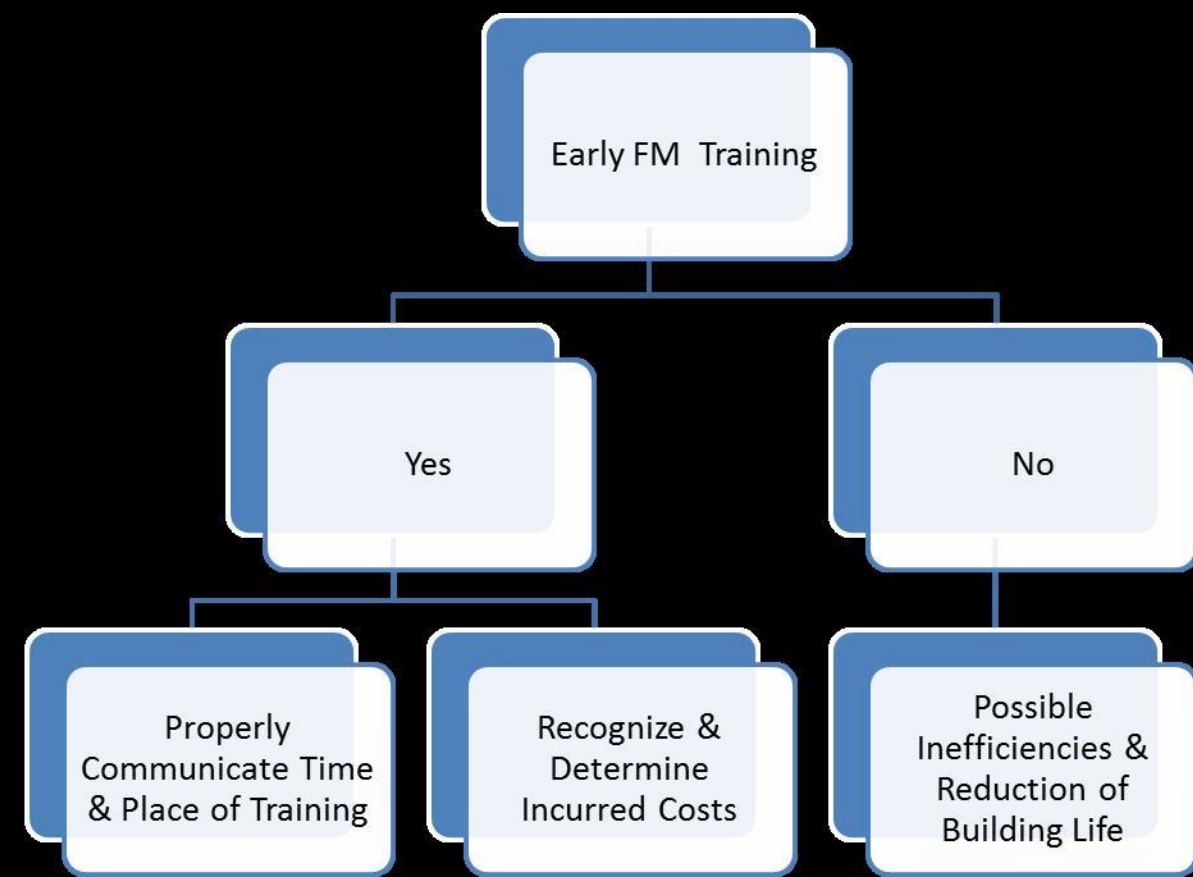
Four cloud-based software programs analyzed

Chosen based off of weighted matrix

- FM: Systems disregarded prior to this point

	Onuma	Maximo	Evolve FM
Strengths	AM, SM, Mobile, BIM, BAS, Cost, Funct., Flex., Help	AM, Mobile, BIM, Funct., BAS, Flex., Help	AM, SM, Function, Flexibility
Weaknesses	None	Cost, SM	Mobile, BIM, BAS, Cost, Help

FM INFO TURNOVER | Analysis



Owner Guide: Early Training

FM TRAINING

PACE Consensus that this was the biggest roadblock

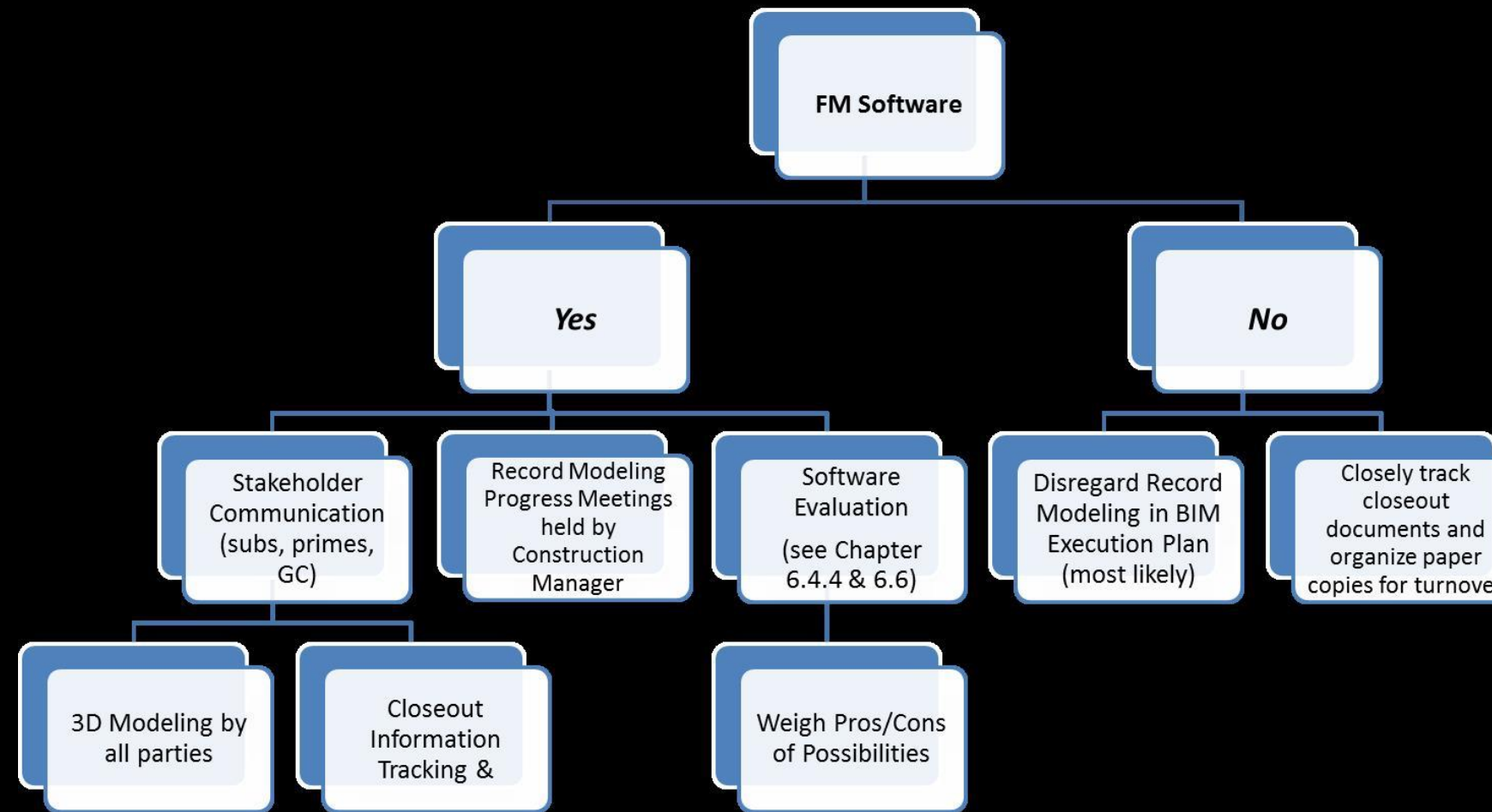
Minimal Costs with huge payoff

Hire early and train before turnover

- Understand costs are incurred; minimal compared to BIM & CMMS

FM must be willing to learn/accept new technology

- Can be determined during hiring process



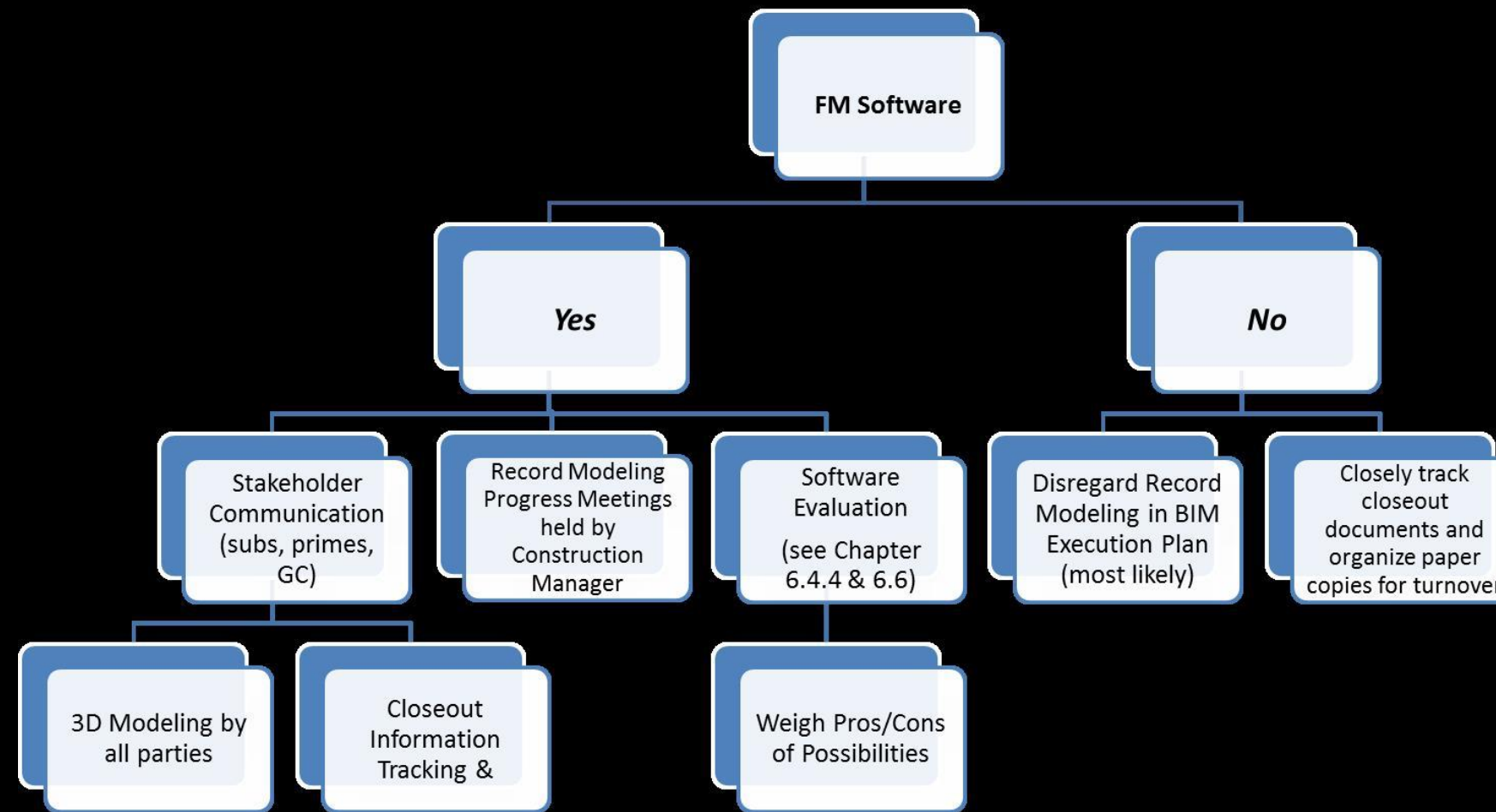
Owner Guide: Software

	Lower Quartile (0.25)	Average	Upper Quartile (0.75)	Actual
Yearly Salary	\$67,234	\$79,709	\$91,144	\$52,000
Weekly	\$1,292.96	\$1,532.87	\$1,752.77	\$1,000.00
Daily	\$258.59	\$306.57	\$350.55	\$200.00

FM INFO TURNOVER | Results



Owner Guide: Early Training



Owner Guide: Software

CWNCHS COSTS

Facilities Management Information Turnover Costs	
Record Modeling Costs	
Total BIM Costs	\$ 50,000.00
% of Man-Hours for Record Modeling	0.73
Record Modeling Costs	\$ 36,500.00
Onuma Software Costs	
Onuma Studio Software (5 users/100 viewers; first year)	\$ 2,311.00
Work Order Module	\$ 850.00
Implementation & Training Services	\$ 20,000.00
Space & Assemt Management Module (per year)	\$ 2,520.00
Operation - Years 2-5	\$ 10,080.00
Purchase, Implementation, and 5-Year Subscription	\$ 33,241.00
Facility Manager Early Training Costs	
FM Actual Salary (\$/yr)	\$ 52,000.00
FM Actual Weekly Pay	\$ 1,000.00
FM Average Salary (Cranberry, PA)	\$ 79,709.00
FM Average Weekly Pay (Cranberry, PA)	\$ 1,532.87
Weeks of Early Training	4
Actual Cost	\$ 4,000.00
Average Cost	\$ 6,131.48
TOTAL FM INVESTMENT	\$73,741 - \$75,873

FM INFO TURNOVER | Recommendation

Project Overview

Prefabricated Masonry Panels

Breadths – Arch & Structural

Lifetime Costs of VE Finishes

Efficient/Effective FM Info Turnover

Alternative Roof Systems Analysis

Final Recommendations

Acknowledgements



RECOMMENDATION

Determine BIM/CMMS aspirations and FM training procedures ASAP using decision tree

If using BIM/CMMS, always utilize early training of FM based on costs

Train all FM stakeholders in CMMS software

Amount of early training may be dependent upon building systems complexity

Onuma/4 weeks of early training at CWNCHS = appropriate



CWNCHS COSTS

Facilities Management Information Turnover Costs	
Record Modeling Costs	
Total BIM Costs	\$ 50,000.00
% of Man-Hours for Record Modeling	0.73
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TOTAL FM INVESTMENT	\$73,741 - \$75,873

ALT. ROOF SYSTEM | Problem Identification

Project Overview

Prefabricated Masonry Panels

Breadths – Arch & Structural

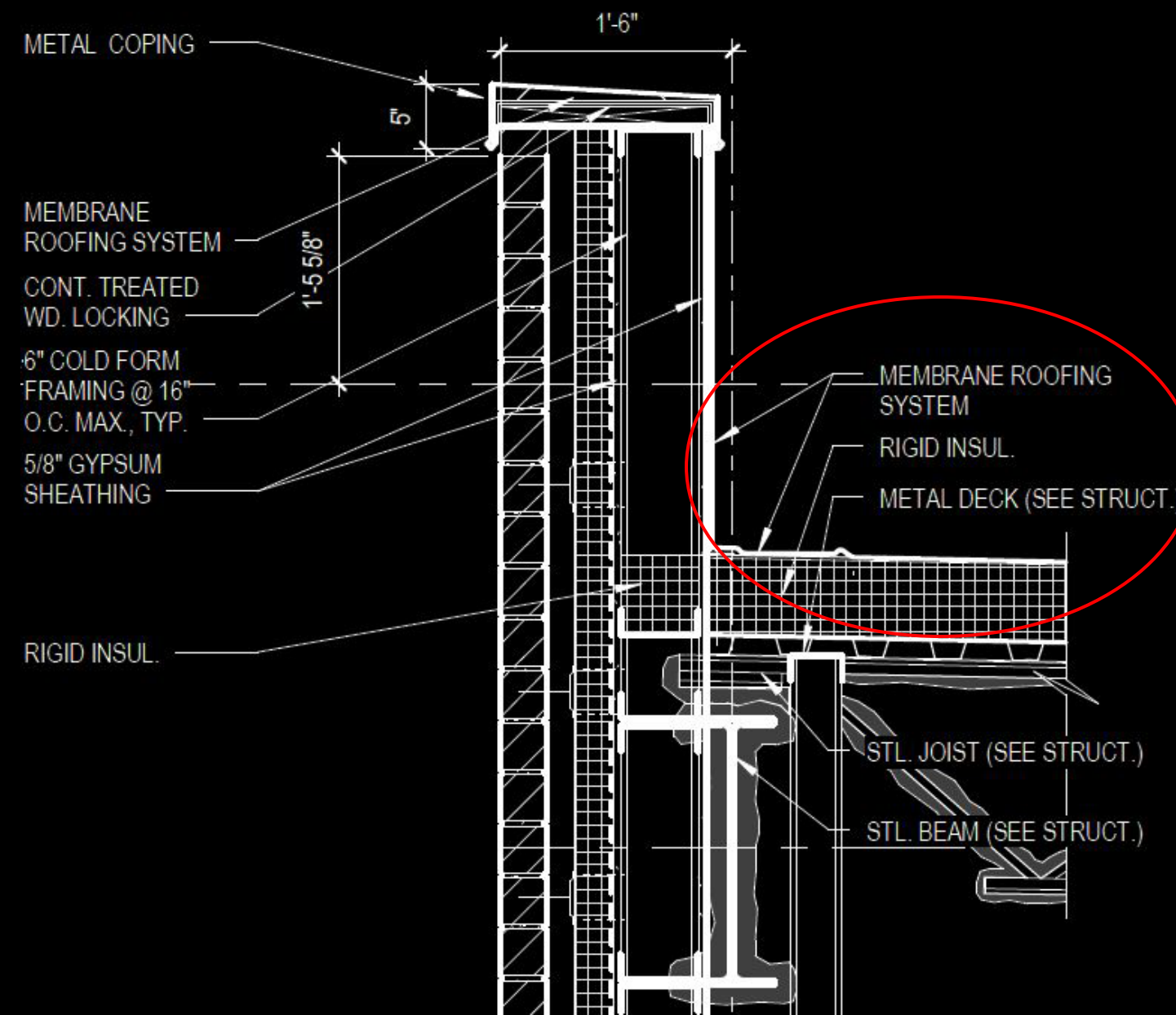
Lifetime Costs of VE Finishes

Efficient/Effective FM Info Turnover

Alternative Roof Systems Analysis

Final Recommendations

Acknowledgements



PROBLEM

TPO scheduled to be installed beginning in February 2013

TPO adhesive not able to be applied $<25^{\circ}$ C

Re-sequencing after delayed building pad turnover + cold-weather presented problems:

- \$15,000 in overtime pay
- Re-sequencing effort
- Quality risks
- Phoenix Roofing required to increase manpower

Could have been avoided with different system recommendation

ALT. ROOF SYSTEM | Problem Identification

Project Overview

Prefabricated Masonry Panels

Breadths – Arch & Structural

Lifetime Costs of VE Finishes

Efficient/Effective FM Info Turnover

Alternative Roof Systems Analysis

Final Recommendations

Acknowledgements



Failed TPO at CWNCHS

PROBLEM

TPO scheduled to be installed beginning in February 2013

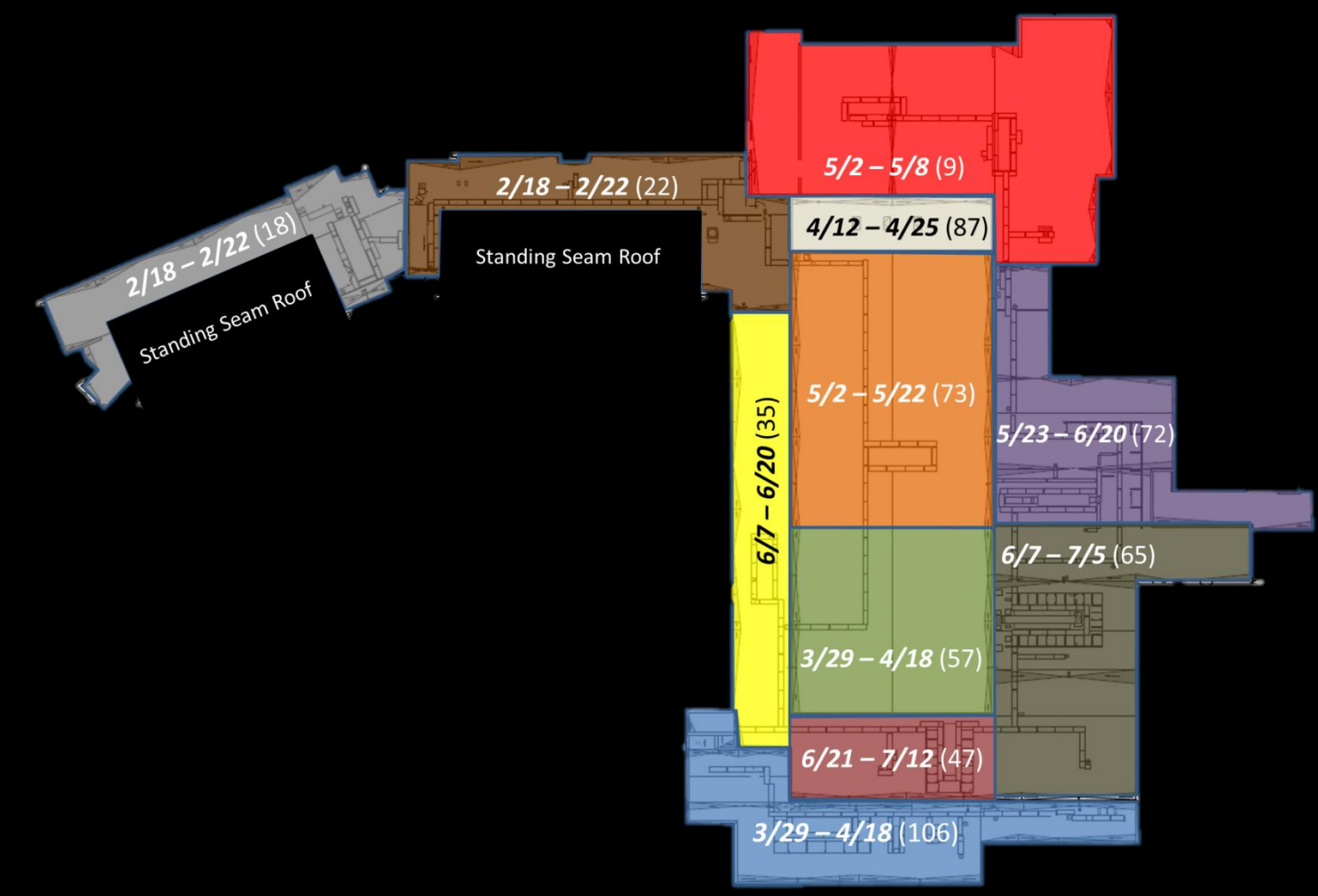
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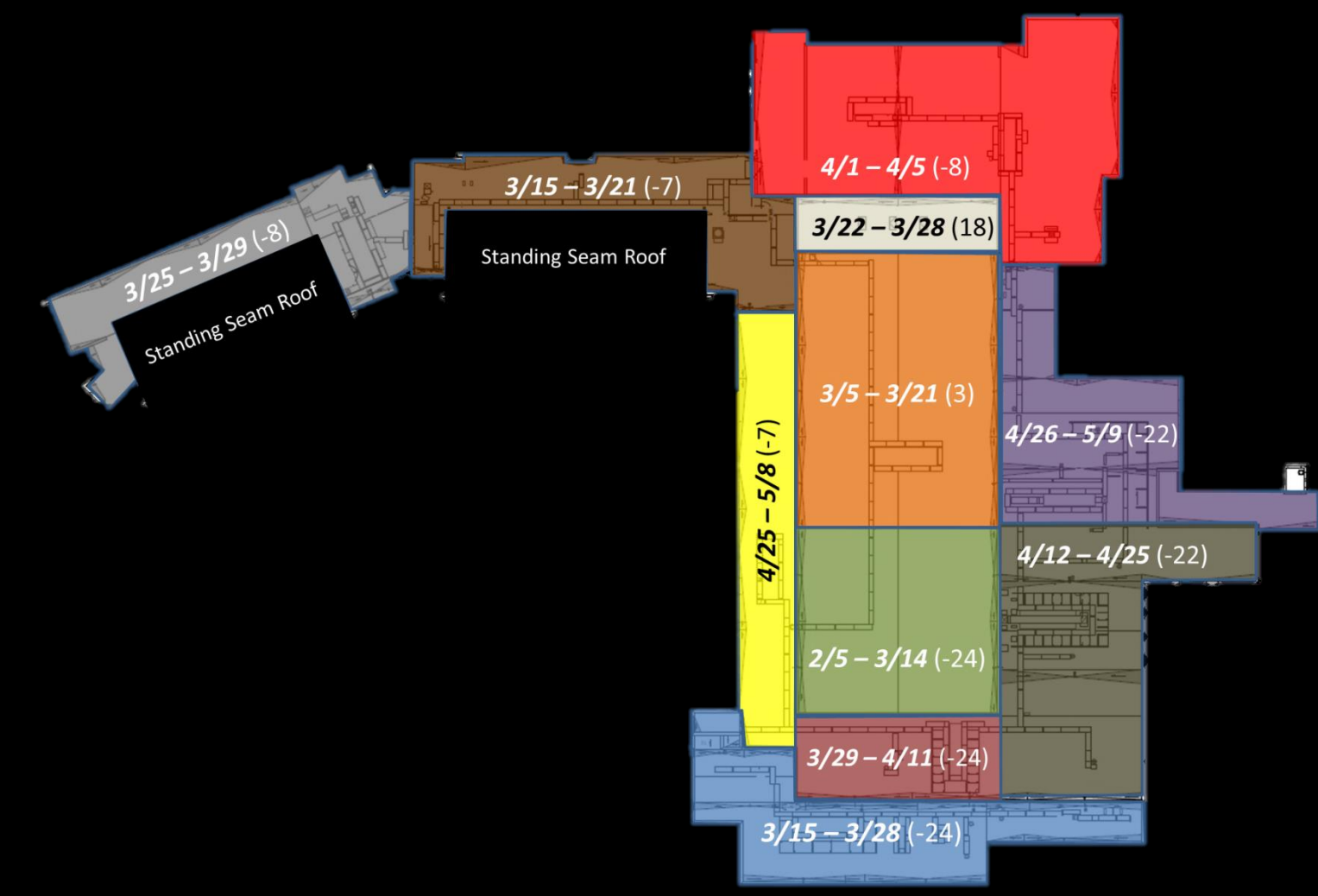
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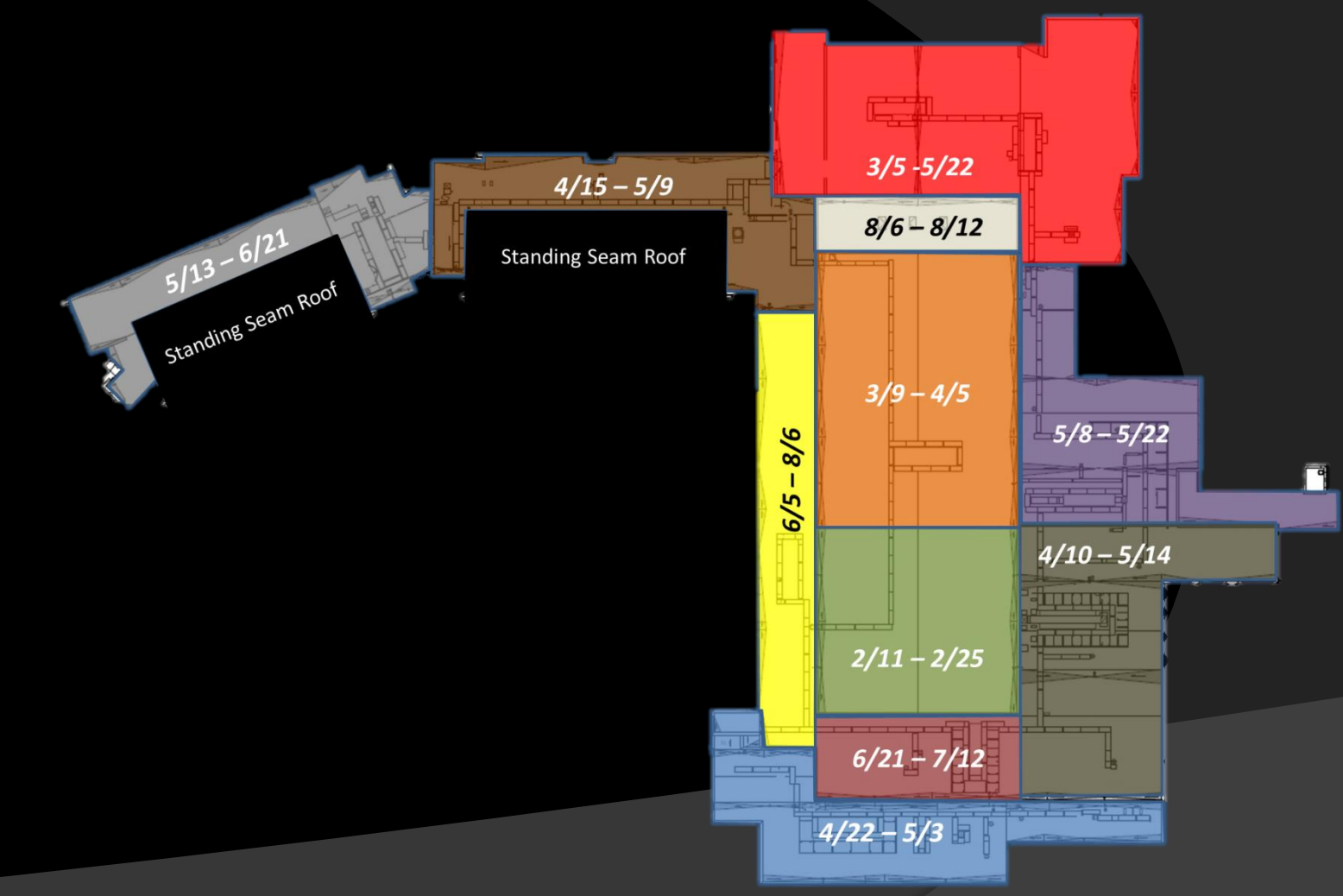
ALT. ROOF SYSTEM | Problem Identification



Baseline Schedule (prior to delay; 09/2012)



Start of TPO Installation (02/2013)



Completion Schedule (08/2013)

ALT. ROOF SYSTEM | Suggestion

Project Overview

Prefabricated Masonry Panels

Breadths – Arch & Structural

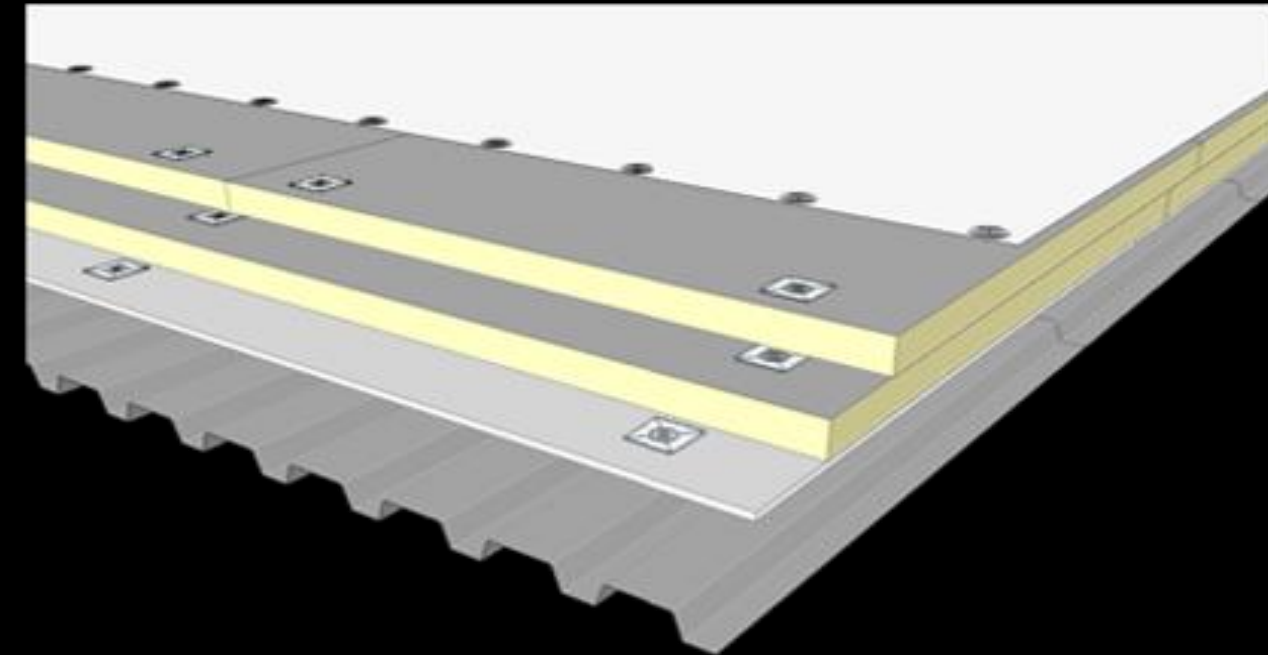
Lifetime Costs of VE Finishes

Efficient/Effective FM Info Turnover

Alternative Roof Systems Analysis

Final Recommendations

Acknowledgements



PVC Assembly (Courtesy of Duro-Last)

SUGGESTION

Use Duro-Last PVC Roofing System

- 50-mil to match TPO 20-yr warranty
- 60-mil to increase to 25-yr warranty

75% Prefabrication in warehouse

Mechanically-adhered at perimeter

- Cold-weather installation is not a problem

Similar installation time; reduces critical path

Less seams → better quality system

No structural concern → lighter or equal weight

ALT. ROOF SYSTEM | Suggestion

Project Overview

Prefabricated Masonry Panels

Breadths – Arch & Structural

Lifetime Costs of VE Finishes

Efficient/Effective FM Info Turnover

Alternative Roof Systems Analysis

Final Recommendations

Acknowledgements



TPO Analysis

Pros

- Cheap
- White Surface
- Fully-Adhered
- LEED Credit

Cons

- Can't install in cold weather
- Not very durable
- No prefabrication
- Poor workmanship & quality of installation during winter weather

PVC Analysis

Pros

- Strength
- Durability
- Weather Resistance
- Prefabrication
- LEED Credit
- Cost Competitive
- Workmanship

Cons

- Mechanically fastened
- Somewhat higher initial investment
- Risk – GC payback may not be as high as estimated

ALT. ROOF SYSTEM | Results

Project Overview

Prefabricated Masonry Panels

Breadths – Arch & Structural

Lifetime Costs of VE Finishes

Efficient/Effective FM Info Turnover

Alternative Roof Systems Analysis

Final Recommendations

Acknowledgements



RESULTS

Duro-Last PVC competitively priced:

- \$1.04/SF (50-mil)
- \$1.17/SF (60-mil)

Time saved from prefabrication; maximum of 30 days

Constructability/quality improved

GC → \$15,000 saved (no OT)

Owner → \$199,555.51 saved (60-mil)

General Conditions Savings from Critical Path Reduction	
Days TPO on Critical Path	
Gymnasium	11 days
Cafeteria	10 days
Area F	13 days
Total TPO Critical Path Time	40 days
Prefabrication of PVC Reduction	(40 days)*(0.75) = 30 days
On-Site PVC Install Duration	10 days
GC Cost Savings	
Total GC Costs	\$2,871,341
Daily GC Costs (21 months)	\$6,835/day
Total Savings	\$205,050

ALT. ROOF SYSTEM | Recommendations

Project Overview

Prefabricated Masonry Panels

Breadths – Arch & Structural

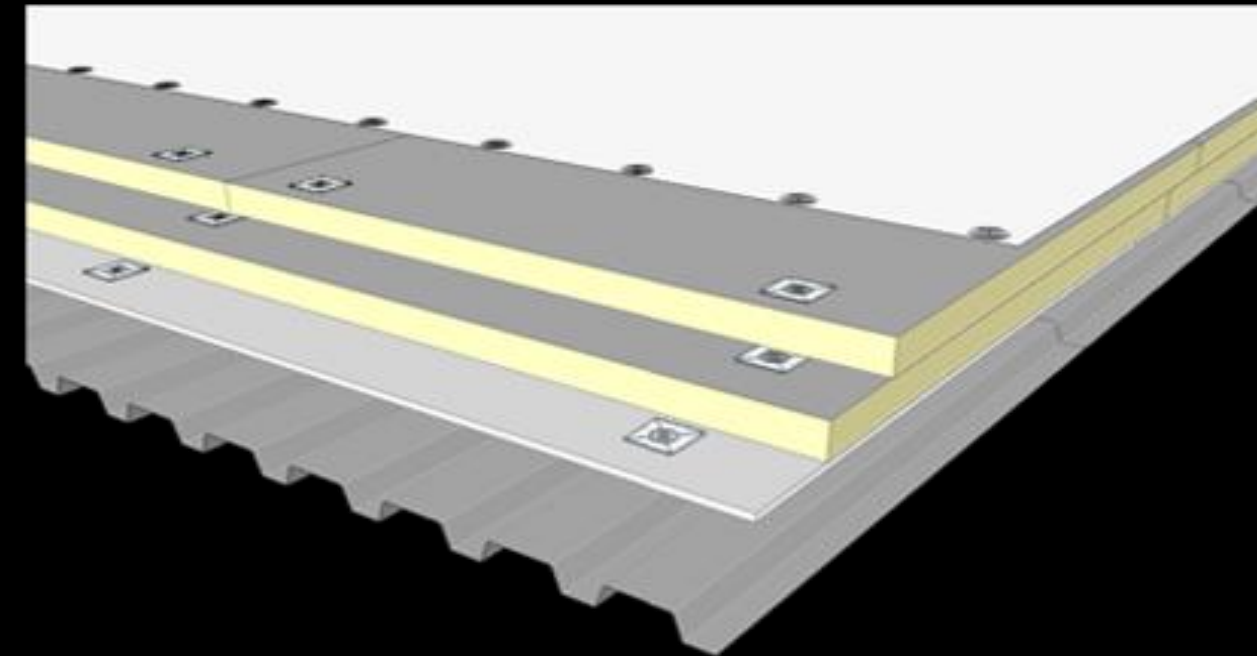
Lifetime Costs of VE Finishes

Efficient/Effective FM Info Turnover

Alternative Roof Systems Analysis

Final Recommendations

Acknowledgements



PVC Assembly (Courtesy of Duro-Last)

RECOMMENDATION

Replace TPO with PVC Roofing System

\$\$\$ Savings for Owner & GC

Overall Schedule Reduction

Longer warranty

Higher quality system

Cold weather installation



CONCLUSION

Project Overview

Prefabricated Masonry Panels

Breadths – Arch & Structural

Lifetime Costs of VE Finishes

Efficient/Effective FM Info Turnover

Alternative Roof Systems Analysis

Final Recommendations

Acknowledgements



Overall Results

Total Cost Savings: \$268,314.34

Maximum Recommended Schedule Reduction = 30 days

Reduction of Constructability concerns on Roof

More maintenance friendly building

Efficient/Effective Use of FM Information

More accurate cost reporting

Analysis #1 – Prefab Panels

- Realization that prefabrication is not fit for this type of building
 - Schedule reduction not critical

Analysis #2 – Lifetime Costs of VE Finishes

- Accurate cost reporting
- One VE decision change = \$54,000 savings

Analysis #3 – Efficient Effective FM Information Turnover

- FM Training Cost is cheap relative to BIM/CMMS
- BIM aids in FM Operations if implemented effectively
 - CWNCHS process was efficient/effective

Analysis #4 – Alternative Roof System Analysis

- \$214,555.51 in cost savings
- 30 day schedule reduction
- Better quality roofing system
- Reduced constructability concerns

ACKNOWLEDGEMENTS

Project Overview

Prefabricated Masonry Panels

Breadths – Arch & Structural

Lifetime Costs of VE Finishes

Efficient/Effective FM Info Turnover

Alternative Roof Systems Analysis

Final Recommendations

Acknowledgements



Thank you!!

Special Thanks

- Family & Friends
- Mike Arnold
- Billy Charles
- CWNCHS Project Team
- PACE Industry Members
- Jay Monteverde
- Dom Baruffi

Academic

- Ray Sowers
- Robert Leicht
- Charlie Cox
- Kevin Parfitt

Industry

- Mascaro Construction
- Astorino
- Catholic Diocese of Pittsburgh
- Sto Panel Tech.
- Duro-Last

CARDINAL WUERL NORTH CATHOLIC HIGH SCHOOL



APPENDIX

Actual Building Costs for Cardinal Wuerl North Catholic High School		
	Construction Cost	Cost/SF
Actual Building Construction Costs (CC)	\$43,027,573.00	\$242.92
Total Project Cost (TC)	\$72,525,969.00	\$13.91
MEP/FP Systems Total Cost	\$8,860,010.00	\$49.99
Structural Systems Cost	\$6,017,485.00	\$33.97

Square Foot Estimate for Cardinal Wuerl North Catholic High School	
Gross Floor Area	177,129
Average Floor Height	20'1"
Perimeter	3,136'
Interpolated Construction Cost	\$162.92/SF
Perimeter Adjustment Cost	\$3.86/SF
Story Height Adjustment Cost	\$14.80/SF
Final CC/SF	\$181.58/SF
Additives	\$1,481,640
Final Total Cost	\$33,644,723.82

GC Estimate	QTY.	UNIT	MAT. \$/UNIT	MAT. TOTAL	LABOR \$/UNIT	LABOR TOTAL	GRAND TOTAL
UTILITIES							
TEMP. HEAT (FUEL, OPERATION, 12 HR/DAY)	886	GSF*40 WK	CSF FLR/WK	\$ 29.68	\$ 1,051,859.20		\$ 1,051,859.20
TEMPORARY STRUCTURES							
JOB OFFICE/TRAILER (50'x12')	2	EA	\$ 31,600.00	\$ 63,200.00			\$ 63,200.00
TRAILER MOB/DEMOB	4	EA	\$ 2,000.00	\$ 8,000.00			\$ 8,000.00
TRAILER SET-UP	2	EA	\$ 10,000.00	\$ 20,000.00			\$ 20,000.00
TRAILER TEAR-DOWN	2	EA	\$ 10,000.00	\$ 20,000.00			\$ 20,000.00
TEMPORARY PARKING & STAGING	1	LS	\$ 50,000.00	\$ 50,000.00			\$ 50,000.00
TEMP. BUILDING ENCLOSURE (FRAMES + TARP)	25,000	SF	\$ 2.63	\$ 65,750.00			\$ 65,750.00
TEMPORARY ACCESS ROADS	10,000	SY	\$ 8.60	\$ 86,000.00			\$ 86,000.00
TEMPORARY SERVICES							
TOILETS/SANITARY SPACE	21	MO	\$ 1,000.00	\$ 21,000.00			\$ 21,000.00
DRINKING WATER	21	MO	\$ 100.00	\$ 2,100.00			\$ 2,100.00
CAMERAS, SITE PHOTOGRAPHY & OX BLUE	21	MO	\$ 1,575.00	\$ 33,075.00			\$ 33,075.00
DUMPSTERS/TRASH REMOVAL	21	MO	\$ 950.00	\$ 19,950.00			\$ 19,950.00
SNOW REMOVAL	12	MO	\$ 500.00	\$ 6,000.00			\$ 6,000.00
DAILY CLEAN UP	455	DAY	\$ 39.50	\$ 17,972.50			\$ 17,972.50
TRAILER CLEANING	455	MO	\$ 39.50	\$ 17,972.50			\$ 17,972.50
TELE/DATA/LIGHTS	21	MO	\$ 256.00	\$ 5,376.00			\$ 5,376.00
SECURITY	21	MO	\$ 3,000.00	\$ 63,000.00			\$ 63,000.00
RADIOS/PHONES	21	MO	\$ 500.00	\$ 10,500.00			\$ 10,500.00
PROJECT RELATED TRAVEL							
UTILITY VEHICLE PURCHASE & FUEL	1	LS	\$ 50,000.00	\$ 50,000.00			\$ 50,000.00
AUTO ALLOWANCES	1	LS	\$ 10,000.00	\$ 10,000.00			\$ 10,000.00
ADMINISTRATIVE SUPPLIES							
OFFICE SUPPLIES	21	MO	\$ 75.00	\$ 1,575.00			\$ 1,575.00
OFFICE EQUIPMENT	21	MO	\$ 220.00	\$ 4,620.00			\$ 4,620.00
OFFICE FURNITURE	1	LS	\$ 8,000.00	\$ 8,000.00			\$ 8,000.00
COMPUTER SOFTWARE/EQUIPMENT	1	LS	\$ 80,000.00	\$ 80,000.00			\$ 80,000.00
PRINTING - DRAWING & SPECS	1	LS	\$ 15,000.00	\$ 15,000.00			\$ 15,000.00
STAFFING MONITOR & EBE							
SR. PROJECT MANAGER	23	WK		\$ 4,000.00		\$ 92,000.00	\$ 92,000.00
PROJECT MANAGER	91	WK		\$ 3,200.00		\$ 291,200.00	\$ 291,200.00
SUPERINTENDENT	91	WK		\$ 2,950.00		\$ 268,450.00	\$ 268,450.00
PROJECT ENGINEER	91	WK		\$ 1,950.00		\$ 177,450.00	\$ 177,450.00
PROJECT ENGINEER	91	WK		\$ 1,950.00		\$ 177,450.00	\$ 177,450.00
HOME OFFICE ADMINISTRATOR	23	WK		\$ 1,100.00		\$ 25,300.00	\$ 25,300.00
PROJECT ADMINISTRATOR	91	WK		\$ 550.00		\$ 50,050.00	\$ 50,050.00
BIM & MEP COORD	1	LS		\$ 50,000.00		\$ 50,000.00	\$ 50,000.00
PRECONSTRUCTION	1	LS		\$ 20,000.00		\$ 20,000.00	\$ 20,000.00
MISCELLANEOUS							
FIRE EXTINGUISHERS (20 LB)	10	EA	\$ 163.00	\$ 1,630.00			\$ 1,630.00
SURVEYING	180,000	SF	\$ 0.50	\$ 90,000.00			\$ 90,000.00
ELECTRICAL/DATA HOOK-UP	1	LS	\$ 1,000.00	\$ 1,000.00			\$ 1,000.00
MISC SAFETY EQUIPMENT	1	LS	\$ 10,000.00	\$ 10,000.00			\$ 10,000.00
SMALL TOOLS	1	LS	\$ 2,000.00	\$ 2,000.00			\$ 2,000.00
PROJECT CLOSEOUT DOCS	1	LS	\$ 5,000.00	\$ 5,000.00			\$ 5,000.00
FIRST AID	1	LS	\$ 2,000.00	\$ 2,000.00			\$ 2,000.00
							SUBTOTAL \$ 2,990,980.20
							LOCATION FACTOR (Butler, PA) 0.96
							TOTAL \$ 2,871,340.99

STRUCTURAL BREADTH CALCULATIONS
ALEX HANLEY

SCORES: 50 SHEETS - 5 SQUARES
9-0236 - 100 SHEETS - 5 SQUARES
9-0237 - 200 SHEETS - 5 SQUARES
9-0137 - 200 SHEETS - FILLER

CONET

FIRST FLOOR PLAN

ROOF PLAN

- Calculate additional weight on columns. Assume 20 PSF uniform exterior wall load over the entire surface area.

COLUMN E12 → $\left(\frac{29'-6''}{2} + 14'-0''\right) (31'-8'') (20 \text{ PSF}) = 11,559 \text{ lbs} = 11.56 \text{ k}$

COLUMN E13 → $\left(\frac{29'-6''}{2} + \frac{26'-2''}{2}\right) (31'-8'') (20 \text{ PSF}) = 17,312 \text{ lbs} = 17.31 \text{ k}$

COLUMN E13.9 → $\left(\frac{26'-2''}{2} + \frac{23'-5 \frac{3}{8}''}{2}\right) (31'-8'') (20 \text{ PSF}) = 15,718 \text{ lbs} = 15.72 \text{ k}$

COLUMN E14.8 → $\left(\frac{23'-5 \frac{3}{8}''}{2}\right) (31'-8'') (20 \text{ PSF}) = 7,432 \text{ lbs} = 7.43 \text{ k}$

REVISED ON NEXT PAGE

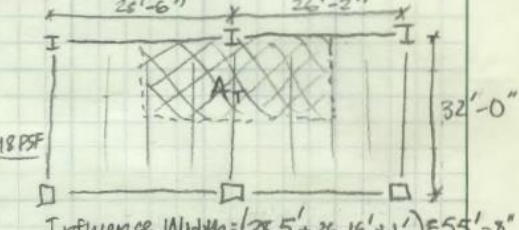
- I will focus on **Column E3** since it has the largest influence area and exterior wall load.

- Continuing to use W10 sections
 - 1 floor, 0.1 roof using 1 column
 - Total Exterior Panel Height = 31'-8"; Panel Load = 20 PSF

LIVE LOAD REDUCTION

$$L = 80 \times \left(0.9 + \frac{0.25 + \frac{15}{\sqrt{18374}}}{15} \right) = 8.6 (80 \text{ PSF}) = 48 \text{ PSF}$$

(1st Floor)



LL_{roof} = 20 PSF } SNOW CONTROLS
 SL_{roof} = 25 PSF }
 (Granbury, PA)
 Influence Width = (28.5' + 26.16' + 1') = 55'-8"
 Influence Length = (32' + 1') = 33'-0"
 $K_{LL} A_T = (56.67)(33') = 1837 \text{ ft}^2$
 $L_0 = 80 \text{ PSF}$ (school w/ corridors)

WALL LOAD (previous page)

$$P_u = 1.2 (633.33 \text{ PLF}) (14.25' + 13.083' + 1' + 1') = 1.2 (633.33)(29.33') = 22,293 \text{ lbs}$$

ASSUMING ONE FLOOR SINCE COLUMN IS CONTINUOUS FROM PIER TO ROOF.

$$A_T = (14.25' + 1' + 13.0833' + 1') (16' + 1') = 499 \text{ ft}^2$$

(roof & first floor)

$$\text{ROOF} = \left[1.2 \left(\frac{12 \text{ PSF}}{\text{TPO}} + \frac{8 \text{ PSF}}{\text{SDL}} + \frac{8 \text{ PSF}}{\text{ROOFING OVER TOP OF COLUMNS}} \right) + 0.5 \left(\frac{25'}{\text{SNOW LOAD}} \right) \right] \times (499 \text{ ft}^2) = 23,004 \text{ lbs} = 23 \text{ K}$$

$$\text{FLOOR} = \left[1.2 \left(\frac{57 \text{ PSF}}{\text{slab}} + \frac{10 \text{ PSF}}{\text{SDL}} + \frac{8 \text{ PSF}}{\text{allowance}} \right) + 1.6 (48 \text{ PSF}) \right] \times (499 \text{ ft}^2) = 83,233.2 \text{ lbs} = 83.24 \text{ K}$$

$$P_u = 83.24 \text{ K} + 23 \text{ K} + 22.3 \text{ K} = 128.54 \text{ K}; KL = 30'-0"$$

(FLR) (ROOF) (wall) → USE W10x49 STILL

$$P_u \text{ (before wall)} = 106.24 \text{ K} @ 30'-0" \rightarrow \text{USE W10x49 STILL}$$

W10x49 @ KL=30' ⇒ $\phi_c P_n = 162 \text{ K}$

*BASED ON THIS CALCULATION, IT CAN BE ASSUMED THAT THE STRUCTURAL SYSTEM WAS DESIGNED WITH ENOUGH CONTINGENCIES THAT IT CAN HANDLE AN ADDITIONAL 20 PSF EXT. WALL LOAD

- Assumptions in structural checks for steel superstructure adjustment due to prefabricated exterior masonry panels:

- 20 PSF UNIFORM LOAD OVER ENTIRE SURFACE AREA REGARDLESS OF WINDOWS & OTHER FINISHES
- SINCE COLUMN EXTENDS FROM FOUNDATION TO ROOF, SPLILING DOESN'T MATTER AND FLR-FLR HEIGHT IS THE HEIGHT FROM BOTTOM OF BRICK TO TOP OF PANEL.
- ALL LATERAL BRACING AND WIND LOADING ACCOUNTED FOR BY PANEL DESIGN ENGINEER/STRUCTURAL ENGINEER
- WHILE LINTELS SUPPORTED SOME OF THE MASONRY LOAD, IT IS ASSUMED THAT THE MAJORITY BEARED DIRECTLY ON THE FOUNDATION.

- LOAD ASSUMPTIONS:

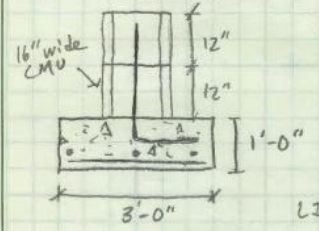
- ROOF:
 - TPO = 0.4 PSF
 - RIGID INSUL = (1.5 PSF/inch)(6") = 9 PSF
 - 1.5B20 ROOF DECK = 2.14 PSF (VULCRAFT MANUAL)
 - VAPOR BARRIER NEGLIGIBLE
 - TOTAL ASSEMBLY = 12 PSF
 - ROOF LIVE LOAD = 20 PSF
 - SNOW LOAD = 25 PSF (IBC 2009 Map)
 - Framing Allowances = 8 PSF
 - ↳ Beams, Girders, Columns = ASTM A992 Grade 50
 - SDL = 8 PSF

• FLOOR

- School Occupancy → Use 80 PSF LL for corridor allowance
- Exterior Wall Load = 20 PSF (sto Panel Allowance)
 - ↳ Reduced to 48 PSF
- Framing Same as roof allowances = 8 PSF
- ↳ ASTM A992 Grade 50 Structural Steel
- SDL = 10 PSF
- SLAB = 5.5" thick w/ 2" 18GA composite steel deck; 3 1/2" NWT Concrete
- ↳ = 57 PSF

- AISC Steel Manual Notes used from AE 404 to size column and perform accompanying calculations.
 - IBC 2009 used for snow load, live load
 - Vulcraft Manual used for Roof Deck & Composite Slab Weights
 - Firestone cutsheets used for TPO and rigid insulation weights.

FOOTING REDESIGN



$$q_a = \frac{P}{B} \rightarrow 2 \text{ KSF} = \frac{P}{3'}$$

$$P = 6 \text{ KLF}$$

BRICK VENEER LOAD = 50 PSF
 TOTAL UNIFORM BRICK HEIGHT = 31'-8"

$$\text{LINER BRICK VENEER LOAD} = (50 \text{ PSF} \times 31'-8") / (1000 \text{ lb/kip}) = 1.5833 \text{ KLF}$$

$q_c = 2000 \text{ PSF}$
 (CONCRETE FILL)

$$\text{ADJUSTED FOOTING LOAD (P)} = 6 - 1.5833$$

$$P = 4.42 \text{ KLF}$$

$$f'_c = 3,000 \text{ PSI}$$

Since a lot of the dead load has been reduced, assume live when using IBC load combos.

$$P_u = 1.6 (4.42 \text{ KLF}) = 7.07 \text{ KLF}$$

$$q = \frac{7.07 \text{ KLF}}{3'} = 2.36 \text{ KSF}$$

$$M_u = \frac{(2.36 \text{ KSF})(1.16')^2}{2} \leftarrow l = \frac{3'-8"}{2} = 1.16'$$

$$M_u = 1.61 \text{ ft} \cdot \text{kips}$$

- Determine footing depth:

$$M_u \leq \phi M_n \quad \phi(5) \sqrt{f'_c} \left(\frac{12 \text{ h}^2}{6} \right)$$

$$(1.61 \text{ ft} \cdot \text{k}) \left(\frac{1000 \text{ lbs}}{1 \text{ k}} \right) \left(\frac{12 \text{ in}}{1 \text{ ft}} \right) = 0.55 (5) \sqrt{3000} \left(\frac{12 \text{ h}^2}{6} \right)$$

$$19,273.33 = 301.25 \text{ h}^2$$

$$\boxed{h = 8"} \leftarrow$$

- Check Shear:

$$\phi V_n = \phi \left(\frac{4}{3} \right) \sqrt{f'_c} b h$$

$$q \leq 0.55 \left(\frac{4}{3} \right) \sqrt{3000} (12 \text{ in}) (8 \text{ in}) / 1000$$

$$2.36 \text{ K} \leq 3.96 \text{ K} \quad \checkmark \text{ OKAY}$$

-Check minimum steel

$$d = 8" - 3" - 0.625" = 4.375" \rightarrow a = 1.96A_s$$

$$\phi M_n = \phi A_s F_y (d - a/2)$$

$$(1.61)(12) = M_u \leq 0.9 A_s (60 \text{ ksi})(4.375" - 0.98 A_s)$$

$$19.32 \leq 236.25 A_s - 52.92 A_s^2$$

$$0 \leq -52.92 A_s^2 + 236.25 A_s - 19.32$$

$$A_s \geq 0.0933 \text{ in}^2$$

→ #5 @ 12" O.C. continuous and 3-#5

continuous bars achieve minimum area and will not be changed.

$$A_s = \frac{0.31}{(12" \times 12")} = 0.00323 \rightarrow p_{min} = 0.0018$$

✓✓ STEEL OKAY

-Check shrinkage:

$$a = 1.96(0.31) = 0.6076$$

$$c = \frac{a}{\beta_1} = \frac{0.6076}{0.95} = 0.715$$

$$E_s = \frac{0.003}{0.715} (4.375" - 0.715") = 0.01557 \frac{\text{in}}{\text{in}} \geq 0.005 \text{ ✓✓ OKAY}$$

IN CONCLUSION, THE WF3 HEIGHT CAN BE REDUCED BY 4" TO A TOTAL OF 8" IF THE STEEL IS KEPT CONSTANT.

ACI Manual referenced from CE 397A notes from FALL 2013.

ADJUSTED COST ANALYSIS

Actual TPO Cost (Mat + Lab + Eq)	\$	1,035,000.00
Estimated TPO Cost (RS Means)	\$	720,099.00
Real Cost Multiplier		(\$1,035,000)/(\$720,099) = 1.4373
EPDM Estimate (RS Means)	\$	761,070.15
EPDM Estimate*Multiplier	\$	1,093,886.13
BUR Estimate (RS Means)	\$	819,423.00
BUR Estimate*Multiplier	\$	1,177,756.68
PVC Estimate (RS Means)	\$	802,041.30
PVC Estimate*Multiplier	\$	1,152,773.96

FINAL RECOMMENDATION ESTIMATE

Actual TPO Subtotal	\$	1,035,000.00
Overtime Labor for TPO	\$	15,000.00
Total TPO Costs (Actual)	\$	1,050,000.00
PVC Estimate (RS Means)	\$	802,041.30
PVC Estimate (Real Cost Adjustment)	\$	1,152,773.96
PVC Estimate (Duro-Last)	\$	725,065.20
PVC Estimate (Real Cost Adjustment)	\$	1,042,136.21
General Conditions Savings		(30 days)*(\$6,835/day) = \$205,050.00
Actual Cost of PVC (RS Means)	\$	947,723.96
Actual Cost of PVC (Duro-Last)	\$	837,086.21
Cost Savings of Prefabricated PVC (Duro-Last)	\$	197,913.79

Alternative Roof Systems Estimate (RS Means & Real Product Cost Info)

Roof Type	CSI Division	Item	Unit	Unit Costs				Quantity	Total Costs					
				Mat.	Labor	Equip.	Total Cost		Total w/ O&P	Material	Labor	Equip.	Total	Total w/ O&P
TPO	72216.1754	Insulation, Polyisocyanurate, 3" thick (2 layers)	SF	\$ 1.22	\$ 0.24		\$ 1.46	\$ 1.75	248310	\$302,938.20	\$ 59,594.40	\$ -	\$362,532.60	\$ 434,542.50
	75423.0200	60 mil TPO membrane, fully adhered	Sq.	\$ 90.00	\$57.00	\$ 7.95	\$ 154.95	\$ 205.00	1241.55	\$111,739.50	\$ 70,768.35	\$ 9,870.32	\$192,378.17	\$ 254,517.75
	72610.1200	Polyethylene Vapor Barrier, 10 mil thickness	Sq.	\$ 8.85	\$9.90		\$ 18.75	\$ 25.00	1241.55	\$ 10,987.72	\$ 12,291.35	\$ -	\$ 23,279.06	\$ 31,038.75
TOTAL TPO Estimated Costs									\$425,665.42	\$142,654.10	\$ 9,870.32	\$578,189.84	\$ 720,099.00	
EPDM	72216.1754	Insulation, Polyisocyanurate, 3" thick (2 layers)	SF	\$ 1.22	\$ 0.24		\$ 1.46	\$ 1.75	248310	\$302,938.20	\$ 59,594.40	\$ -	\$362,532.60	\$ 434,542.50
	75323.4800	EPDM Roofing, 60 mils, 0.4 psf, full adhered w/ adhesive	Sq.	\$124.00	\$54.50	\$ 7.65	\$ 186.15	\$ 238.00	1241.55	\$153,952.20	\$ 67,664.48	\$ 9,497.86	\$231,114.53	\$ 295,488.90
	72610.1200	Polyethylene Vapor Barrier, 10 mil thickness	Sq.	\$ 8.85	\$9.90		\$ 18.75	\$ 25.00	1241.55	\$ 10,987.72	\$ 12,291.35	\$ -	\$ 23,279.06	\$ 31,038.75
TOTAL EPDM Estimated Costs									\$467,878.12	\$139,550.22	\$ 9,497.86	\$616,926.20	\$ 761,070.15	
PVC	72216.1754	Insulation, Polyisocyanurate, 3" thick (2 layers)	SF	\$ 1.22	\$ 0.24		\$ 1.46	\$ 1.75	248310	\$302,938.20	\$ 59,594.40	\$ -	\$362,532.60	\$ 434,542.50
	75419.8890	Duro-Last PVC, Heat-welded, 50 mil, 0.4 psf, mech. ad.	SF	\$ 1.17	\$0.55	\$ 0.08	\$ 1.80	\$ 2.09	1241.55	\$145,261.35	\$ 68,285.25	\$ 9,497.86	\$223,044.46	\$ 259,483.95
	72610.1200	Polyethylene Vapor Barrier, 10 mil thickness	Sq.	\$ 8.85	\$9.90		\$ 18.75	\$ 25.00	1241.55	\$ 10,987.72	\$ 12,291.35	\$ -	\$ 23,279.06	\$ 31,038.75
TOTAL PVC Estimated Costs									\$459,187.27	\$140,171.00	\$ 9,497.86	\$608,856.12	\$ 725,065.20	
Built-Up	72216.1754	Insulation, Polyisocyanurate, 3" thick (2 layers)	SF	\$ 1.22	\$ 0.24		\$ 1.46	\$ 1.75	248310	\$302,938.20	\$ 59,594.40	\$ -	\$362,532.60	\$ 434,542.50
	72610.1200	Polyethylene Vapor Barrier, 10 mil thickness	Sq.	\$ 8.85	\$9.90		\$ 18.75	\$ 25.00	1241.55	\$ 10,987.72	\$ 12,291.35	\$ -	\$ 23,279.06	\$ 31,038.75
	75113.0000	BUR, Asphalt flood, asph. Base, 3 plies #15, mopped, nailable	Sq.	\$ 96.00	\$89.00	\$24.00	\$ 209.00	\$ 285.00	1241.55	\$119,488.80	\$110,497.95	\$29,797.20	\$259,483.95	\$ 353,841.75
TOTAL BUR Estimated Costs									\$433,114.72	\$182,383.70	\$29,797.20	\$645,295.61	\$ 819,423.00	

CARDINAL WUERL NORTH CATHOLIC HIGH SCHOOL - CERAMIC TILE LIFE CYCLE COSTS

Year	Capital Costs	Maintenance (\$/yr)	Energy (\$/year)	Repair (\$)	Replace (\$)	Annual Net Cash Flow	Present Value Factor	PV
0	\$ 161,372.51	\$ -	\$ -	\$ -	\$ -	\$ 161,372.51	1.000000	\$ 161,372.51
1	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.909091	\$ -
2	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.826446	\$ -
3	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.751315	\$ -
4	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.683013	\$ -
5	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.620921	\$ -
6	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.564474	\$ -
7	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.513158	\$ -
8	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.466507	\$ -
9	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.424098	\$ -
10	\$ -	\$ -	\$ -	\$ 3,799.00	\$ -	\$ 3,799.00	0.385543	\$ 1,464.68
11	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.350494	\$ -
12	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.318631	\$ -
13	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.289664	\$ -
14	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.263331	\$ -
15	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.239392	\$ -
16	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.217629	\$ -
17	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.197845	\$ -
18	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.179859	\$ -
19	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.163508	\$ -
20	\$ -	\$ -	\$ -	\$ 3,799.00	\$ -	\$ 3,799.00	0.148644	\$ 564.70
21	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.135131	\$ -
22	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.122846	\$ -
23	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.111678	\$ -
24	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.101526	\$ -
25	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.092296	\$ -
26	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.083905	\$ -
27	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.076278	\$ -
28	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.069343	\$ -
29	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.063039	\$ -
30	\$ -	\$ -	\$ -	\$ 3,799.00	\$ -	\$ 3,799.00	0.057309	\$ 217.72
31	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.052099	\$ -
32	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.047362	\$ -
33	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.043057	\$ -
34	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.039143	\$ -
35	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.035584	\$ -
36	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.032349	\$ -
37	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.029408	\$ -
38	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.026735	\$ -
39	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.024304	\$ -
40	\$ -	\$ -	\$ -	\$ 3,799.00	\$ -	\$ 3,799.00	0.022095	\$ 83.94
41	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.020086	\$ -
42	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.018260	\$ -
43	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.016600	\$ -
44	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.015091	\$ -
45	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.013719	\$ -
46	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.012472	\$ -
47	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.011338	\$ -
48	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.010307	\$ -
49	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.009370	\$ -
50	\$ -	\$ -	\$ -	\$ 3,799.00	\$ -	\$ 3,799.00	0.008519	\$ 32.36
PRESENT VALUE LIFECYCLE COST								\$ 163,735.90

CARDINAL WUERL NORTH CATHOLIC HIGH SCHOOL - PAINT LIFE CYCLE COSTS

Year	Capital Costs	Maintenance (\$/yr)	Energy (\$/year)	Repair (\$)	Replace (\$)	Annual Net Cash Flow	Present Value Factor	PV
0	\$ 9,313.80	\$ -	\$ -	\$ -	\$ -	\$ 9,313.80	1.000000	\$ 9,313.80
1	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.909091	\$ -
2	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.826446	\$ -
3	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.751315	\$ -
4	\$ -	\$ 17,544.60	\$ -	\$ -	\$ -	\$ 17,544.60	0.683013	\$ 11,983.20
5	\$ -	\$ 47,002.20	\$ -	\$ -	\$ -	\$ 47,002.20	0.620921	\$ 29,184.67
6	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.564474	\$ -
7	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.513158	\$ -
8	\$ -	\$ 17,544.60	\$ -	\$ -	\$ -	\$ 17,544.60	0.466507	\$ 8,184.69
9	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.424098	\$ -
10	\$ -	\$ 47,002.20	\$ -	\$ -	\$ -	\$ 47,002.20	0.385543	\$ 18,121.38
11	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.350494	\$ -
12	\$ -	\$ 17,544.60	\$ -	\$ -	\$ -	\$ 17,544.60	0.318631	\$ 5,590.25
13	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.289664	\$ -
14	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.263331	\$ -
15	\$ -	\$ 47,002.20	\$ -	\$ -	\$ -	\$ 47,002.20	0.239392	\$ 11,251.95
16	\$ -	\$ 17,544.60	\$ -	\$ -	\$ -	\$ 17,544.60	0.217629	\$ 3,818.22
17	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.197845	\$ -
18	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.179859	\$ -
19	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.163508	\$ -
20	\$ -	\$ 64,546.80	\$ -	\$ 892.39	\$ -	\$ 65,439.19	0.148644	\$ 9,727.12
21	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.135131	\$ -
22	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.122846	\$ -
23	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.111678	\$ -
24	\$ -	\$ 17,544.60	\$ -	\$ -	\$ -	\$ 17,544.60	0.101526	\$ 1,781.23
25	\$ -	\$ 47,002.20	\$ -	\$ -	\$ -	\$ 47,002.20	0.092296	\$ 4,338.11
26	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.083905	\$ -
27	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.076278	\$ -
28	\$ -	\$ 17,544.60	\$ -	\$ -	\$ -	\$ 17,544.60	0.069343	\$ 1,216.60
29	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.063039	\$ -
30	\$ -	\$ 47,002.20	\$ -	\$ -	\$ -	\$ 47,002.20	0.057309	\$ 2,693.63
31	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.052099	\$ -
32	\$ -	\$ 17,544.60	\$ -	\$ -	\$ -	\$ 17,544.60	0.047362	\$ 830.96
33	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.043057	\$ -
34	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.039143	\$ -
35	\$ -	\$ 47,002.20	\$ -	\$ -	\$ -	\$ 47,002.20	0.035584	\$ 1,672.53
36	\$ -	\$ 17,544.60	\$ -	\$ -	\$ -	\$ 17,544.60	0.032349	\$ 567.55
37	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.029408	\$ -
38	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.026735	\$ -
39	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.024304	\$ -
40	\$ -	\$ 64,546.80	\$ -	\$ 892.39	\$ -	\$ 65,439.19	0.022095	\$ 1,445.87
41	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.020086	\$ -
42	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.018260	\$ -
43	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.016600	\$ -
44	\$ -	\$ 17,544.60	\$ -	\$ -	\$ -	\$ 17,544.60	0.015091	\$ 264.77
45	\$ -	\$ 47,002.20	\$ -	\$ -	\$ -	\$ 47,002.20	0.013719	\$ 644.83
46	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.012472	\$ -
47	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.011338	\$ -
48	\$ -	\$ 17,544.60	\$ -	\$ -	\$ -	\$ 17,544.60	0.010307	\$ 180.84
49	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.009370	\$ -
50	\$ -	\$ 47,002.20	\$ -	\$ -	\$ -	\$ 47,002.20	0.008519	\$ 400.39
PRESENT VALUE LIFECYCLE COST								\$ 123,212.59

CARDINAL WUERL NORTH CATHOLIC HIGH SCHOOL - POLISHED CONCRETE LIFE CYCLE COSTS

Year	Capital Costs	Maintenance (\$/yr)	Energy (\$/year)	Repair (\$)	Refinish (\$)	Annual Net Cash Flow	Present Value Factor	PV
0	\$ 97,800.00	\$ -	\$ -	\$ -	\$ -	\$ 97,800.00	1.000000	\$ 97,800.00
1	\$ -	\$ 6,065.39	\$ 400.00	\$ -	\$ -	\$ 6,465.39	0.909091	\$ 5,877.63
2	\$ -	\$ 6,065.39	\$ 432.00	\$ -	\$ -	\$ 6,497.39	0.826446	\$ 5,369.74
3	\$ -	\$ 6,065.39	\$ 466.56	\$ -	\$ -	\$ 6,531.95	0.751315	\$ 4,907.55
4	\$ -	\$ 6,065.39	\$ 503.88	\$ -	\$ -	\$ 6,569.27	0.683013	\$ 4,486.90
5	\$ -	\$ 6,065.39	\$ 544.20	\$ -	\$ -	\$ 6,609.59	0.620921	\$ 4,104.03
6	\$ -	\$ 6,065.39	\$ 587.73	\$ -	\$ -	\$ 6,653.12	0.564474	\$ 3,755.51
7	\$ -	\$ 6,065.39	\$ 634.75	\$ -	\$ -	\$ 6,700.14	0.513158	\$ 3,438.23
8	\$ -	\$ 6,065.39	\$ 685.53	\$ -	\$ -	\$ 6,750.92	0.466507	\$ 3,149.35
9	\$ -	\$ 6,065.39	\$ 740.37	\$ -	\$ -	\$ 6,805.76	0.424098	\$ 2,886.31
10	\$ -	\$ 6,065.39	\$ 799.60	\$ -	\$ -	\$ 6,864.99	0.385543	\$ 2,646.75
11	\$ -	\$ 6,065.39	\$ 863.57	\$ -	\$ -	\$ 6,928.96	0.350494	\$ 2,428.56
12	\$ -	\$ 6,065.39	\$ 932.66	\$ -	\$ -	\$ 6,998.05	0.318631	\$ 2,229.79
13	\$ -	\$ 6,065.39	\$ 1,007.27	\$ -	\$ -	\$ 7,072.66	0.289664	\$ 2,048.70
14	\$ -	\$ 6,065.39	\$ 1,087.85	\$ -	\$ -	\$ 7,153.24	0.263331	\$ 1,883.67
15	\$ -	\$ 6,065.39	\$ 1,174.88	\$ -	\$ -	\$ 7,240.27	0.239392	\$ 1,733.26
16	\$ -	\$ 6,065.39	\$ 1,268.87	\$ -	\$ -	\$ 7,334.26	0.217629	\$ 1,596.15
17	\$ -	\$ 6,065.39	\$ 1,370.38	\$ -	\$ -	\$ 7,435.77	0.197845	\$ 1,471.13
18	\$ -	\$ 6,065.39	\$ 1,480.01	\$ -	\$ -	\$ 7,545.40	0.179859	\$ 1,357.11
19	\$ -	\$ 6,065.39	\$ 1,598.41	\$ -	\$ -	\$ 7,663.80	0.163508	\$ 1,253.09
20	\$ -	\$ 6,065.39	\$ 1,726.28	\$ -	\$ -	\$ 7,791.67	0.148644	\$ 1,158.18
21	\$ -	\$ 6,065.39	\$ 1,864.38	\$ -	\$ -	\$ 7,929.77	0.135131	\$ 1,071.55
22	\$ -	\$ 6,065.39	\$ 2,013.53	\$ -	\$ -	\$ 8,078.92	0.122846	\$ 992.46
23	\$ -	\$ 6,065.39	\$ 2,174.62	\$ -	\$ -	\$ 8,240.01	0.111678	\$ 920.23
24	\$ -	\$ 6,065.39	\$ 2,348.59	\$ -	\$ -	\$ 8,413.98	0.101526	\$ 854.23
25	\$ -	\$ 6,065.39	\$ 2,536.47	\$ -	\$ 336,000.00	\$ 344,601.86	0.092296	\$ 31,805.37
26	\$ -	\$ 6,065.39	\$ 2,739.39	\$ -	\$ -	\$ 8,804.78	0.083905	\$ 738.77
27	\$ -	\$ 6,065.39	\$ 2,958.54	\$ -	\$ -	\$ 9,023.93	0.076278	\$ 688.32
28	\$ -	\$ 6,065.39	\$ 3,195.22	\$ -	\$ -	\$ 9,260.61	0.069343	\$ 642.16
29	\$ -	\$ 6,065.39	\$ 3,450.84	\$ -	\$ -	\$ 9,516.23	0.063039	\$ 599.90
30	\$ -	\$ 6,065.39	\$ 3,726.91	\$ -	\$ -	\$ 9,792.30	0.057309	\$ 561.18
31	\$ -	\$ 6,065.39	\$ 4,025.06	\$ -	\$ -	\$ 10,090.45	0.052099	\$ 525.70
32	\$ -	\$ 6,065.39	\$ 4,347.07	\$ -	\$ -	\$ 10,412.46	0.047362	\$ 493.16
33	\$ -	\$ 6,065.39	\$ 4,694.83	\$ -	\$ -	\$ 10,760.22	0.043057	\$ 463.30
34	\$ -	\$ 6,065.39	\$ 5,070.42	\$ -	\$ -	\$ 11,135.81	0.039143	\$ 435.88
35	\$ -	\$ 6,065.39	\$ 5,476.05	\$ -	\$ -	\$ 11,541.44	0.035584	\$ 410.69
36	\$ -	\$ 6,065.39	\$ 5,914.14	\$ -	\$ -	\$ 11,979.53	0.032349	\$ 387.53
37	\$ -	\$ 6,065.39	\$ 6,387.27	\$ -	\$ -	\$ 12,452.66	0.029408	\$ 366.21
38	\$ -	\$ 6,065.39	\$ 6,898.25	\$ -	\$ -	\$ 12,963.64	0.026735	\$ 346.58
39	\$ -	\$ 6,065.39	\$ 7,450.11	\$ -	\$ -	\$ 13,515.50	0.024304	\$ 328.49
40	\$ -	\$ 6,065.39	\$ 8,046.12	\$ -	\$ -	\$ 14,111.51	0.022095	\$ 311.79
41	\$ -	\$ 6,065.39	\$ 8,689.81	\$ -	\$ -	\$ 14,755.20	0.020086	\$ 296.38
42	\$ -	\$ 6,065.39	\$ 9,384.99	\$ -	\$ -	\$ 15,450.38	0.018260	\$ 282.13

CARDINAL WUERL NORTH CATHOLIC HIGH SCHOOL - LINOLEUM LIFE CYCLE COSTS

Year	Capital Costs	Maintenance (\$/yr)	Energy (\$/year)	Repair (\$)	Replace (\$)	Annual Net Cash Flow	Present Value Factor	PV
0	\$113,400.00	\$ 2,320.59	\$ -	\$ -	\$ -	\$ 115,720.59	1.000000	\$ 115,720.59
1	\$ -	\$ 2,320.59	\$ 200.00	\$ -	\$ -	\$ 2,520.59	0.909091	\$ 2,291.45
2	\$ -	\$ 2,320.59	\$ 216.00	\$ -	\$ -	\$ 2,536.59	0.826446	\$ 2,096.36
3	\$ -	\$ 2,320.59	\$ 233.28	\$ -	\$ -	\$ 2,553.87	0.751315	\$ 1,918.76
4	\$ -	\$ 2,320.59	\$ 251.94	\$ -	\$ -	\$ 2,572.53	0.683013	\$ 1,757.07
5	\$ -	\$ 2,320.59	\$ 272.10	\$ -	\$ -	\$ 2,592.69	0.620921	\$ 1,609.86
6	\$ -	\$ 2,320.59	\$ 293.87	\$ -	\$ -	\$ 2,614.46	0.564474	\$ 1,475.79
7	\$ -	\$ 2,320.59	\$ 317.37	\$ -	\$ -	\$ 2,637.96	0.513158	\$ 1,353.69
8	\$ -	\$ 2,320.59	\$ 342.76	\$ -	\$ -	\$ 2,663.35	0.466507	\$ 1,242.47
9	\$ -	\$ 2,320.59	\$ 370.19	\$ -	\$ -	\$ 2,690.78	0.424098	\$ 1,141.15
10	\$ -	\$ 2,320.59	\$ 399.80	\$ -	\$ -	\$ 2,720.39	0.385543	\$ 1,048.83
11	\$ -	\$ 2,320.59	\$ 431.78	\$ -	\$ -	\$ 2,752.37	0.350494	\$ 964.69
12	\$ -	\$ 2,320.59	\$ 466.33	\$ -	\$ -	\$ 2,786.92	0.318631	\$ 888.00
13	\$ -	\$ 2,320.59	\$ 503.63	\$ -	\$ -	\$ 2,824.22	0.289664	\$ 818.08
14	\$ -	\$ 2,320.59	\$ 543.92	\$ -	\$ -	\$ 2,864.51	0.263331	\$ 754.32
15	\$ -	\$ 2,320.59	\$ 587.44	\$ -	\$ -	\$ 2,908.03	0.239392	\$ 696.16
16	\$ -	\$ 2,320.59	\$ 634.43	\$ -	\$ -	\$ 2,955.02	0.217629	\$ 643.10
17	\$ -	\$ 2,320.59	\$ 685.19	\$ -	\$ -	\$ 3,005.78	0.197845	\$ 594.68
18	\$ -	\$ 2,320.59	\$ 740.00	\$ -	\$ 340,200.00	\$ 343,260.59	0.179859	\$ 61,738.43
19	\$ -	\$ 2,320.59	\$ 799.20	\$ -	\$ -	\$ 3,119.79	0.163508	\$ 510.11
20	\$ -	\$ 2,320.59	\$ 863.14	\$ -	\$ -	\$ 3,183.73	0.148644	\$ 473.24
21	\$ -	\$ 2,320.59	\$ 932.19	\$ -	\$ -	\$ 3,252.78	0.135131	\$ 439.55
22	\$ -	\$ 2,320.59	\$ 1,006.77	\$ -	\$ -	\$ 3,327.36	0.122846	\$ 408.75
23	\$ -	\$ 2,320.59	\$ 1,087.31	\$ -	\$ -	\$ 3,407.90	0.111678	\$ 380.59
24	\$ -	\$ 2,320.59	\$ 1,174.29	\$ -	\$ -	\$ 3,494.88	0.101526	\$ 354.82
25	\$ -	\$ 2,320.59	\$ 1,268.24	\$ -	\$ -	\$ 3,588.83	0.092296	\$ 331.23
26	\$ -	\$ 2,320.59	\$ 1,369.70	\$ -	\$ -	\$ 3,690.29	0.083905	\$ 309.64
27	\$ -	\$ 2,320.59	\$ 1,479.27	\$ -	\$ -	\$ 3,799.86	0.076278	\$ 289.84
28	\$ -	\$ 2,320.59	\$ 1,597.61	\$ -	\$ -	\$ 3,918.20	0.069343	\$ 271.70
29	\$ -	\$ 2,320.59	\$ 1,725.42	\$ -	\$ -	\$ 4,046.01	0.063039	\$ 255.06
30	\$ -	\$ 2,320.59	\$ 1,863.45	\$ -	\$ -	\$ 4,184.04	0.057309	\$ 239.78
31	\$ -	\$ 2,320.59	\$ 2,012.53	\$ -	\$ -	\$ 4,333.12	0.052099	\$ 225.75
32	\$ -	\$ 2,320.59	\$ 2,173.53	\$ -	\$ -	\$ 4,494.12	0.047362	\$ 212.85
33	\$ -	\$ 2,320.59	\$ 2,347.42	\$ -	\$ -	\$ 4,668.01	0.043057	\$ 200.99
34	\$ -	\$ 2,320.59	\$ 2,535.21	\$ -	\$ -	\$ 4,855.80	0.039143	\$ 190.07
35	\$ -	\$ 2,320.59	\$ 2,738.03	\$ -	\$ -	\$ 5,058.62	0.035584	\$ 180.01
36	\$ -	\$ 2,320.59	\$ 2,957.07	\$ -	\$ 340,200.00	\$ 345,477.66	0.032349	\$ 11,175.92
37	\$ -	\$ 2,320.59	\$ 3,193.63	\$ -	\$ -	\$ 5,514.22	0.029408	\$ 162.16
38	\$ -	\$ 2,320.59	\$ 3,449.13	\$ -	\$ -	\$ 5,769.72	0.026735	\$ 154.25
39	\$ -	\$ 2,320.59	\$ 3,725.06	\$ -	\$ -	\$ 6,045.65	0.024304	\$ 146.94
40	\$ -	\$ 2,320.59	\$ 4,023.06	\$ -	\$ -	\$ 6,343.65	0.022095	\$ 140.16
41	\$ -	\$ 2,320.59	\$ 4,344.90	\$ -	\$ -	\$ 6,665.49	0.020086	\$ 133.89
42	\$ -	\$ 2,320.59	\$ 4,692.50	\$ -	\$ -	\$ 7,013.09	0.018260	\$ 128.06
43	\$ -	\$ 2,320.59	\$ 5,067.90	\$ -	\$ -	\$ 7,388.49	0.016600	\$ 122.65
44	\$ -	\$ 2,320.59	\$ 5,473.33	\$ -	\$ -	\$ 7,793.92	0.015091	\$ 117.62
45	\$ -	\$ 2,320.59	\$ 5,911.19	\$ -	\$ -	\$ 8,231.78	0.013719	\$ 112.93
46	\$ -	\$ 2,320.59	\$ 6,384.09	\$ -	\$ -	\$ 8,704.68	0.012472	\$ 108.56
47	\$ -	\$ 2,320.59	\$ 6,894.82	\$ -	\$ -	\$ 9,215.41	0.011338	\$ 104.49
48	\$ -	\$ 2,320.59	\$ 7,446.40	\$ -	\$ -	\$ 9,766.99	0.010307	\$ 100.67
49	\$ -	\$ 2,320.59	\$ 8,042.11	\$ -	\$ -	\$ 10,362.70	0.009370	\$ 97.10
50	\$ -	\$ 2,320.59	\$ 8,685.48	\$ -	\$ -	\$ 11,006.07	0.008519	\$ 93.76

PRESENT VALUE LIFECYCLE COST \$ 216,926.62

CARDINAL WUERL NORTH CATHOLIC HIGH SCHOOL -VCT LIFE CYCLE COSTS

Year	Capital Costs	Maintenance (\$/yr)	Energy (\$/year)	Replacement (\$)	Refinish (\$)	Annual Net Cash Flow	Present Value Factor	PV
0	\$ 44,515.47	\$ -	\$ -	\$ -	\$ -	\$ 44,515.47	1.000000	\$ 44,515.47
1	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.909091	\$ -
2	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.826446	\$ -
3	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.751315	\$ -
4	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.683013	\$ -
5	\$ -	\$ -	\$ -	\$ -	\$ 23,647.00	\$ 23,647.00	0.620921	\$ 14,682.93
6	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.564474	\$ -
7	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.513158	\$ -
8	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.466507	\$ -
9	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.424098	\$ -
10	\$ -	\$ -	\$ -	\$ -	\$ 23,647.00	\$ 23,647.00	0.385543	\$ 9,116.94
11	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.350494	\$ -
12	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.318631	\$ -
13	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.289664	\$ -
14	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.263331	\$ -
15	\$ -	\$ -	\$ -	\$ -	\$ 23,647.00	\$ 23,647.00	0.239392	\$ 5,660.90
16	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.217629	\$ -
17	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.197845	\$ -
18	\$ -	\$ -	\$ -	\$ 148,630.98	\$ -	\$ 148,630.98	0.179859	\$ 26,732.59
19	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.163508	\$ -
20	\$ -	\$ -	\$ -	\$ -	\$ 23,647.00	\$ 23,647.00	0.148644	\$ 3,514.98
21	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.135131	\$ -
22	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.122846	\$ -
23	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.111678	\$ -
24	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.101526	\$ -
25	\$ -	\$ -	\$ -	\$ -	\$ 23,647.00	\$ 23,647.00	0.092296	\$ 2,182.52
26	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.083905	\$ -
27	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.076278	\$ -
28	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.069343	\$ -
29	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.063039	\$ -
30	\$ -	\$ -	\$ -	\$ -	\$ 23,647.00	\$ 23,647.00	0.057309	\$ 1,355.18
31	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.052099	\$ -
32	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.047362	\$ -
33	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.043057	\$ -
34	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.039143	\$ -
35	\$ -	\$ -	\$ -	\$ -	\$ 23,647.00	\$ 23,647.00	0.035584	\$ 841.46
36	\$ -	\$ -	\$ -	\$ 148,630.98	\$ -	\$ 148,630.98	0.032349	\$ 4,808.09
37	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.029408	\$ -
38	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.026735	\$ -
39	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.024304	\$ -
40	\$ -	\$ -	\$ -	\$ -	\$ 23,647.00	\$ 23,647.00	0.022095	\$ 522.48
41	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.020086	\$ -
42	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.018260	\$ -
43	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.016600	\$ -
44	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.015091	\$ -
45	\$ -	\$ -	\$ -	\$ -	\$ 23,647.00	\$ 23,647.00	0.013719	\$ 324.42
46	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.012472	\$ -
47	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.011338	\$ -
48	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.010307	\$ -
49	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.009370	\$ -
50	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.008519	\$ -

PRESENT VALUE LIFECYCLE COST \$ 114,257.95

CARDINAL WUERL NORTH CATHOLIC HIGH SCHOOL - CARPET LIFE CYCLE COSTS

Year	Capital Costs	Maintenance (\$/yr)	Energy (\$/year)	Replacement (\$)	Refinish (\$)	Annual Net Cash Flow	Present Value Factor	PV
0	\$ 77,514.50	\$ -	\$ -	\$ -	\$ -	\$ 77,514.50	1	\$ 77,514.50
1	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.909091	\$ -
2	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.826446	\$ -
3	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.751315	\$ -
4	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.683013	\$ -
5	\$ -	\$ 2,884.20	\$ -	\$ -	\$ -	\$ 2,884.20	0.620921	\$ 1,790.86
6	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.564474	\$ -
7	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.513158	\$ -
8	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.466507	\$ -
9	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.424098	\$ -
10	\$ -	\$ 2,884.20	\$ -	\$ -	\$ -	\$ 2,884.20	0.385543	\$ 1,111.98
11	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.350494	\$ -
12	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.318631	\$ -
13	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.289664	\$ -
14	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.263331	\$ -
15	\$ -	\$ 2,884.20	\$ -	\$ -	\$ -	\$ 2,884.20	0.239392	\$ 690.45
16	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.217629	\$ -
17	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.197845	\$ -
18	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.179859	\$ -
19	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.163508	\$ -
20	\$ -	\$ 2,884.20	\$ -	\$ -	\$ -	\$ 2,884.20	0.148644	\$ 428.72
21	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.135131	\$ -
22	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.122846	\$ -
23	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.111678	\$ -
24	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.101526	\$ -
25	\$ -	\$ 2,884.20	\$ -	\$ 133,539.75	\$ -	\$ 136,423.95	0.092296	\$ 12,591.38
26	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.083905	\$ -
27	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.076278	\$ -
28	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.069343	\$ -
29	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.063039	\$ -
30	\$ -	\$ 2,884.20	\$ -	\$ -	\$ -	\$ 2,884.20	0.057309	\$ 165.29
31	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.052099	\$ -
32	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.047362	\$ -
33	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.043057	\$ -
34	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.039143	\$ -
35	\$ -	\$ 2,884.20	\$ -	\$ -	\$ -	\$ 2,884.20	0.035584	\$ 102.63
36	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.032349	\$ -
37	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.029408	\$ -
38	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.026735	\$ -
39	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.024304	\$ -
40	\$ -	\$ 2,884.20	\$ -	\$ -	\$ -	\$ 2,884.20	0.022095	\$ 63.73
41	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0	

CARDINAL WUERL NORTH CATHOLIC HIGH SCHOOL - ARMSTRONG SCHOOL ZONE FINE FISSURED LIFE CYCLE COSTS

Year	Capital Costs	Maintenance (\$/yr)	Energy (\$/year)	Replacement (\$)	Refinish (\$)	Annual Net Cash Flow	Present Value Factor	PV
0	\$ 121,864.87	\$ -	\$ -	\$ -	\$ -	\$ 121,864.87	1.000000	\$ 121,864.87
1	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.909091	\$ -
2	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.826446	\$ -
3	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.751315	\$ -
4	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.683013	\$ -
5	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.620921	\$ -
6	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.564474	\$ -
7	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.513158	\$ -
8	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.466507	\$ -
9	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.424098	\$ -
10	\$ -	\$ -	\$ -	\$ 2,437.30	\$ -	\$ 2,437.30	0.385543	\$ 939.68
11	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.350494	\$ -
12	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.318631	\$ -
13	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.289664	\$ -
14	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.263331	\$ -
15	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.239392	\$ -
16	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.217629	\$ -
17	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.197845	\$ -
18	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.179859	\$ -
19	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.163508	\$ -
20	\$ -	\$ -	\$ -	\$ 2,437.30	\$ -	\$ 2,437.30	0.148644	\$ 362.29
21	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.135131	\$ -
22	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.122846	\$ -
23	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.111678	\$ -
24	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.101526	\$ -
25	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.092296	\$ -
26	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.083905	\$ -
27	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.076278	\$ -
28	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.069343	\$ -
29	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.063039	\$ -
30	\$ -	\$ -	\$ -	\$ 121,864.91	\$ -	\$ 121,864.91	0.057309	\$ 6,983.90
31	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.052099	\$ -
32	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.047362	\$ -
33	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.043057	\$ -
34	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.039143	\$ -
35	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.035584	\$ -
36	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.032349	\$ -
37	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.029408	\$ -
38	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.026735	\$ -
39	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.024304	\$ -
40	\$ -	\$ -	\$ -	\$ 2,437.30	\$ -	\$ 2,437.30	0.022095	\$ 53.85
41	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.020086	\$ -
42	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.018260	\$ -
43	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.016600	\$ -
44	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.015091	\$ -
45	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.013719	\$ -
46	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.012472	\$ -
47	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.011338	\$ -
48	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.010307	\$ -
49	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.009370	\$ -
50	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.008519	\$ -

PRESENT VALUE LIFECYCLE COST \$ 130,204.60

CARDINAL WUERL NORTH CATHOLIC HIGH SCHOOL - ULTIMA CEILING TILE LIFE CYCLE COSTS

Year	Capital Costs	Maintenance (\$/yr)	Energy (\$/year)	Replacement (\$)	Refinish (\$)	Annual Net Cash Flow	Present Value Factor	PV
0	\$ 175,864.93	\$ -	\$ -	\$ -	\$ -	\$ 175,864.93	1.000000	\$ 175,864.93
1	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.909091	\$ -
2	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.826446	\$ -
3	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.751315	\$ -
4	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.683013	\$ -
5	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.620921	\$ -
6	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.564474	\$ -
7	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.513158	\$ -
8	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.466507	\$ -
9	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.424098	\$ -
10	\$ -	\$ -	\$ -	\$ 3,517.30	\$ -	\$ 3,517.30	0.385543	\$ 1,356.07
11	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.350494	\$ -
12	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.318631	\$ -
13	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.289664	\$ -
14	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.263331	\$ -
15	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.239392	\$ -
16	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.217629	\$ -
17	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.197845	\$ -
18	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.179859	\$ -
19	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.163508	\$ -
20	\$ -	\$ -	\$ -	\$ 3,517.30	\$ -	\$ 3,517.30	0.148644	\$ 522.82
21	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.135131	\$ -
22	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.122846	\$ -
23	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.111678	\$ -
24	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.101526	\$ -
25	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.092296	\$ -
26	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.083905	\$ -
27	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.076278	\$ -
28	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.069343	\$ -
29	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.063039	\$ -
30	\$ -	\$ -	\$ -	\$ 175,864.93	\$ -	\$ 175,864.93	0.057309	\$ 10,078.56
31	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.052099	\$ -
32	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.047362	\$ -
33	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.043057	\$ -
34	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.039143	\$ -
35	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.035584	\$ -
36	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.032349	\$ -
37	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.029408	\$ -
38	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.026735	\$ -
39	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.024304	\$ -
40	\$ -	\$ -	\$ -	\$ 3,517.30	\$ -	\$ 3,517.30	0.022095	\$ 77.71
41	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.020086	\$ -
42	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.018260	\$ -
43	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.016600	\$ -
44	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.015091	\$ -
45	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.013719	\$ -
46	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.012472	\$ -
47	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.011338	\$ -
48	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.010307	\$ -
49	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.009370	\$ -
50	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.008519	\$ -

PRESENT VALUE LIFECYCLE COST \$ 187,900.10

CARDINAL WUERL NORTH CATHOLIC HIGH SCHOOL - CURVED DRYWALL CEILING (PAINT) LIFE CYCLE COSTS

Year	Capital Costs	Maintenance (\$/yr)	Energy (\$/year)	Replacement (\$)	Refinish (\$)	Annual Net Cash Flow	Present Value Factor	PV
0	\$ 57,837.50	\$ -	\$ -	\$ -	\$ -	\$ 57,837.50	1.000000	\$ 57,837.50
1	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.909091	\$ -
2	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.826446	\$ -
3	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.751315	\$ -
4	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.683013	\$ -
5	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.620921	\$ -
6	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.564474	\$ -
7	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.513158	\$ -
8	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.466507	\$ -
9	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.424098	\$ -
10	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.385543	\$ -
11	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.350494	\$ -
12	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.318631	\$ -
13	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.289664	\$ -
14	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.263331	\$ -
15	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.239392	\$ -
16	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.217629	\$ -
17	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.197845	\$ -
18	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.179859	\$ -
19	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.163508	\$ -
20	\$ -	\$ 760.33	\$ -	\$ -	\$ -	\$ 760.33	0.148644	\$ 112.22
21	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.135131	\$ -
22	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.122846	\$ -
23	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.111678	\$ -
24	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.101526	\$ -
25	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.092296	\$ -
26	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.083905	\$ -
27	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.076278	\$ -
28	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.069343	\$ -
29	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.063039	\$ -
30	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.057309	\$ -
31	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.052099	\$ -
32	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.047362	\$ -
33	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.043057	\$ -
34	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.039143	\$ -
35	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.035584	\$ -
36	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.032349	\$ -
37	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.029408	\$ -
38	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.026735	\$ -
39	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.024304	\$ -
40	\$ -	\$ 760.33	\$ -	\$ -	\$ -	\$ 760.33	0.022095	\$ 16.88
41	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.020086	\$ -
42	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.018260	\$ -
43	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.016600	\$ -
44	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.015091	\$ -
45	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.013719	\$ -
46	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.012472	\$ -
47	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.011338	\$ -
48	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.010307	\$ -
49	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.009370	\$ -
50	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.008519	\$ -

PRESENT VALUE LIFECYCLE COST \$ 92,944.07

CARDINAL WUERL NORTH CATHOLIC HIGH SCHOOL - LINEAR WOOD CEILING LIFE CYCLE COSTS						
	Capital Costs	Maintenance (\$/yr)	Energy (\$/year)	Replacement (\$)	Refinish (\$)	
0	\$129,837.50	\$ -	\$ -	\$ -	\$ -	\$ 129,837.50
1	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 0.909091
2	\$ -	\$ 497.00	\$ -	\$ -	\$ -	\$ 0.826446
3	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 0.751315
4	\$ -	\$ 497.00	\$ -	\$ -	\$ -	\$ 0.683013
5	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 0.620921
6	\$ -	\$ 497.00	\$ -	\$ -	\$ -	\$ 0.564474
7	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 0.513158
8	\$ -	\$ 497.00	\$ -	\$ -	\$ -	\$ 0.466507
9	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 0.424098
10	\$ -	\$ 497.00	\$ -	\$ -	\$ -	\$ 0.385543
11	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 0.350494
12	\$ -	\$ 497.00	\$ -	\$ -	\$ -	\$ 0.318631
13	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 0.289664
14	\$ -	\$ 497.00	\$ -	\$ -	\$ -	\$ 0.263331
15	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 0.239392
16	\$ -	\$ 497.00	\$ -	\$ -	\$ -	\$ 0.217629
17	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 0.197845
18	\$ -	\$ 497.00	\$ -	\$ -	\$ -	\$ 0.179859
19	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 0.163508
20	\$ -	\$ 497.00	\$ -	\$ -	\$ -	\$ 0.148644
21	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 0.135131
22	\$ -	\$ 497.00	\$ -	\$ -	\$ -	\$ 0.122846
23	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 0.111678
24	\$ -	\$ 497.00	\$ -	\$ -	\$ -	\$ 0.101526
25	\$ -	\$ -	\$ -	\$ 2,596.75	\$ -	\$ 0.092296
26	\$ -	\$ 497.00	\$ -	\$ -	\$ -	\$ 0.083905
27	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 0.076278
28	\$ -	\$ 497.00	\$ -	\$ -	\$ -	\$ 0.069343
29	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 0.063039
30	\$ -	\$ 497.00	\$ -	\$ -	\$ -	\$ 0.057309
31	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 0.052099
32	\$ -	\$ 497.00	\$ -	\$ -	\$ -	\$ 0.047362
33	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 0.043057
34	\$ -	\$ 497.00	\$ -	\$ -	\$ -	\$ 0.039143
35	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 0.035584
36	\$ -	\$ 497.00	\$ -	\$ -	\$ -	\$ 0.032349
37	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 0.029408
38	\$ -	\$ 497.00	\$ -	\$ -	\$ -	\$ 0.026735
39	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 0.024304
40	\$ -	\$ 497.00	\$ -	\$ -	\$ -	\$ 0.022095
41	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 0.020086
42	\$ -	\$ 497.00	\$ -	\$ -	\$ -	\$ 0.018260
43	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 0.016600
44	\$ -	\$ 497.00	\$ -	\$ -	\$ -	\$ 0.015091
45	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 0.013719
46	\$ -	\$ 497.00	\$ -	\$ -	\$ -	\$ 0.012472
47	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 0.011338
48	\$ -	\$ 497.00	\$ -	\$ -	\$ -	\$ 0.010307
49	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 0.009370
50	\$ -	\$ 497.00	\$ -	\$ -	\$ -	\$ 0.008519

PRESENT VALUE LIFECYCLE COST \$ 132,423.68