



creation.

AEI Team #04-2013

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creation.

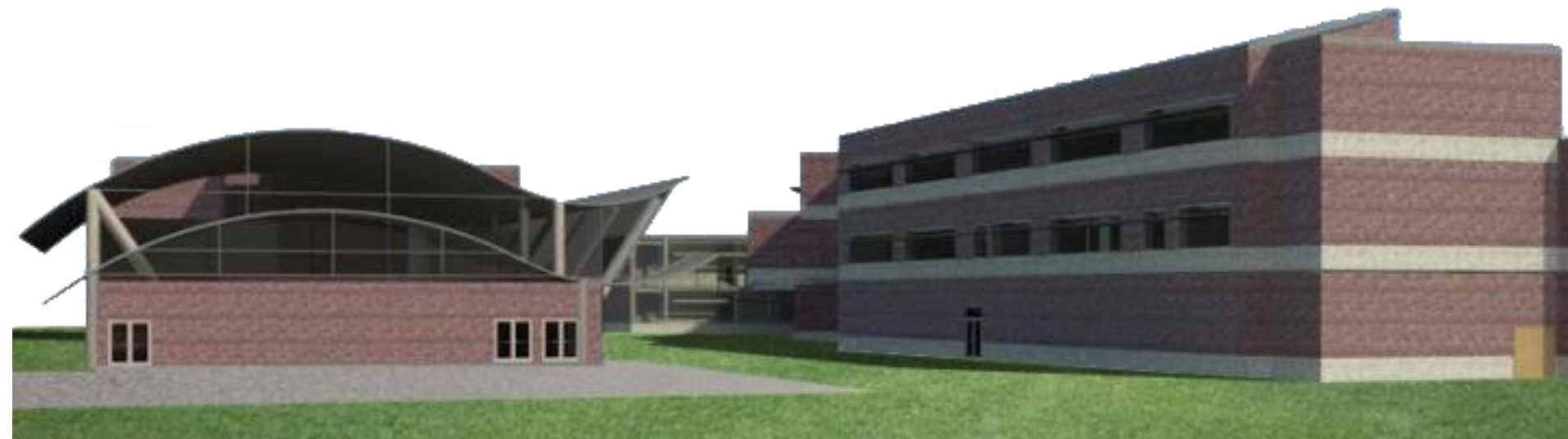
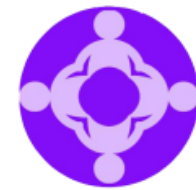
creation's one true aim is to enhance the quality of the communities we work with through innovative ideas and sustainable design

Ingenuity | Quality | Enjoyment | Integrity

PENNSSTATE



Project Overview



- **The Challenge**
 - *Competition Prompt*
 - Team Response
- The Process
- Master Plan
- Site Orientation
- Security Measures
- LEED Certification



The Challenge

1. **Construction & Design issues** related to a high performance building
2. Address **Security** for Reading, Pennsylvania
3. **LEED** Certified
4. **Budget & Schedule** for School District

1. Innovative Building Systems Approach
2. Population:88,000 5th largest city in Pennsylvania
 1. Reading has the largest share of citizens living in poverty(37%)
 2. Crime Index of 480.8 (National Average of 319.1)
3. *LEED Silver*
4. *\$19M & 14 Month Schedule*

The term 'high-performance building' means a building that integrates and optimizes on a life cycle basis all major high performance attributes, including energy conservation, environment, safety, security, durability, accessibility, cost-benefit, productivity, sustainability, functionality, and operational considerations.

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The Challenge

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2. Address Security for Reading, Pennsylvania
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4. Budget & Schedule for School District

1. **Innovative Building Systems** Approach
2. Population:88,000 **5th largest city** in Pennsylvania
 1. Reading has the largest share of citizens living in **poverty**(37%)
 2. Crime Index of 480.8 (National Average of 319.1)
3. **LEED Silver**
4. **\$19M & 14 Month Schedule**



- The Challenge
- The Process
 - BIM Execution Planning
 - *Project Information*
 - BIM Roles & Organization
 - BIM Objectives & Uses
 - Collaboration Procedures
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The Process

PROJECT MILESTONE	ESTIMATED START	ESTIMATED COMPLETION	PROJECT DELIVERABLE	INVOLVED PROJECT STAKEHOLDERS
Preliminary Planning	9/1/12	9/14/12	Presentation 1	MEP, Struct, CM
Schematic Design	9/14/12	10/3/12	Presentation 2	MEP, Struct, CM
Design Development	10/3/12	10/24/12	Presentation3	MEP, Struct, CM
Construction Documents	10/24/12	11/12/12	Proposal	MEP, Struct, CM
AEI Submission	11/12/12	2/22/12	Electronic Submission	MEP, Struct, CM
Short List Selection	2/22/12	3/8/12	None	MEP, Struct, CM
Finalist Presentation	3/8/12	4/3/12	Final Presentation	MEP, Struct, CM
Award	4/5/12	4/5/12	None	MEP, Struct, CM

BIM Execution Planning

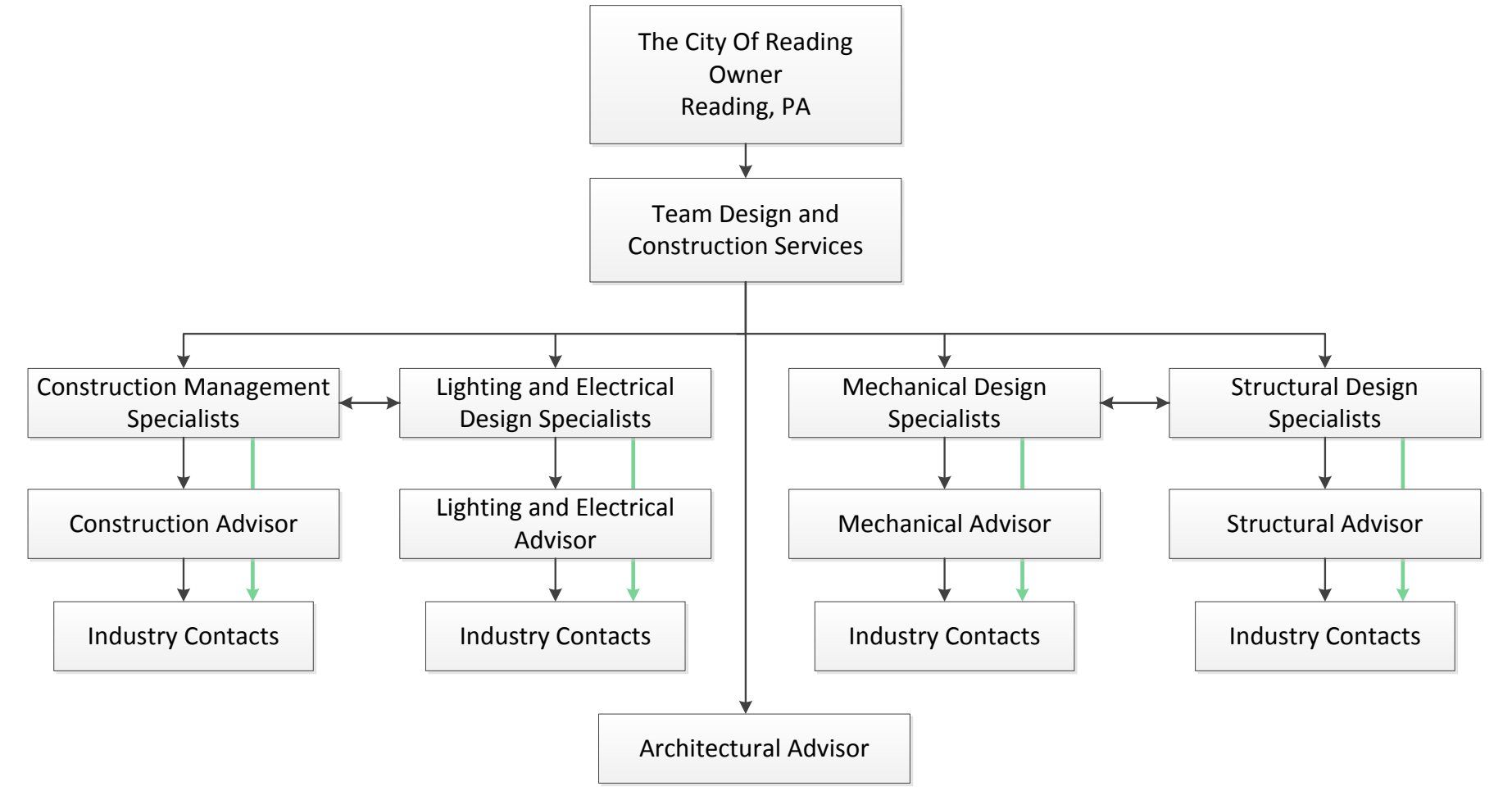
Section 1: BIM Project Execution Plan Overview

Section 2: Project Information

- Section 3: Key Project Contacts & Staffing
- Section 4: BIM Roles and Organization
- Section 5: Project BIM Objectives and Project BIM Uses
- Section 6: BIM Process Design
- Section 7: Collaboration Procedures
- Section 8: Technological Infrastructure Requirements
- Section 9: Model and Database Structure
- Section 10: Quality Control Procedures
- Section 11: Project Deliverables
- Section 12: Attachments

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The Process
















TASK	ROLE	Staff Size	Hours Planned	Weeks
Model Development	Architect(Collaborative)	8	2 hrs/wk	3
	CM	2	8 hrs/wk	8
	Electrical	2	8 hrs/wk	8
	Lighting	2	8 hrs/wk	8
	Mechanical	2	8 hrs/wk	8
Model Review	Structural	2	8 hrs/wk	8
	CM	2	1 hr/wk	16
	Electrical	2	1 hr/wk	16
	Lighting	2	1 hr/wk	16
	Mechanical	2	1 hr/wk	16
Structural Analysis & Design	Structural	2	10 hrs/wk	8
	Structural	2	10 hrs/wk	8
Lighting/Electrical Analysis & Design	Lighting/Electrical	2	10 hrs/wk	8
Mechanical Analysis & Design	Mechanical	2	10 hrs/wk	8
LEED Certification Plus+ Reviews	Collaborative	8	4 hrs/wk	6
Schedule Development	Construction Manager	2	5 hrs/wk	2
Cost Estimating	Construction Manager	2	10 hrs/wk	2
Value Engineering	Collaborative	8	3 hrs/wk	Ongoing
	Structural	2	4 hrs/wk	3
3D Coordination	Lighting/Electrical	2	4 hrs/wk	3
	Mechanical	2	4 hrs/wk	3
	Construction Manager	2	7 hrs/wk	3
4D Modeling	Construction Manager	2	5 hrs/wk	3

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The Process






Symbol	Name	Software Uses	Symbol	Name	Software Uses
	AutoCAD	2D Drawing/Modeling		SKM	Arc Flash Studies
	Trane Trace	Mechanical Load Calculations		Trimble SketchUp	Virtual Mock-Ups
	Autodesk Revit	3D Drawing/Modeling		Microsoft Project	Construction Scheduling
	Daysim	Daylighting and Electrical Analysis		RSMeans CostWorks	Construction Estimation
	Bentley RAM	Structural System Design		Oracle P6	Construction Scheduling
	AGi32	Lighting Calculations		3ds Max	3D Model Rendering
	ETABS	Lateral Structural System Design		Autodesk Navisworks	3D Coordination & 4D Modeling
	Microsoft Excel	Mechanical & Structural Calculations & Estimate Organizational Tool			

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 - *Collaboration Procedures*
- Master Plan
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The Process

Symbol	Name	Software Uses
	University Server	Store and share large files and backups, organize documents
	Revit Central Model	Integrated modeling
	Google Drive	Group communication and small document sharing
	GroupMe Application	Informal and 'instant access' group communication
	External Hard Drive	Backup all project documents

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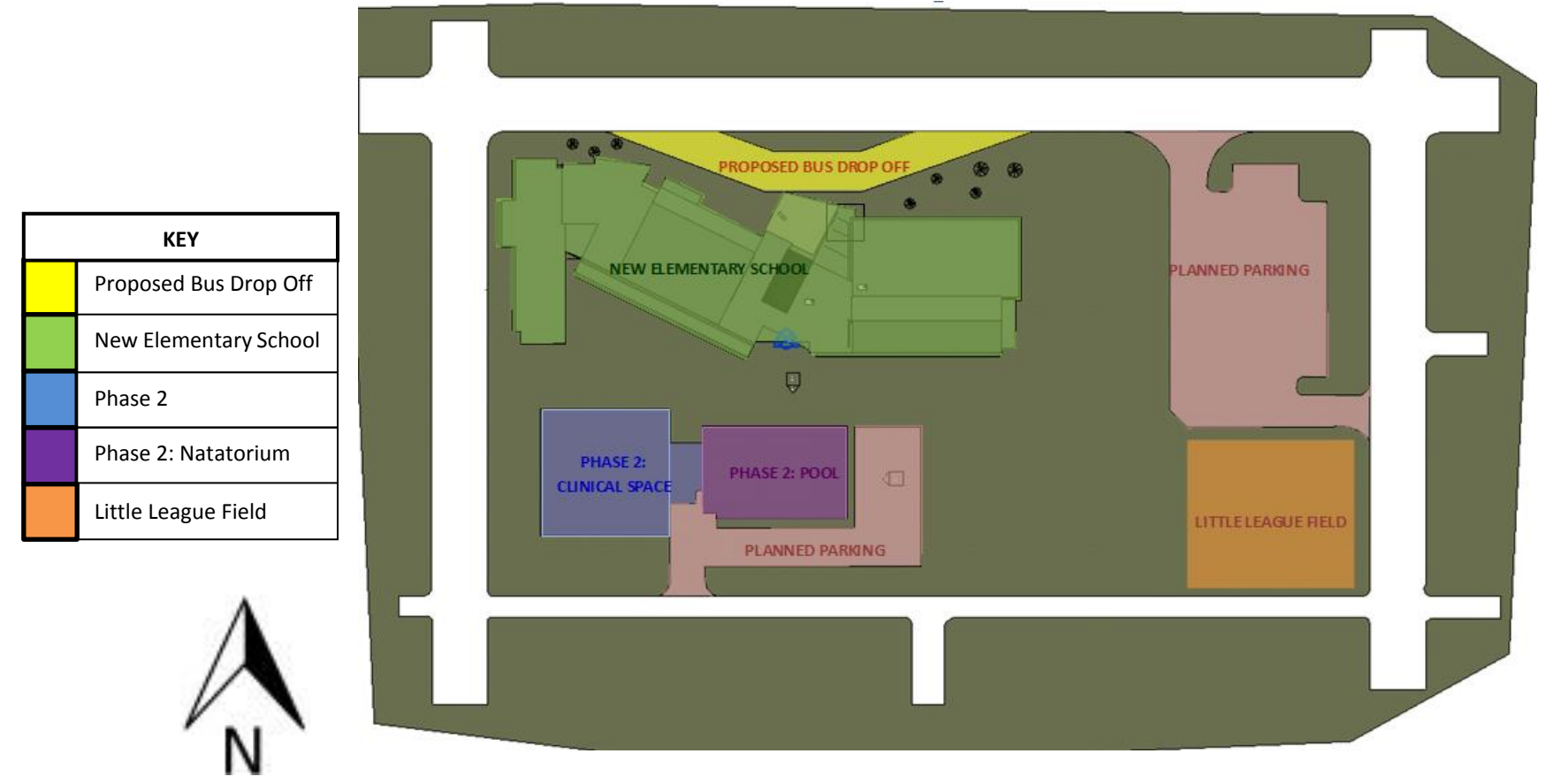
- The Challenge
- The Process
- *Master Plan*
 - Construction Phase 1
 - Construction Phase 2
- Site Orientation
- Security Measures
- LEED Certification

Master Plan

Reading Elementary

Phase 1 – New Construction

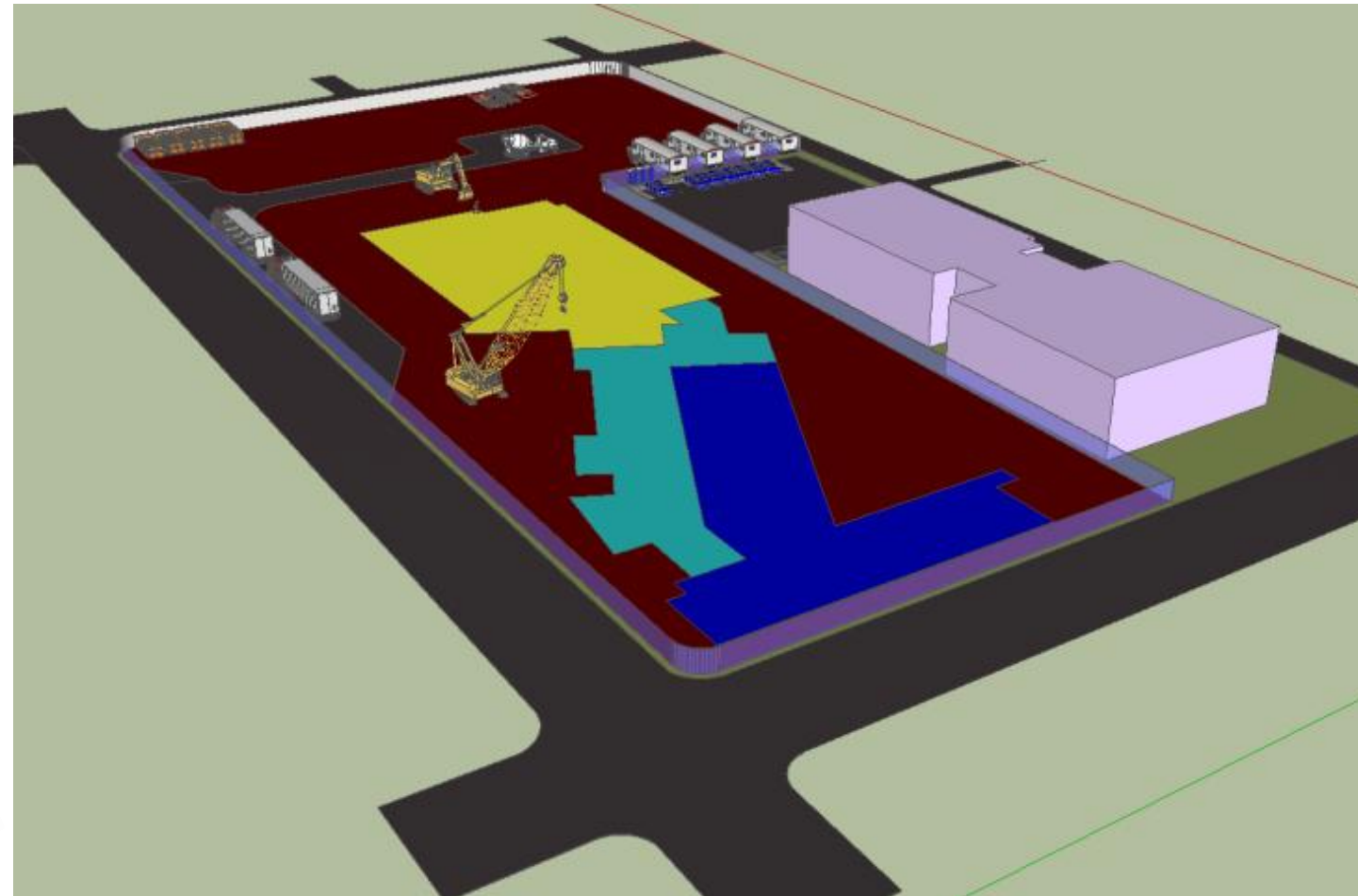
Phase 2 – Renovate Existing School for Pool and Clinical Space



- The Challenge
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- **Master Plan**
 - *Construction Phase 1*
 - Construction Phase 2
- Site Orientation
- Security Measures
- LEED Certification

Phase 1

Reading Elementary



Master Plan Details

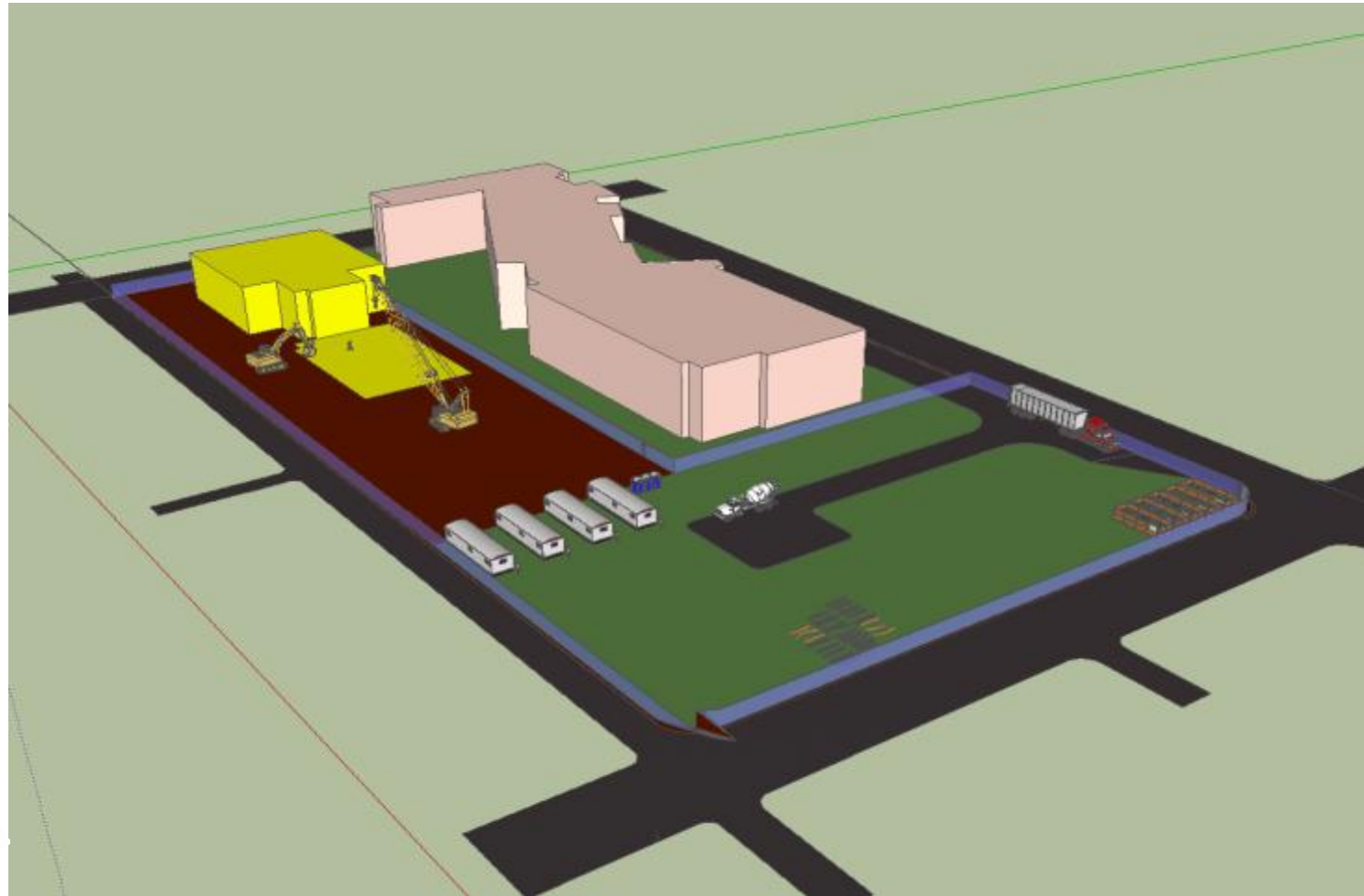
- \$16,000,000 New Construction
- 12 Month Schedule
- Rammed Aggregate Pier Foundation
- Structural Steel Frame
- Prefabricated Concrete Wall Panels
- Brick & Limestone Façade
- Clerestories & Ribbon Windows
- Atrium
- Educational Green Roof Space
- Ground Source Heat Pump System
- Building Automation System
- Vandal Resistant Security System
- Bullet Proof Glass Add/Alternate

- The Challenge
- The Process
- **Master Plan**
 - Construction Phase 1
 - *Construction Phase 2*
- Site Orientation
- Security Measures
- LEED Certification

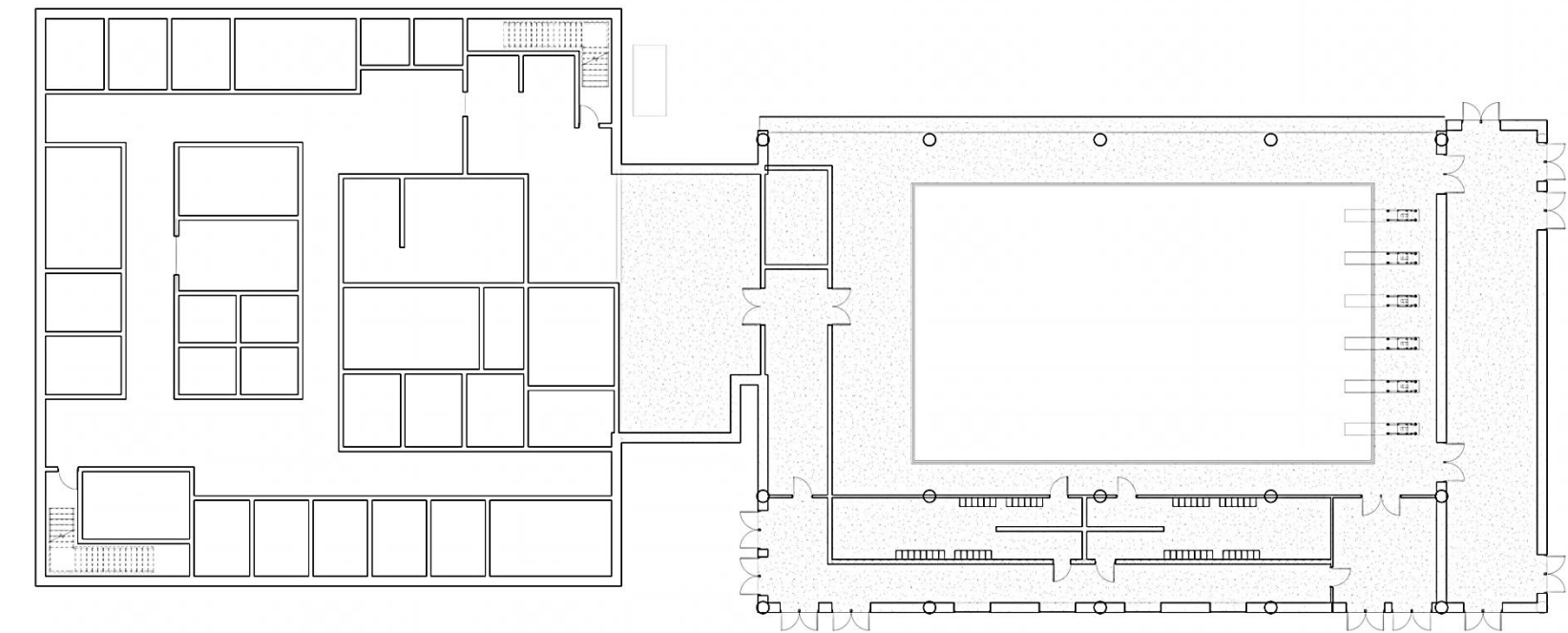
Master Plan Details

- \$3,000,000 Renovation
- 3 Month Schedule
- Rammed Aggregate Pier Foundation
- Structural Steel Frame
- Variable Refrigerant Volume with Heat Recovery

Phase 2
Reading Elementary



Clinic and Natatorium Plan



↑ ↑ ↑

Renovation (Clinic) New Construction (Natatorium)

- The Challenge
- The Process
- *Master Plan*
- Site Orientation
- Security Measures
- LEED Certification

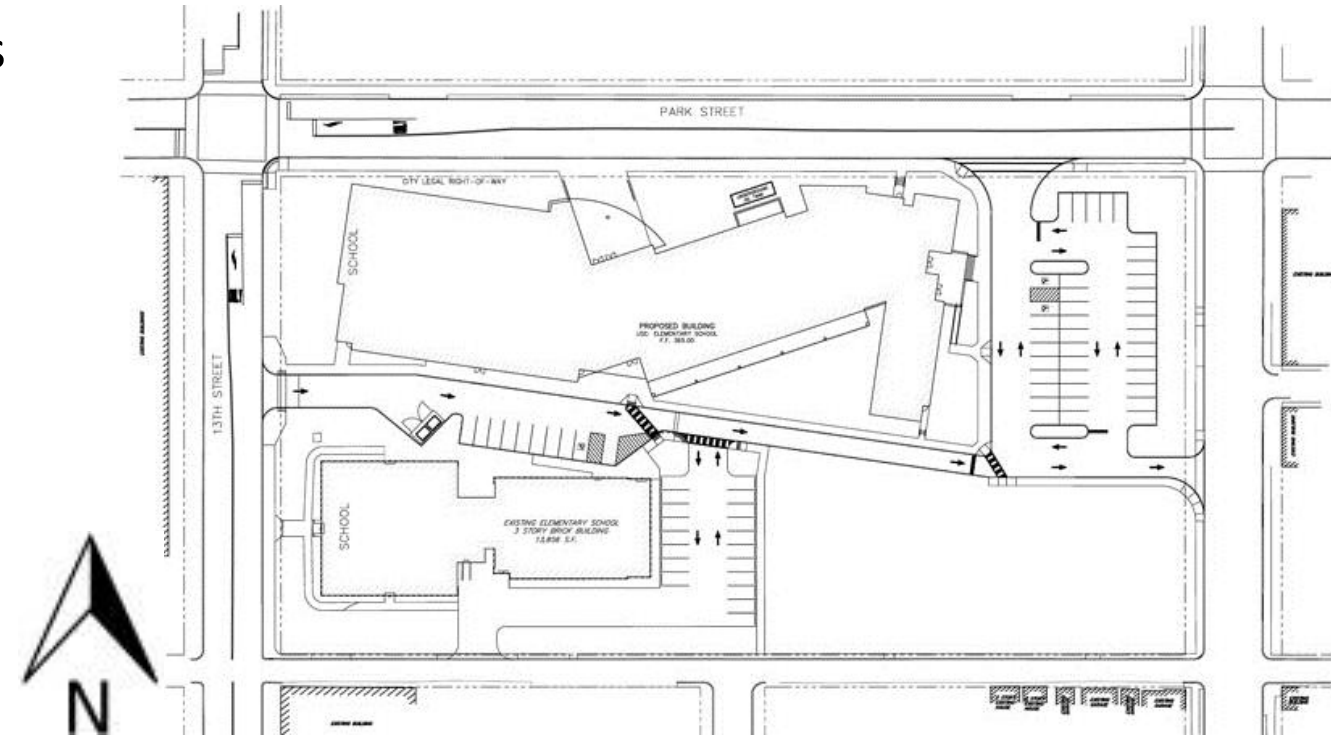
Finished Master Plan

Reading Elementary



- The Challenge
- The Process
- Master Plan
- *Site Orientation*
- Security Measures
- LEED Certification

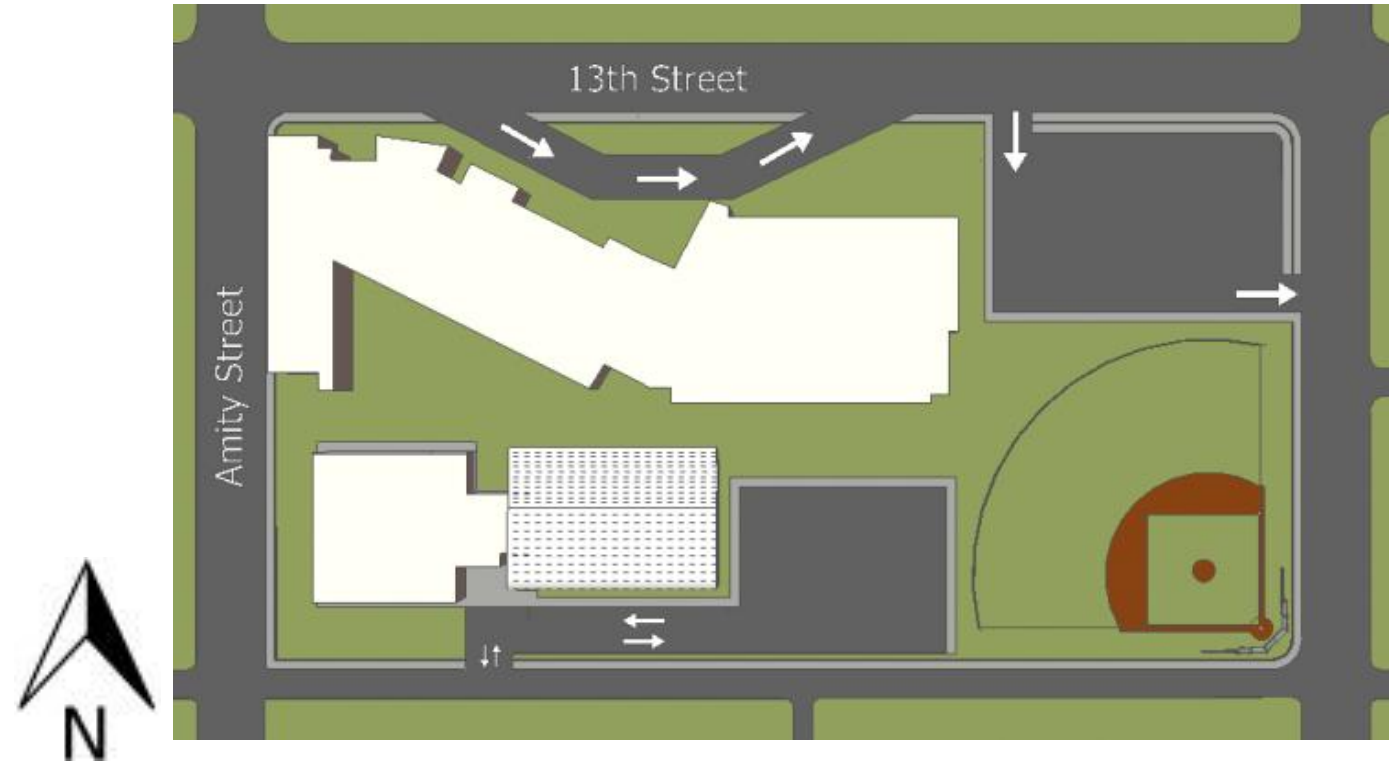
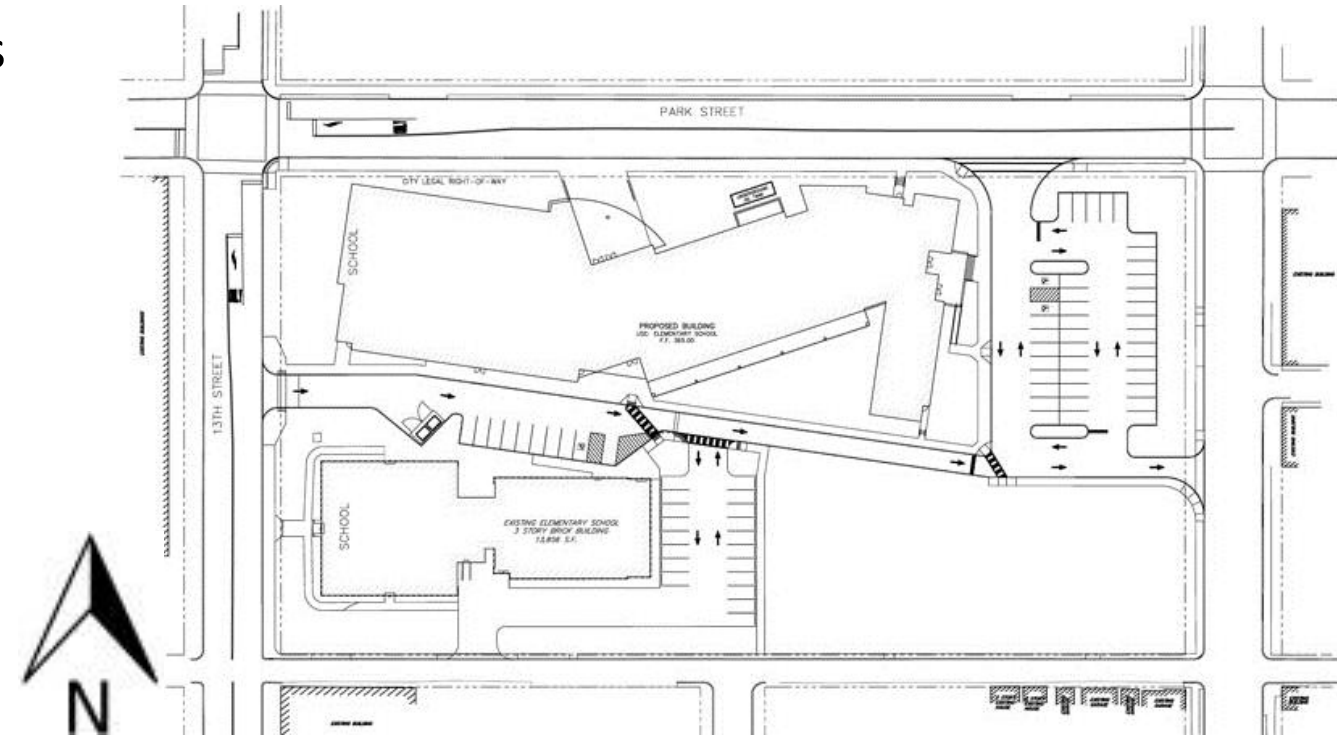
Site Orientation



- **Project Location:**
Amity & 13th Streets
- **Flip footprint over vertical axis**

- The Challenge
- The Process
- Master Plan
- *Site Orientation*
- Security Measures
- LEED Certification

Site Orientation

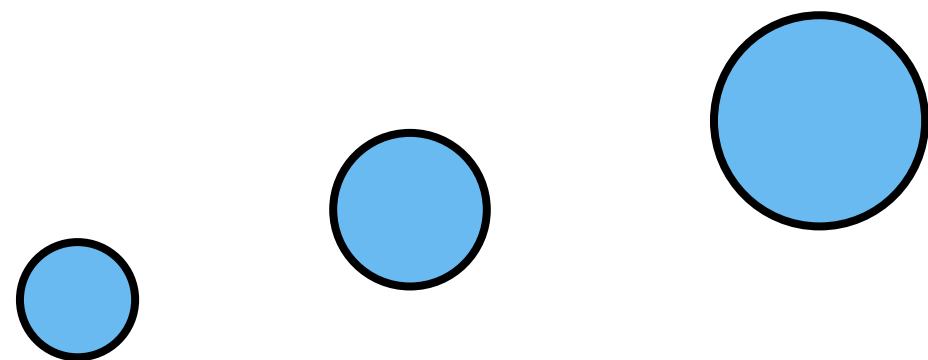


- **Project Location:**
Amity & 13th Streets
- **Flip footprint over vertical axis**

Site Orientation



creation.







- Multipurpose space near parking
- Daylighting For Perimeter Classrooms
- Maximize Outdoor Space
- Eliminate Interior Bus Loop
- Security and Safety



- The Challenge
- The Process
- Master Plan
- Site Orientation
- **Security Measures**
- LEED Certification

Security Measures


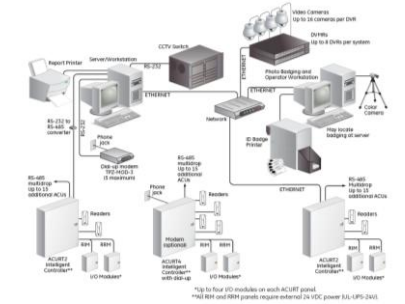


-  Visitor entrance, guests must be buzzed in and sign in at front desk
-  Unlocked for public access
-  Locked; faculty card swipe access only
-  Locked; emergency exit only

Daytime (6:00 am – 5:00 pm)



Evenings / Weekends (access to public spaces only)



Security Cameras	Topaz Access Control	Card Readers	Glass Break Sensor
			
Vandal Resistant Security Cameras	Building Control System	Building Access Control	Acoustic and PIR Glass Break Sensor and Transmitter

- Also Included:
- K-rated security fence around the property
 - Bulletproof glass at Main Visitor Entry
 - Integrated building alarm and announcement system



- The Challenge
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- Security Measures
- **LEED Certification**

LEED Silver Certification

Point Breakdown			
Category	Points Possible	Points Earned	Comments
Sustainable Sites	25	19	
Water Efficiency	10	4	
Energy & Atmosphere	35	13	
Materials & Resources	14	5	
Indoor Environment Quality	15	9	
Innovative Design	6	1	
Regional Priority	4	1	
Total:	109	52	LEED Silver

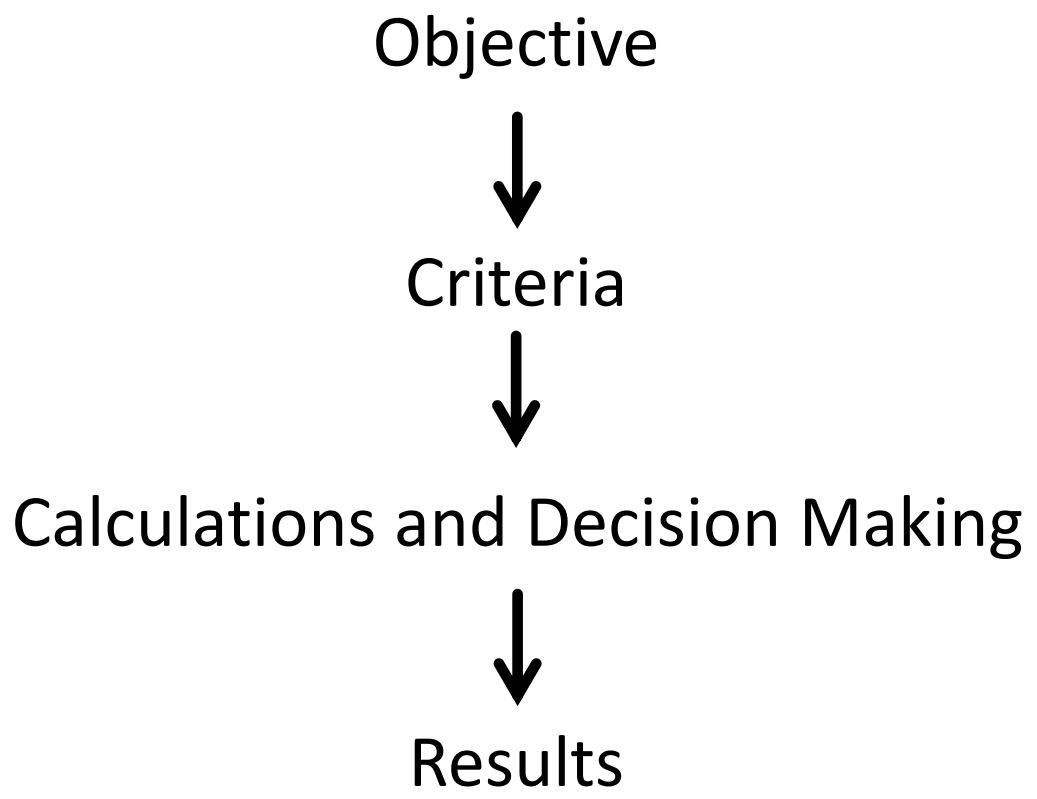


Structural Systems



- *Design Process*
- Phase 1
 - Foundation
 - Gravity System
 - Lateral System
 - Enclosure
- Phase 2
 - Clinic
 - Natatorium
- Conclusion

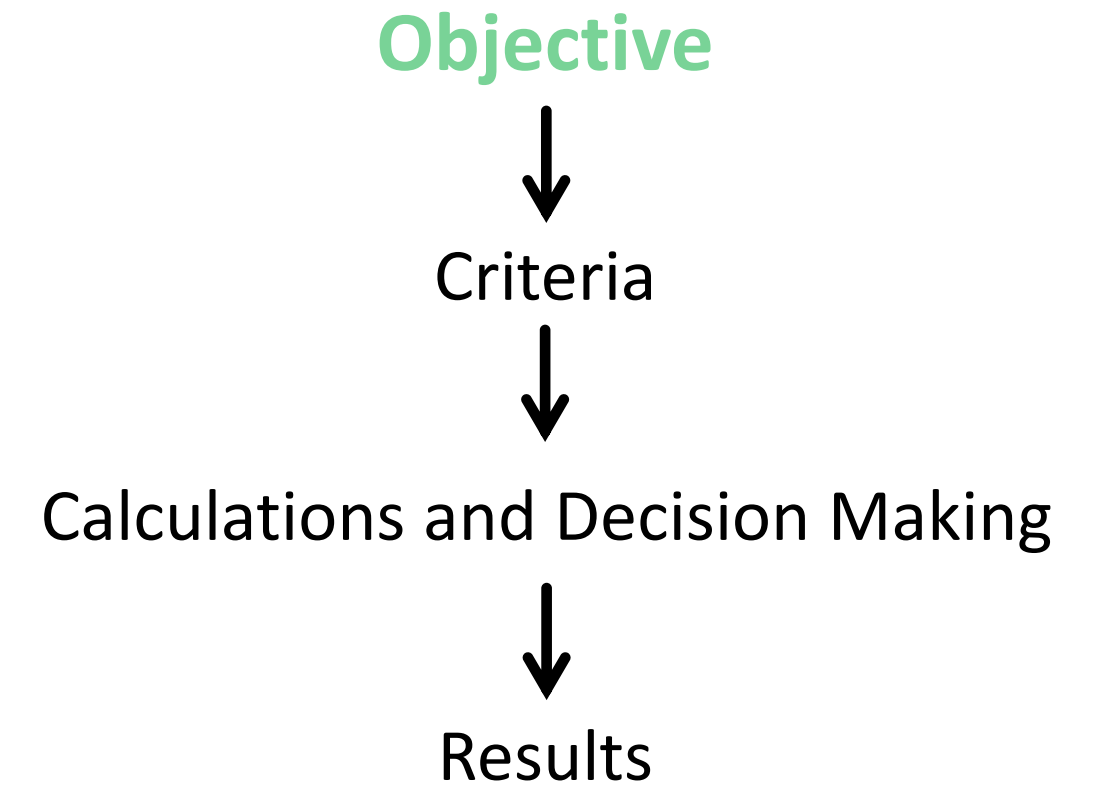
Design Process



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create an **innovative** structural system that reflects our project goals of *functionality*, *efficiency*, and *appeal*

Design Process

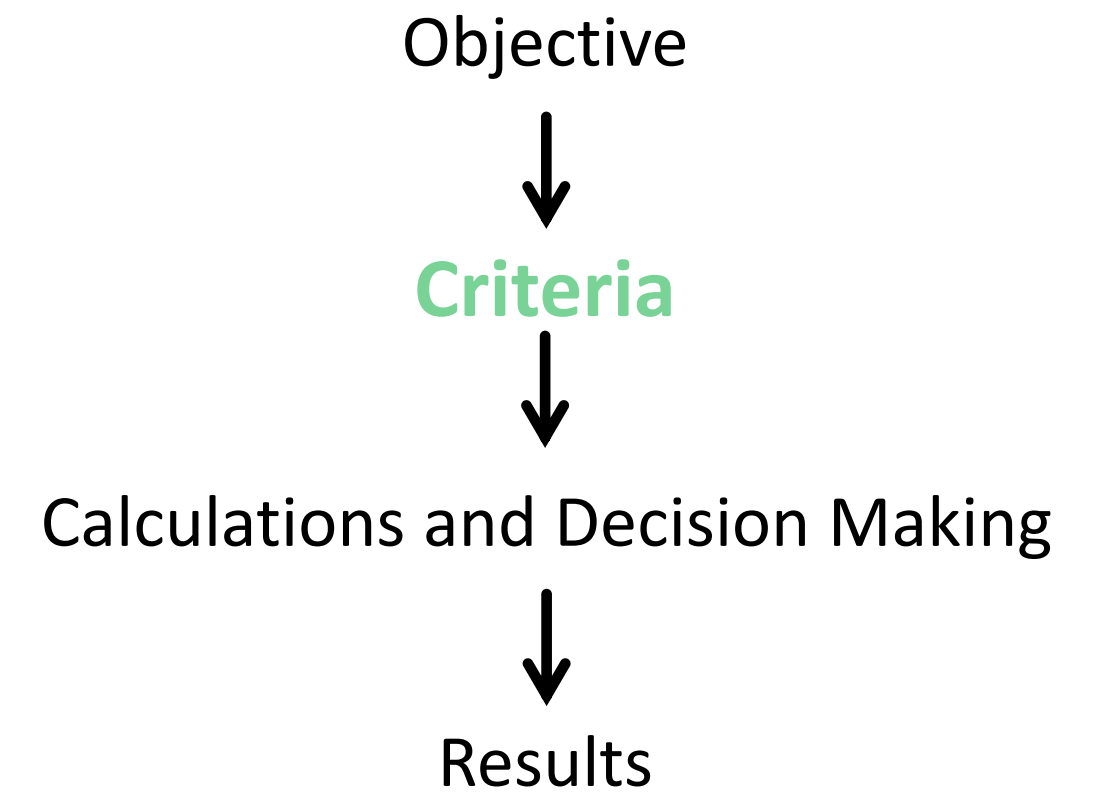


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create an **innovative** structural system that reflects our project goals of *functionality*, *efficiency*, and *appeal*

develop specific requirements for each **package** while considering cost, existing conditions, *coordination between disciplines*, constructability, and other factors

Design Process



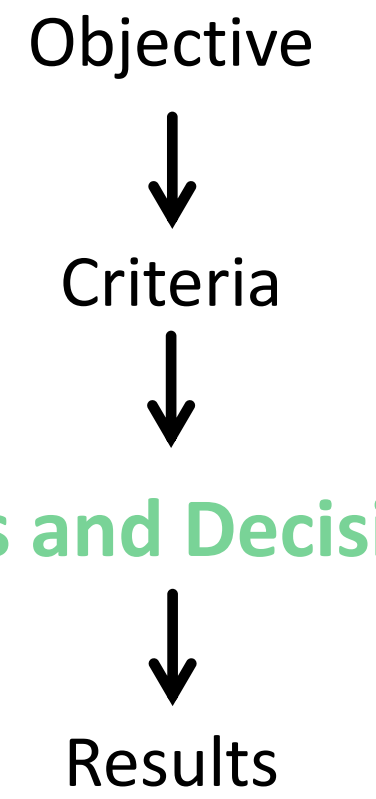
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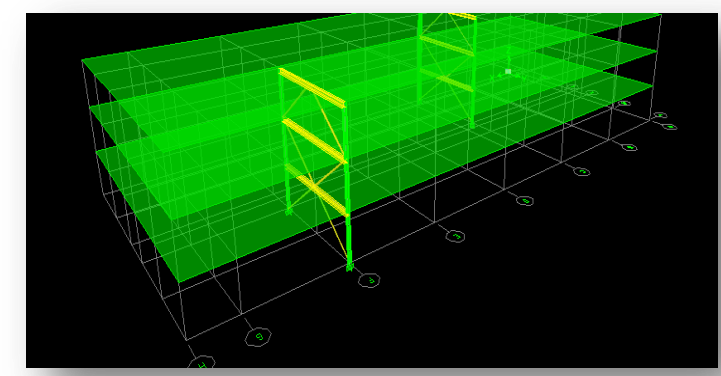
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creation.

Design Process



COLUMNS											
i.	Reduce d Floor L	Factored L (lbs)	Unfact . Snow (psf)	Load Combos			Pu (kip)	Mu (ft- kip)	Peq	Column	
				1.2D + 1.6L + 0.5S	1.2D + 1.6Lr + L	1.2D + 1.6L + 0.5Lr				Size	Weight (lb/ft)
	0.00	12800.00	22.7	48784.00	55876.00	51876.00	55.88	50.00	175.88	W10x33	33.00
	0.00	12800.00	22.7	48784.00	55876.00	51876.00	55.88	50.00	175.88	W10x33	33.00
	0.00	34560.00	22.7	110775.60	129924.00	119124.00	129.92	50.00	249.92	W10x33	33.00



Calculations and Decision Making

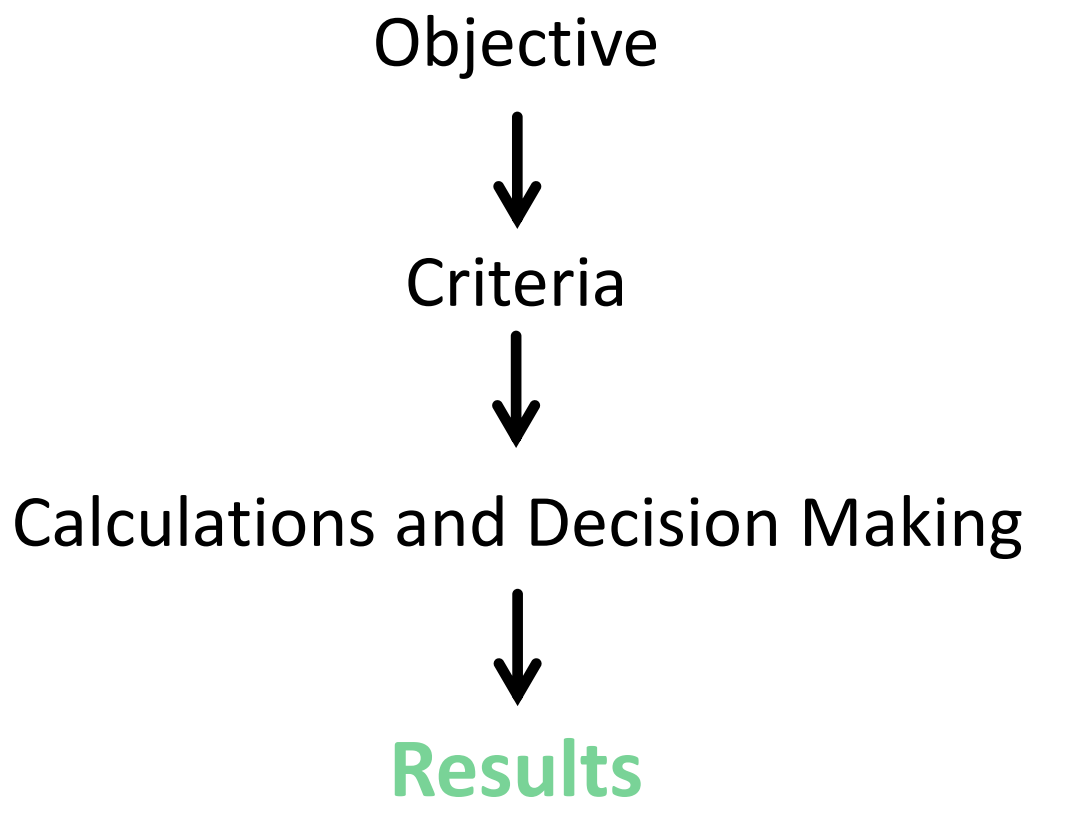
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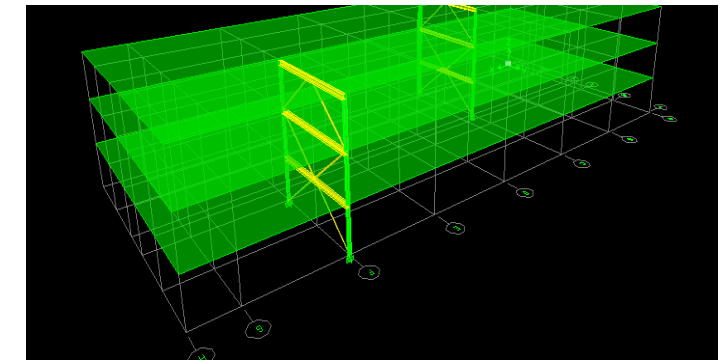
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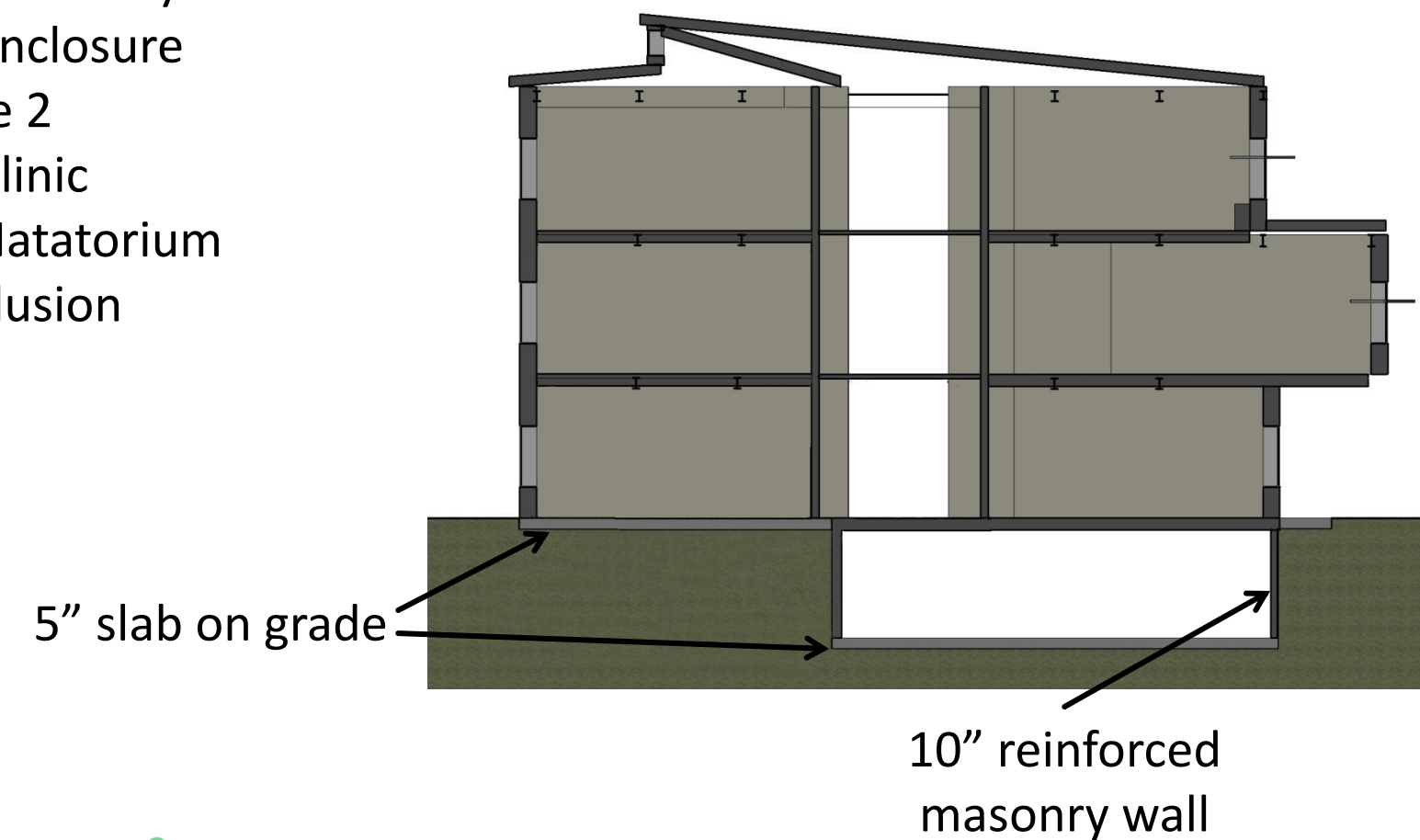
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Foundation

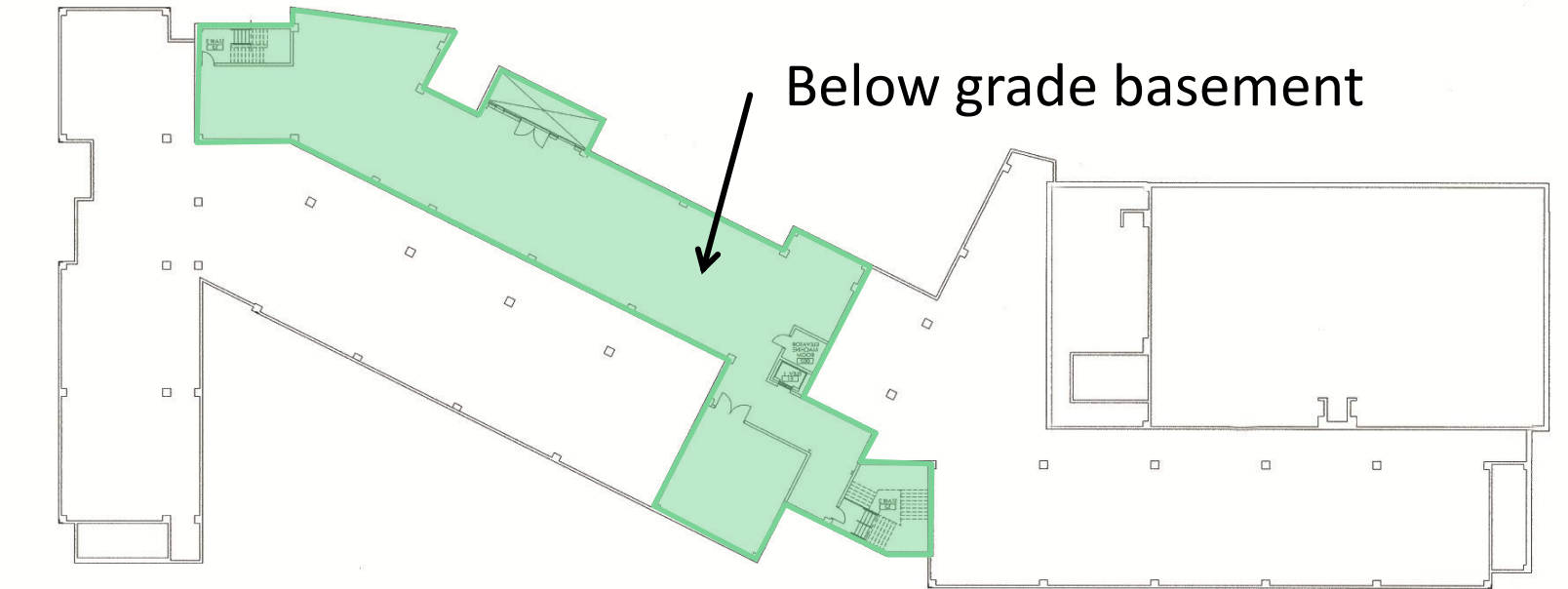
Design Criteria

- Adapt to existing soil conditions
- Cost and predictability
- Constructability and schedule

Possible Systems

1. Compaction Grouting
2. Excavation
3. Micropiles
4. Rammed Aggregate Piers

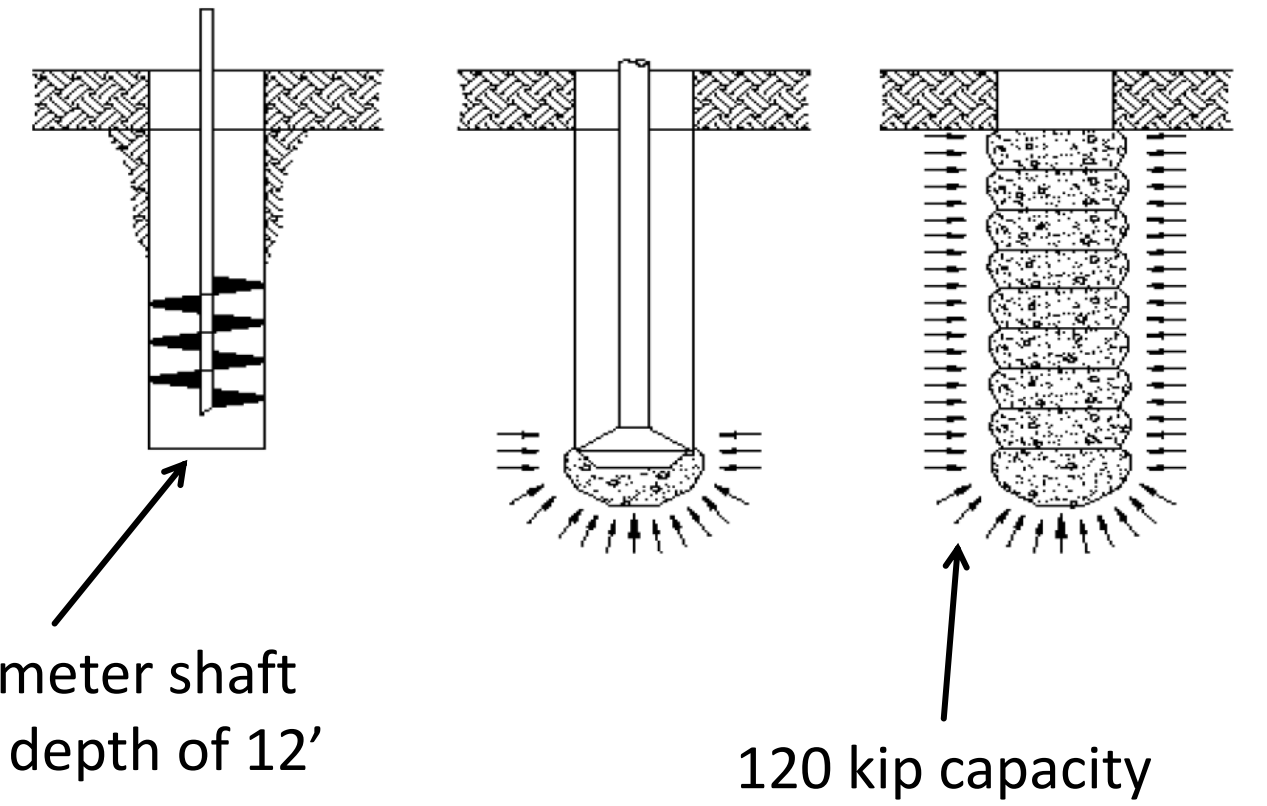
Building Footprint



34,000 SF total building footprint
 7,300 SF basement
 615 ft masonry retaining wall

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Pier Construction Process



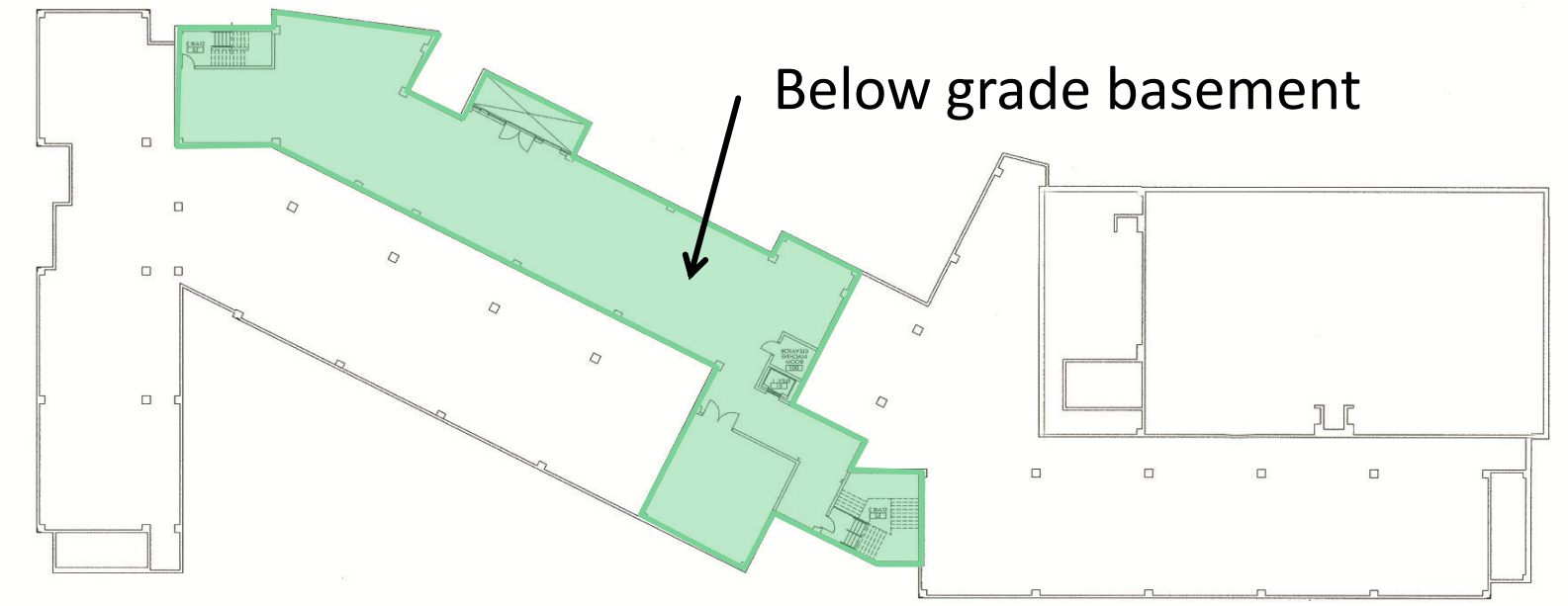
Foundation

Rammed Aggregate Piers

- Use local and recyclable resources
- Increases soil strength and stiffness
- 240 total piers installed at a rate of 30 to 60 piers per day
- Occupy 30-50% of shallow footing plan area



Building Footprint



34,000 SF total building footprint
7,300 SF basement
615 ft masonry retaining wall

- Design Process
- **Phase 1**
 - Foundation
 - **Gravity System**
 - *Analysis*
 - Framing System
 - Floor System
 - Atrium
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Live Loads (psf) (ASCE7-05)	
Assembly area movable seats/Gym	100
Corridor on 1st floor	100
Corridor above 1st floor	80
Lobbies	100
Library Stacks	150
Library Reading Room	60
School Classroom	40
Offices	50
Stage Floors	150
Stairs/exit ways	100
Ordinary flat/pitched/curved roof	20
Roof used for garden/assembly	100
Walkway/elevated platform	60

Gravity System

Design Criteria

- Consider placement of columns and expansion joints
- Adapt to the architecture
- Accommodate all mechanical, electrical, plumbing, and lighting elements

Steel vs. *Concrete*

Dead Loads (psf)		
Enclosure	Exterior Brick Wall Panel	45
	Glass Curtain Wall	15
Roof	Gym Roof	15
	Flat Roof	15
	Sloped Roof	15
	Green Roof	200
Floor	Composite Deck	45
	Superimposed (ceiling, lights, MEP, etc.)	15
	Total for Typical Floor	60
Mechanical Equipment	Large Air Handling Unit	4000 lbs
	Small Air Handling Unit	2000 lbs

Snow Loads (psf)		
Ground	$p_g =$	30.0
Flat Roof	$p_f =$	22.7
1:12 sloped roof	$p_{s1} =$	22.7
1:4 sloped roof	$p_{s2} =$	22.7

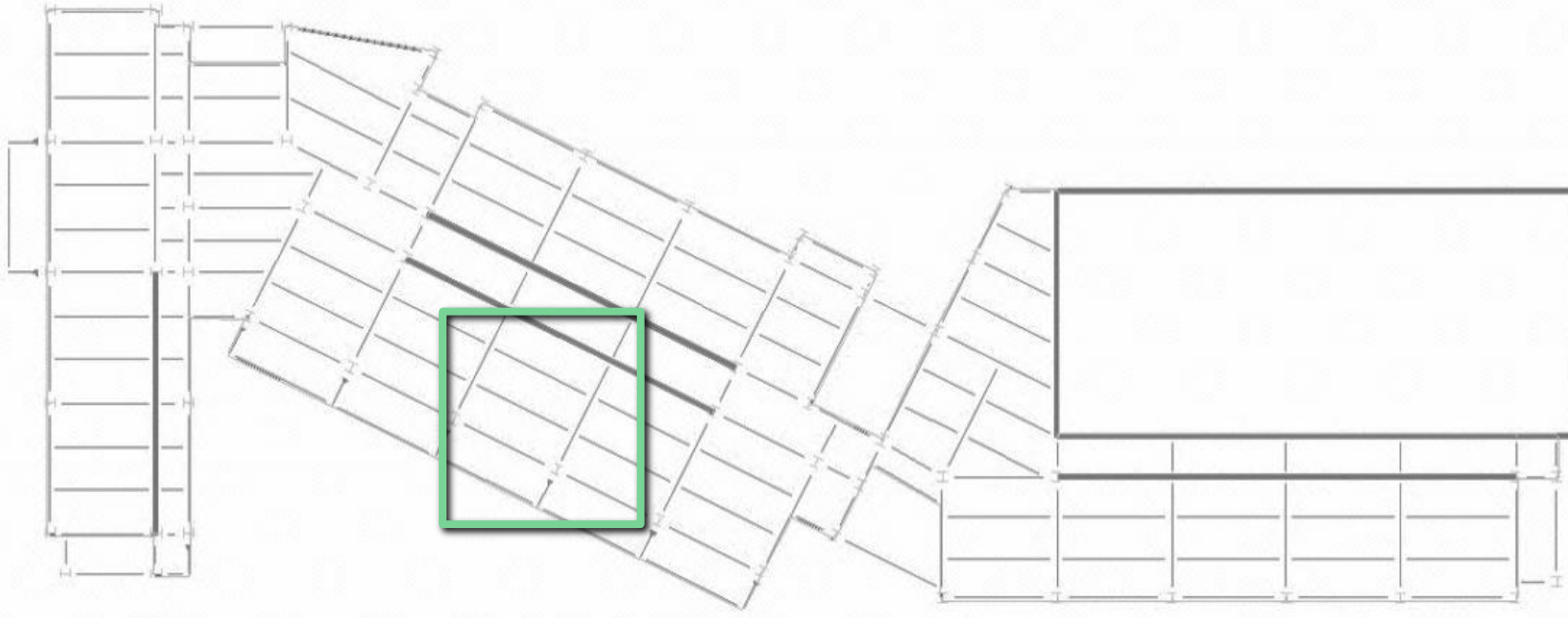
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Typical Classroom



Gravity System

Framing Layout

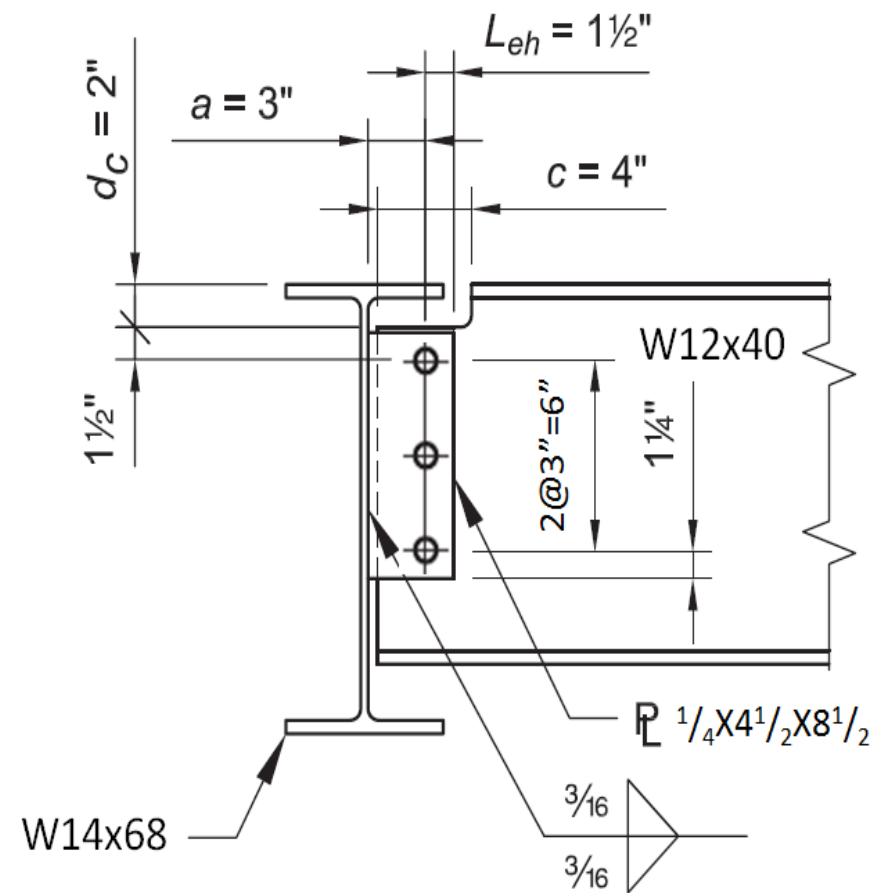


- Typical columns W10x33 and W14x61
- Beams range from W8x10 to W16x67
- Typical bay size 28x30
- 14 ft story height

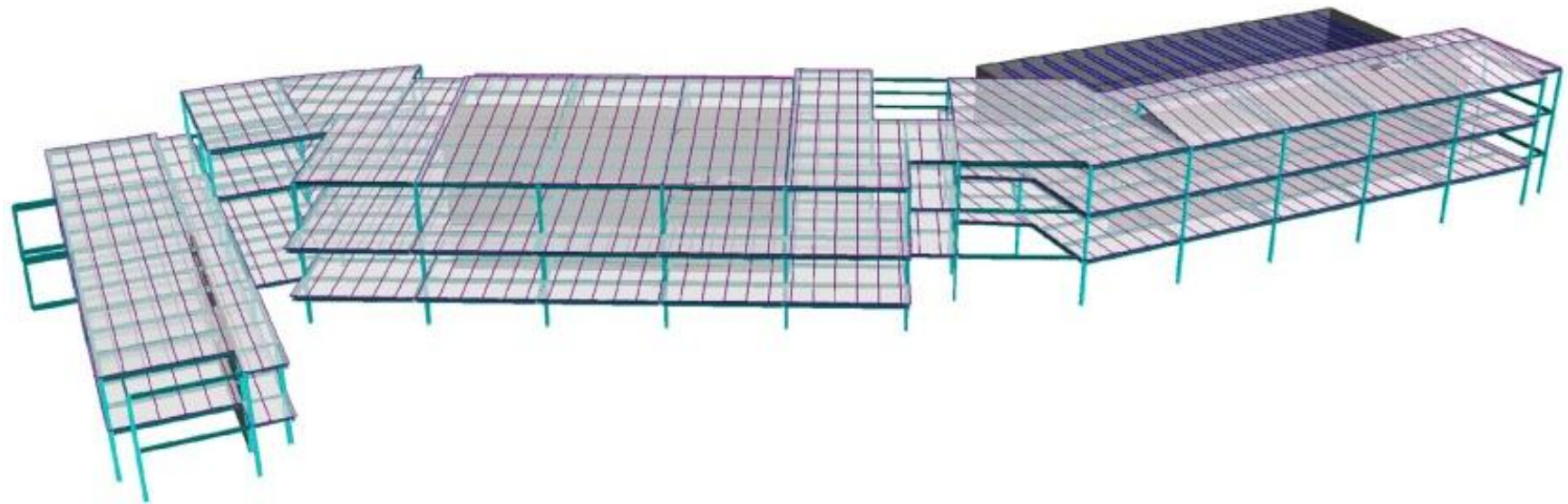
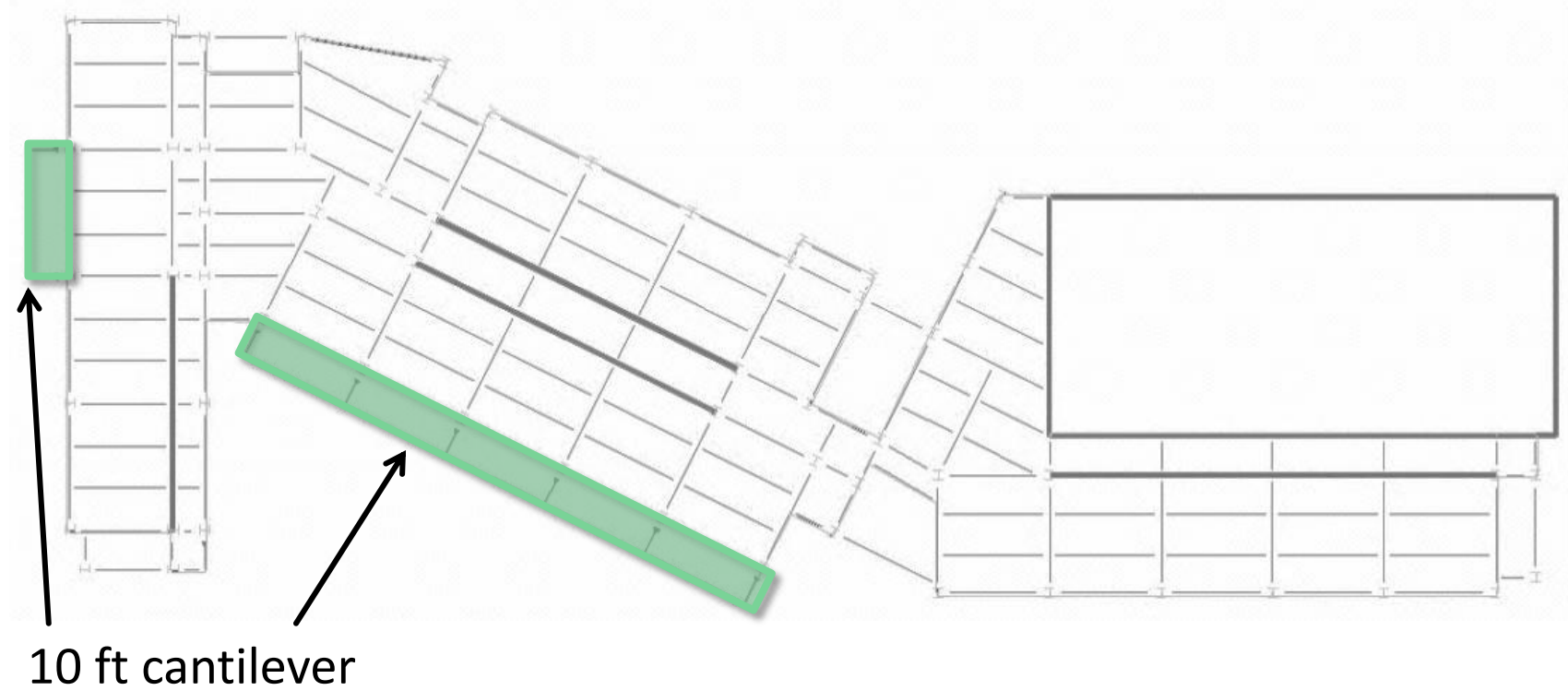
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Gravity System

Typical Shear Connection

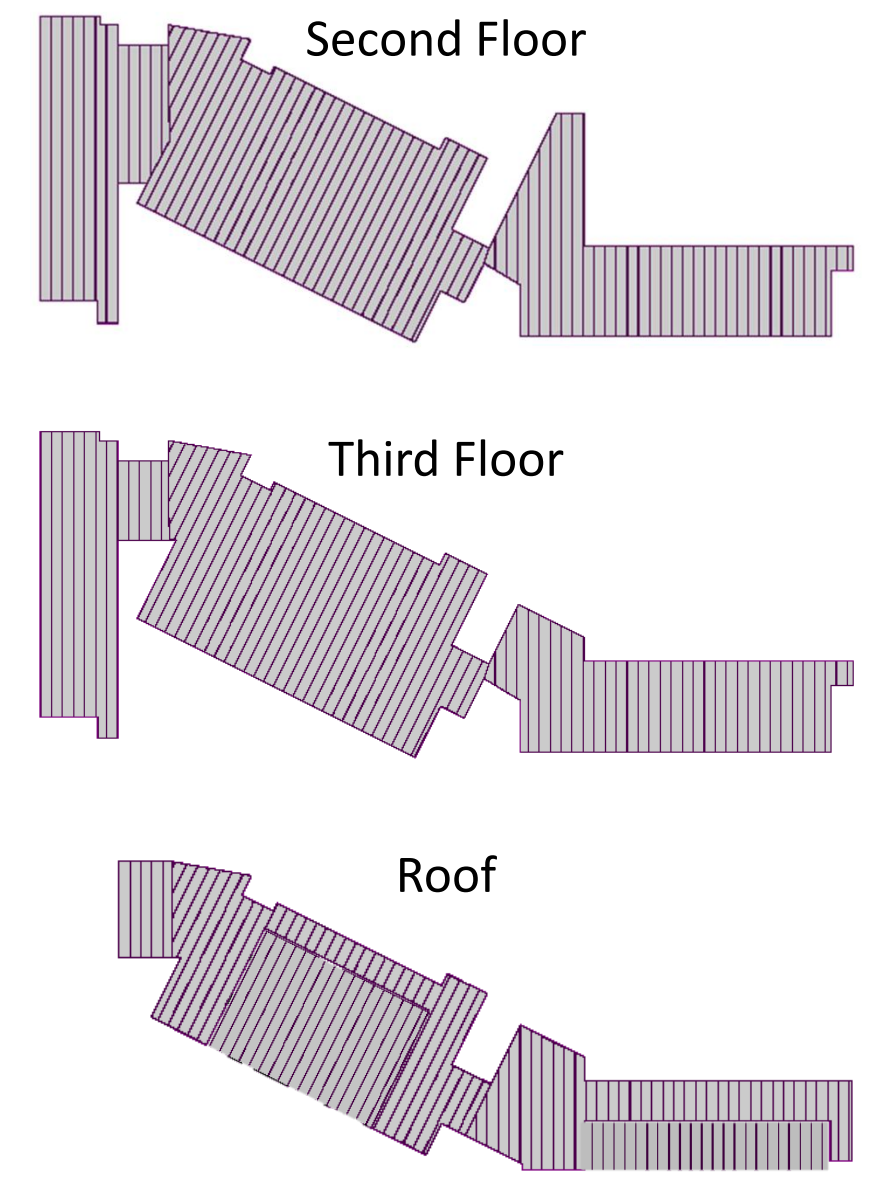


Framing Layout

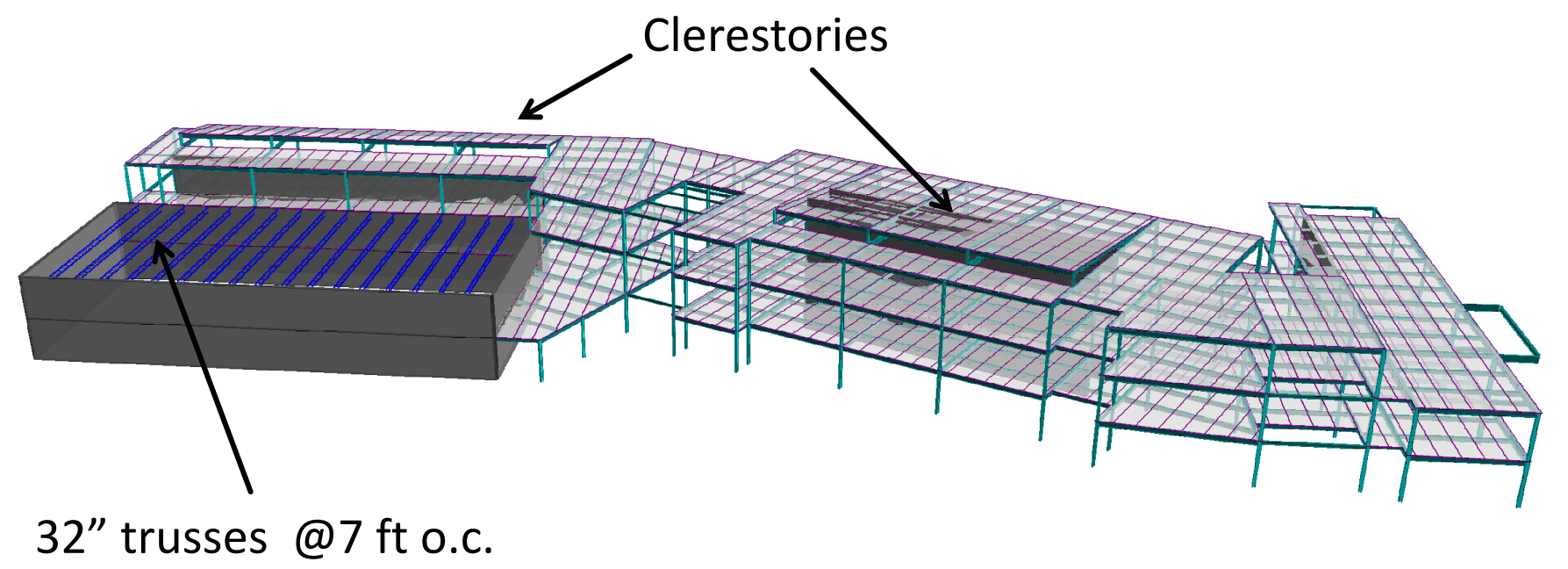


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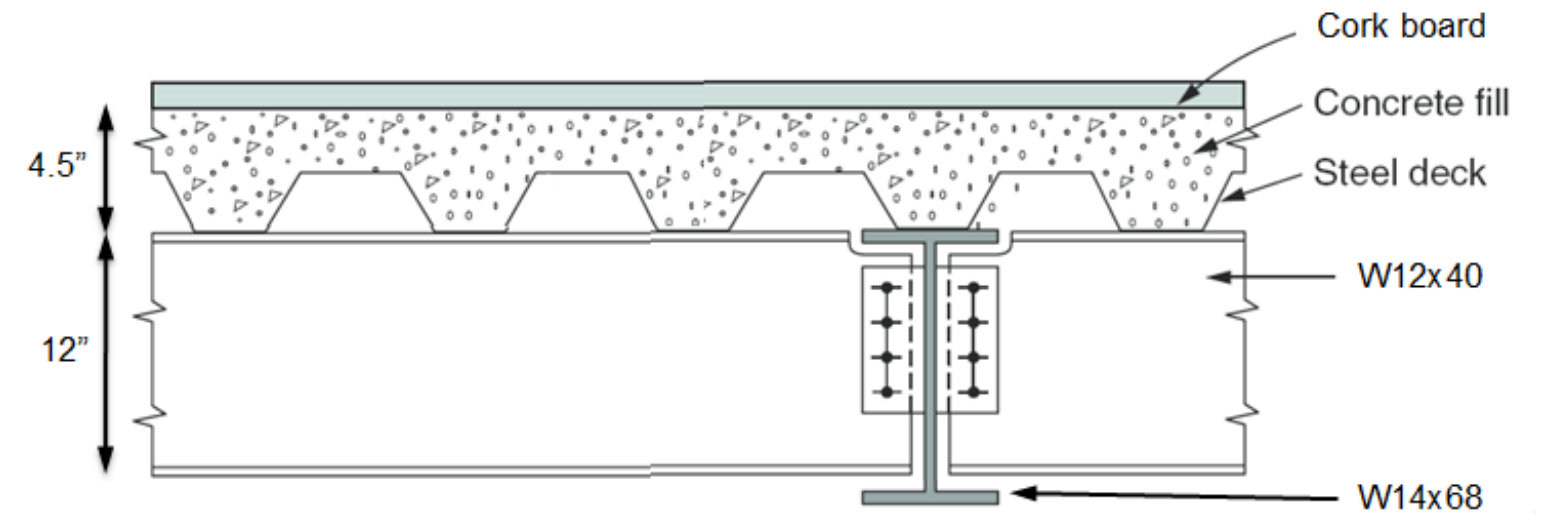
- Design Process
- **Phase 1**
 - Foundation
 - **Gravity System**
 - Analysis
 - Framing System
 - **Floor System**
 - Atrium
 - Lateral System
 - Enclosure
- Phase 2
 - Clinic
 - Natatorium
- Conclusion



Gravity System



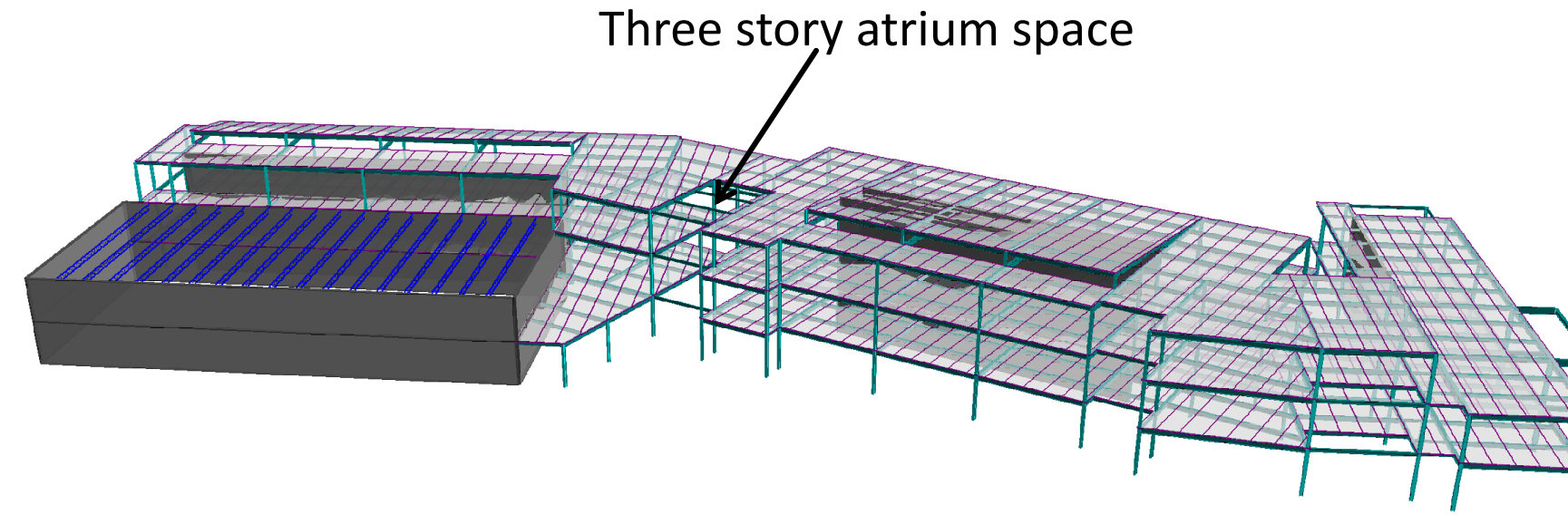
Decking		
Typical Floor	2VLI20	4.5" Composite Deck w/o Studs
Typical Flat or Sloped Roof	1.5BA16	Metal Non-composite
Green Roof	2VLI18	5.5" Composite Deck w/o Studs
Multipurpose Room Roof	1.5BA20	Metal Non-composite



- Design Process
- Phase 1
 - Foundation
 - Gravity System
 - Analysis
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 - Floor System
 - Atrium
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- Conclusion



Atrium



5' 6" cantilevered W14x38 beams

Design Criteria

- Consider aesthetics of exposed structural members
- Develop a creative solution to support cantilevered walkways
- Provide redundancy and possible additional loads

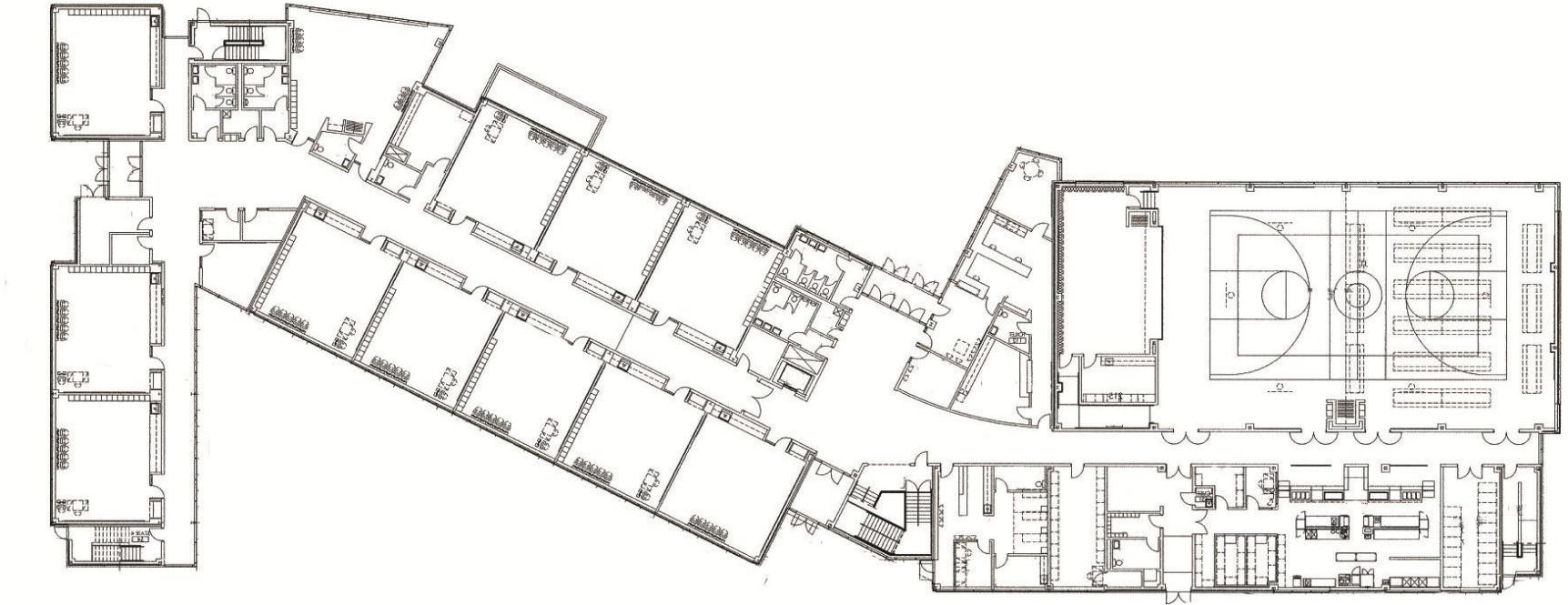
- Design Process
- Phase 1
 - Foundation
 - Gravity System
 - **Lateral System**
 - Braced Frames
 - Shear Walls
 - Enclosure
- Phase 2
 - Clinic
 - Natatorium
- Conclusion

Lateral System

Design Criteria

- Minimize torsional effects
- Provide redundancy
- Adapt to the architecture and limit obstruction of open space

First Floor Plan



- Design Process
- **Phase 1**
 - Foundation
 - Gravity System
 - **Lateral System**
 - Braced Frames
 - Shear Walls
 - Enclosure
- Phase 2
 - Clinic
 - Natatorium
- Conclusion

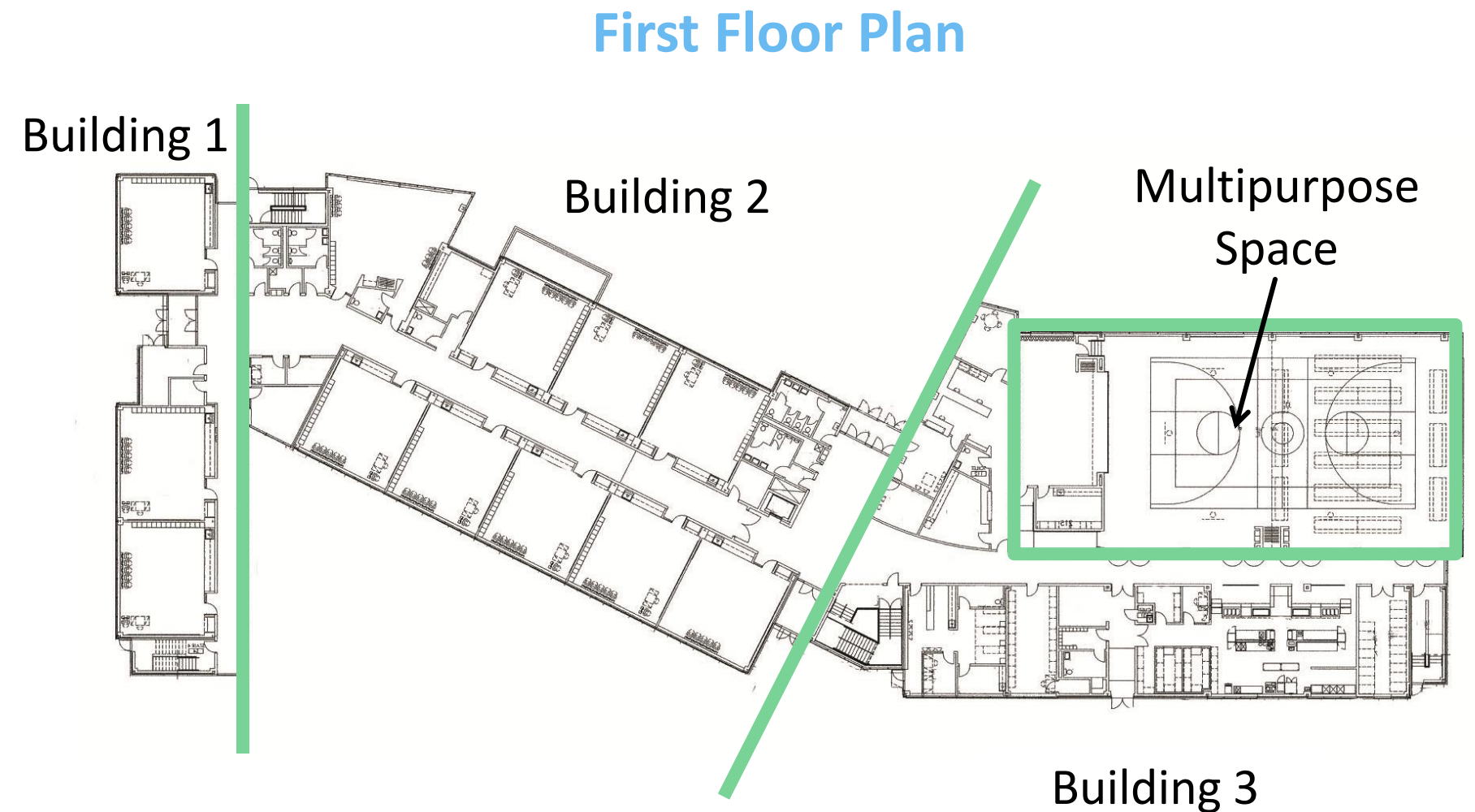
Wind Load Analysis

	Total Base Shear (k)		Overtopping Moment (k-ft)
	N/S	E/W	
Building 1	N/S	16.0	445
	E/W	75.6	2100
Building 2	N/S	123	3444
	E/W	62	1730
Building 3	N/S	149	4200
	E/W	33	924
Multipurpose	N/S	678	1890
	E/W	29	812

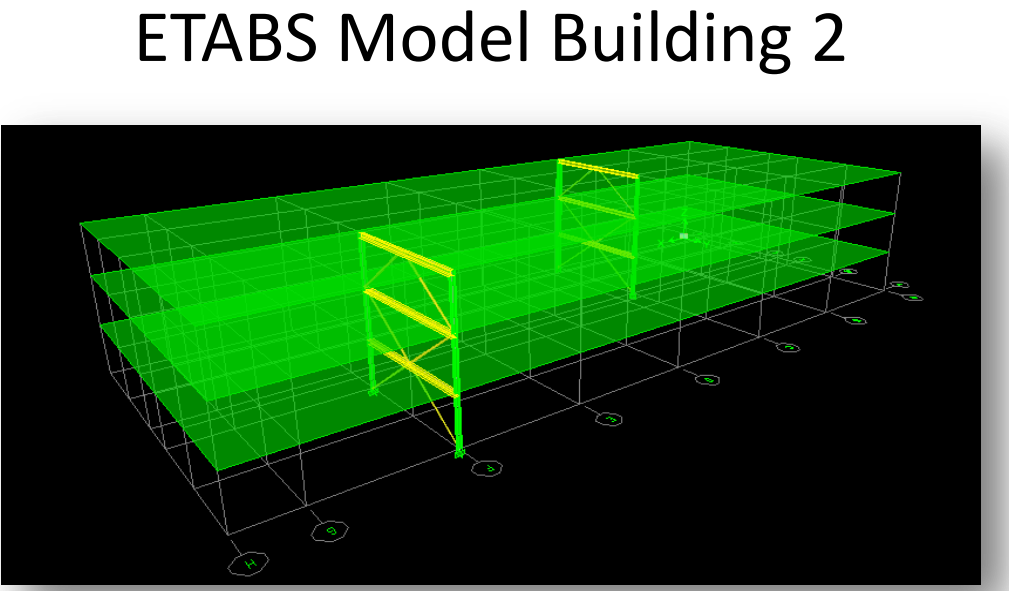
Lateral System

- #### Design Criteria
- Minimize torsional effects
 - Provide redundancy
 - Adapt to the architecture and limit obstruction of open space

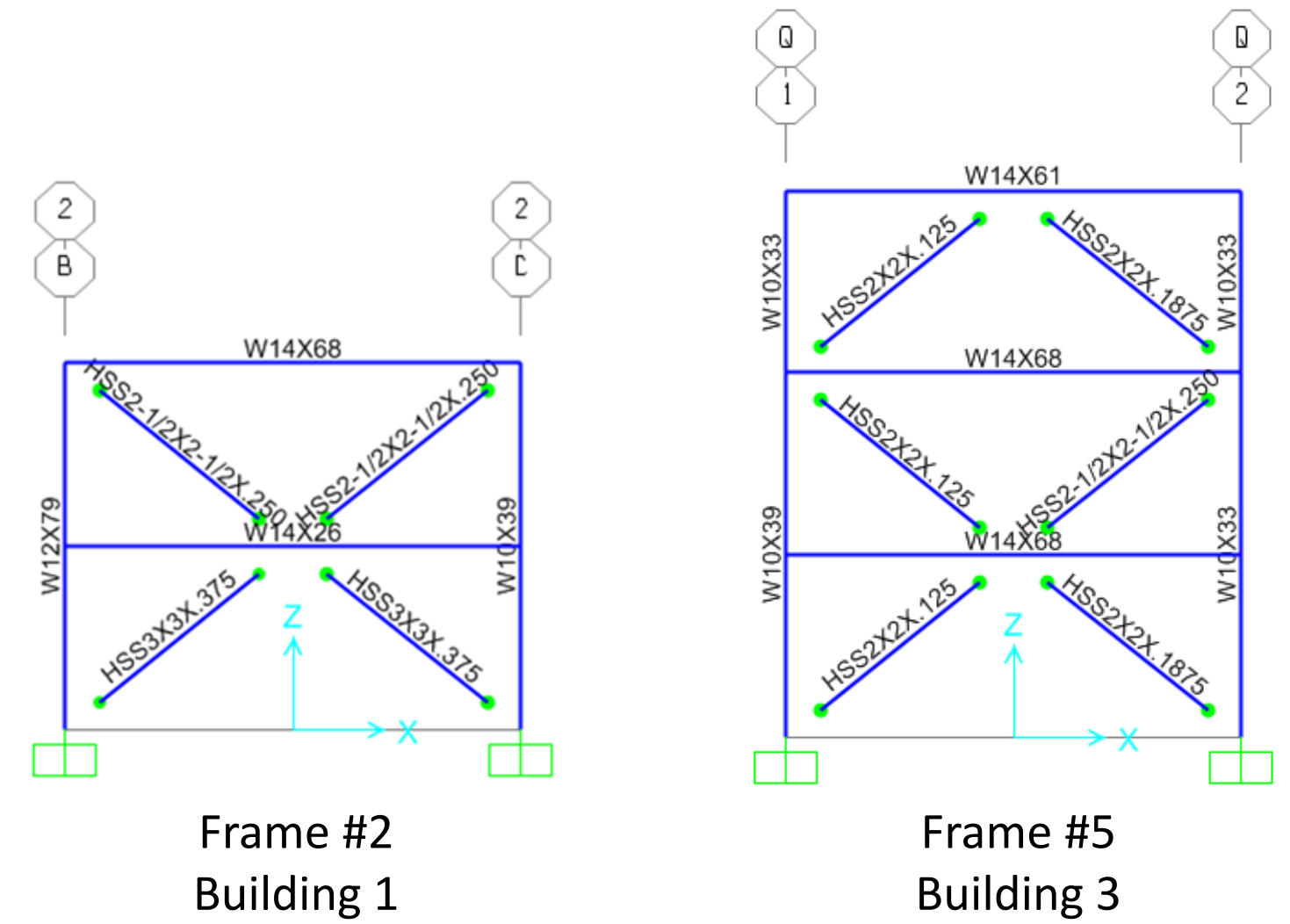
Total Building Weight (kips)	
Building 1	1540
Building 2	1812
Building 3	1109



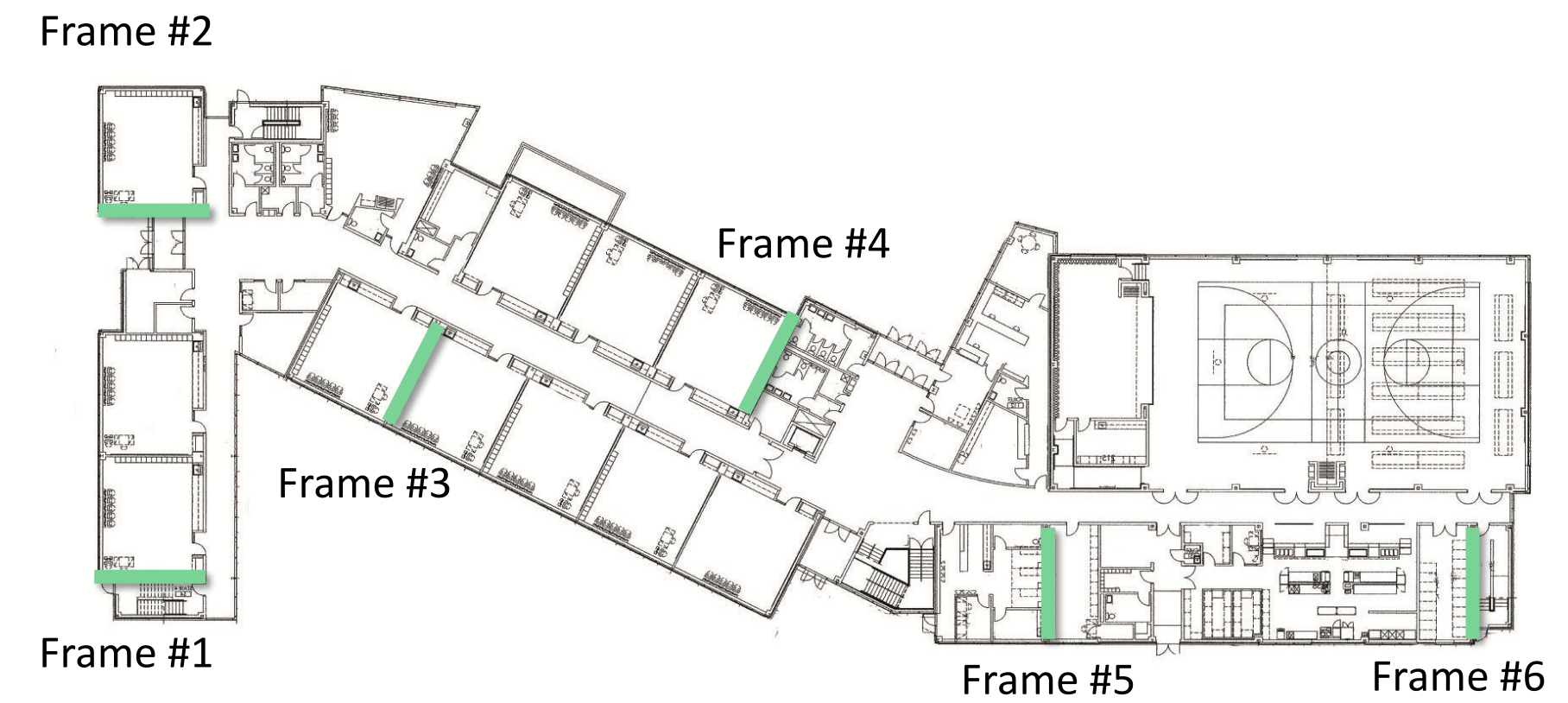
- Design Process
- **Phase 1**
 - Foundation
 - Gravity System
 - **Lateral System**
 - *Braced Frames*
 - Shear Walls
 - Enclosure
- Phase 2
 - Clinic
 - Natatorium
- Conclusion



Braced Frames



First Floor Plan



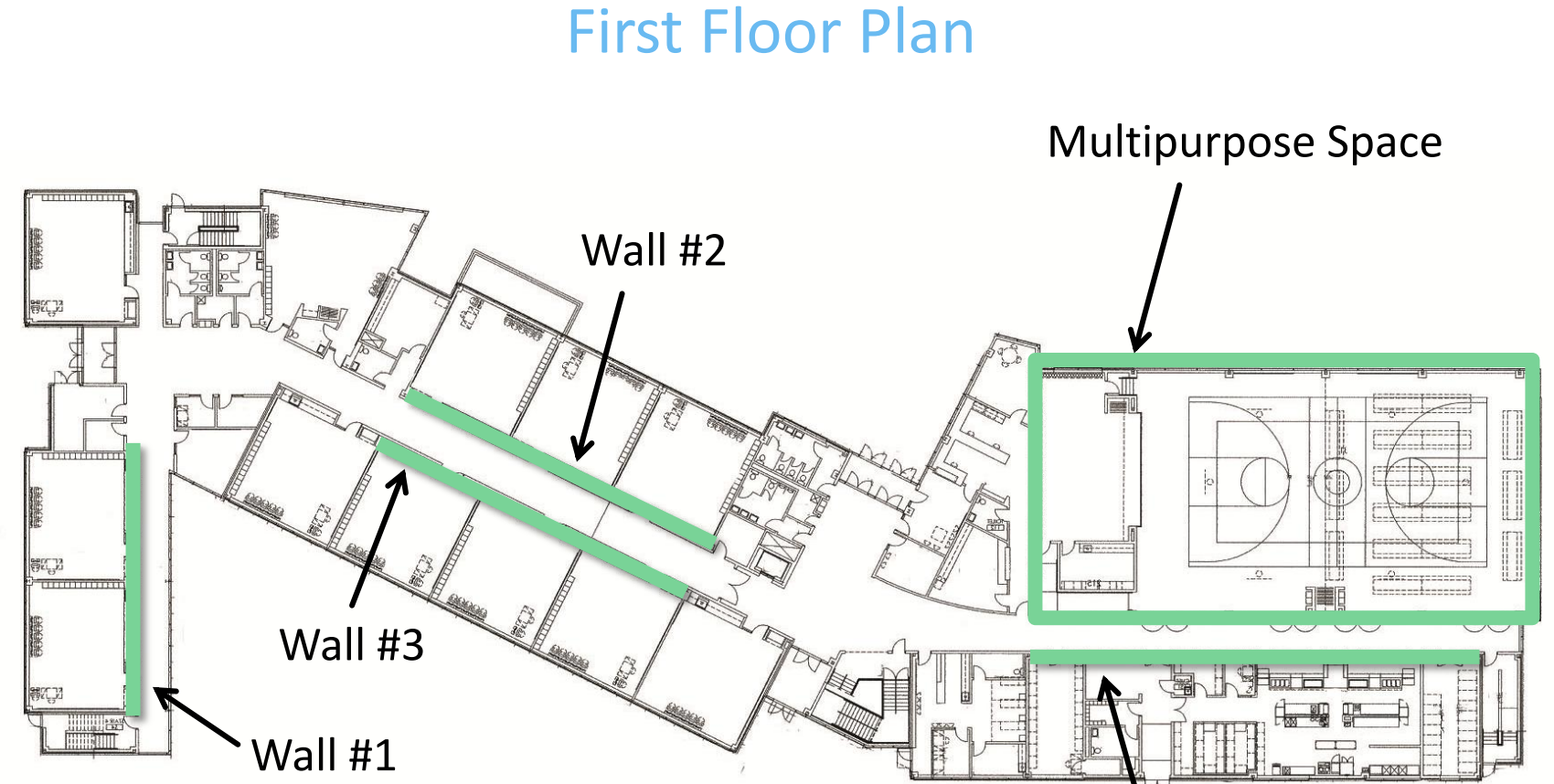
- Design Process
- **Phase 1**
 - Foundation
 - Gravity System
 - **Lateral System**
 - Braced Frames
 - **Shear Walls**
 - Enclosure
- Phase 2
 - Clinic
 - Natatorium
- Conclusion

Reinforcement Requirements for Masonry Shear Walls		
Wall	Bar #	Total Length (ft)
1	8	72
	4	1190
	3	18
2	8	180
	4	404
	3	63
3	8	180
	4	404
	3	63
4	8	240
	4	516
	3	168

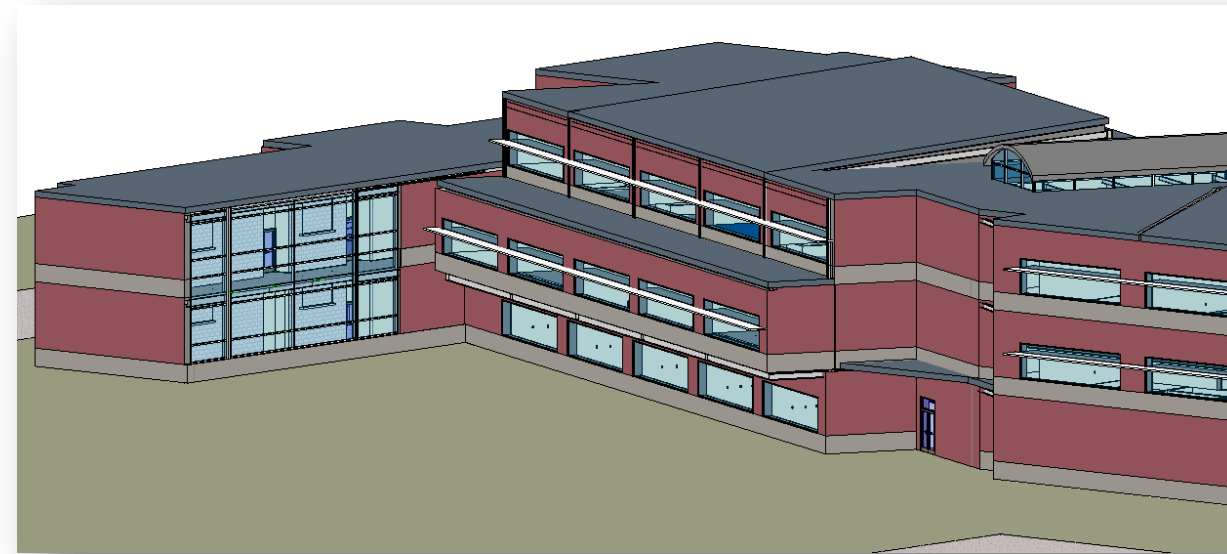
Reinforced Masonry Shear Walls



Masonry Properties		
Shear Wall	10" stacked block, fully grouted	f'c = 1500 psi
Multipurpose Space	10" stacked block, fully grouted	f'c = 1500 psi

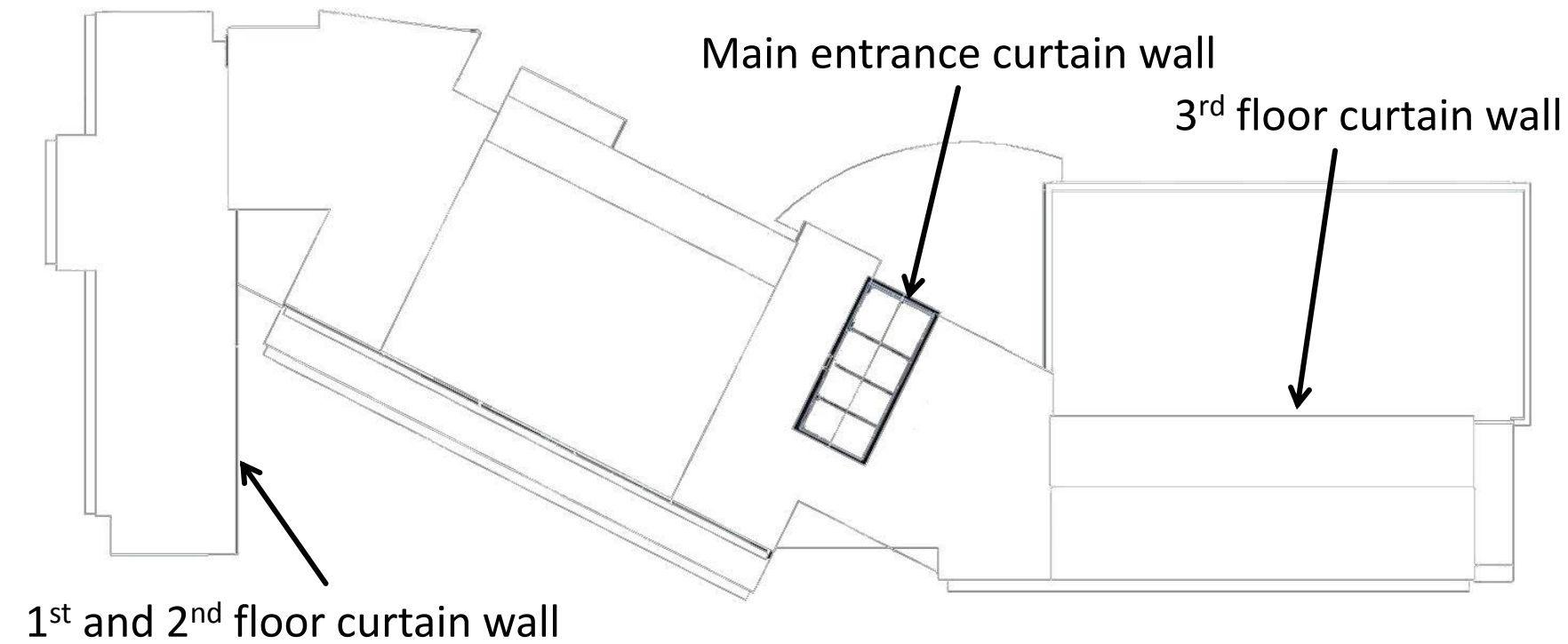


- Design Process
- Phase 1
 - Foundation
 - Gravity System
 - Lateral System
 - Enclosure
 - Walls
 - Roof
- Phase 2
 - Clinic
 - Natatorium
- Conclusion



Brick & Limestone
Glass curtain wall

Enclosure

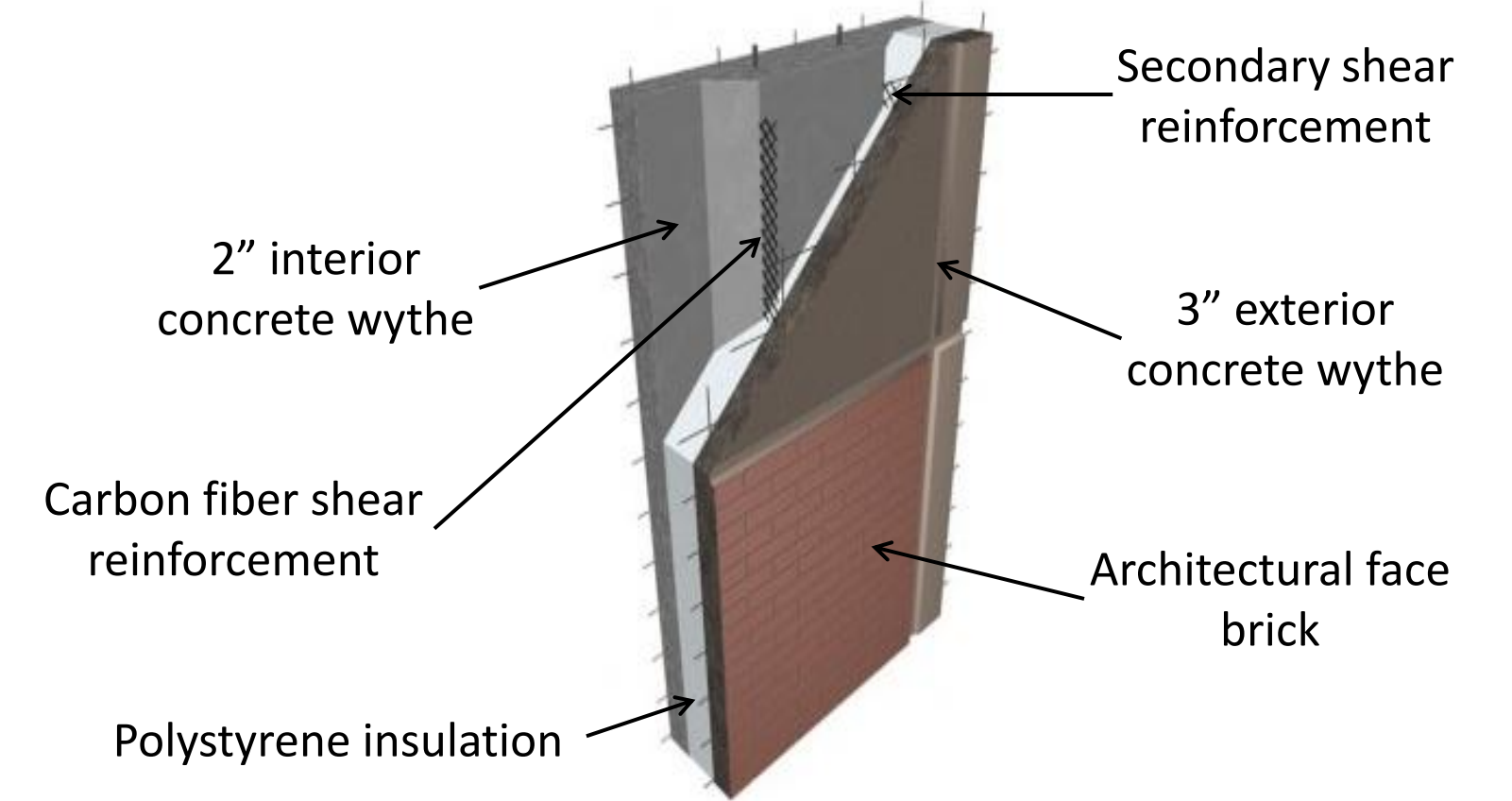


Design Criteria

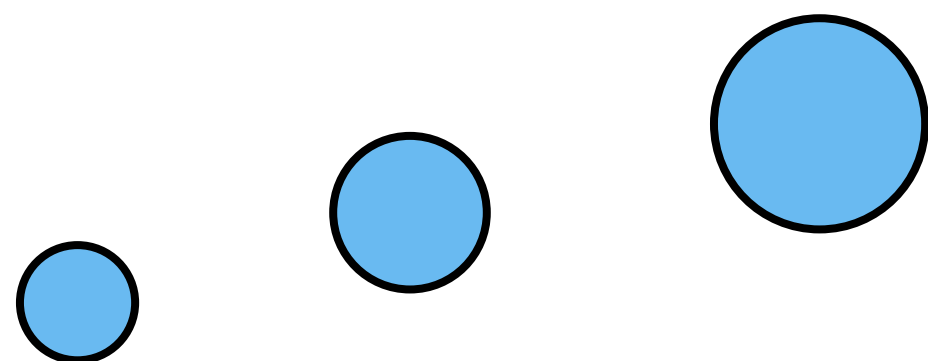
- Utilize prefabricated assemblies
- Efficient connection to superstructure
- Resist wind, snow, and earthquake loads



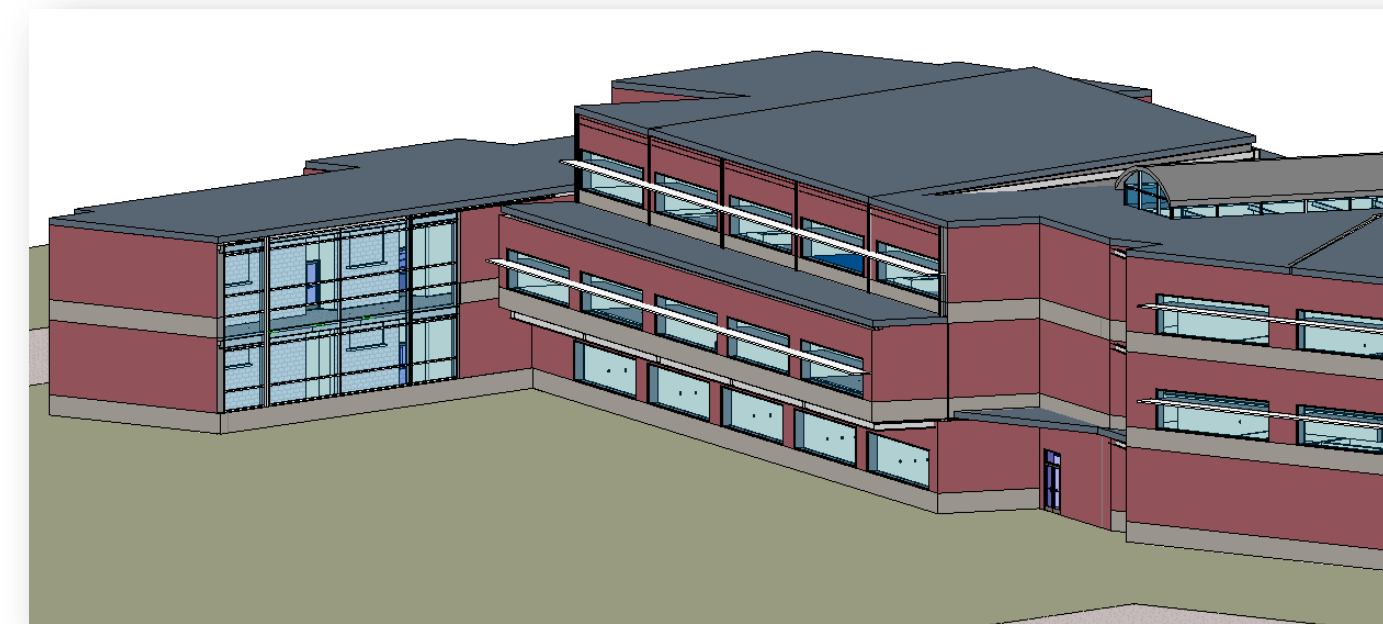
Precast Panels



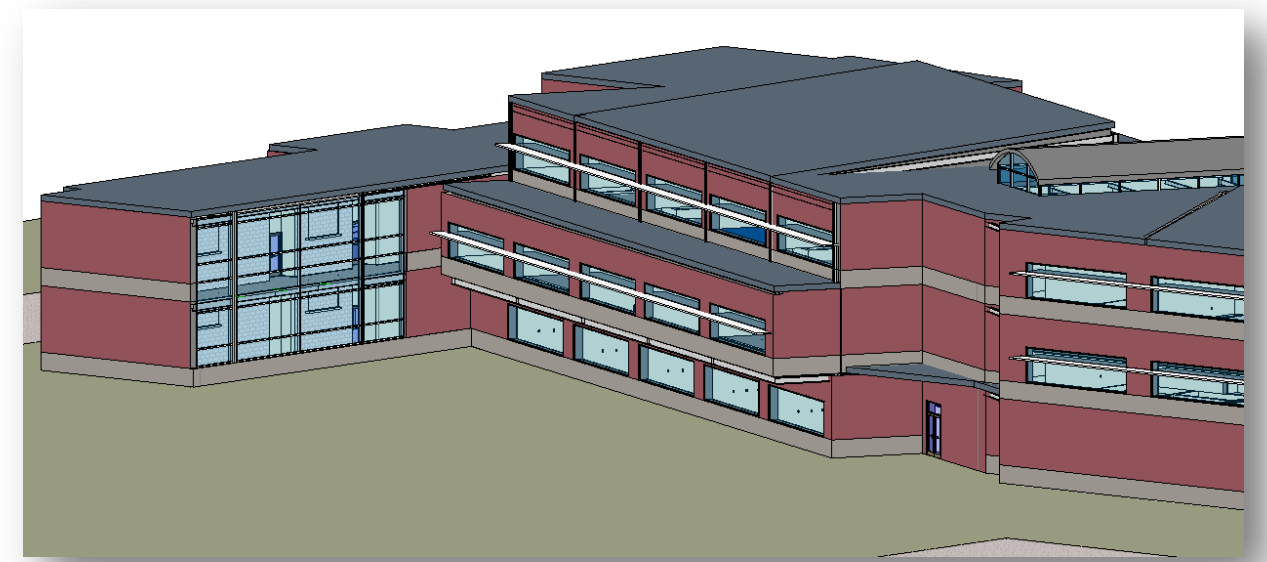
Enclosure



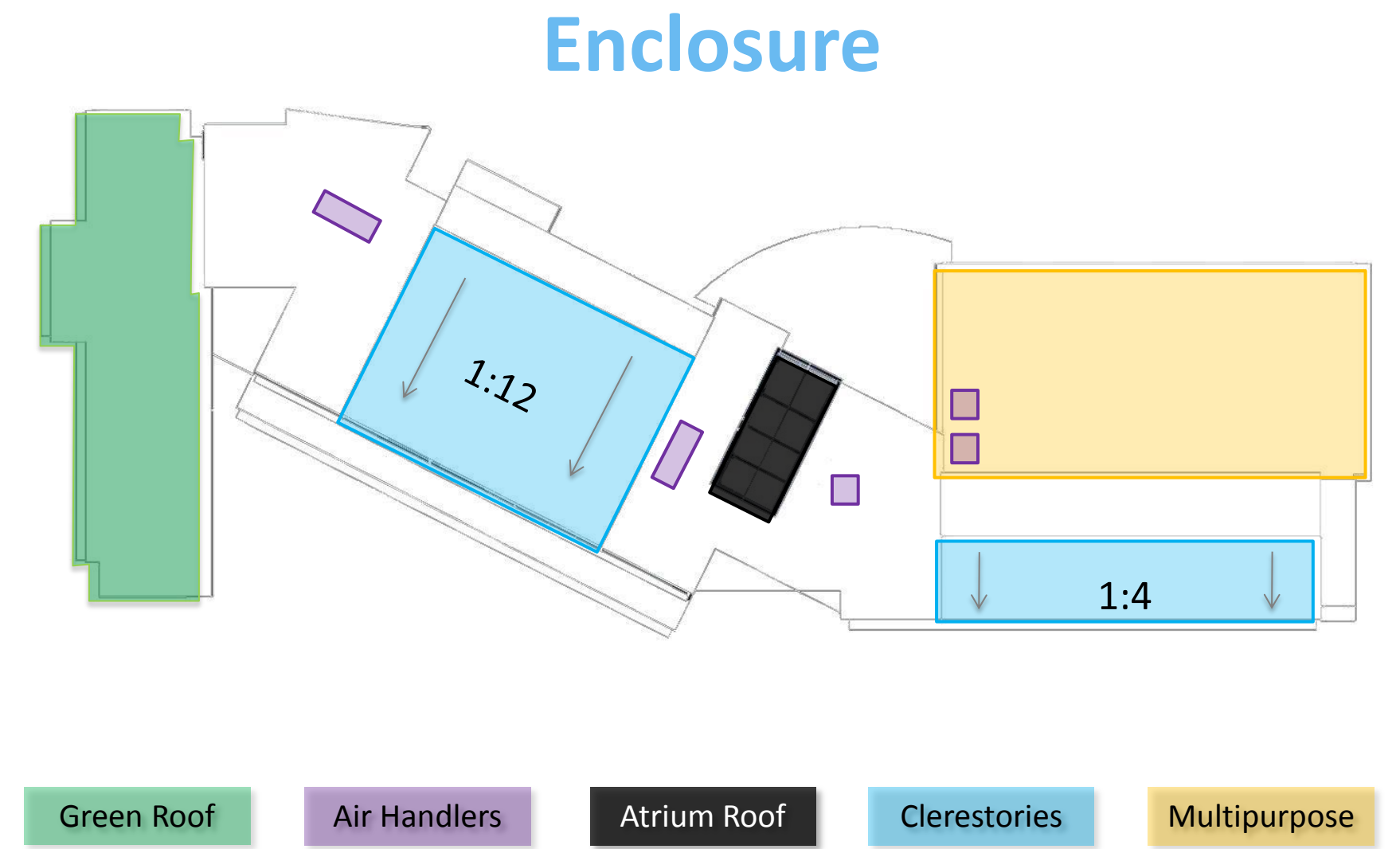
- R-Value
- Lightweight
- Architectural Flexibility
- Receptacle layout
- Local contractors



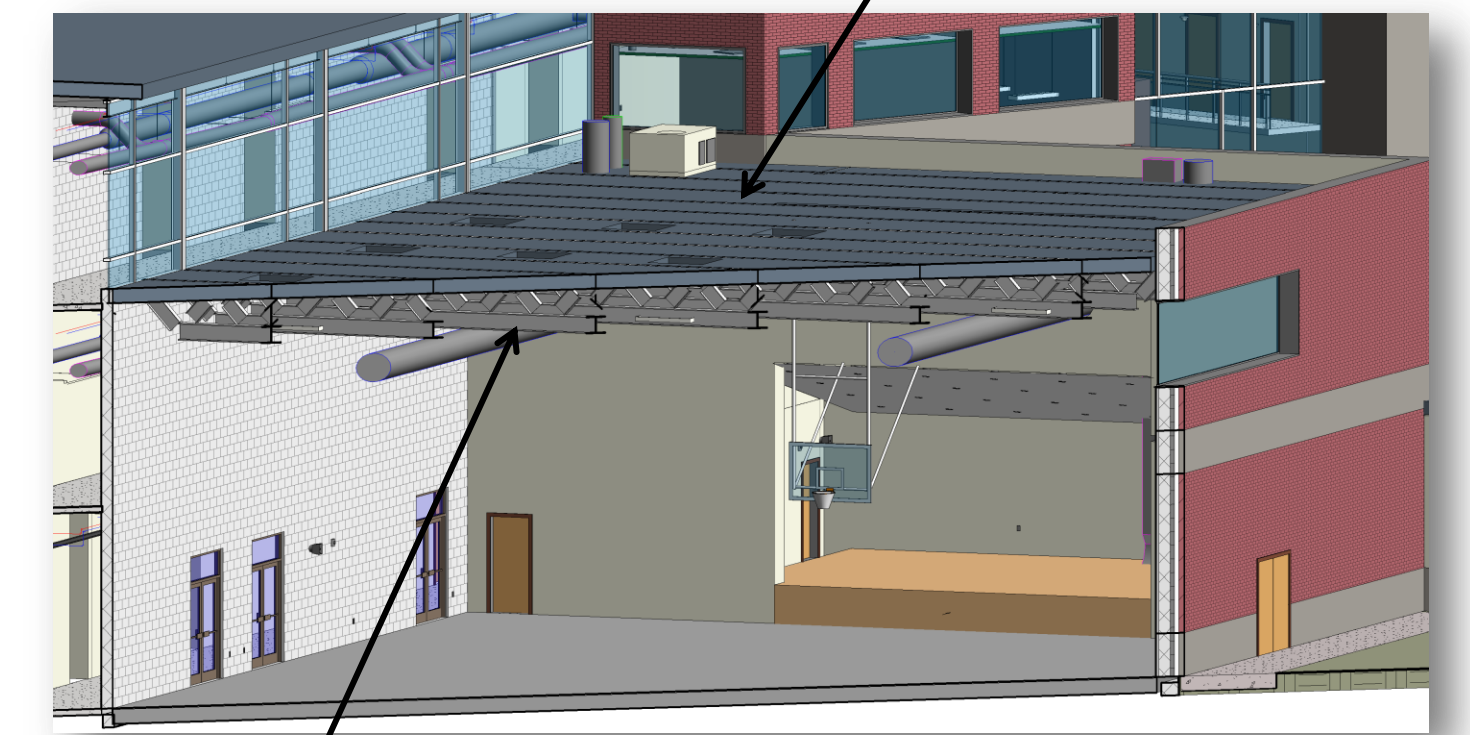
- Design Process
- **Phase 1**
 - Foundation
 - Gravity System
 - Lateral System
 - **Enclosure**
 - Walls
 - *Roof*
- Phase 2
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 - Natatorium
- Conclusion



Brick & Limestone
Glass curtain wall

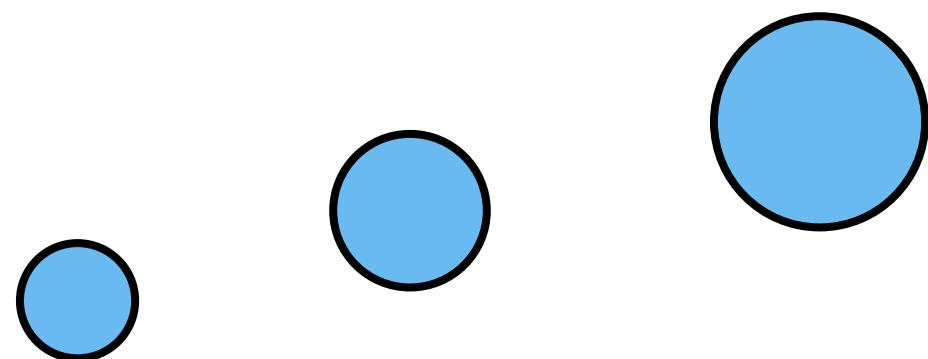


Insulated roof prevents joist movement due to temperature change

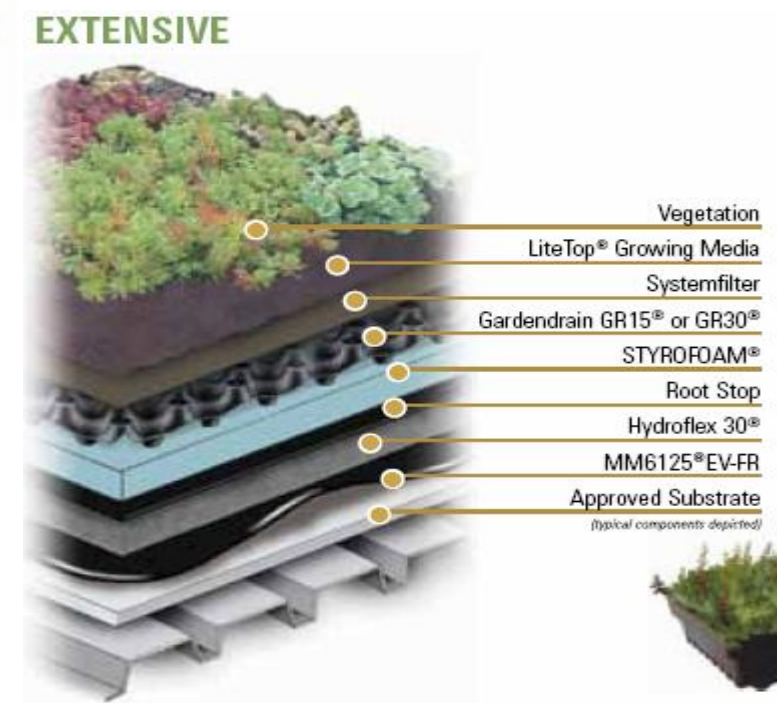
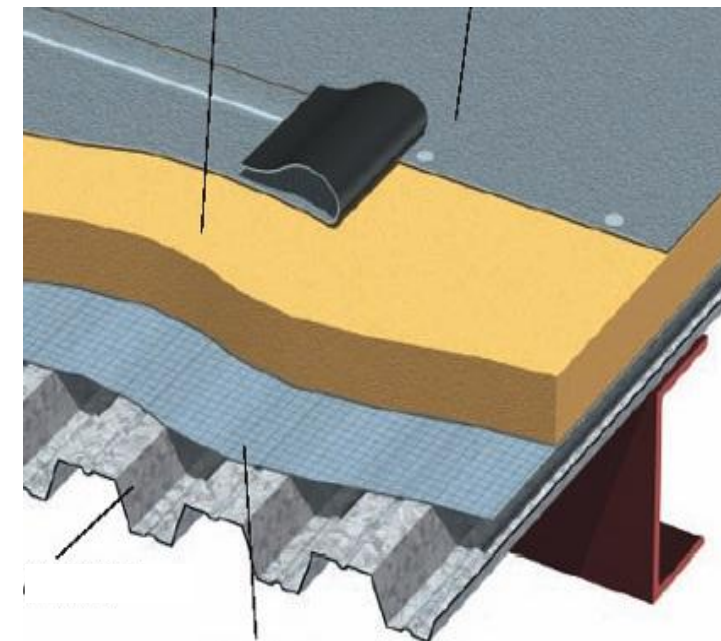


K-series joists fabricated with oversized slots in top chord anchored to steel bearing plate



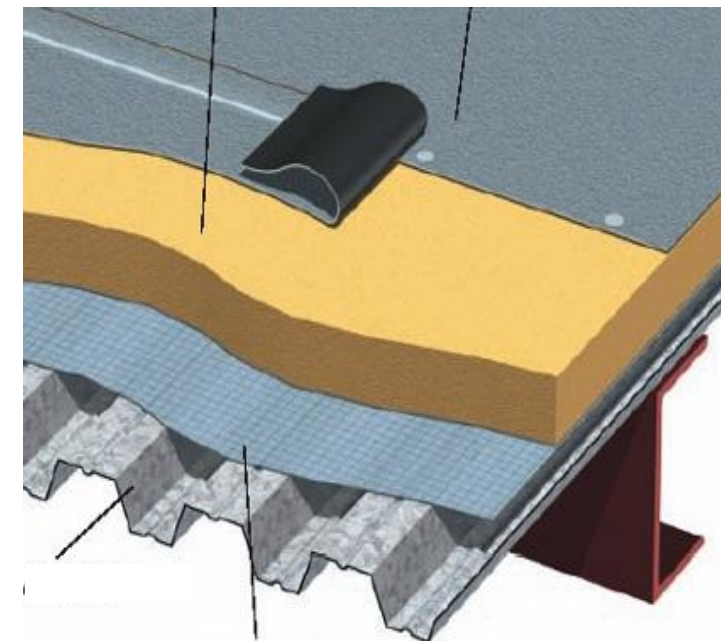


- R-Value
- AHU Placement
- High reflectance
- Cost considerations of additional features
- Placement of green roof
- Drainage





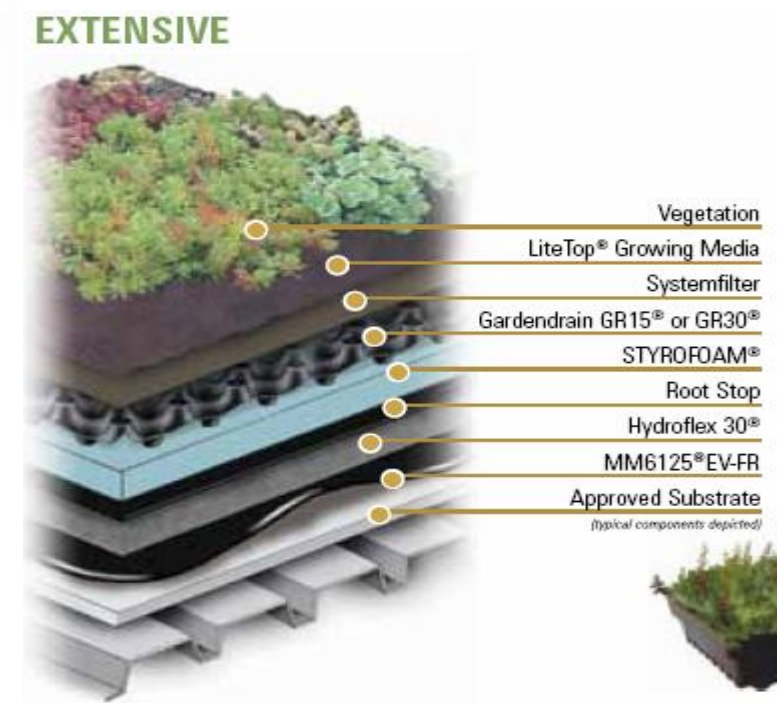
- R-Value
- AHU Placement
- High reflectance
- **Cost considerations** of additional features
- Placement of green roof
- Drainage



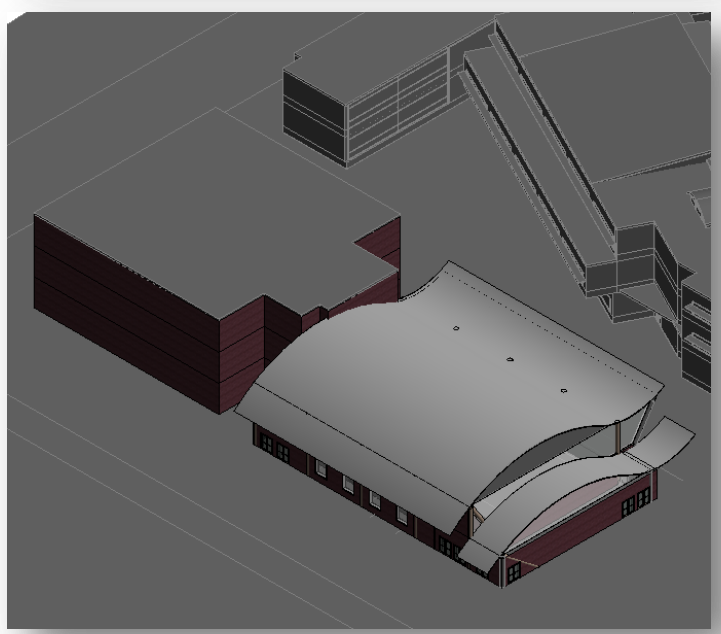
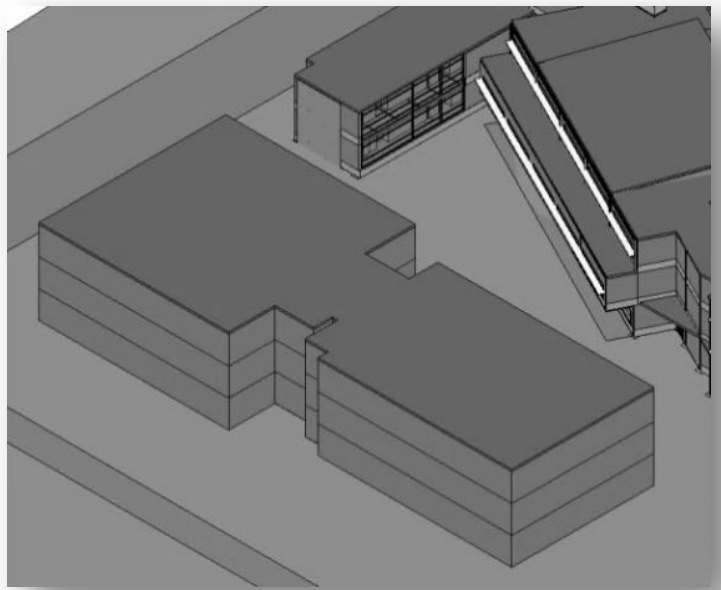
Photovoltaic Panels

20+ Year

Payback Period



- Design Process
- Phase 1
 - Foundation
 - Gravity System
 - Lateral System
 - Enclosure
- **Phase 2**
 - Clinic
 - Natatorium
- Conclusion

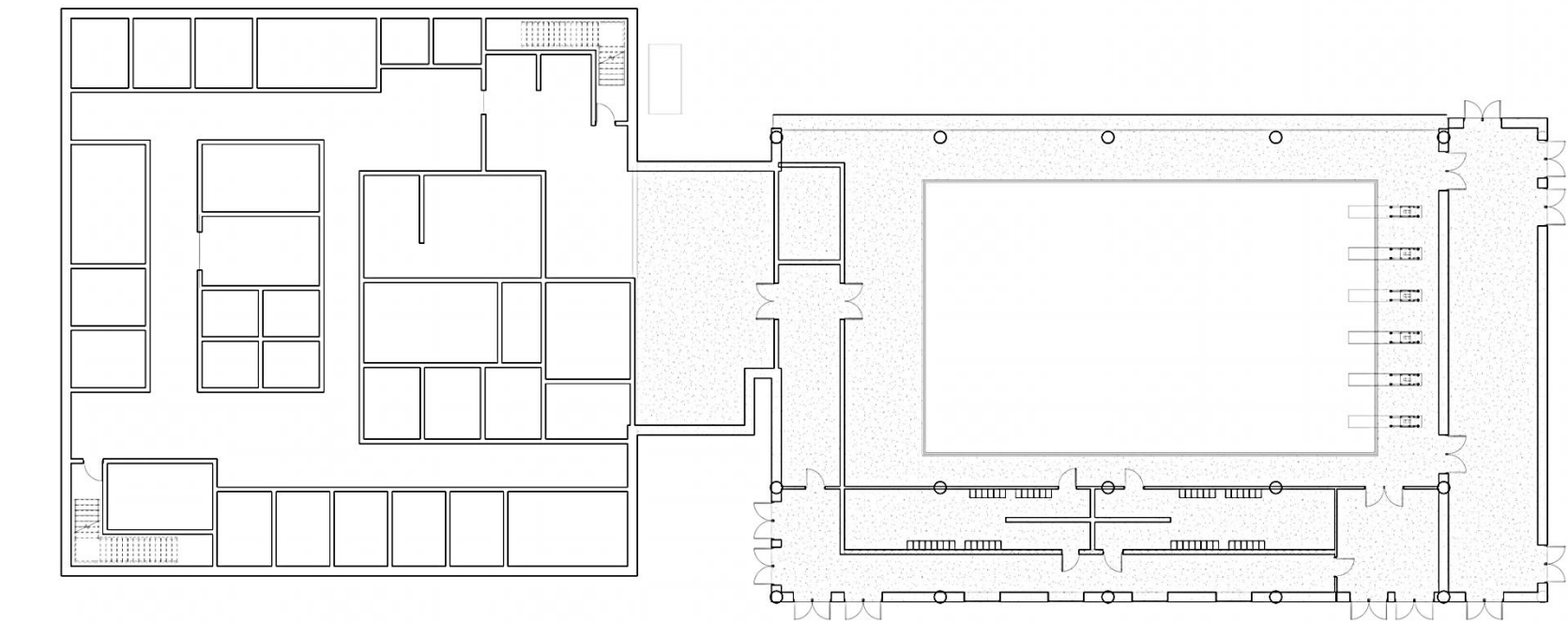


Phase 2

Design Criteria

- Create an iconic building that the community can be proud of
- Utilize existing building
- Develop a creative solution to spanning the large pool space

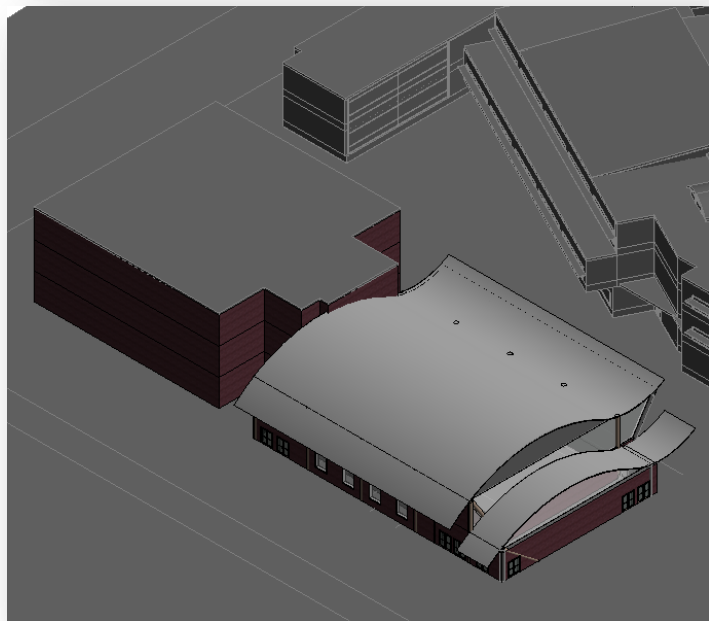
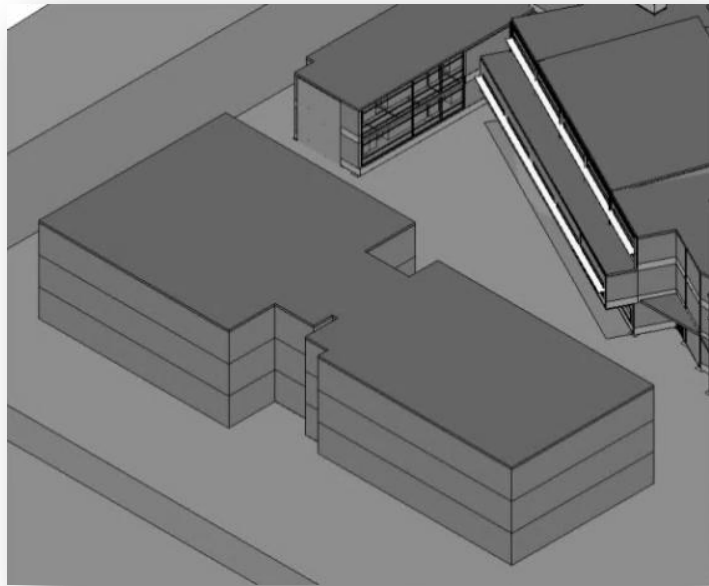
Clinic and Natatorium Plan



Renovation

New Construction

- Design Process
- Phase 1
 - Foundation
 - Gravity System
 - Lateral System
 - Enclosure
- Phase 2
 - **Clinic**
 - Natatorium
- Conclusion



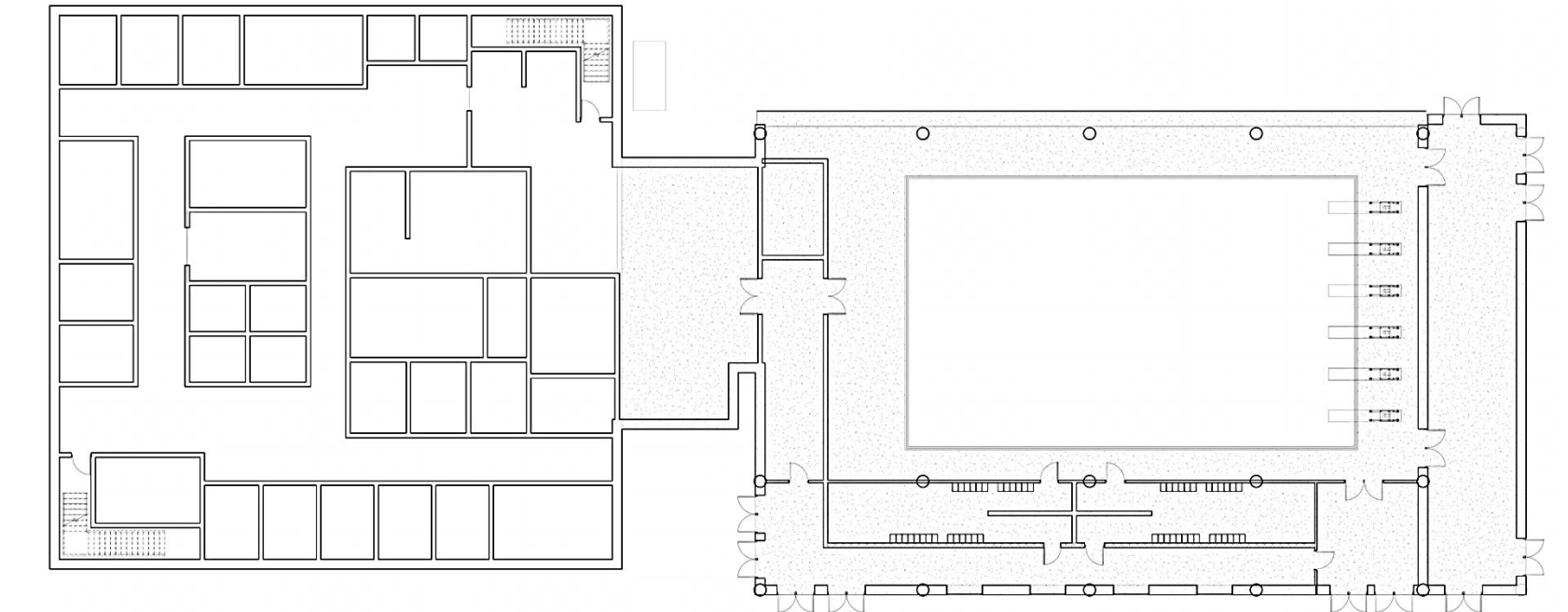
Clinic

By *reusing the existing building* we assumed *no additional upgrades to the structure* would be required for the renovation portion of **Phase 2**

Assumptions

- Steel structure
- Modular spaced bays with moment connections

Clinic and Natatorium Plan

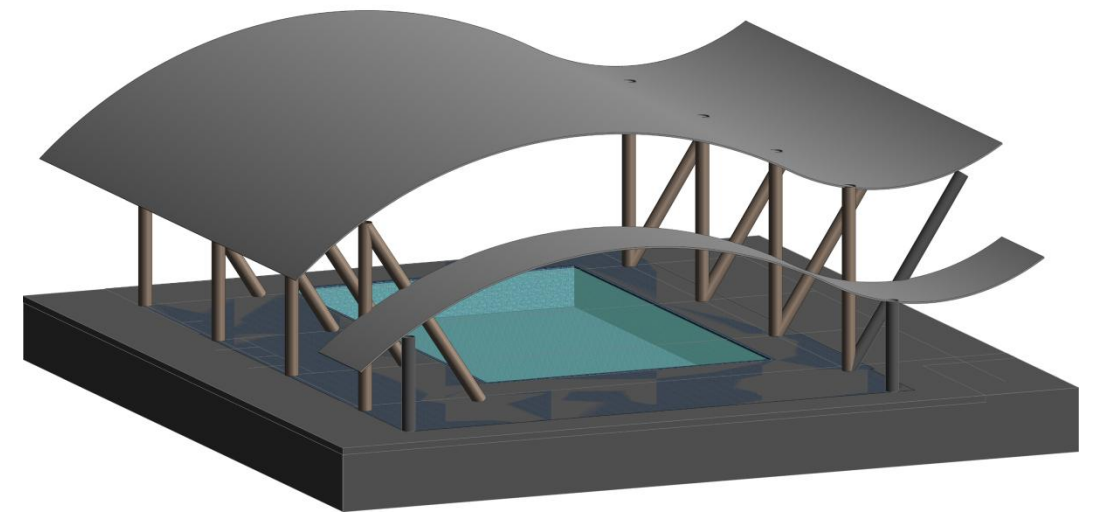
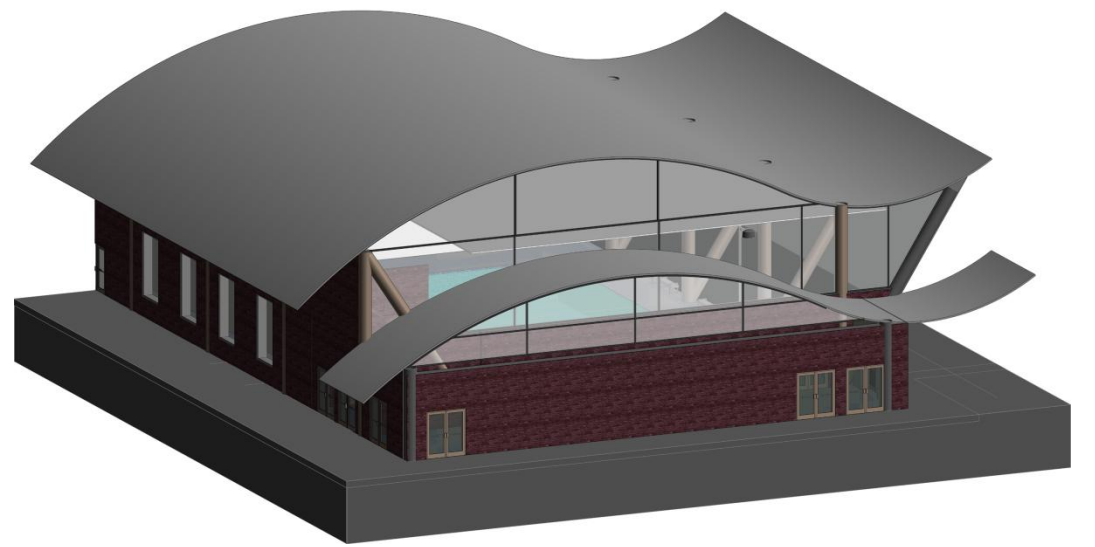


Renovation

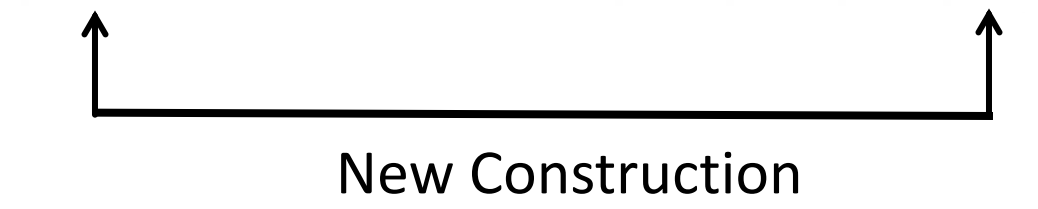
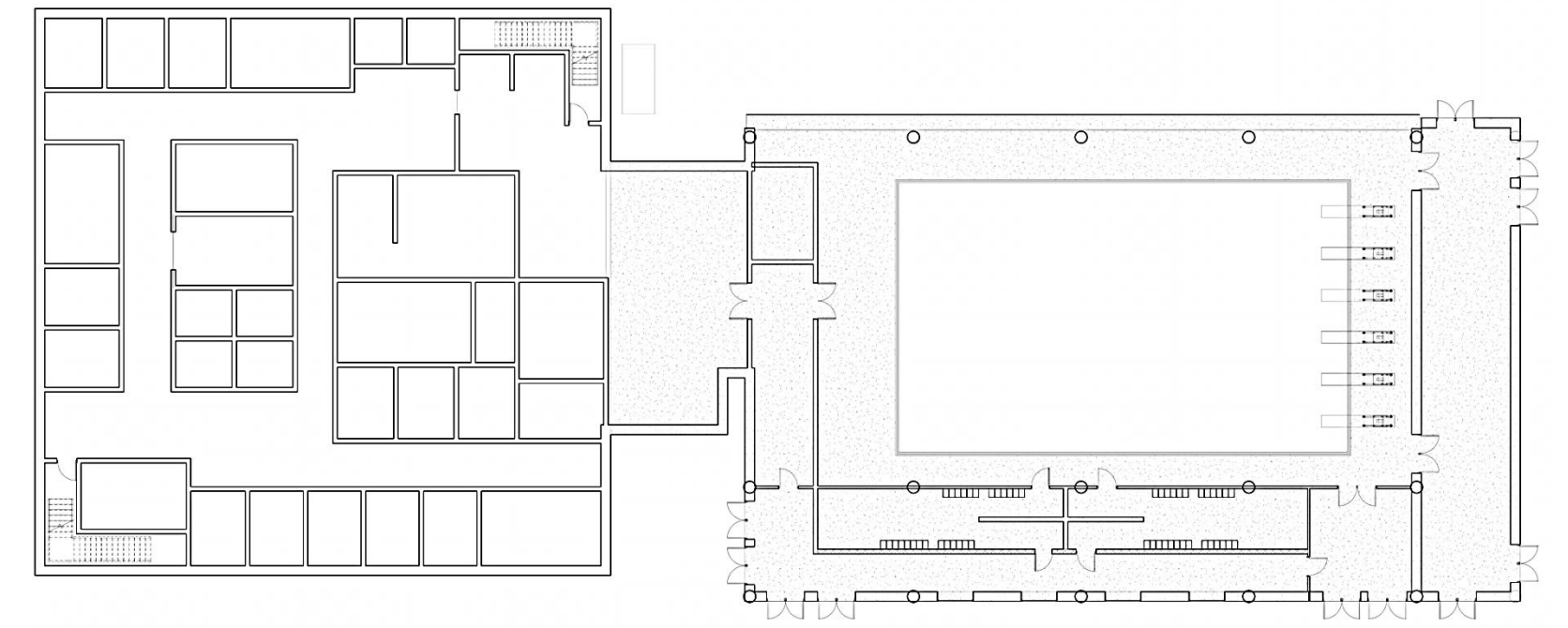
- Design Process
- Phase 1
 - Foundation
 - Gravity System
 - Lateral System
 - Enclosure
- **Phase 2**
 - Clinic
 - *Natatorium*
- Conclusion

- Prefabricated insulated metal deck panels
- W21x147 girders and W12x30 purlins
- Vertical and slanted PIPE10 and PIPE5 hollow circular steel columns
- Extra roof drainage

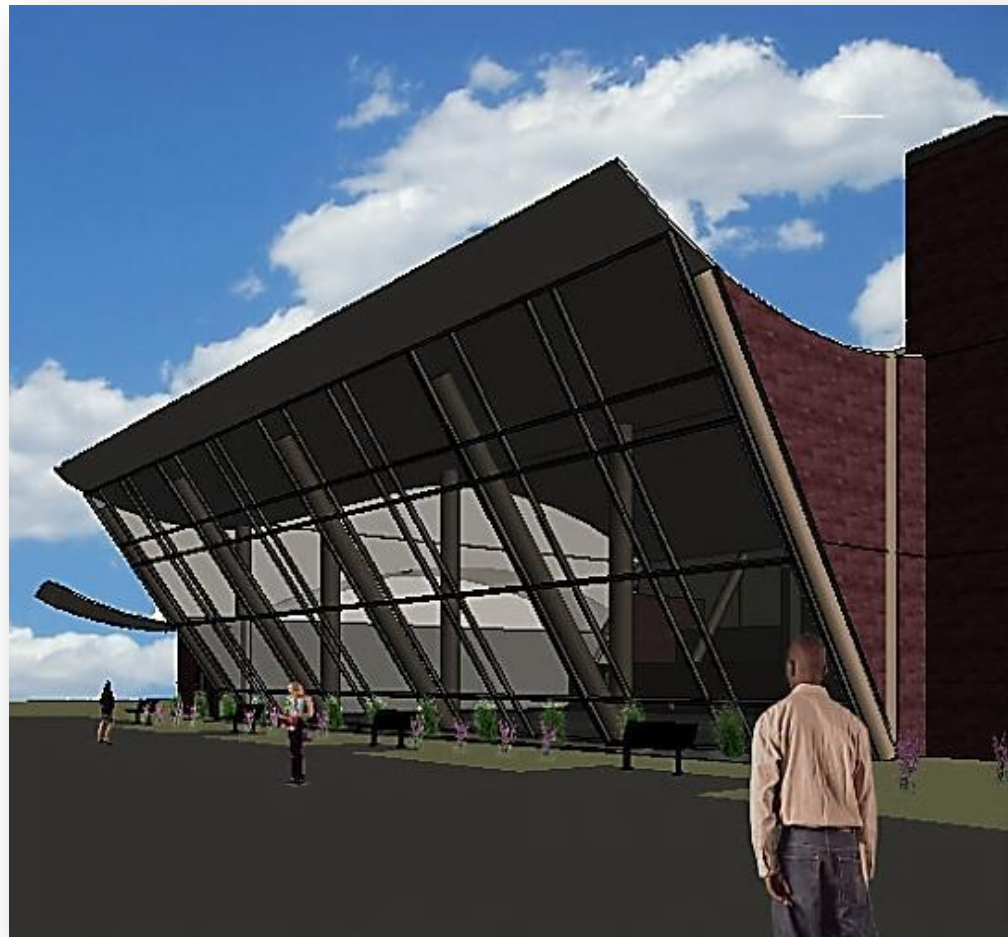
Natatorium



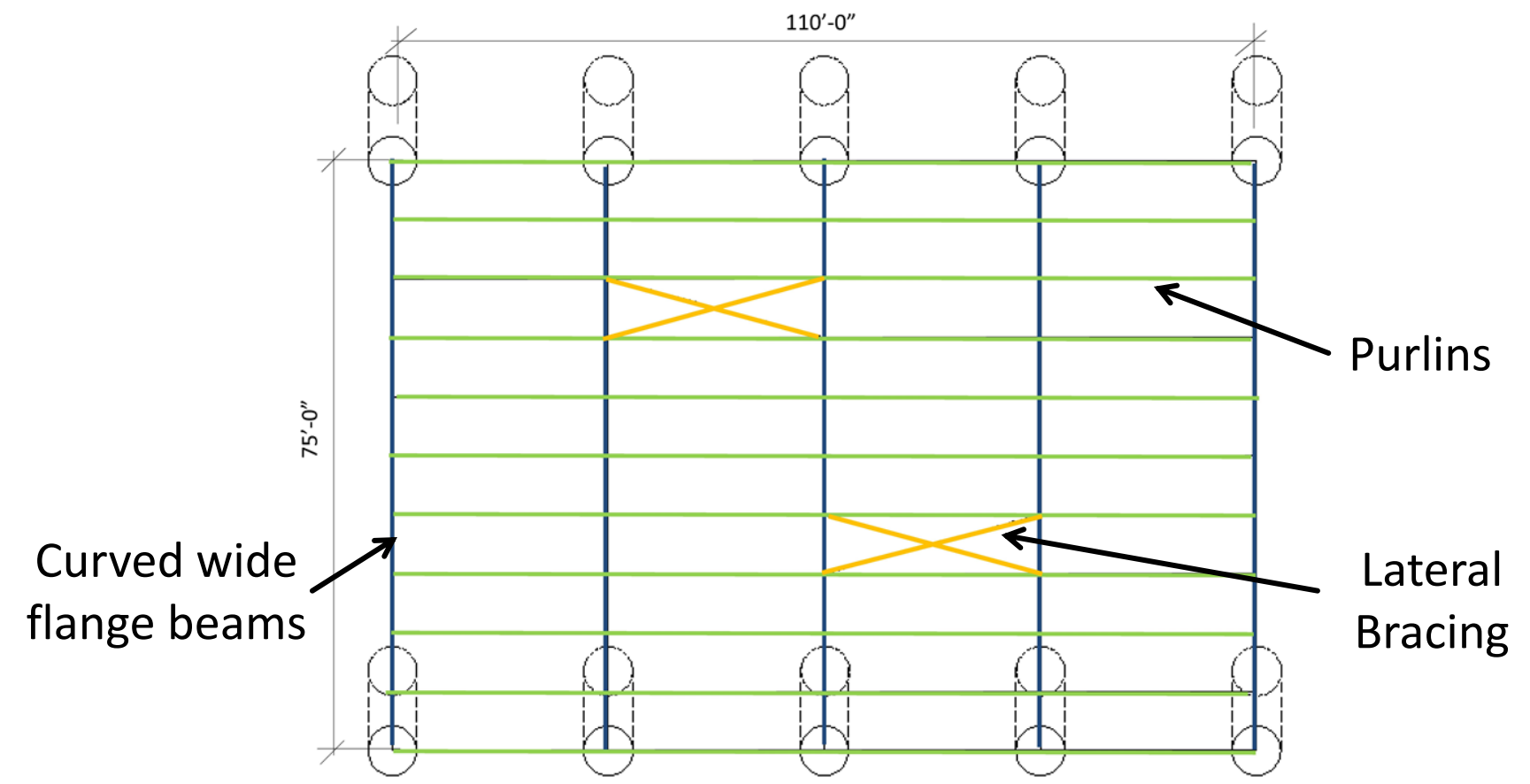
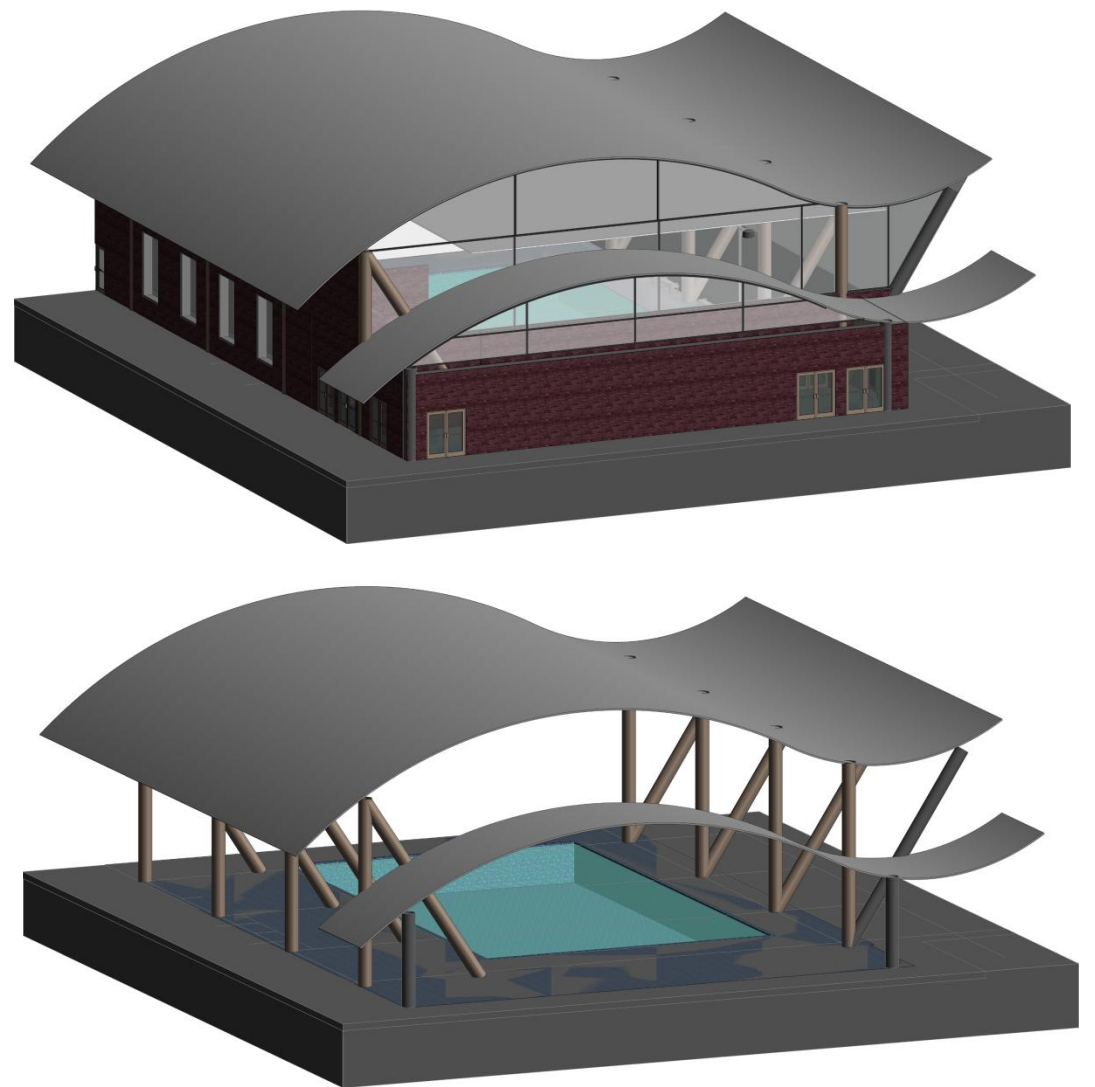
Clinic and Natatorium Plan

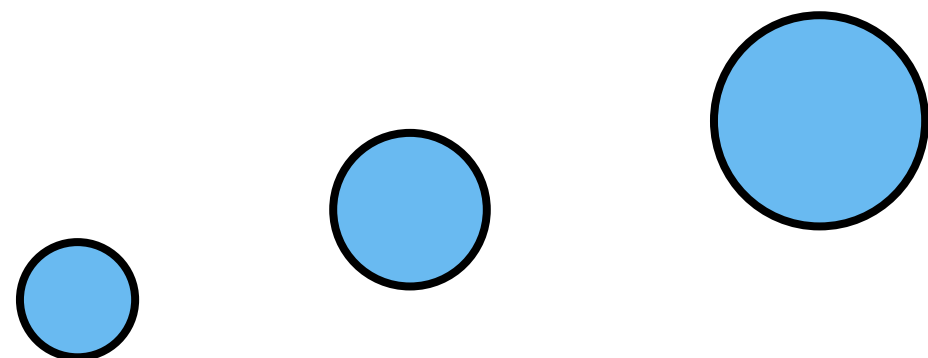


- Design Process
- Phase 1
 - Foundation
 - Gravity System
 - Lateral System
 - Enclosure
- Phase 2
 - Clinic
 - **Natatorium**
- Conclusion

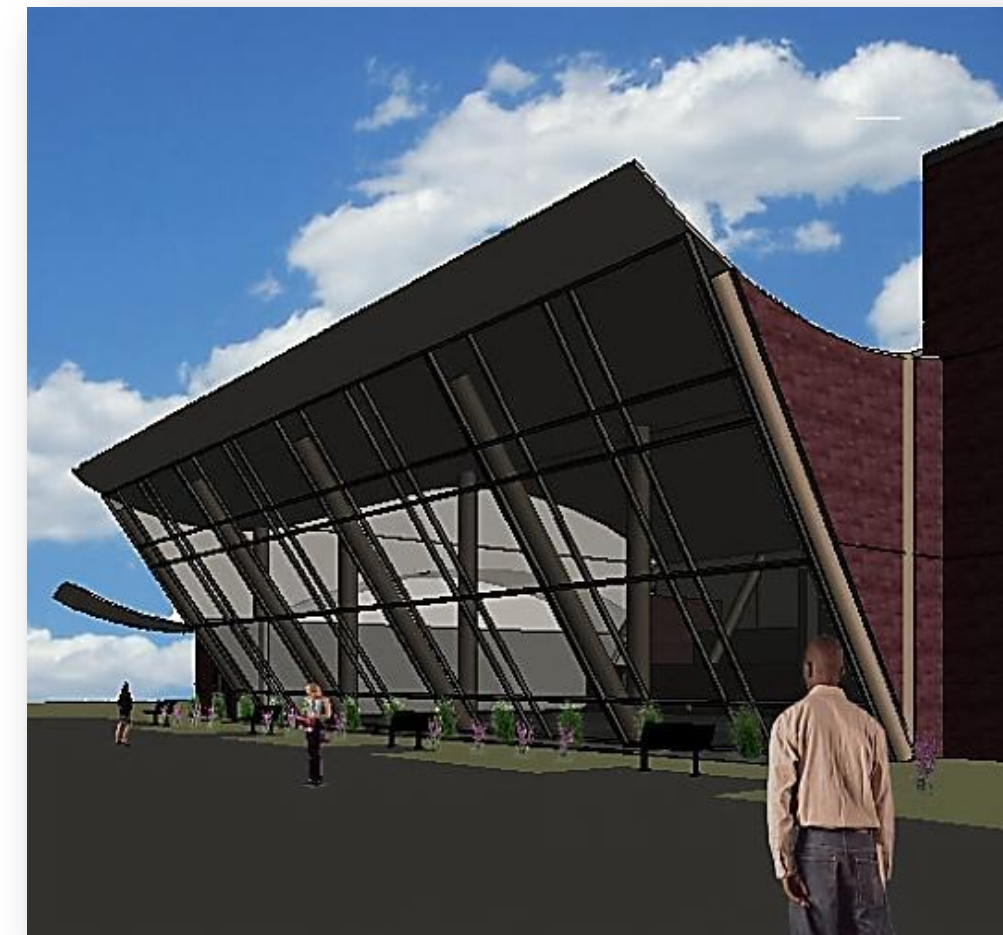


Natatorium





- Lane lighting requirements
- Corrosion prevention
- All-encompassing AHU
- Daylighting Concerns
- Community



- Design Process
- Phase 1
 - Foundation
 - Gravity System
 - Lateral System
 - Enclosure
- Phase 2
 - Clinic
 - Natatorium

- **Conclusion**



Summary

Phase 1 Systems

- Structural steel frame with typical bay size 28'x30'
- W10 and W12 columns spliced at 3rd floor
- Beams range from W8 to W16
- Braced frames and reinforced masonry shear walls
- Composite metal deck roof and floors
- Precast concrete panel enclosure

Phase 2 Systems

- Prefabricated insulated metal deck panels span 75 ft natatorium
- W21x147 girders and W12x30 purlins
- Vertical and slanted PIPE10 and PIPE5 hollow circular steel columns

Mechanical Systems



- *Introduction*
- HVAC Design
- Plumbing Design
- Conclusion

Construction Phase 1

Enclosure

Total energy reduction of 15%

Ground Source Heat Pump with 100% DOAS

Total energy reduction of 17%

Building total energy reduction of 32%

Plumbing

Water use reduction by 46%

Introduction

*As a BIM team, we determined our project specific goal was to create an **innovative, high-performance environment in a way that stimulates involvement in both education and the community***

Construction Phase 2

Clinic

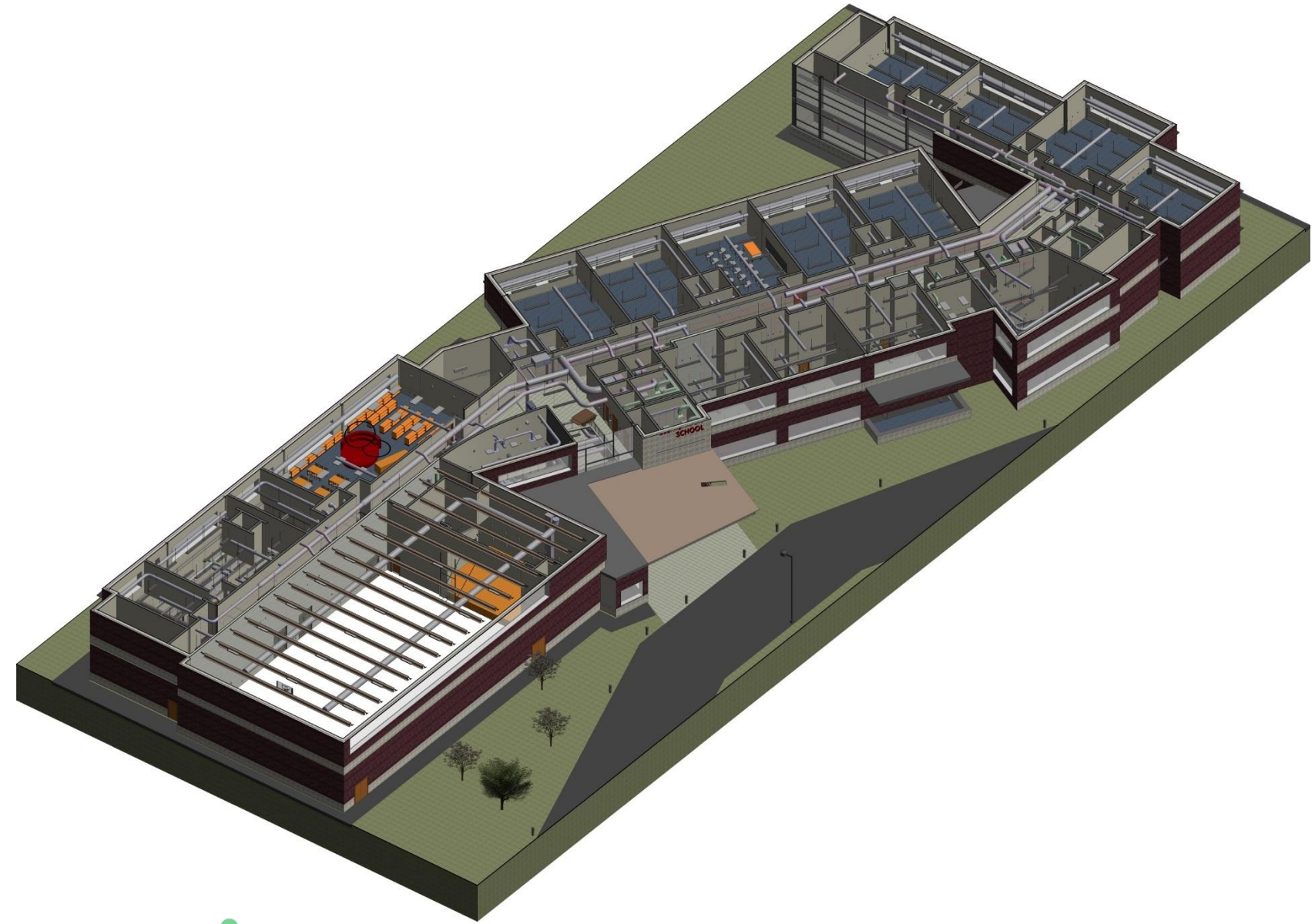
VRV with Heat Recovery

Total energy reduction of 13%

Natatorium

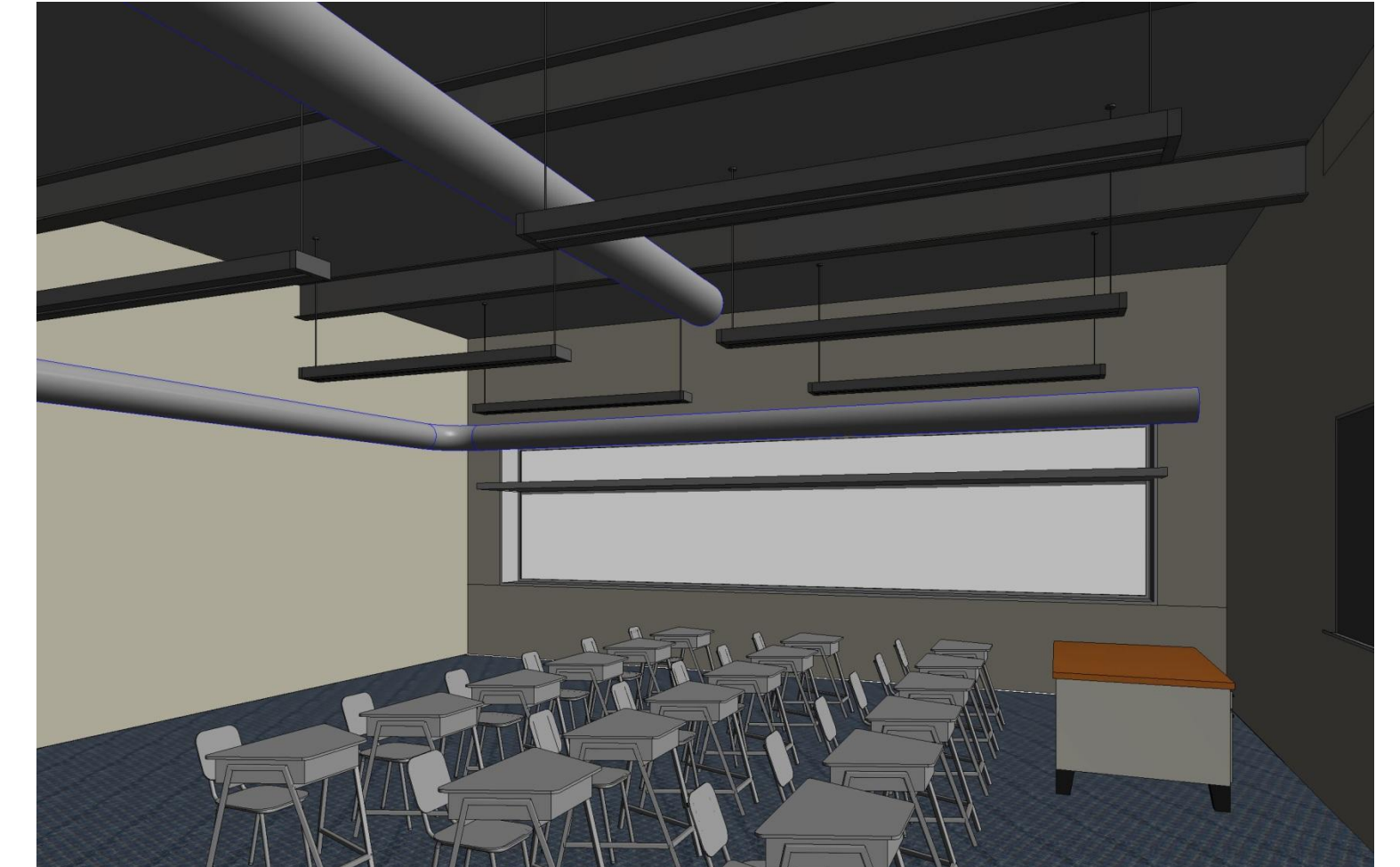
All- encompassing AHU

Total reduction of 1,398MMBTH or \$3,850



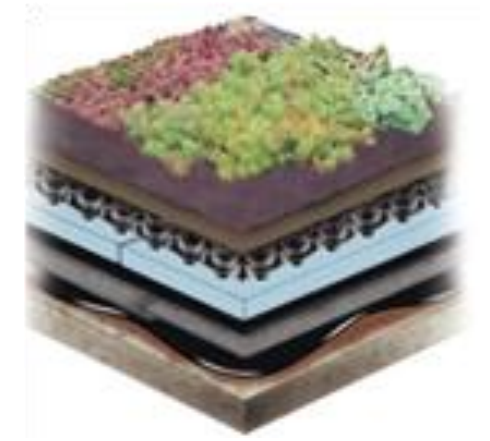
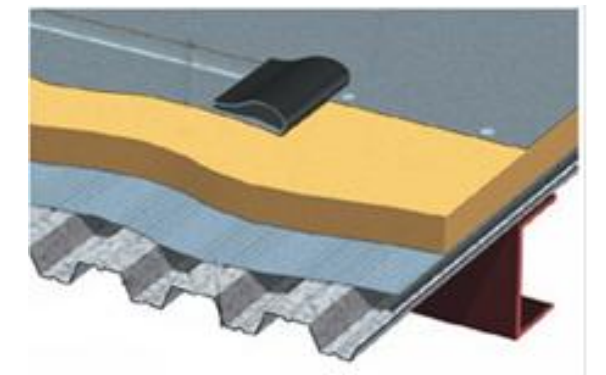
Construction Phase 1

Reading Elementary School



- Introduction
- HVAC Design
 - **Construction Phase 1**
 - *Enclosure Design*
 - System Design
 - Construction Phase 2
- Plumbing Design
- Conclusion

Roof

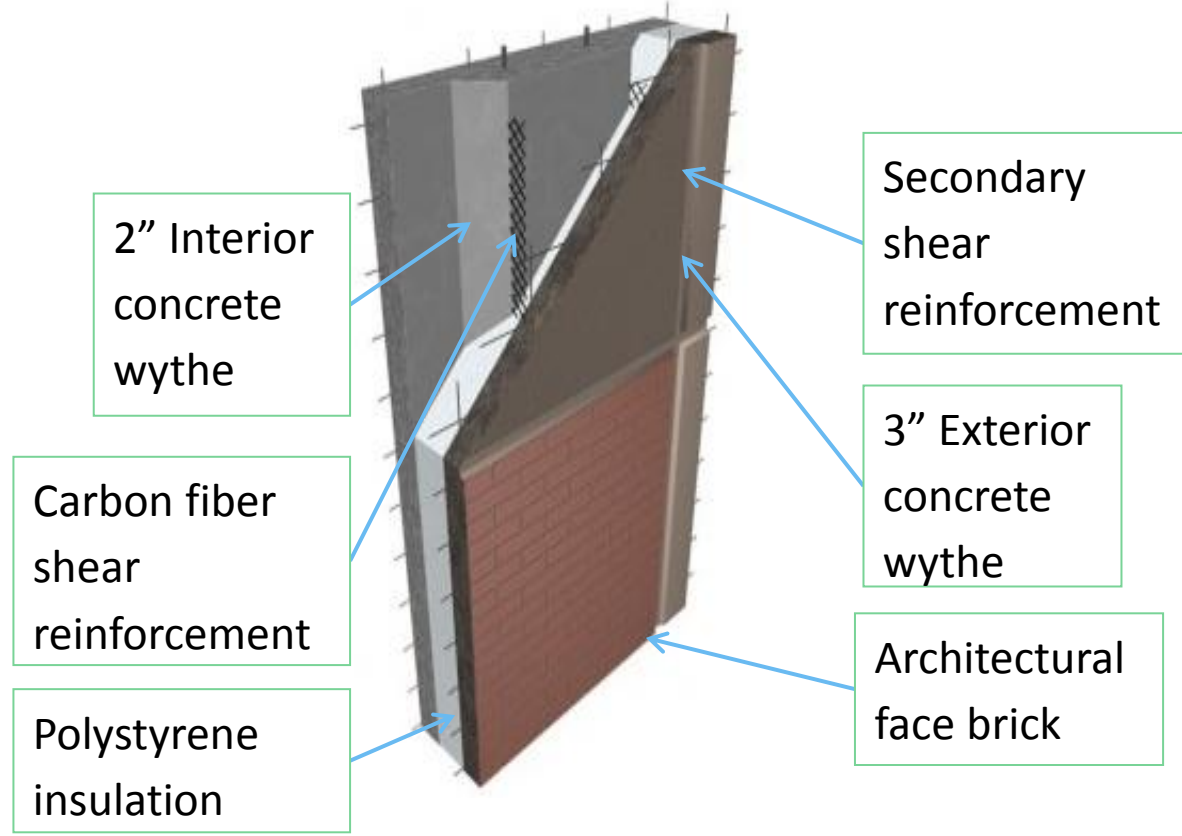


ENCLOSURE DESIGN

REDUCED ENERGY CONSUMPTION BY: 15%

	ASHRAE 50%		
	ASHRAE 90.1	Energy Savings	Our Value
Wall Design U-Values	0.069	0.037	0.0383
Window Design U-Values	0.55	0.45	0.54
Roof Design U-Values	0.048	0.0333	0.0333
Green Roof Savings			\$430/year

Facade



- Introduction
- HVAC Design
 - Construction Phase 1
 - Enclosure Design
 - System Design
 - Airside System
 - Waterside System
 - Construction Phase 2
- Plumbing Design
- Conclusion

SYSTEM CONSIDERATIONS

Critical Zones

- Introduction
- HVAC Design
 - Construction Phase 1
 - Enclosure Design
 - System Design
 - Airside System
 - Waterside System
 - Construction Phase 2
- Plumbing Design
- Conclusion

SYSTEM CONSIDERATIONS

Critical Zones

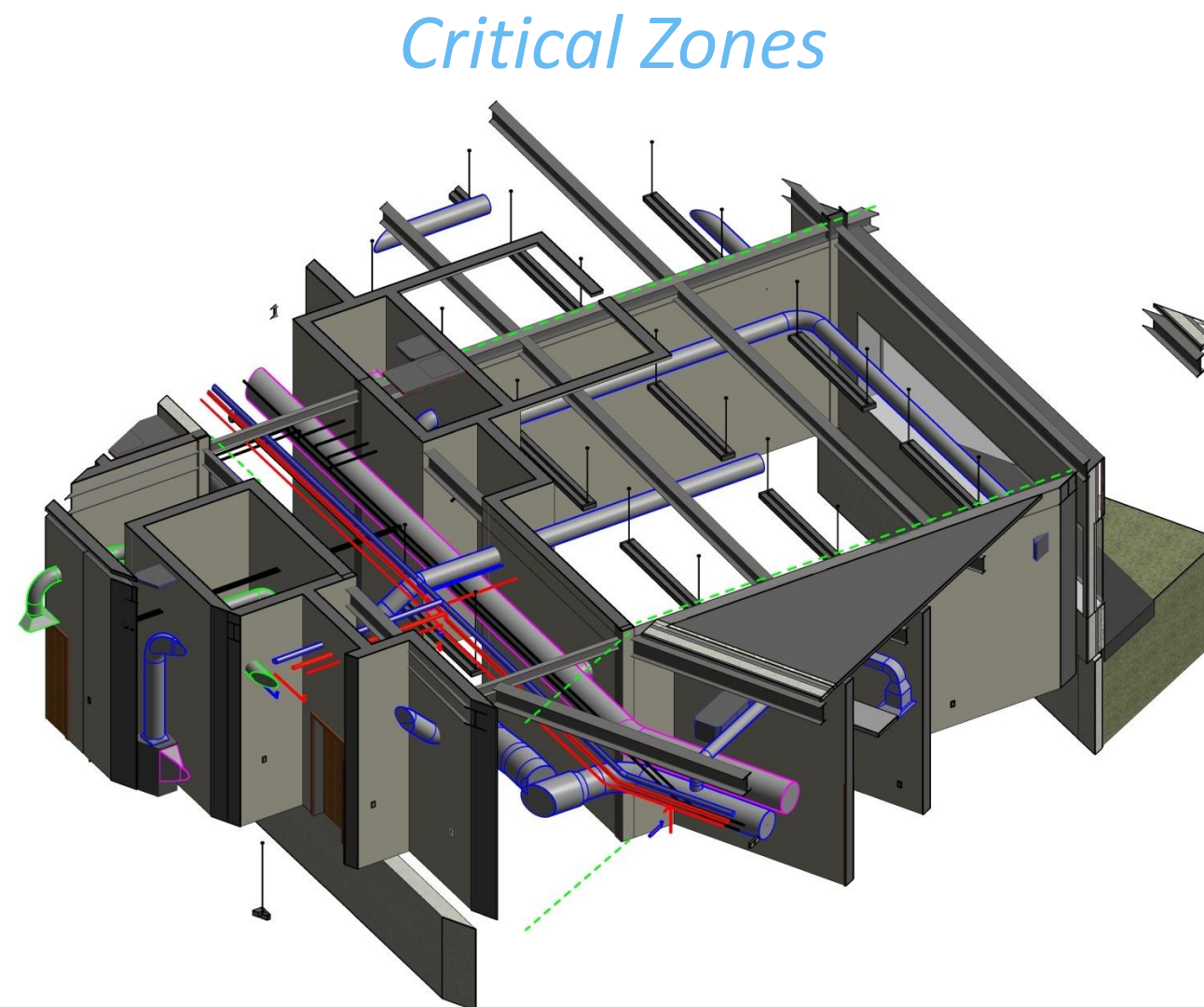
Atrium



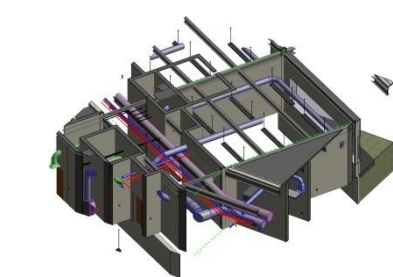
Atrium

- Introduction
- HVAC Design
 - Construction Phase 1
 - Enclosure Design
 - System Design
 - Airside System
 - Waterside System
 - Construction Phase 2
- Plumbing Design
- Conclusion

Classroom



Atrium



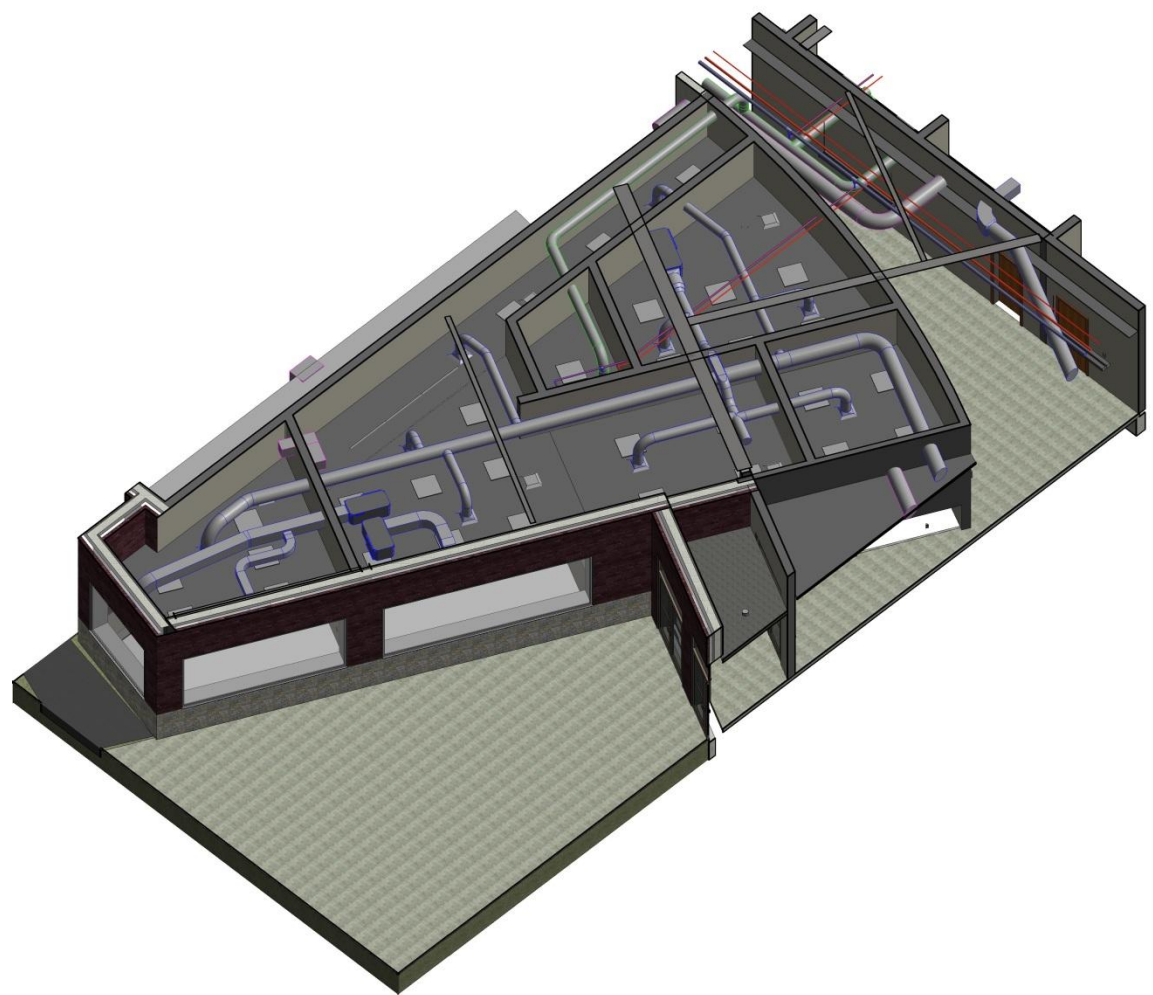
Classroom

- Introduction
- HVAC Design
 - Construction Phase 1
 - Enclosure Design
 - System Design
 - Airside System
 - Waterside System
 - Construction Phase 2
- Plumbing Design
- Conclusion

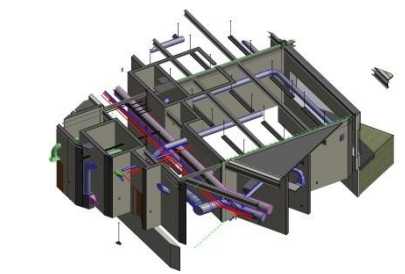
Administration

SYSTEM CONSIDERATIONS

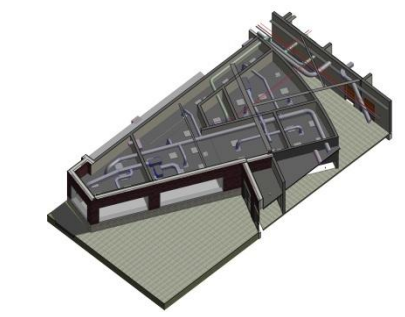
Critical Zones



Atrium



Classroom



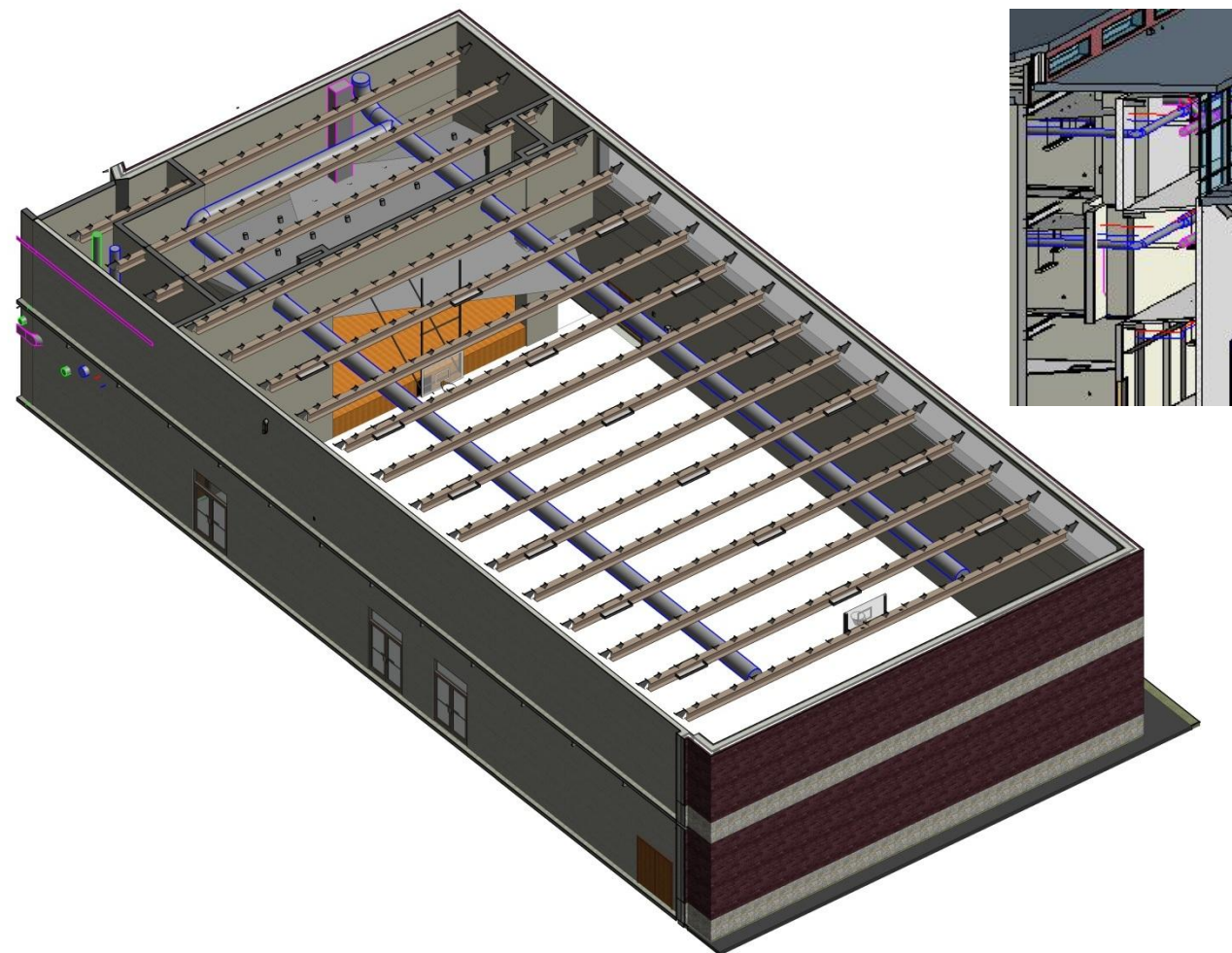
Administration

- Introduction
- HVAC Design
 - Construction Phase 1
 - Enclosure Design
 - System Design
 - Airside System
 - Waterside System
 - Construction Phase 2
- Plumbing Design
- Conclusion

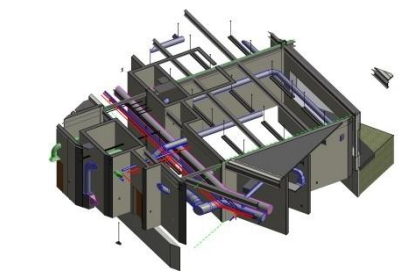
SYSTEM CONSIDERATIONS

Multipurpose Facility

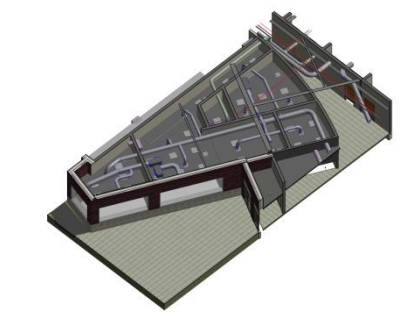
Critical Zones



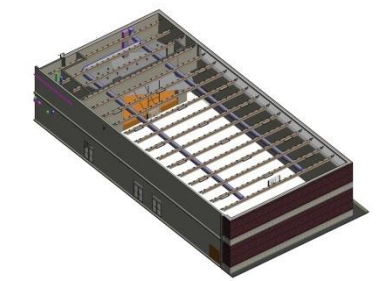
Atrium



Classroom



Administration



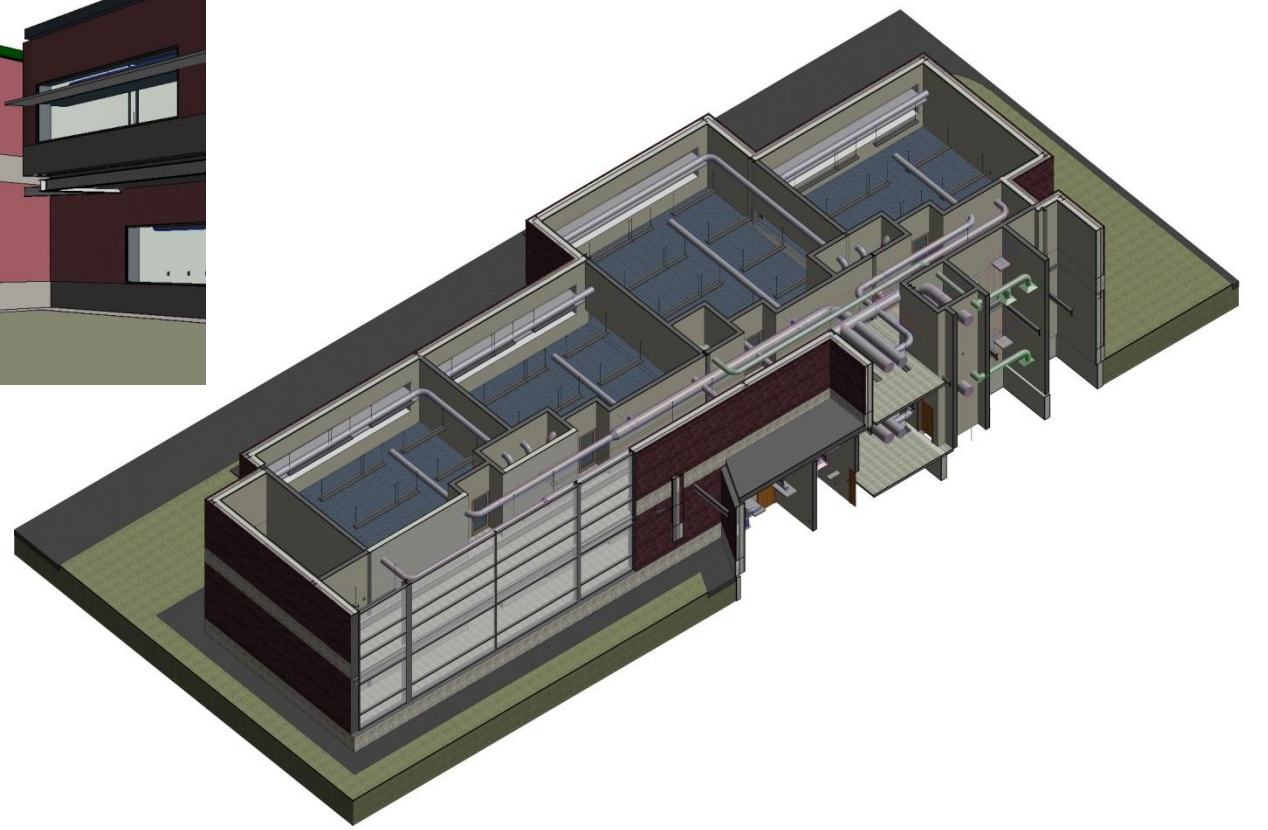
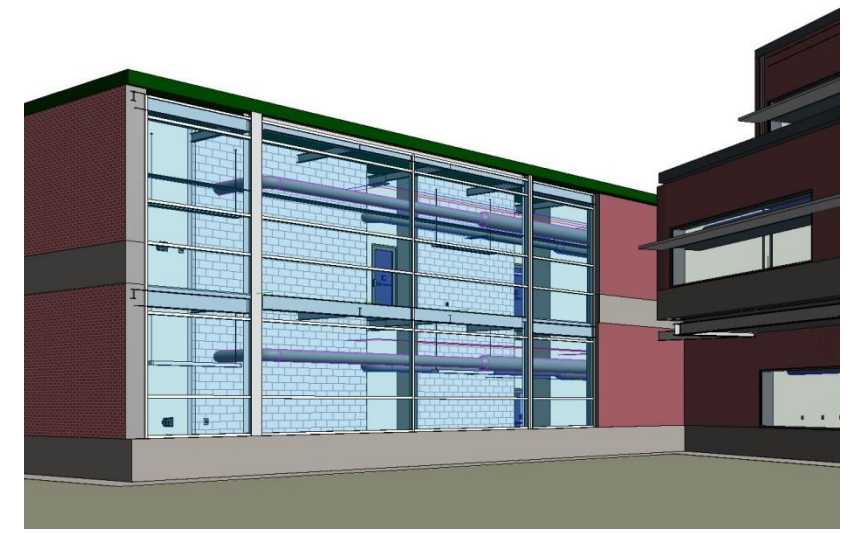
Multipurpose Facility

- Introduction
- HVAC Design
 - Construction Phase 1
 - Enclosure Design
 - System Design
 - Airside System
 - Waterside System
 - Construction Phase 2
- Plumbing Design
- Conclusion

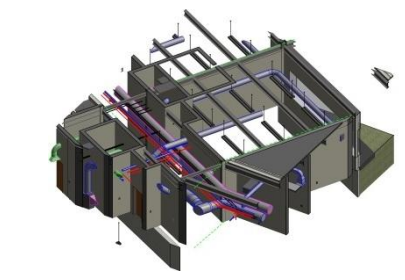
SYSTEM CONSIDERATIONS

Critical Zones

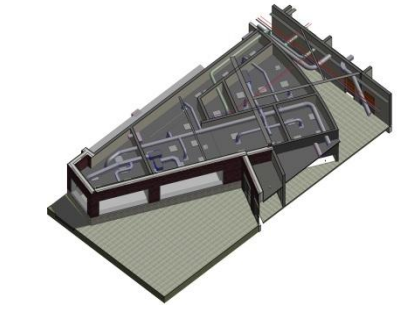
Corridor



Atrium



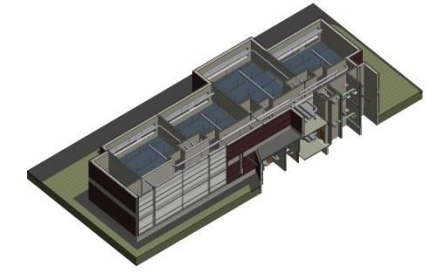
Classroom



Administration



Multipurpose Facility



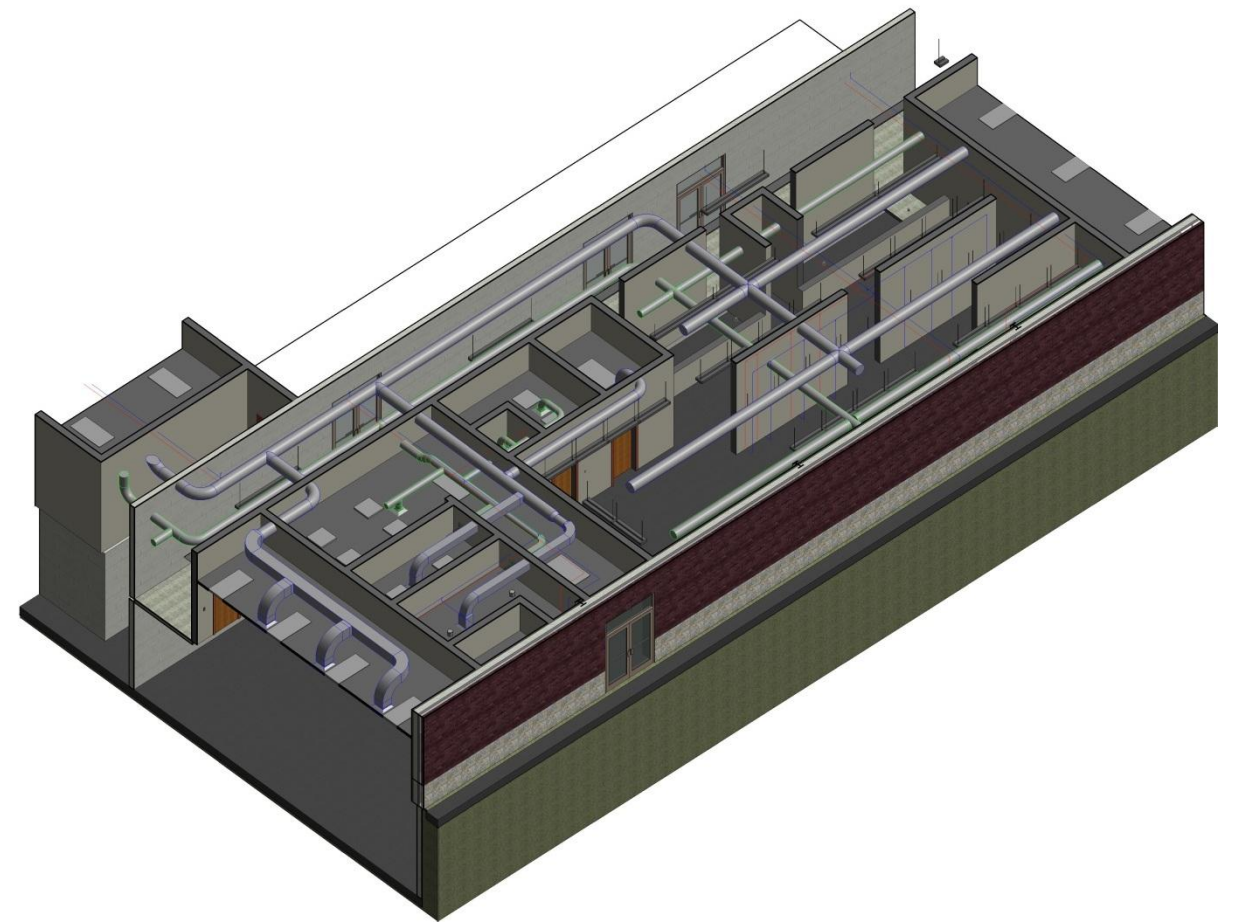
Corridor

- Introduction
- HVAC Design
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 - Enclosure Design
 - System Design
 - Airside System
 - Waterside System
 - Construction Phase 2
- Plumbing Design
- Conclusion

SYSTEM CONSIDERATIONS

Critical Zones

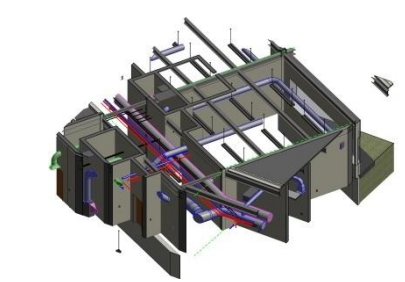
Kitchen



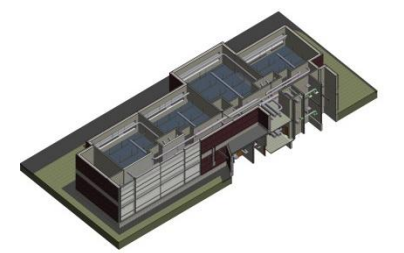
Atrium



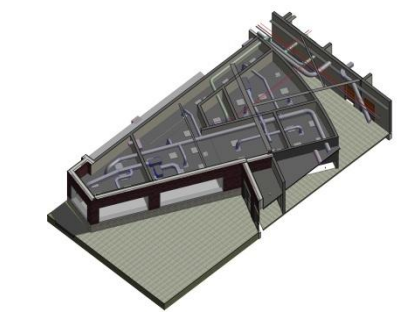
Multipurpose Facility



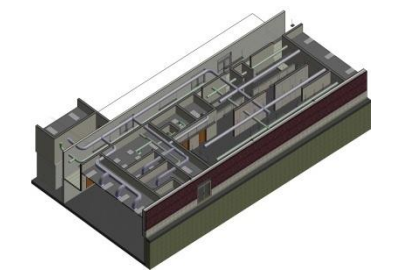
Classroom



Corridor



Administration



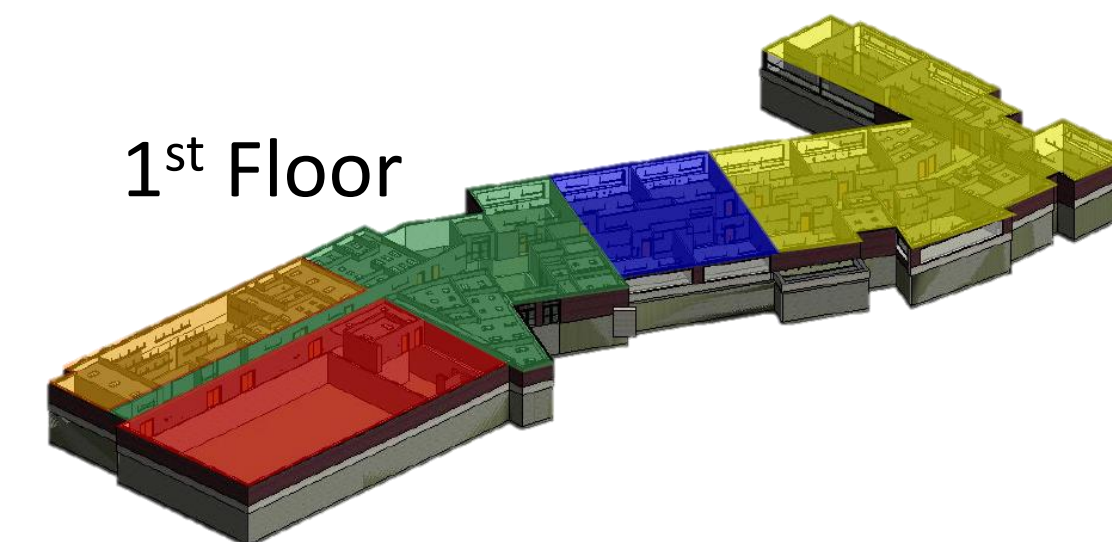
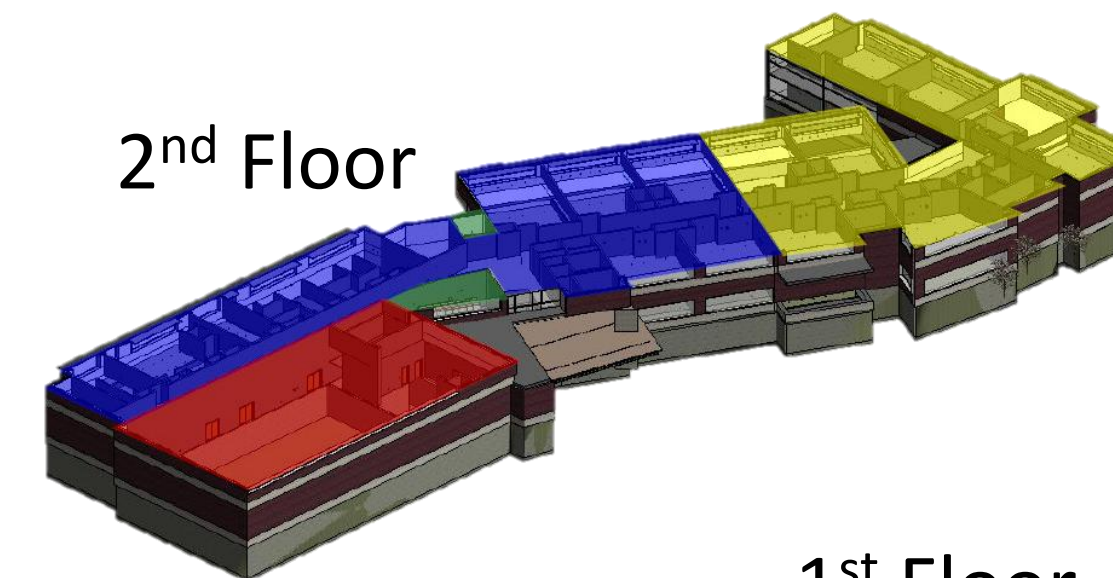
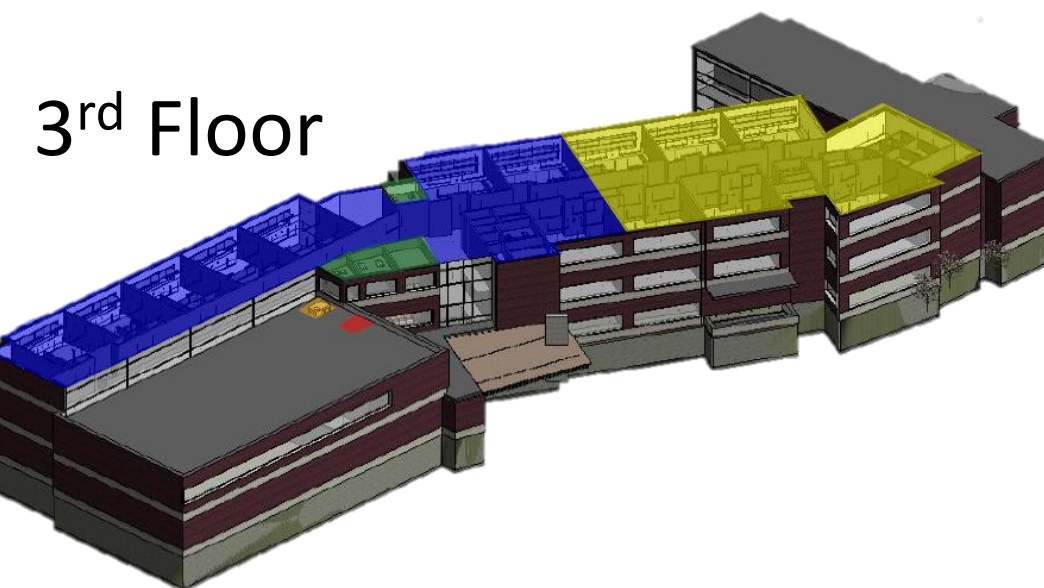
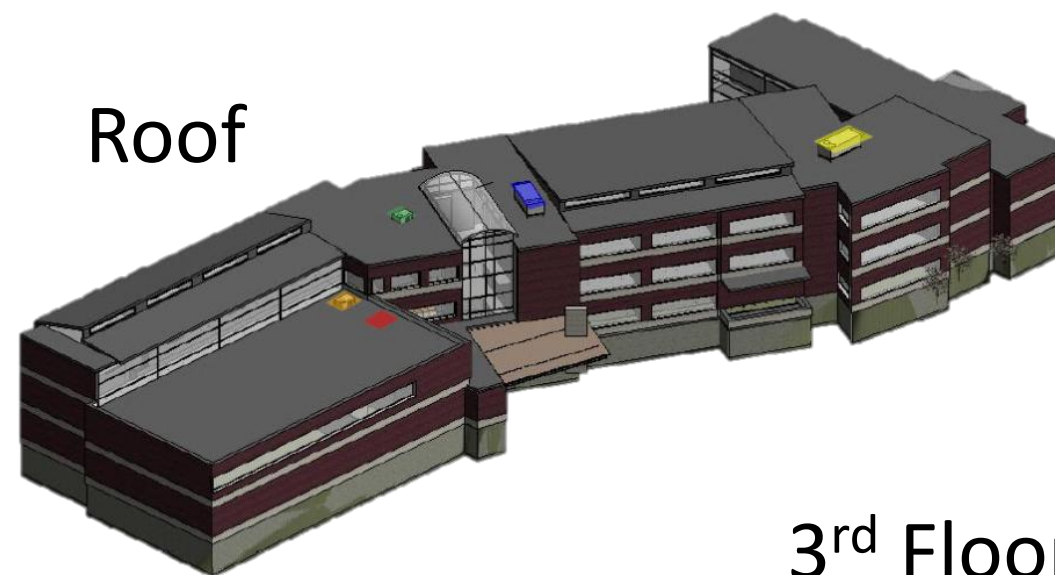
Kitchen

- Introduction
- HVAC Design
 - Construction Phase 1
 - Enclosure Design
 - System Design
 - Airside System
 - Waterside System
 - Construction Phase 2
- Plumbing Design
- Conclusion

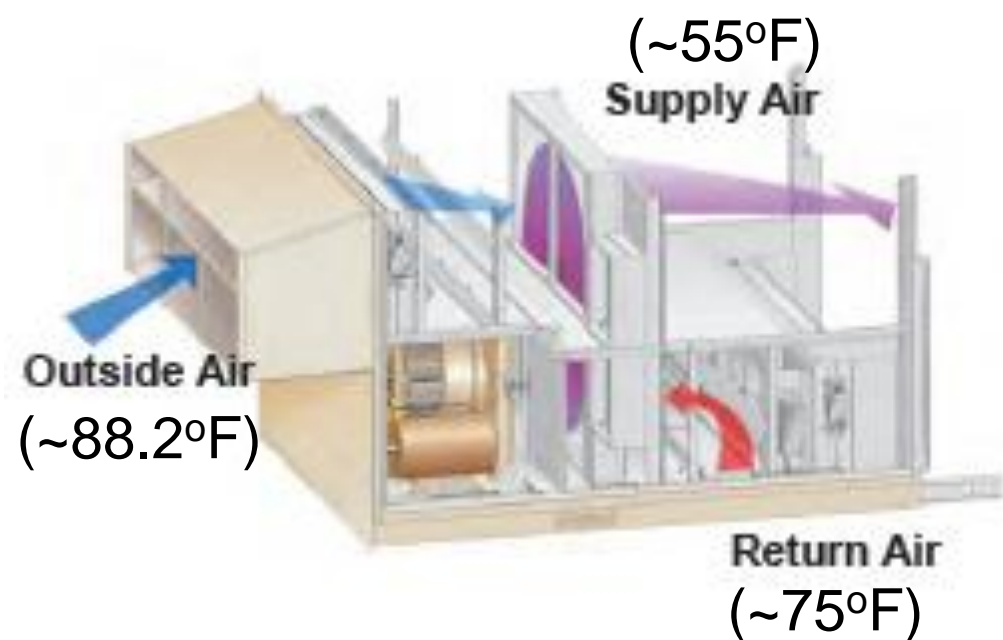
VENTILATION DESIGN

Ventilation CFM	
ZONE 1	6,718
ZONE 2	944
ZONE 3	1,937
ZONE 4	12,927
ZONE 5	13,470

**Total Ventilation :
35,996 CFM**



- Introduction
- HVAC Design
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AIRSIDE DESIGN

Dedicated Outdoor Air System

NEUTRAL SUPPLY AIR CONDITION (~70°F)

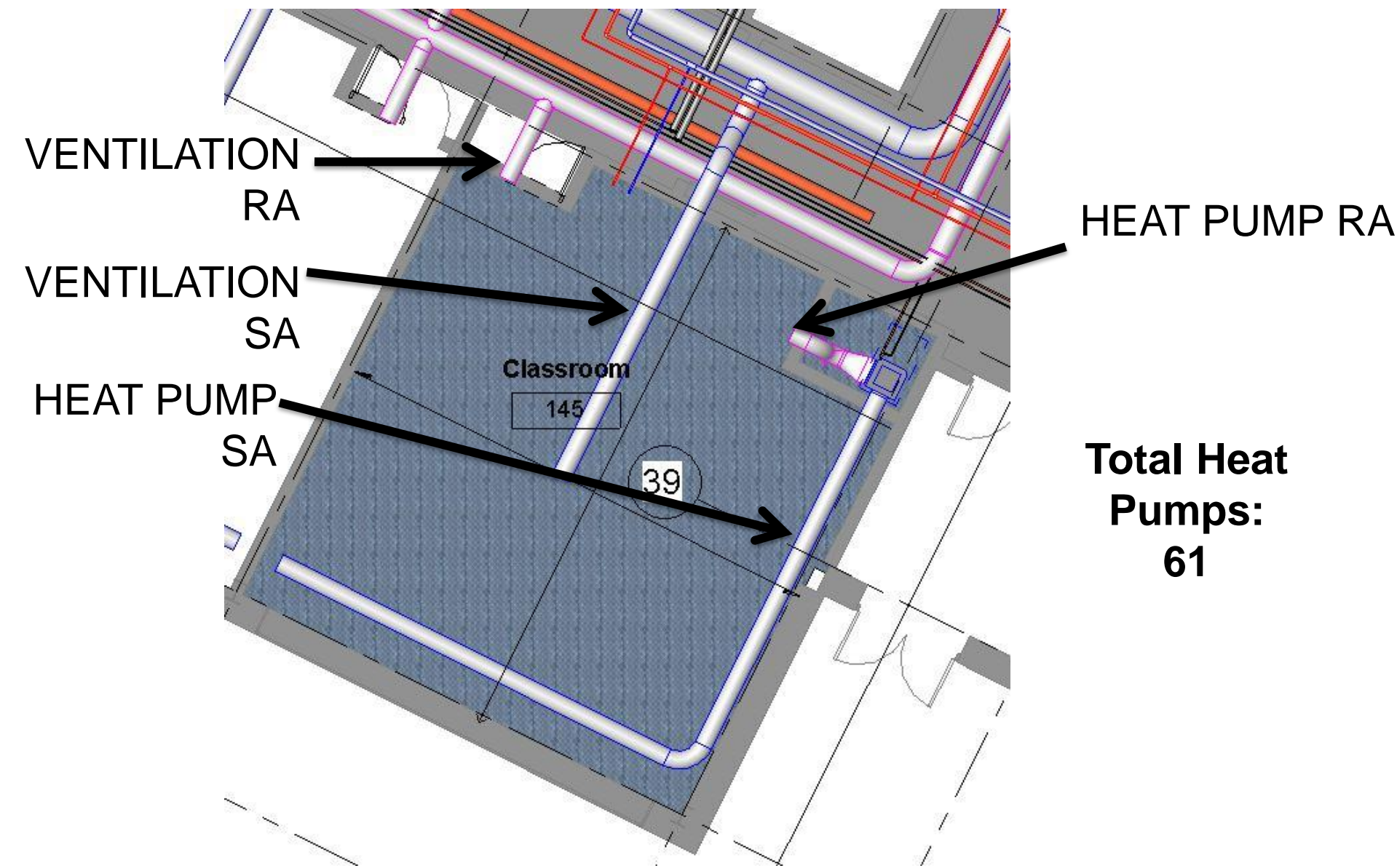
- Wastes sensible cooling done by the AHU
- Takes all the latent load

COLD SUPPLY AIR CONDITION (~55°F)

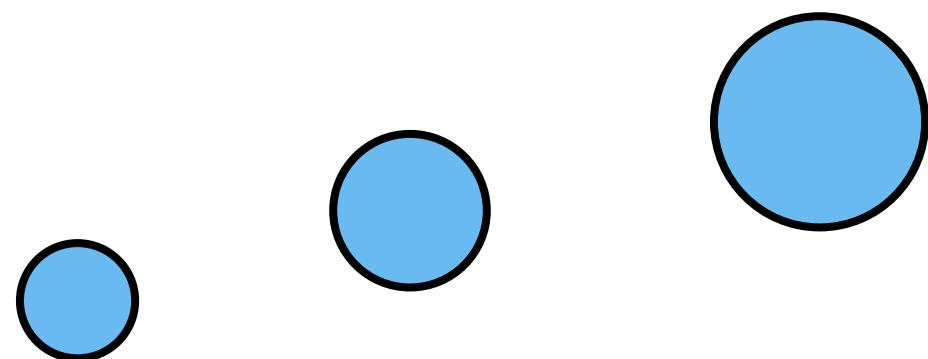
- Takes the majority of latent and sensible loads
- Offset larger portion of the sensible load
- REDUCED HEAT PUMP SIZE BY 48%

CONTROL SYSTEM

- Occupancy sensors
- CO₂ Sensors
- Outdoor Air Economizer



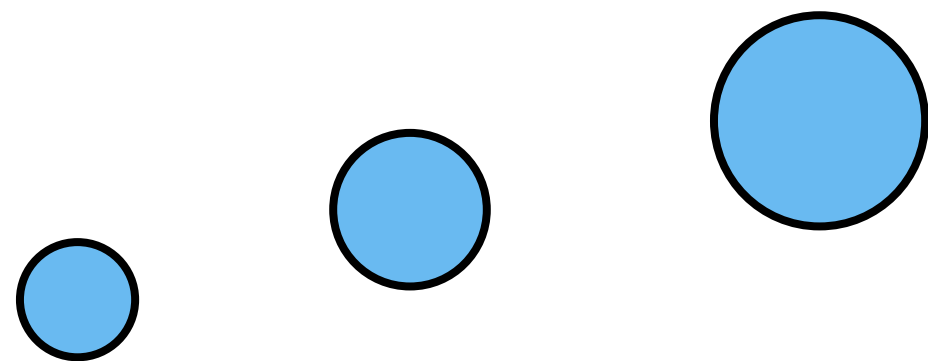
SPLIT SYSTEM SCHEMATIC



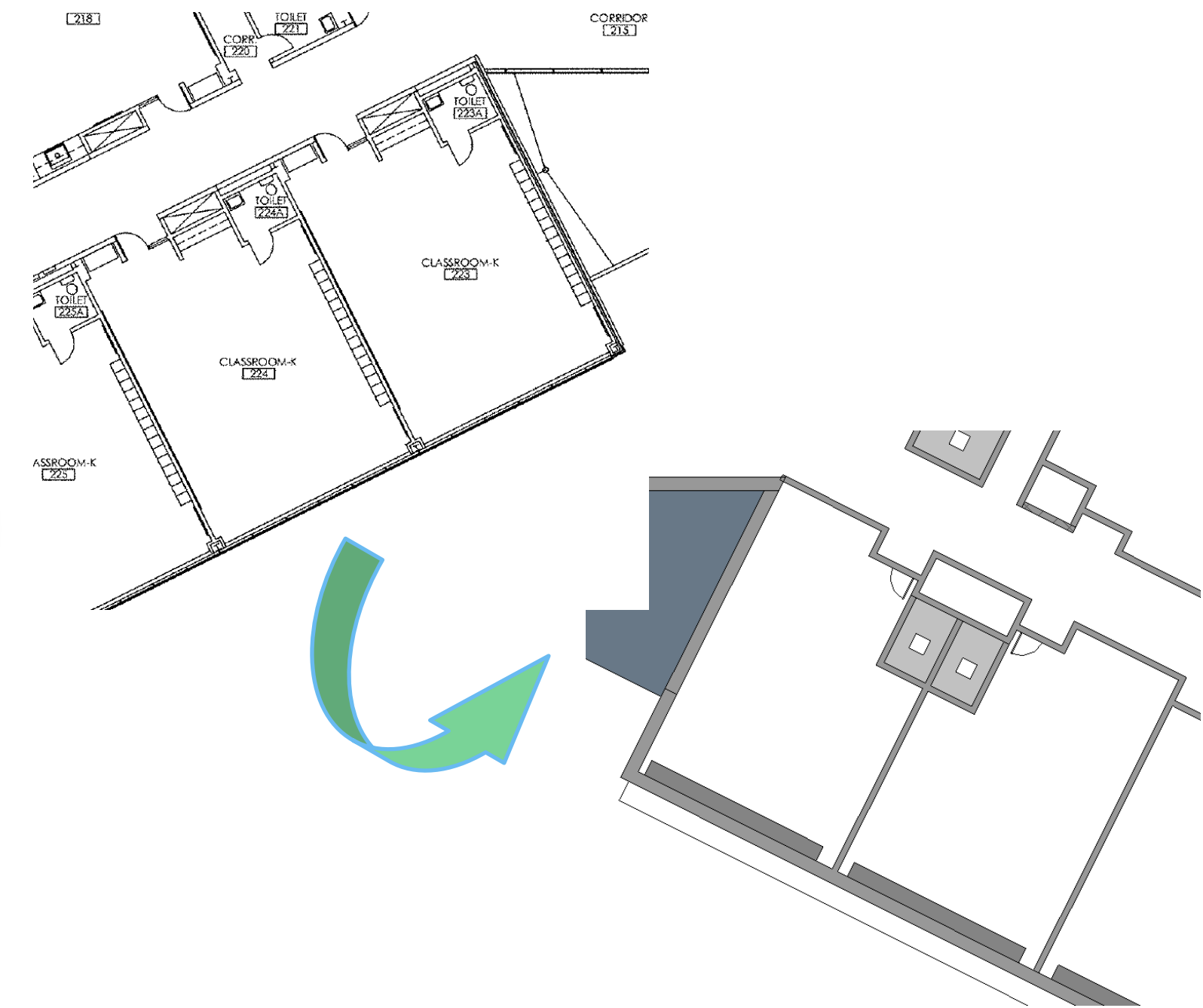
- **System Placement Coordination**
- Window Sizing
- Beam Depths
- Braced Frame
- Fire Alarm and Announcements
- Heat Pump Closet vs. Architecture



Classroom



- System Placement Coordination
- Window Sizing
- Beam Depths
- Braced Frame
- Fire Alarm and Announcements
- **Heat Pump Closet vs. Architecture**



- Introduction
- HVAC Design
 - Construction Phase 1
 - Enclosure Design
 - System Design
 - Airside System
 - **Waterside System**
 - Construction Phase 2
- Plumbing Design
- Conclusion

WATERSIDE DESIGN

Ground Source Heat Pump System

COOLING

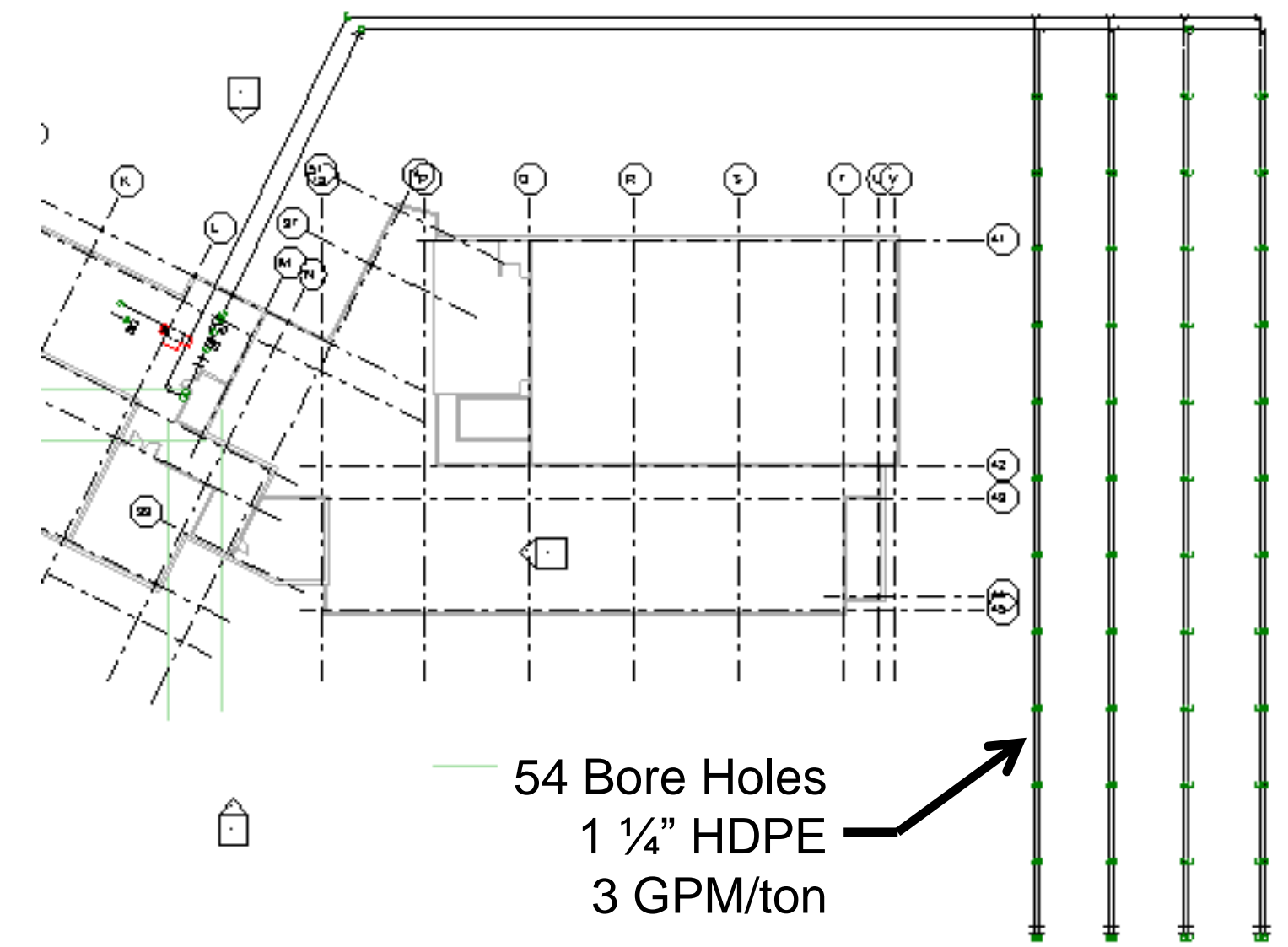
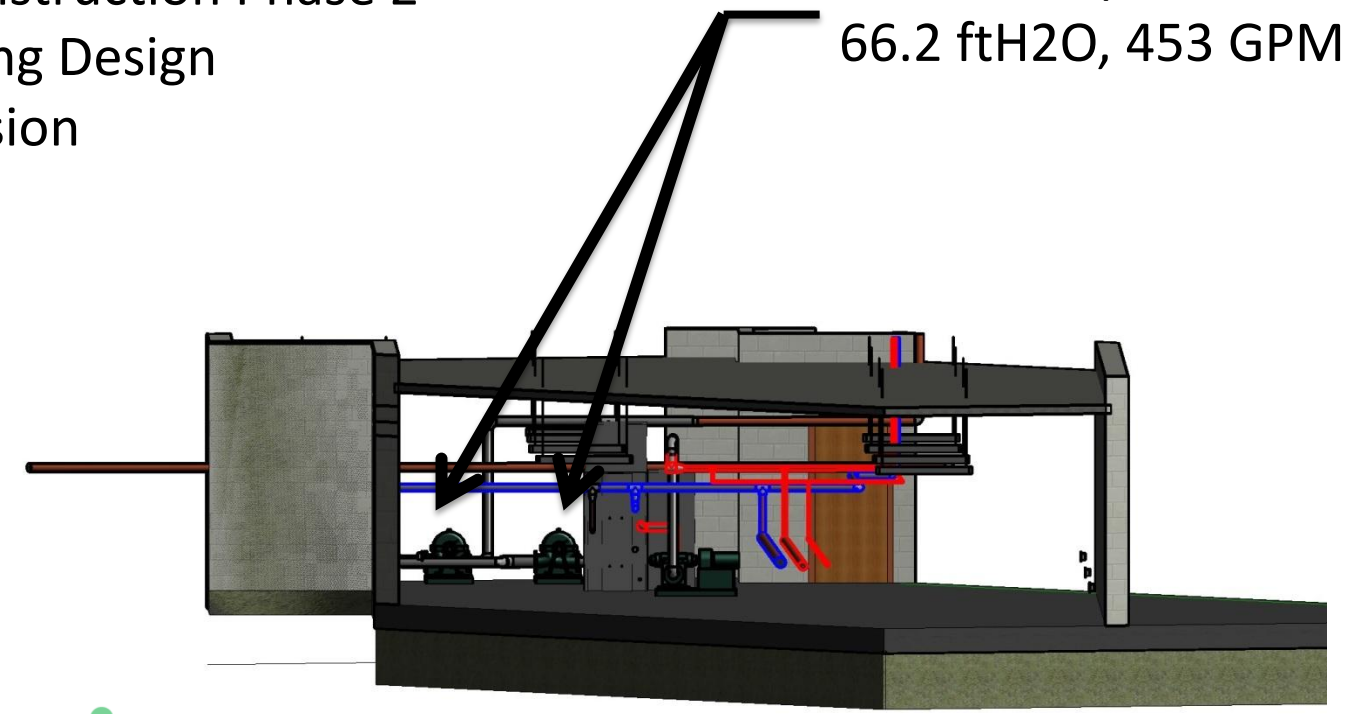
- Block Load: 151 tons
- Heat pump entering water temp: 75F
- **Length: 26,400ft (175 ft/ton)**
- **54 Bore Holes**

HEATING

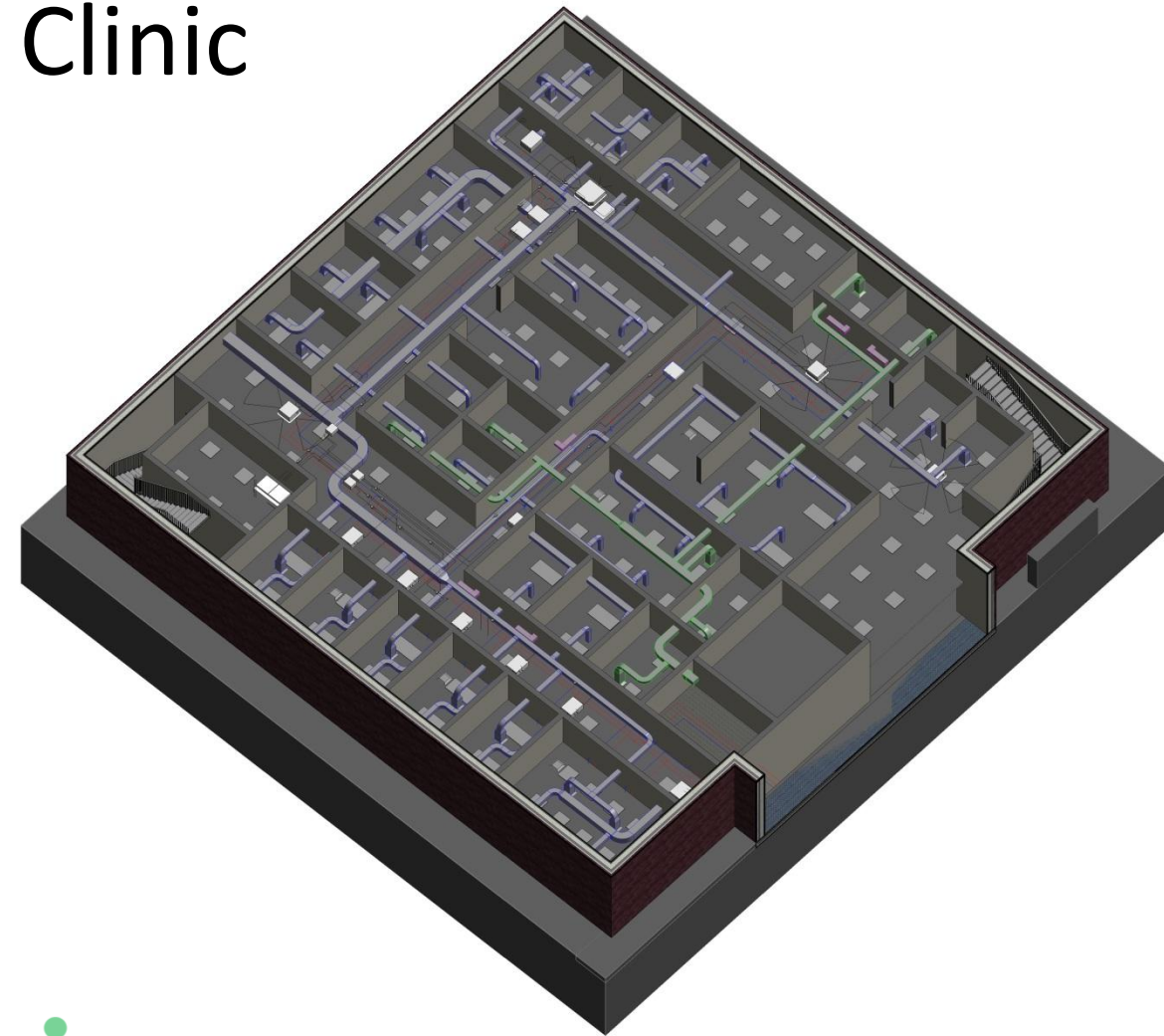
- Block Load: 44 tons
- Heat pump entering water temp: 45F
- Length: 9500Ft (215 ft/ton)
- 16 Bore Holes

$$L_c = \frac{q_a R_{ga} + (q_{lc} - 3.41 W_c)(R_b + PLF_m R_{gm} + R_{gd} F_{sc})}{t_g - \frac{t_{wi} + t_{wo}}{2} - t_p}$$

2 VFD Pumps
66.2 ftH2O, 453 GPM

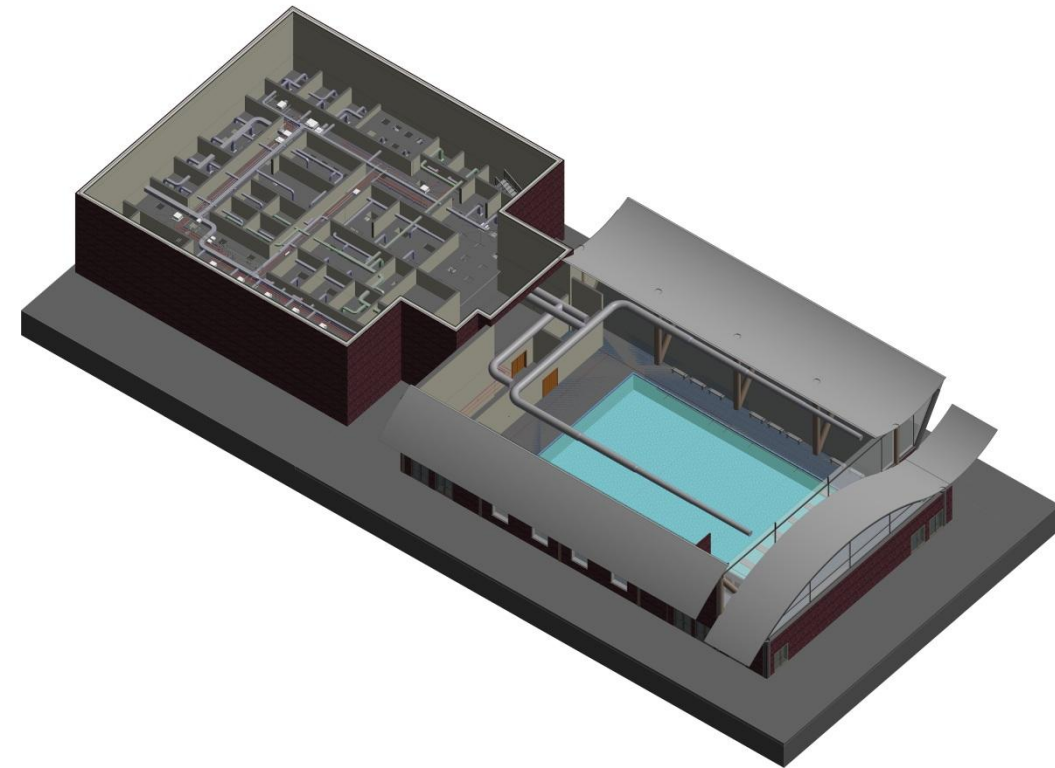


Clinic

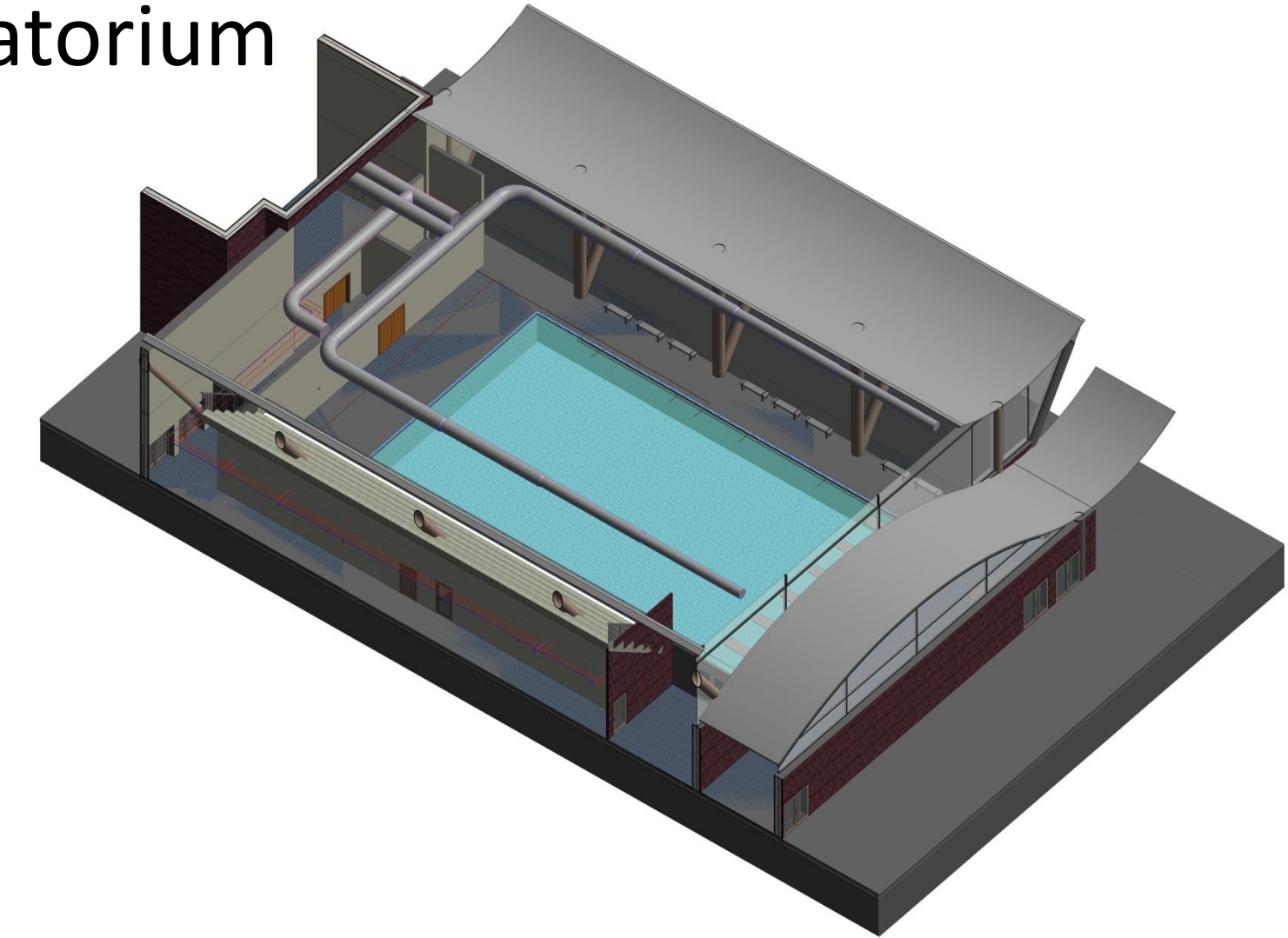


Construction Phase 2

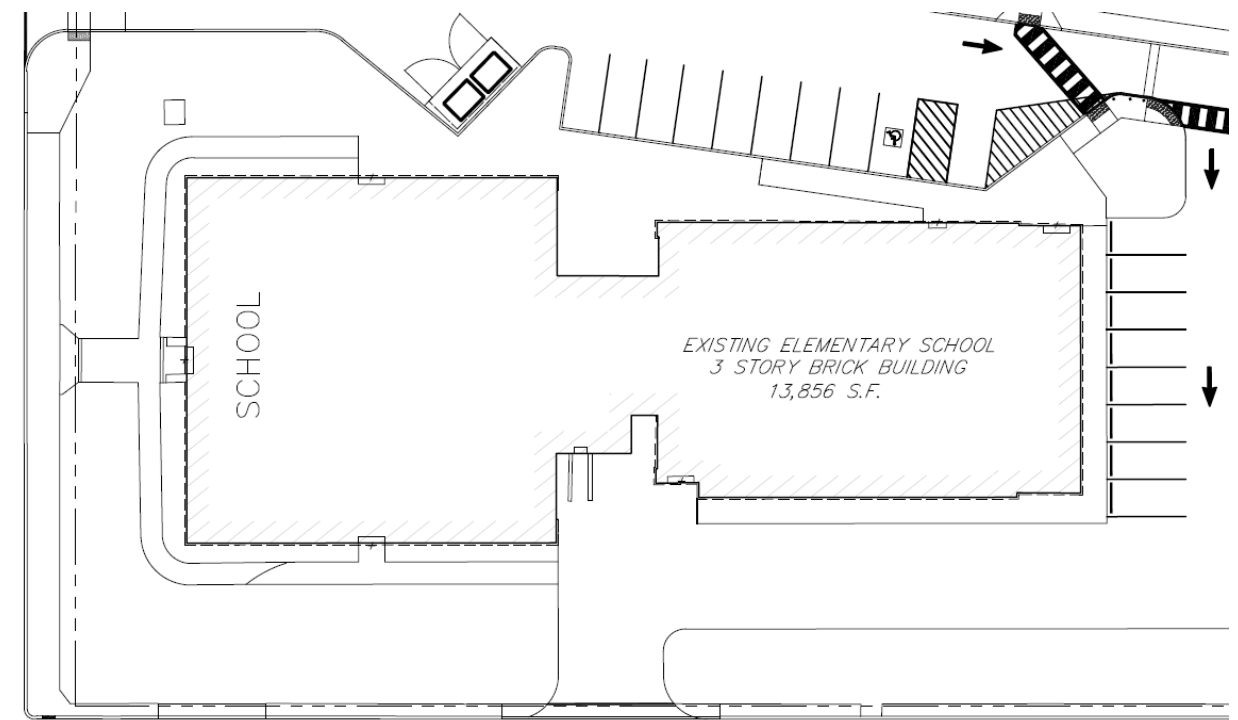
Clinic and Natatorium



Natatorium



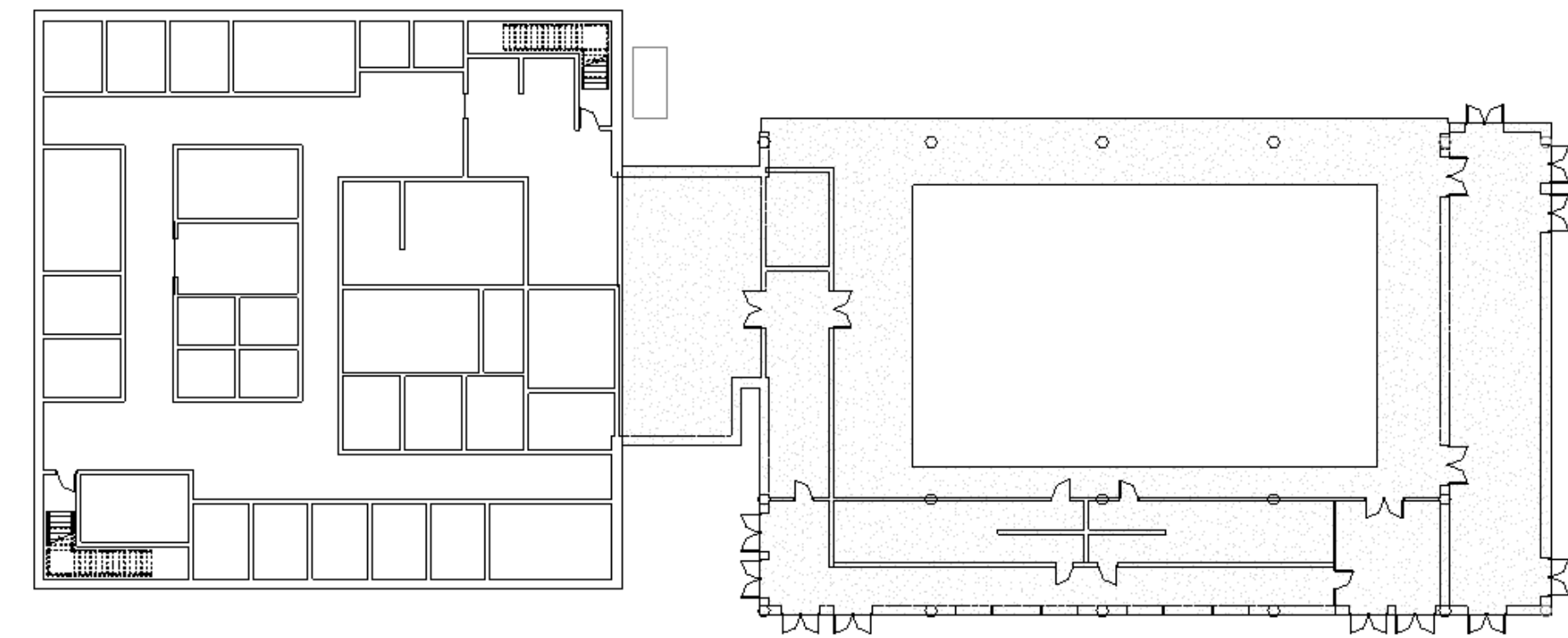
- Introduction
- HVAC Design
 - Construction Phase 1
 - **Construction Phase 2**
 - Assumptions
 - Clinic
 - Natatorium
- Plumbing Design
- Conclusion



PHASE 2 ASSUMPTIONS

Key Mechanical Assumptions:

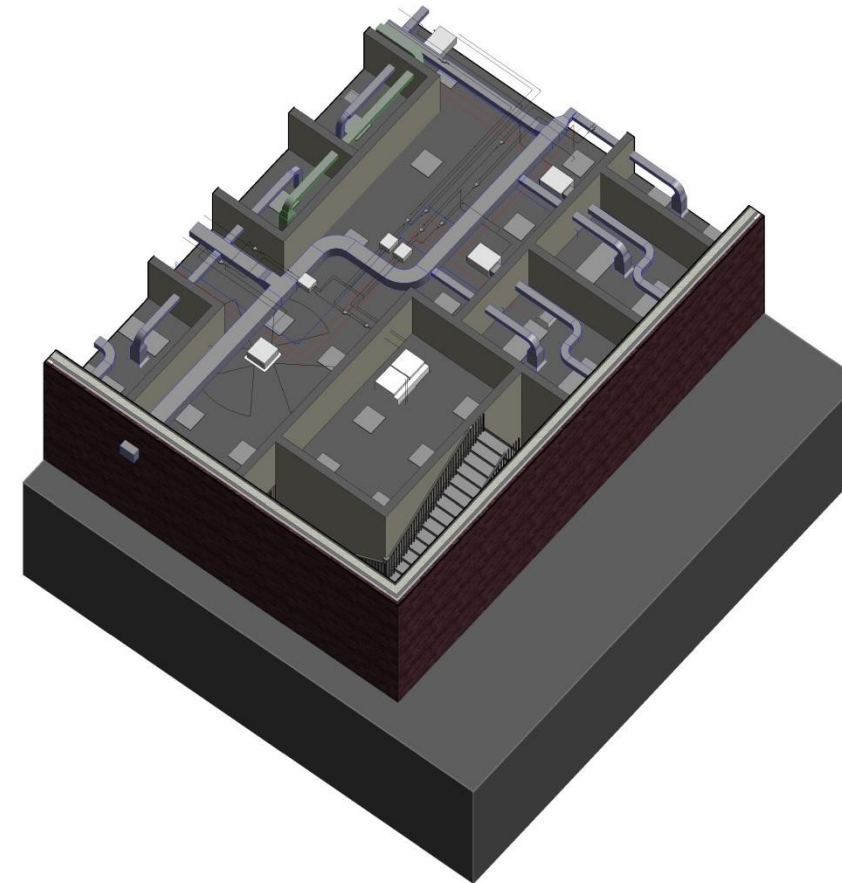
- **Existing Air Handling Unit** will be disconnected from existing first floor and will **remain in use** for the second and third floors
- **Existing exhaust fans are adequately sized** to account for the clinic space. Clinic space will tap into exhaust shaft where previous first floor connected.
- Clinical space roof can support second Air Handling Unit for natatorium
- 120/208 Volt, 3 phase power
- Exterior façade will remain the same for clinic space
 - Walls and windows closely resembled the standard set forth by **ASHRAE 90.1**



- Introduction
- HVAC Design
 - Construction Phase 1
 - **Construction Phase 2**
 - Assumptions
 - *Clinic*
 - Airside System
 - Refrigerant System
 - Natatorium
- Plumbing Design
- Conclusion

CLINIC

Variable Refrigerant Volume System with Heat Recovery



Pros of System:

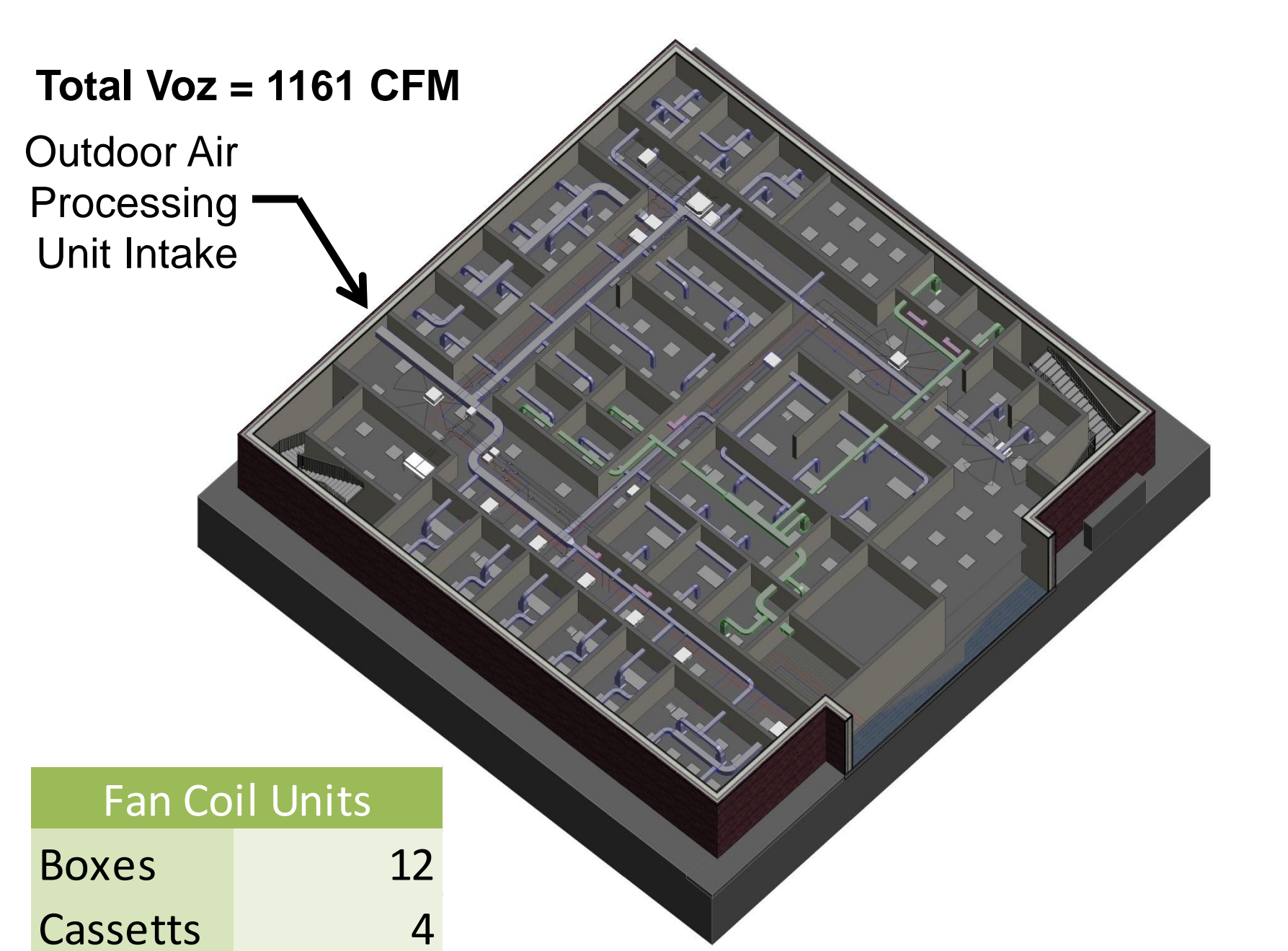
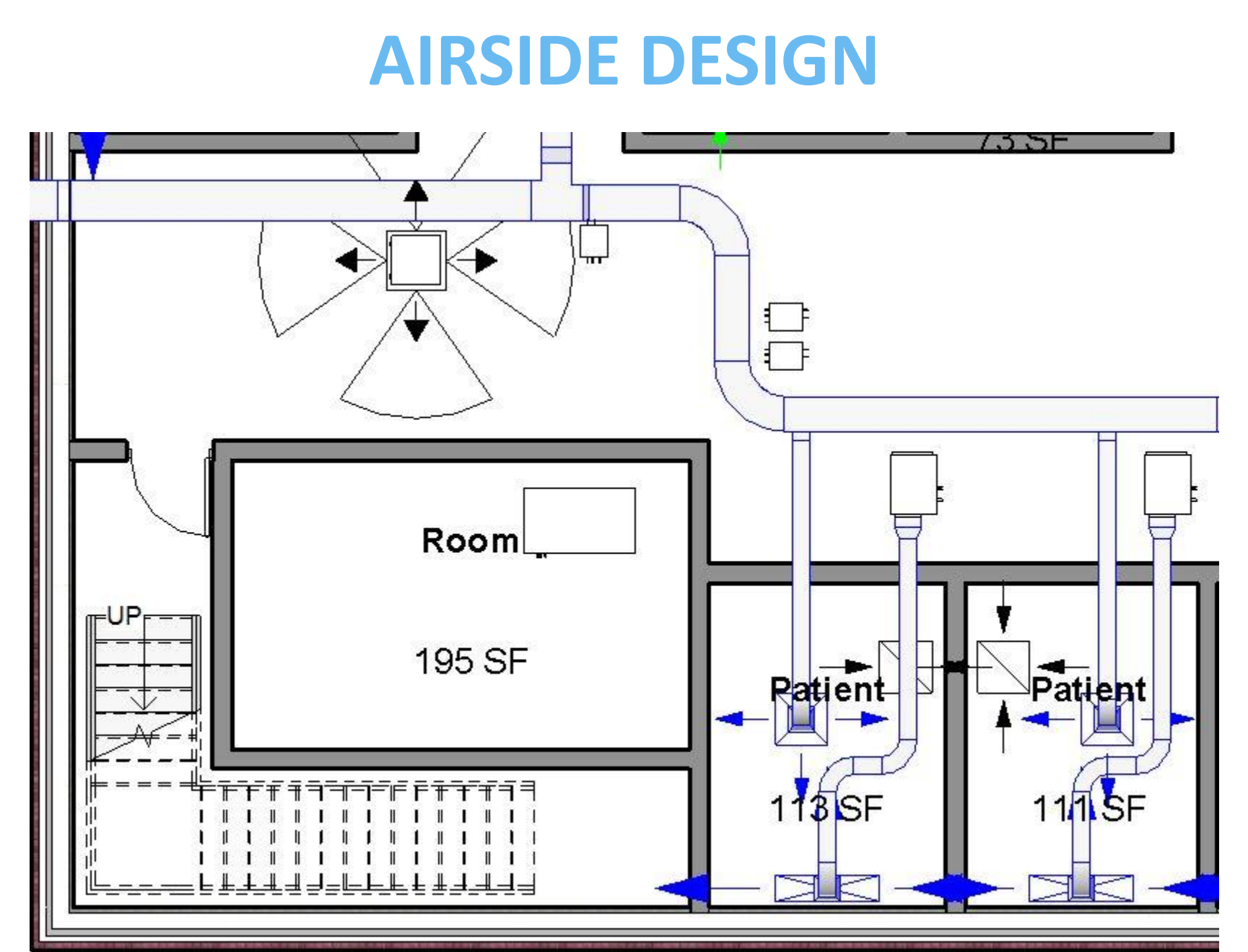
- Little space disruption
- Inexpensive compared to modular chillers
- Low maintenance
- Long Life

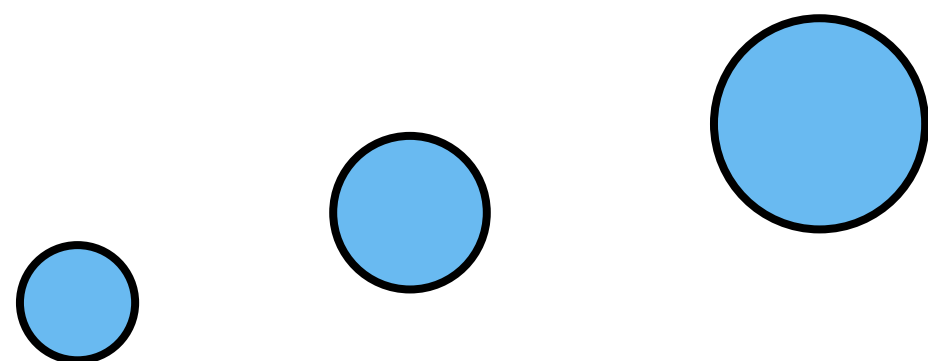
System Components:

- 100% Outdoor Air Processing Unit
- Indoor Condensing Unit
- Fan Coils

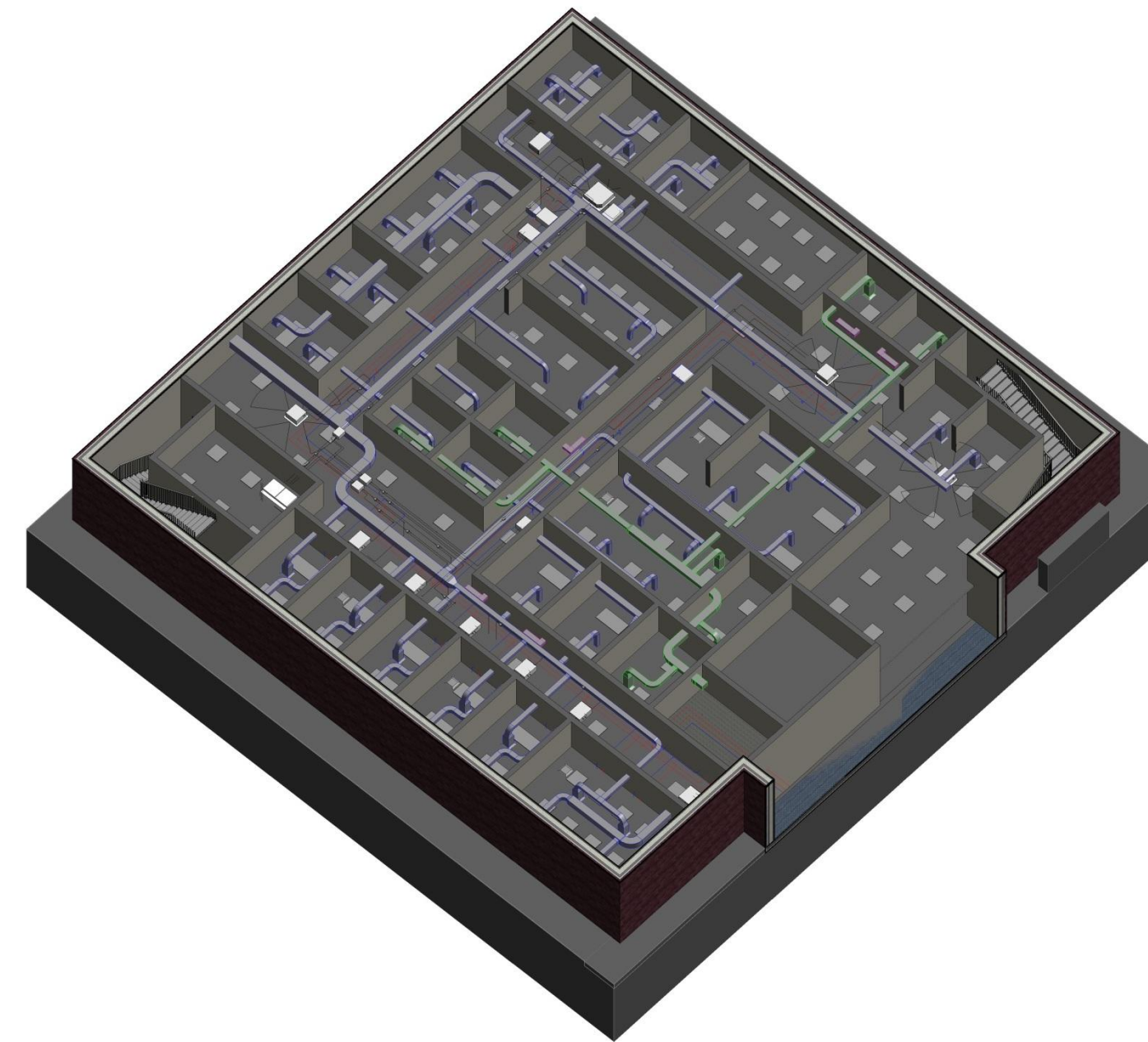
- Introduction
- HVAC Design
 - Construction Phase 1
 - Construction Phase 2
 - Assumptions
 - Clinic
 - Airside System
 - Refrigerant System
 - Natatorium
- Plumbing Design
- Conclusion

Ventilation Rates		
	Rp(CFM/per)	Ra (CFM/SF)
Patient	25	0
Double Patient	25	0
XRAY	25	0.3
Nurse Station	7.5	0.3
Med Storage	5	0.6
Soiled Utility	5	0.6
Clean Supply	10	0.6
Office	5	0.3
Break Room	5	0.3
Office Supply	5	0.3
Front Desk	5	0.3
Room 24	5	0.06
Lavatory	5	0.06
Storage Closet	0	0.6
Electrical Closet	0	0.3
Corridor	0	0.3
Waiting Room	7.5	0.3

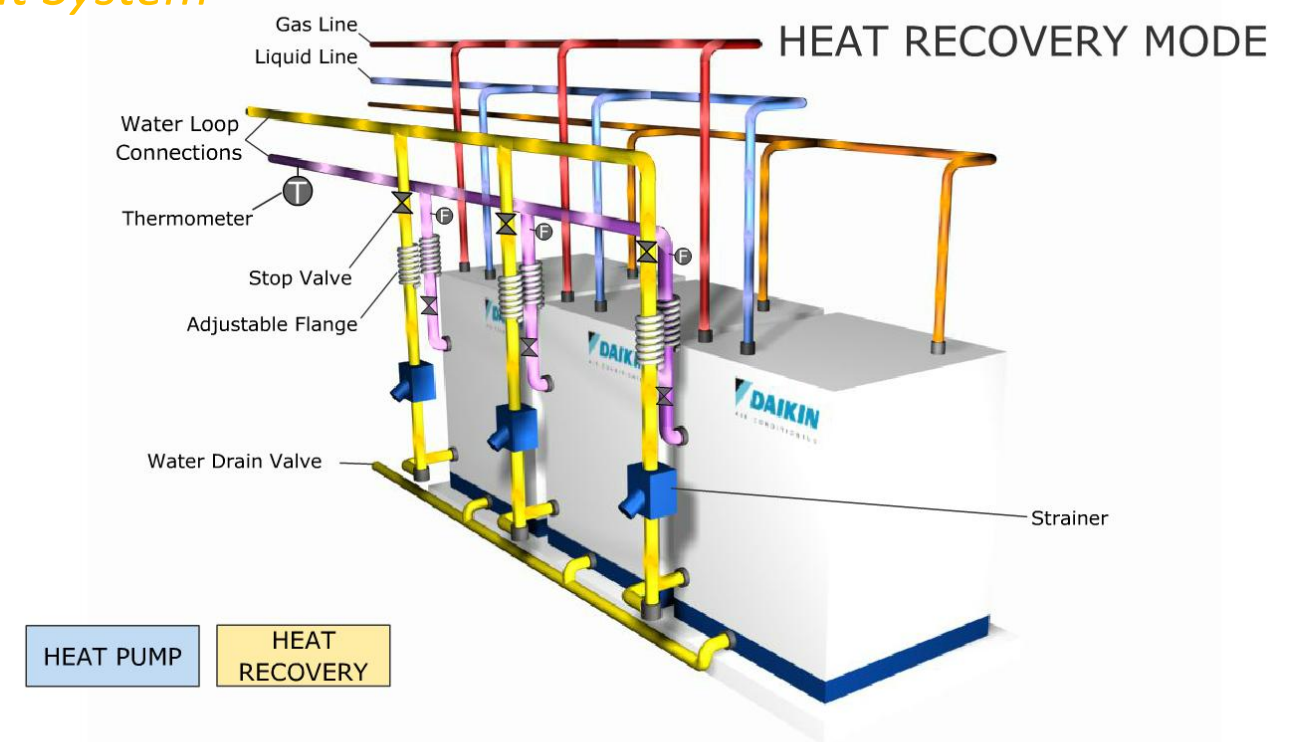




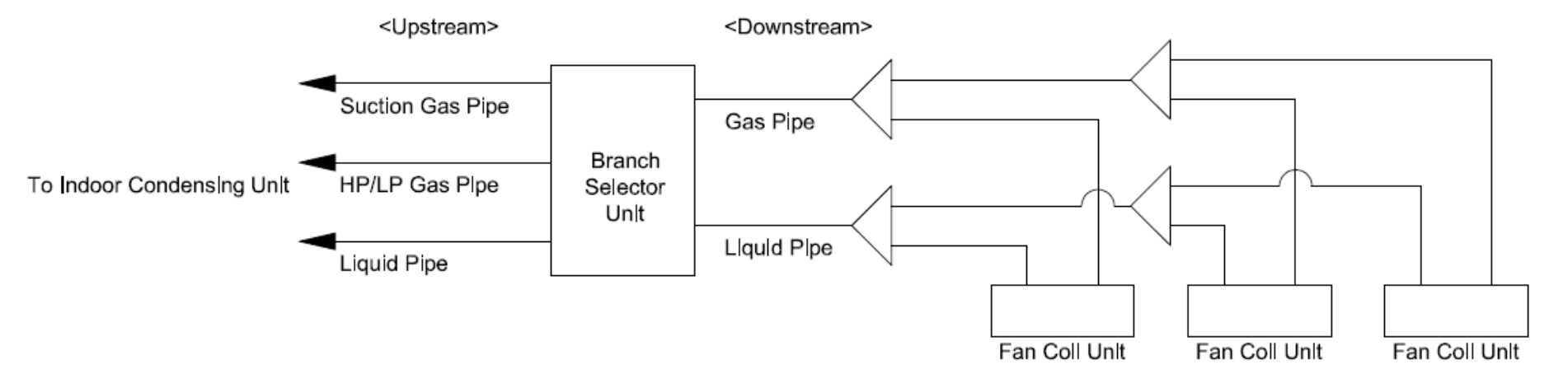
- Retrofit – tie into existing water loops
- Space
- Little disruption
- Time of construction
- Growth
- Use of existing power equipment



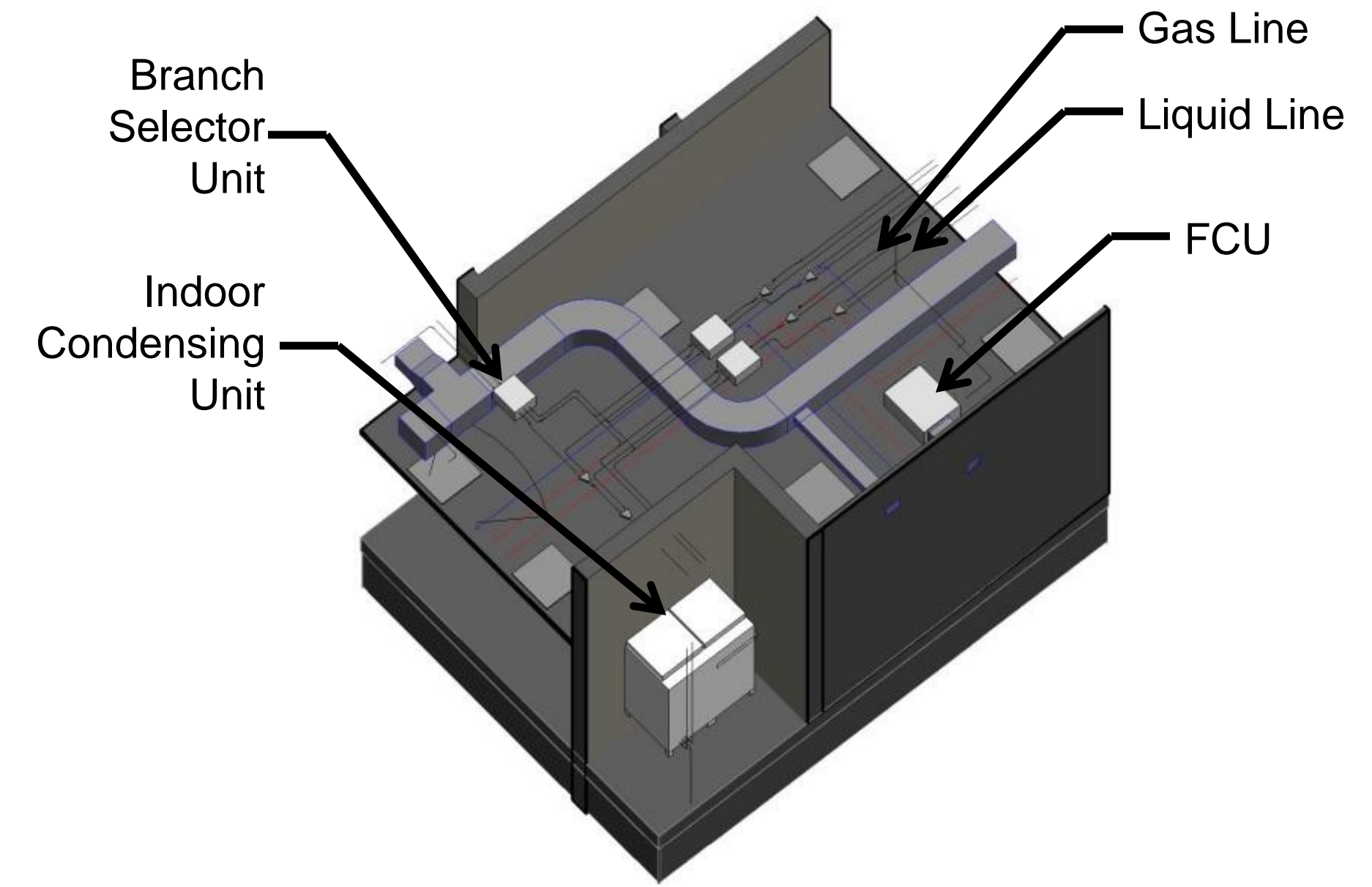
- Introduction
- HVAC Design
 - Construction Phase 1
 - **Construction Phase 2**
 - Assumptions
 - Clinic
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 - **Refrigerant System**
 - Natatorium
- Plumbing Design
- Conclusion



REFRIGERANT DESIGN



VRV-WIII - Indoor Condensing Unit with Heat Recovery Schedule									
QTY	Cooling Capacity (Btu/h)	Full Load EER	Heating Capacity	Full Load COP	Power	Liquid Pipe Size	Suction Gas Pipe Size	Discharge Gas Pipe Size	Maximum #of Indoor Units
1	144,000	15.1	162,000	5.3	208/120	1/2"	1 1/8"	7/8"	20



- Introduction
- HVAC Design
 - Construction Phase 1
 - **Construction Phase 2**
 - Assumptions
 - Clinic
 - Natatorium
 - *Airside System*
- Plumbing Design
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Ventilation

Pool Area Ventilation: 2400 CFM
 Spectator Ventilation: 2260 CFM

Exhaust

Pool Area Exhaust: 2640 CFM
 Spectator Exhaust: 2490 CFM

Moisture Load

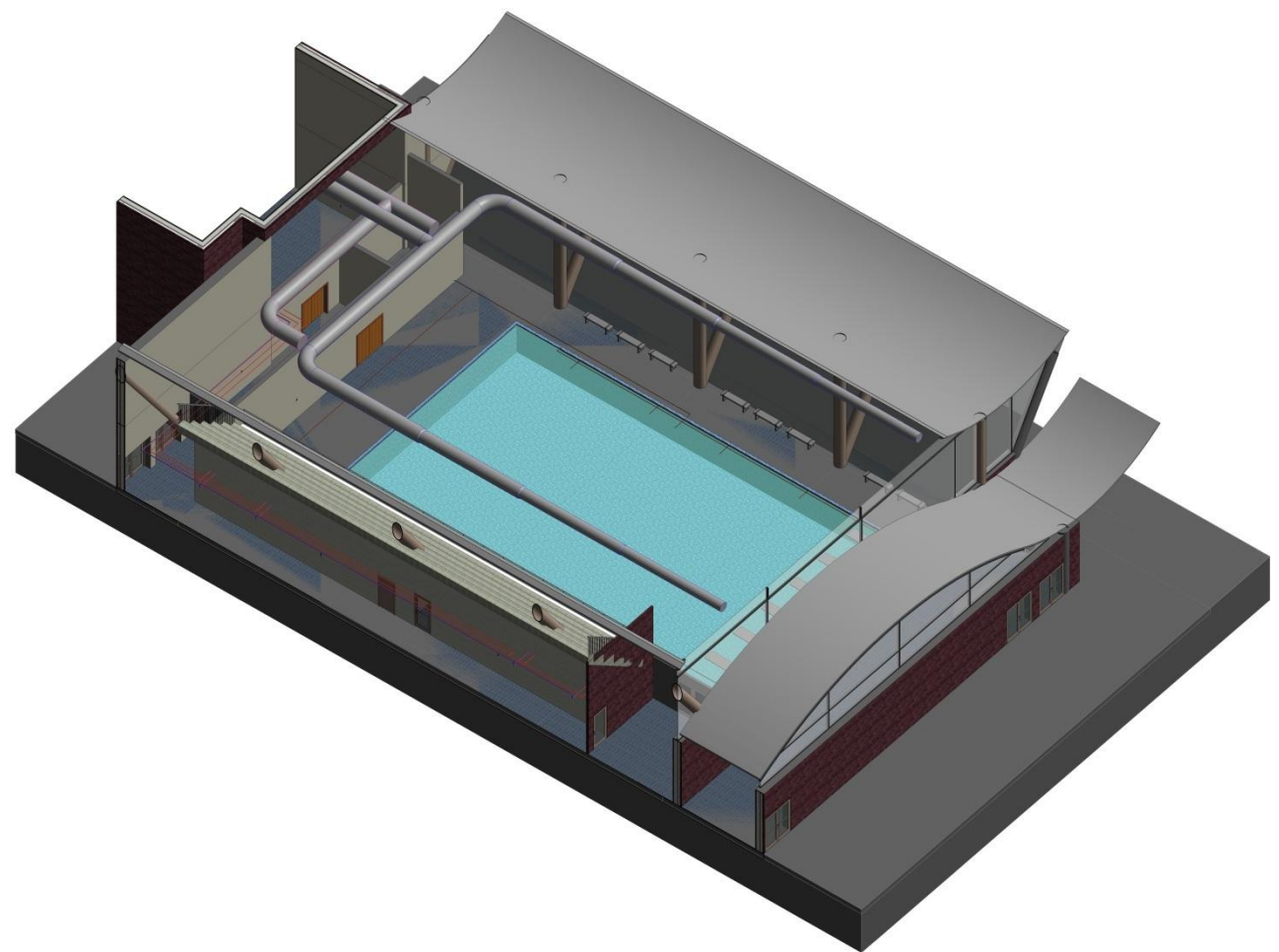
Day (active): 51 Lb/hr
 Night (inactive): 0 Lb/hr

Evaporation Rate

Day (active): 102 Lb/hr
 Night (inactive): 51 Lb/hr

NATATORIUM

All-encompassing AHU



Duct Design

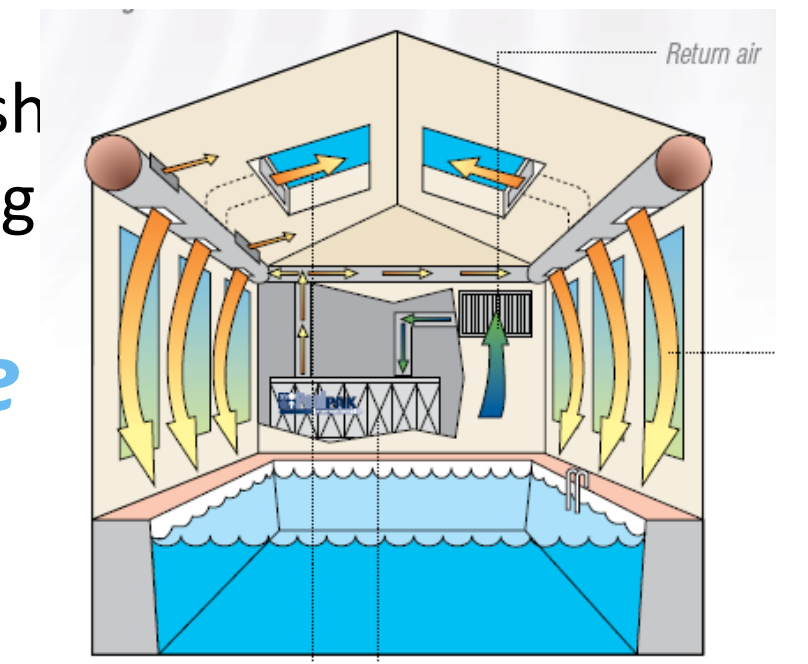
80% air directed wall wash
 20% air directed at ceiling

Surface Temperature

Heating: 59°F
 Cooling: 84°F

AHU Provides:

- Ventilation
- Dehumidification
- Heat Recovery



Pool Savings

\$3,850/year

PLUMBING DESIGN

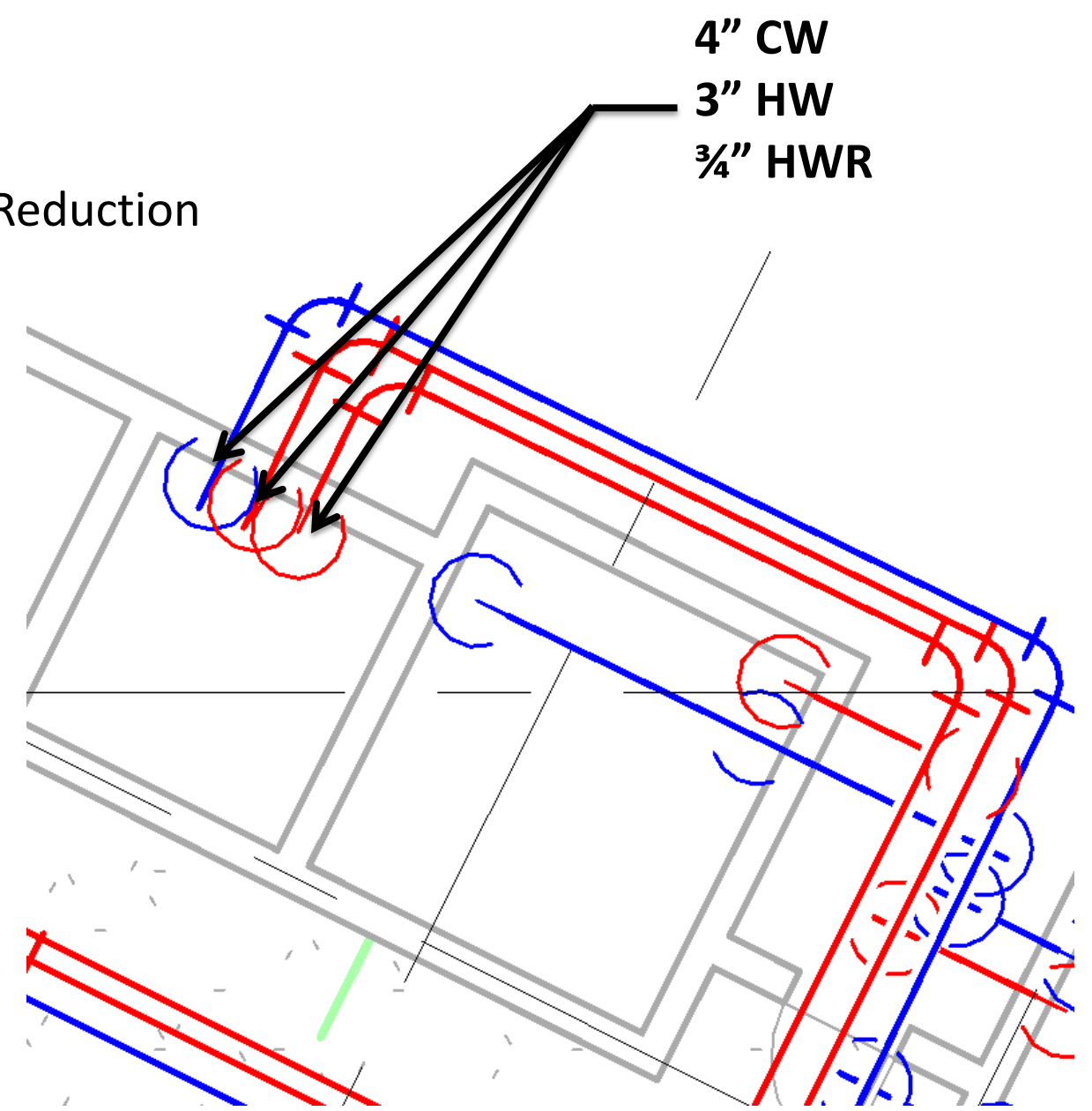
- Introduction
- HVAC Design
- **Plumbing Design**
 - *Water Use Reduction*
 - Pipe Sizing
- Conclusion

- WATER USE REDUCTION
- Low flow plumbing fixtures
 - Waterless Urinals
 - Total Uses as Designed/Baseline Usage
 - **46% Reduction**
 - **Saves \$9,160/year**

	Baseline Flow		Our Design		
	Rate	Baseline Cost	Flow Rate	Our Cost	Savings
Lavatory Faucets	1.6 gpf	\$22.95	1.1 gpf	\$15.78	\$7.17
Water Closets	1.5 gpm	\$16.13	0.5 gpm	\$5.38	\$10.75
Urinals	1.0 gpf	\$7.17	0 gpf	\$0.00	\$7.17



- Introduction
- HVAC Design
- **Plumbing Design**
 - Water Use Reduction
 - *Pipe Sizing*
- Conclusion



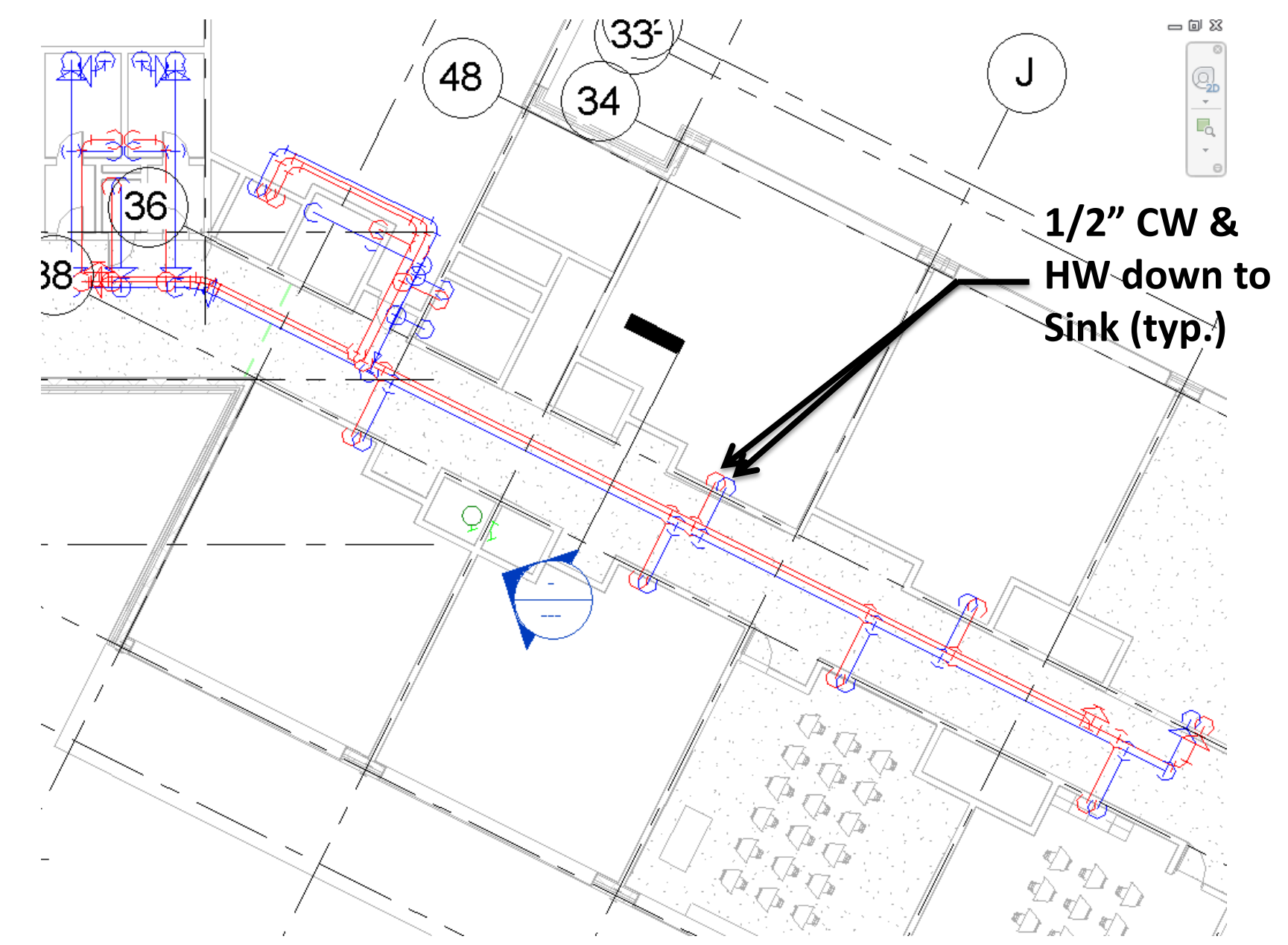
PLUMBING DESIGN

International Plumbing Code:

- Table 604.3
- Water Closet 4gpm
- Showers 3gpm
- Sinks 3gpm
- Commercial Dishwashers 6gpm

DOMESTIC HOT WATER DEMAND LOADS				
Fixture	#	Connection Size	Gallons/hour (4 ft/s)	Total (4 ft/s)
Lavatory Sink	85	1/2"	2	170
Service Sink	6	1 1/4"	15	90
Kitchen Sink	6	1 1/4"	15	90
Dishwasher	2	1 1/2"	150	300

Total:	650
X Demand Factor (0.25)	162.5



- Introduction
- HVAC Design
- Plumbing Design
- *Conclusion*

CONCLUSION

Construction Phase 1

*Ground Source Heat Pump
with 100% DOAS*

Total energy reduction of 32%

Construction Phase 2

VRV with Heat Recovery

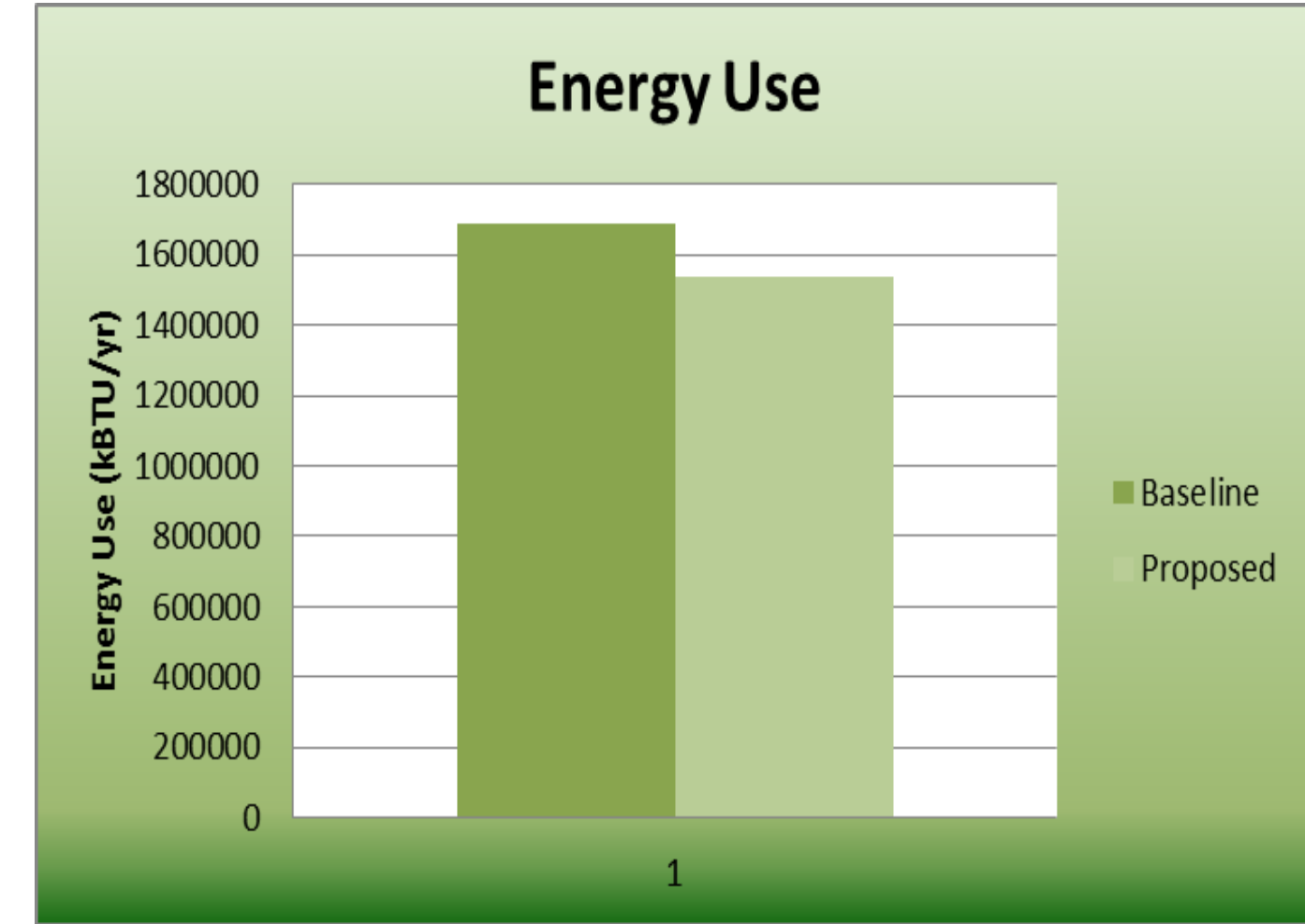
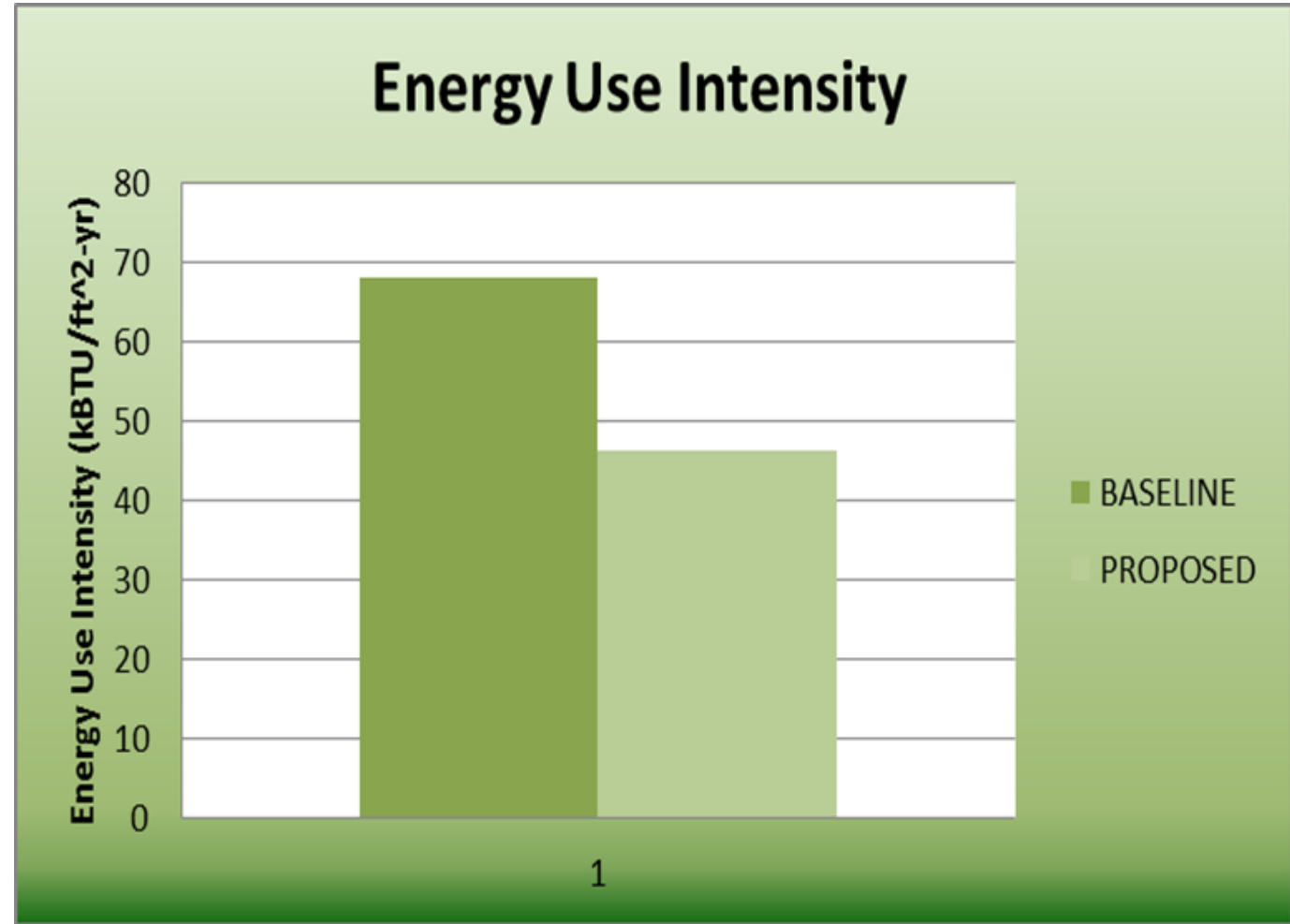
Total energy reduction of 13%

All- encompassing AHU

Total savings 1,398MMBTH or \$3,850

Clinic

Natatorium



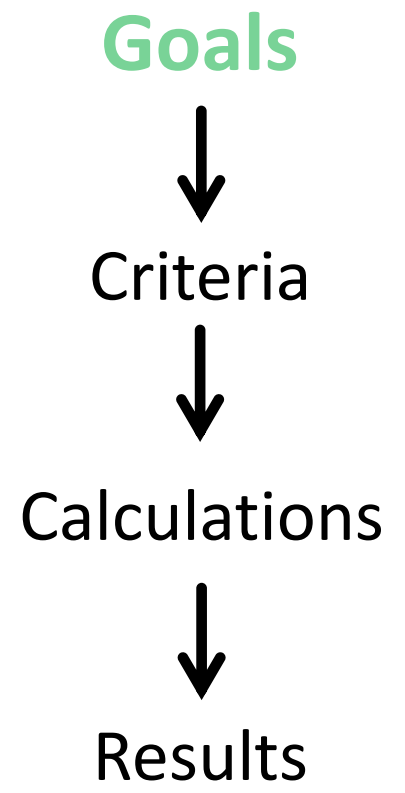
Lighting/Electrical Systems



- **Introduction**
 - *Goals*
- Phase 1 Design
- Phase 2 Design

create an **energy efficient** lighting and electrical system that provides a *functional* and *user friendly* design

Design Process

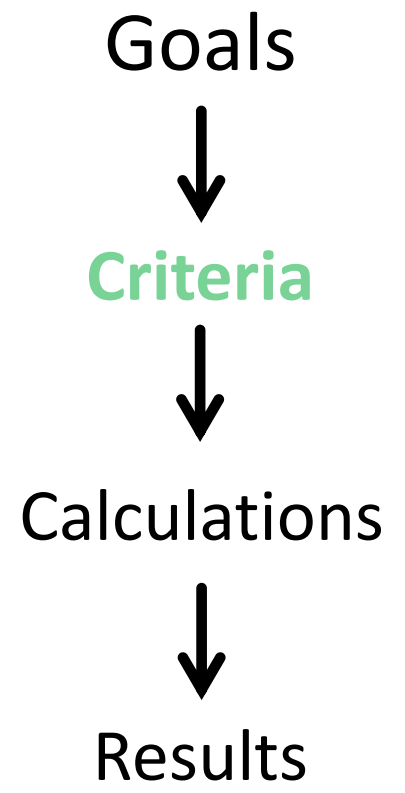


- **Introduction**
 - *Goals*
- Phase 1 Design
- Phase 2 Design

create an **energy efficient** lighting and electrical system that provides a *functional* and *user friendly* design

implement a design that **meets codes and requirements** while achieving our *team and option goals*

Design Process

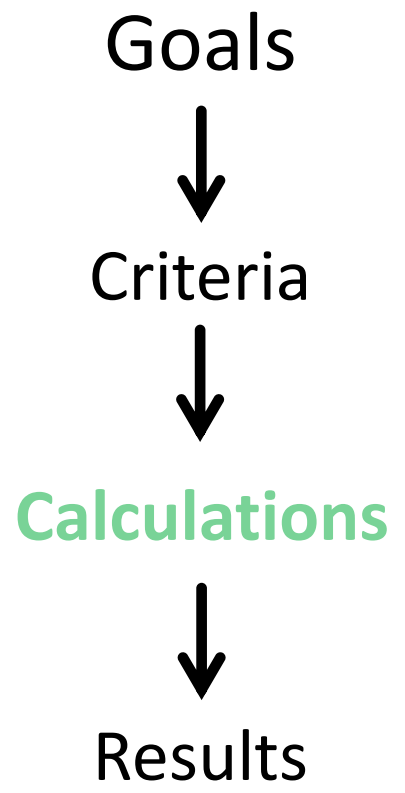


- **Introduction**
 - *Goals*
- Phase 1 Design
- Phase 2 Design

create an **energy efficient** lighting and electrical system that provides a **functional** and **user friendly** design

implement a design that **meets codes and requirements** while achieving our **team and option goals**

Design Process



use **state-of-the-art software** and **innovative ideas** to meet **design criteria and goals**

- Introduction
- Phase 1 Design
 - *Electrical System Overview*
 - Lamp Comparisons
 - Site & Façade Lighting
 - Enclosure
 - Atrium
 - Classrooms
 - Library
 - Multipurpose Room
- Phase 2 Design

Suggested Building Equipment



Type	Number	Specification	Voltage
Panelboard	16	100A, 42 Pole	480/277V
Panelboard	2	225A, 42 Pole	480/277V
MDP	1	400A, 42 Pole	480/277V
Panelboard	1	100A, 42 Pole	208/120V
Panelboard	10	225A, 42 Pole	208/120V
MDP	3	400A, 42 Pole	208/120V
In-Switchboard Breaker	1	20A CB	208V
In-Switchboard Breaker	1	30A CB	208V
In-Switchboard Breaker	1	225A CB	208V
In-Switchboard Breaker	1	300A CB	208V
Switchboard	1	Switchboard	480/277V
Automatic Transfer Switch	1	1000A ATS	480/277V
Automatic Transfer Switch	1	225A ATS	480/277V
Automatic Transfer Switch	2	100A ATS	480/277V
Generator	1	350KW	480/277V
Transformer	3	150 KVA	480V to 120/208V
Transformer	1	112.5 KVA	480V to 120/208V

Phase 1 – Electrical System Overview

**Total Building Load
714.5 kVA**

Type	kVA
Lighting Load	65.5
Power Load	242.8
Mechanical Equipment	311.9
Emergency Loads: Life Safety	10.2
Emergency Loads: Critical	221.1

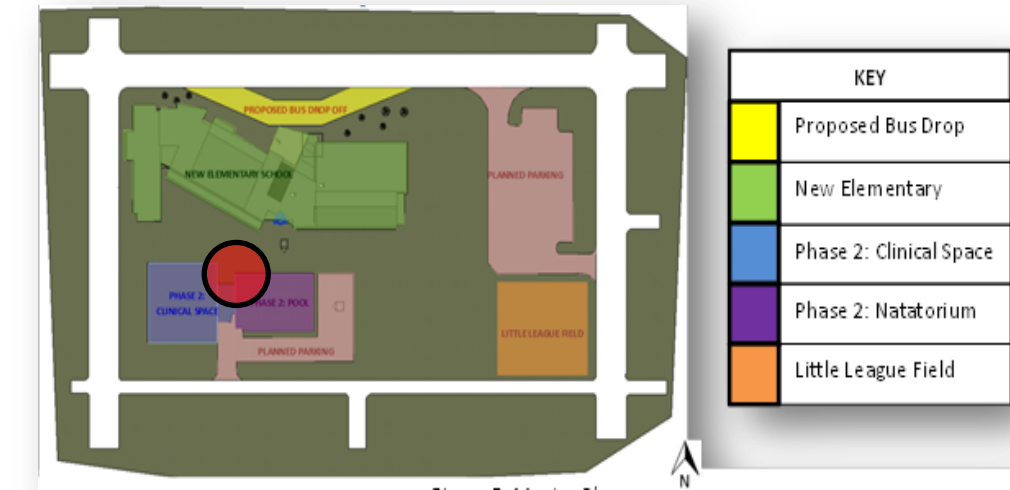
Lighting Design Achievements

- Lighting loads 42% below the ASHRAE 2010 Standard 90.1 Space-by-Space lighting requirements
- Total watts used by the lighting system is approximately 50,083 W, well below the allowed 85,871 W.
- Low wattage, high efficiency lamps and fixtures
- Energy saving controls
- Ideal daylighting systems

RUN TIME HOURS	USABLE CAPACITY (GAL)	L	W	H	WT	dBA*
NO TANK	-	175	58	78	8106	
7	183	175	58	91	9054	
17	438	175	58	103	9366	
27	693	175	58	115	9669	85
37	946	206	58	116	11313	
52	1325	278	58	118	12146	

Generator Information

- Serves entire 1st floor and egress lighting in rest of building
- Generator shared with Phase 2
- 350kW total load
- Load shedding ability
- 27 hour diesel generator



- Introduction
- Phase 1 Design
 - Electrical System Overview
 - **Lamp Comparisons**
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Lamp Comparisons

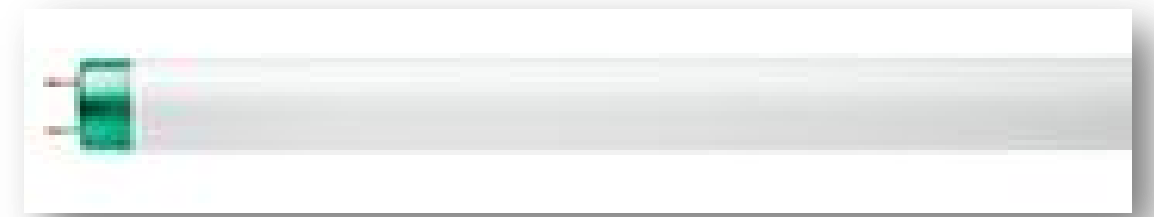
Other General Purpose Lighting



Classroom and General Purpose Lighting

	Fixtures/ Room	Watts/ Lamp	Hours/ Year	kWh/ Year	Room Energy Usage/Year	Maintenance Costs/Lamp/Year	Ballast Costs	Lamp Costs	Lamp Lifespan	Fixture Cost	Fixture Lifespan	Initial Fixture Cost	Lifetime Cost
T5 (4ft)	12	28	2600	72.8	\$58.53	\$5.00	\$52.00	\$4.75	9.2	\$150.00	20	\$2,169.00	\$4,918.12
T8 (4ft)	12	32	2600	83.2	\$66.89	\$5.00	\$46.00	\$2.75	9.2	\$120.00	20	\$1,749.00	\$4,601.36
LED (4ft)	8	60	2600	156	\$83.62	\$2.00	\$0.00	\$0.00	20.0	\$260.00	20	\$2,080.00	\$4,072.32

Selection:
28W T8 Lamp
Electronic Dimming Ballast

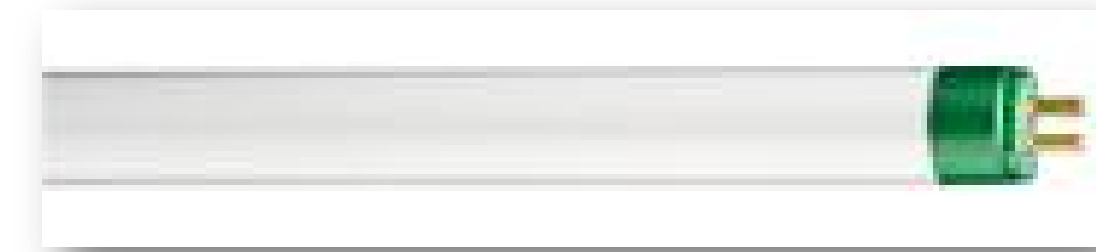


High Bay Multipurpose Room & Natatorium Lighting

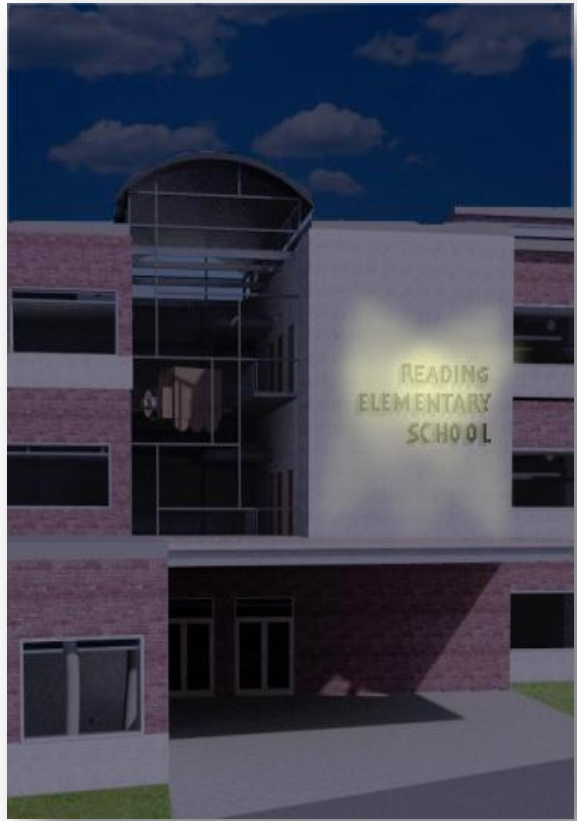
	Fixtures/ Room	Watts/ Lamp	Hours/ Year	kWh/ Year	Room Energy Usage/Year	Maintenance Costs/Year	Ballast Cost	Lamp Costs	Lamp Lifespan	Fixture Cost	Fixture Lifespan	Initial Fixture Cost	Lifetime Cost
6LT5	15	324	2600	842.4	\$846.61	\$15.00	\$23.00	\$4.75	9.2	\$160.00	20	\$3,862.50	\$26,832
6LT8	24	190	2600	494	\$794.35	\$15.00	\$21.00	\$2.75	9.2	\$120.00	20	\$4,788.00	\$29,849
250W MH	20	275	2600	715	\$958.10	\$10.00	\$32.00	\$28.00	7.7	\$140.00	20	\$8,080.00	\$29,338
350W LED	24	350	2600	910	\$1,463.28	\$2.00	\$0.00	\$0.00	19.2	\$450.00	20	\$10,800.00	\$41,026



Selection:
54W T5HO Lamp
Stepped Dimming Ballast

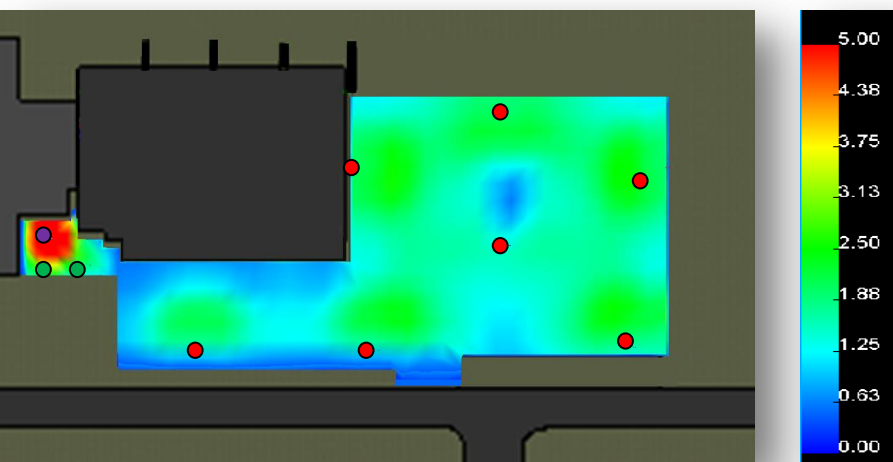
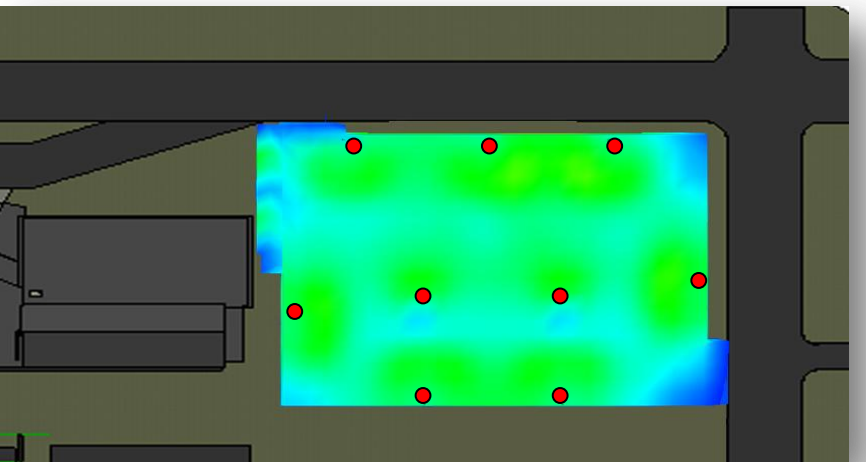
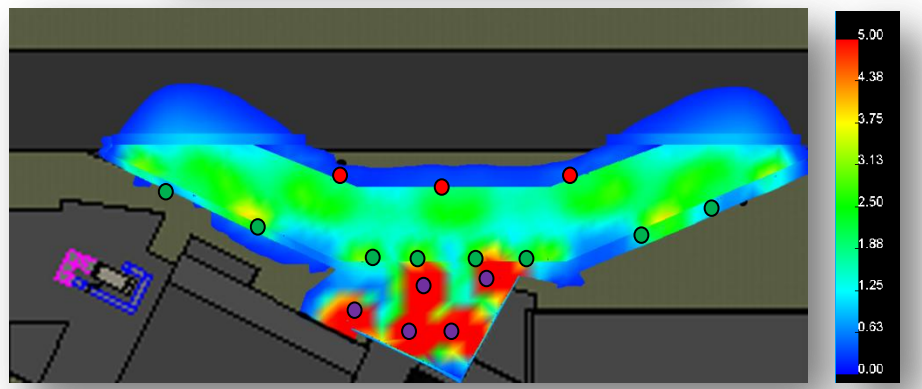


- Introduction
- Phase 1 Design
 - Electrical System Overview
 - Lamp Comparison
 - **Site & Façade Lighting**
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- Phase 2 Design



Site & Façade Lighting

Fixture Description	Mounting	Lamp
18' Mounting Street Lamp	Pole	89W LED
Canopy Light	Surface	37W LED
LED Bollard	Pole	10W LED
Wall Pack	Wall	26W LED
In Ground Spot Light	In Ground	9W LED



Clinic Parking		Criteria	As Designed
Horizontal Parking Lot Illuminance	Avg. (fc)	0.8	1.66
	Max. (fc)	--	2.8
	Min. (fc)	0.2	0.3
Max:Min		20:1	9:01
Vertical Parking Lot Illuminance @ 5'	Avg. (fc)	0.5	0.9
	Max. (fc)	--	2.5
	Min. (fc)	0.1	0.2
Power Density (W/SF)		0.06	0.053

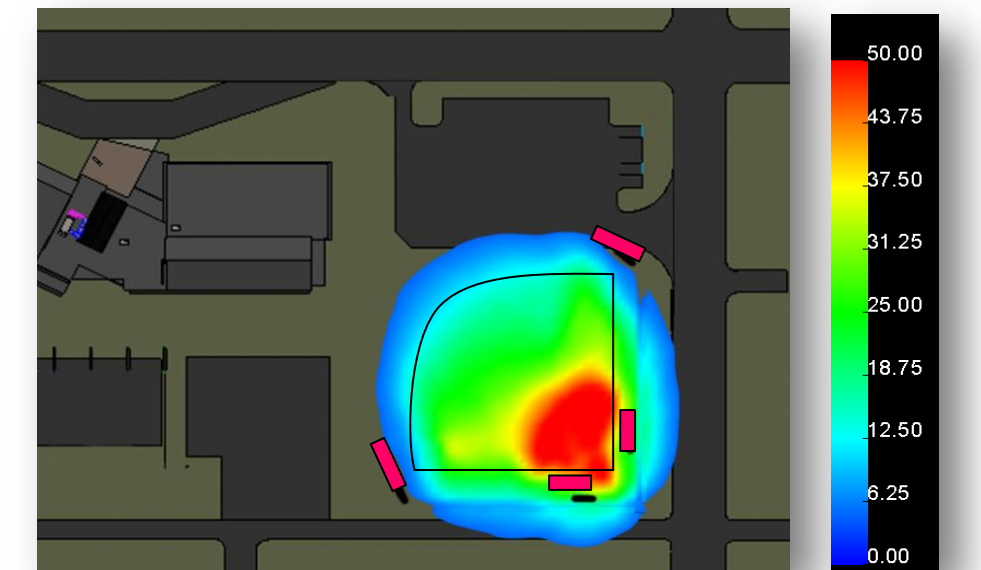
School Parking		Criteria	As Designed
Horizontal Parking Lot Illuminance	Avg. (fc)	0.8	1.88
	Max. (fc)	--	3
	Min. (fc)	0.2	0.6
Max:Min		20:1	5:1
Vertical Parking Lot Illuminance @ 5'	Avg. (fc)	0.5	0.81
	Max. (fc)	--	2.8
	Min. (fc)	0.1	0.3
Power Density (W/SF)		0.06	0.053

Main Entry		Criteria	As Designed
Illuminance Values	Avg. (fc)	2	2
	Max. (fc)	5	4.3
	Min. (fc)	0.2	0.5
Max:Min		10:1	8.5:1
Power Density (W/SF)		0.25	0.07

Baseball Field

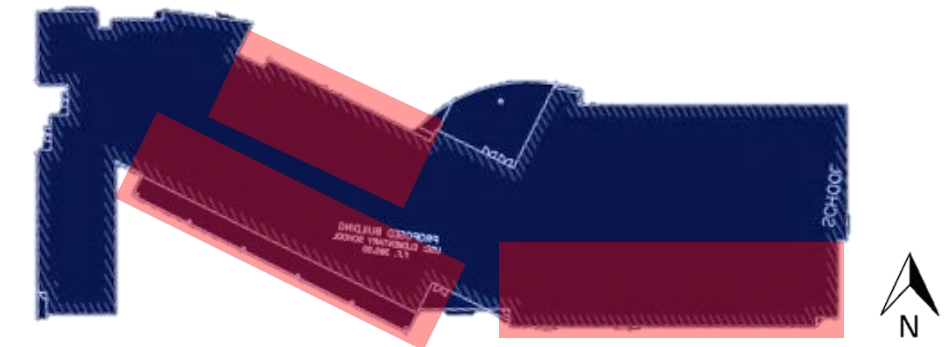
Fixture Description	Mounting	Lamp
Glare and Uplight Reducing Sports Light	Pole	400W MH

Baseball Field		Criteria	As Designed
Infield Illuminance Values	Avg. (fc)	50	43.9
	Max. (fc)	--	52.7
	Min. (fc)	25	29.9
Max:Min		2:1	1.5:1
Outfield Illuminance Values	Avg. (fc)	30	24.6
	Max. (fc)	--	45.9
	Min. (fc)	12	11.6
Max:Min		2.5:1	2.2:1
Power Density (W/SF)		1.2	0.79

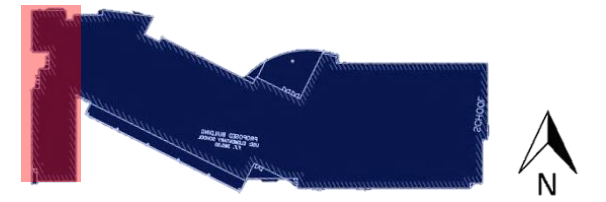


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Clerestory Analysis



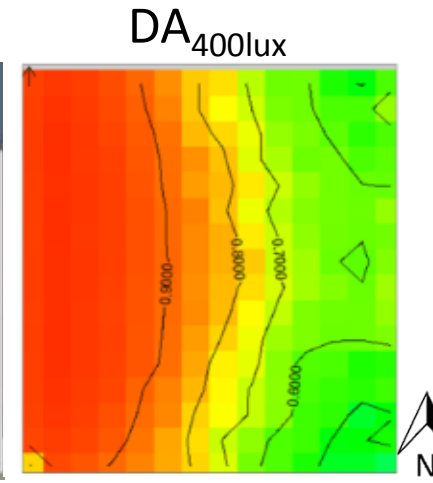
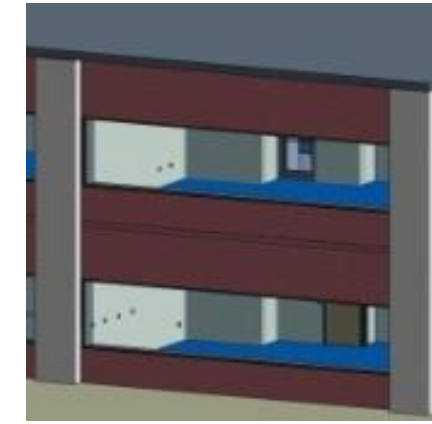
Clerestory Analysis	Without Clerestory	With Clerestory
Energy Savings (kWh)	485	720
Cost Savings (\$)	\$32.50	\$48.24



Enclosure

West Classroom Analysis

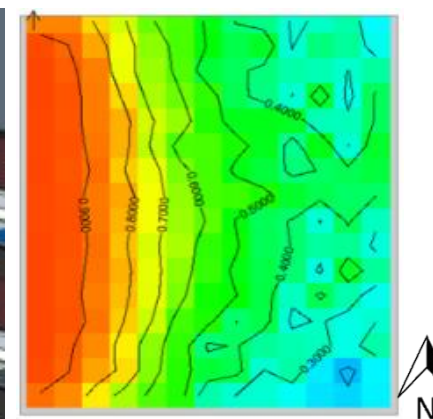
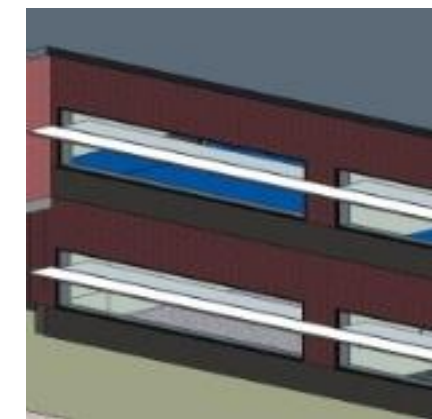
Fins



Direct Sunlight Penetration

800 hrs/ school year
50% of the year

Light Shelf

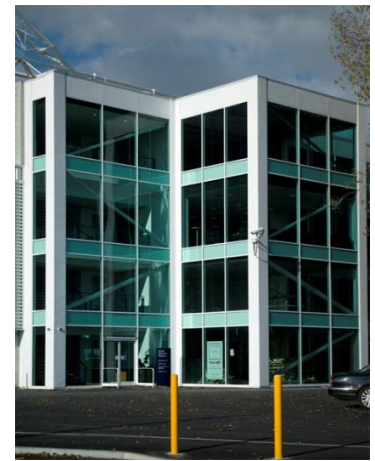


Direct Sunlight Penetration

540 hrs/ school year
33% of the year

Glazing

Glazing Types	Assembly U-Value	Assembly SHGC	VT
Double High Performance Tint (Argon)	0.54	0.39	0.607
Double Low Solar Low-E Clear (Air)	0.40	0.382	0.701
Double Glazed Triple Silver Low-E (Argon)	0.35	0.272	0.638



http://www.padihamglass.co.uk/img/full_tints-hpp-01.jpg

ASHRAE Standard 90.1 Building Envelope Requirements

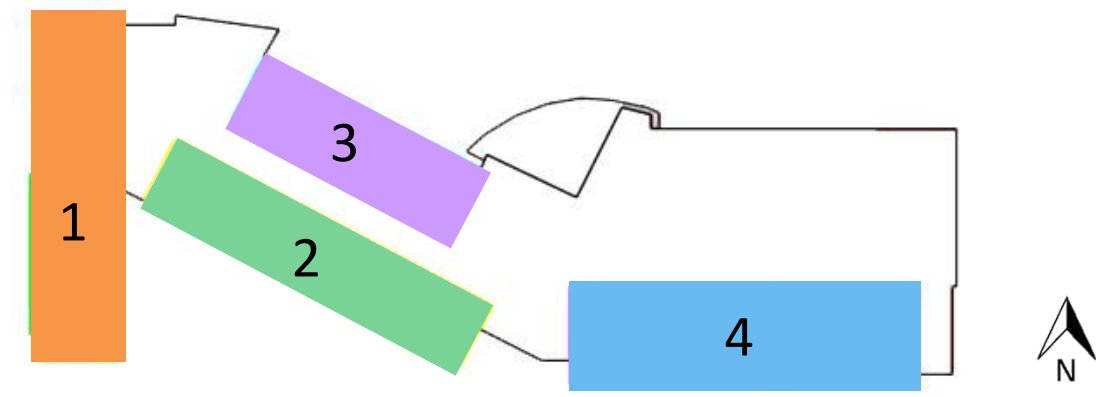
Assembly Max. U-Value: **0.55**
Assembly Max. SHGC: **0.40**

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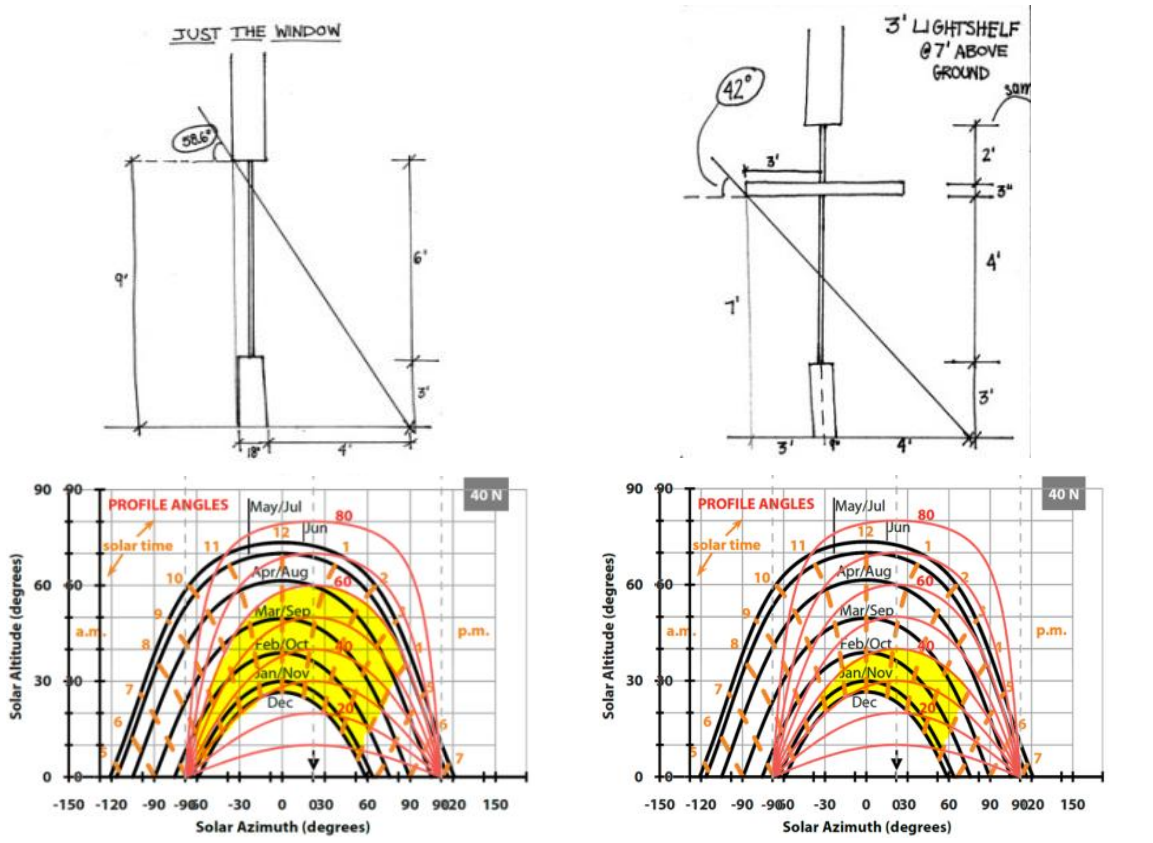
Enclosure

Final Static Shading Solutions



1. Lightshelves
2. Lightshelves
3. Clerestories
4. Lightshelves and Clerestories

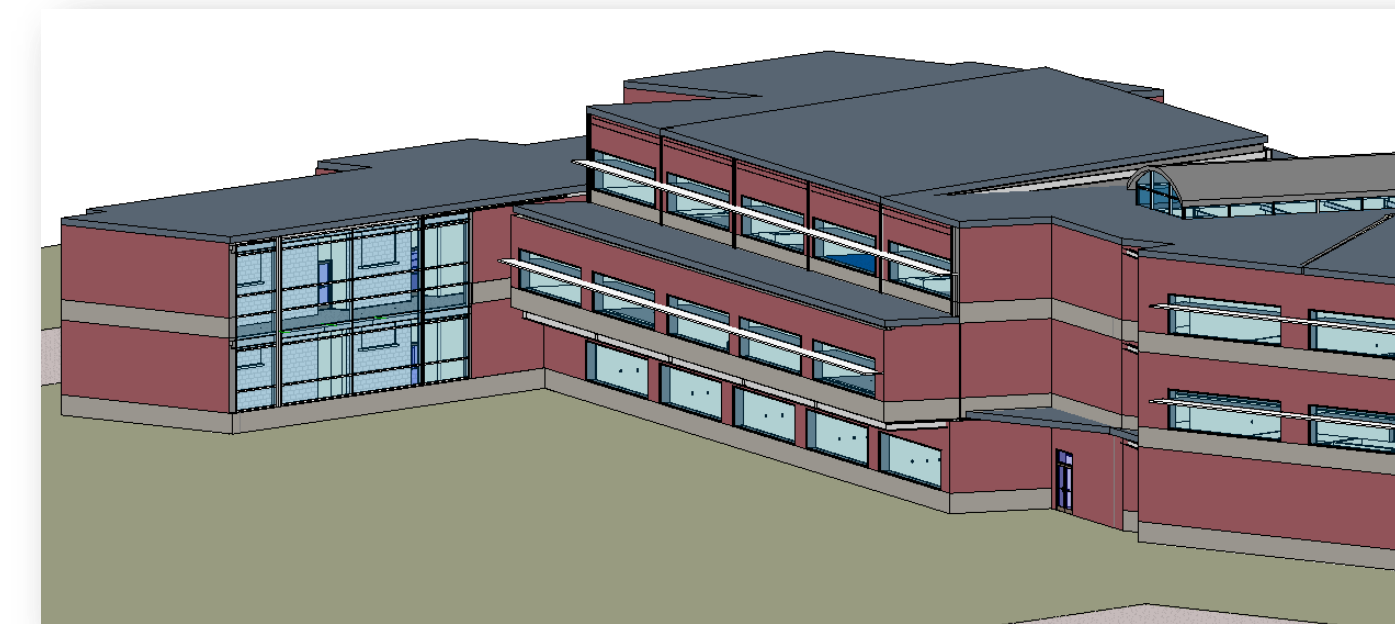
Lightshelf Analysis



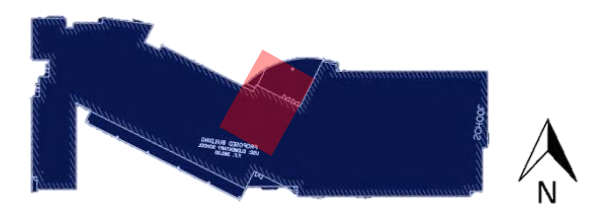
Fenestrations



- Visible Transmittance
- SHGC Effect on Mechanical Loads
- Glazing Selection and Pricing
- Curtain Wall – Connection to Steel Frame
- Bulletproof Glass Add-Alternate

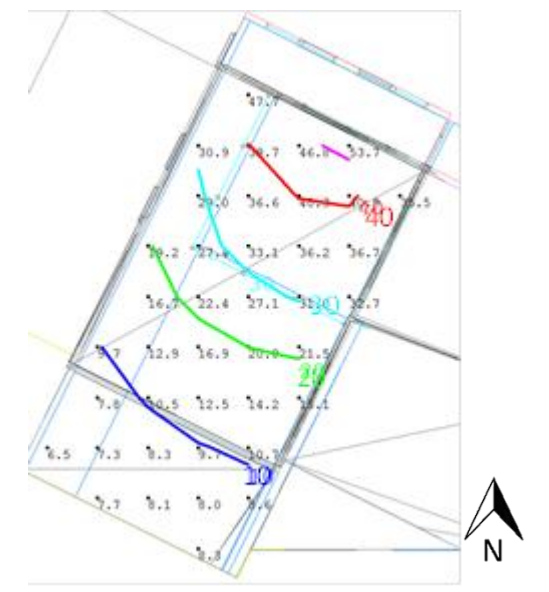


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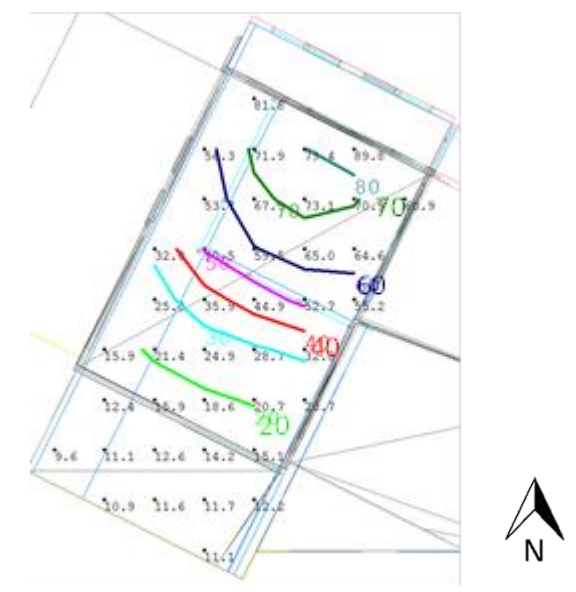
Atrium

December 21st @ Noon



Avg. Illuminance: **25 fc**

June 21st @ Noon



Avg. Illuminance: **53 fc**

Target Avg. Illuminance: 10 fc

Note: All calculations were analyzed with a Partly Cloudy Sky

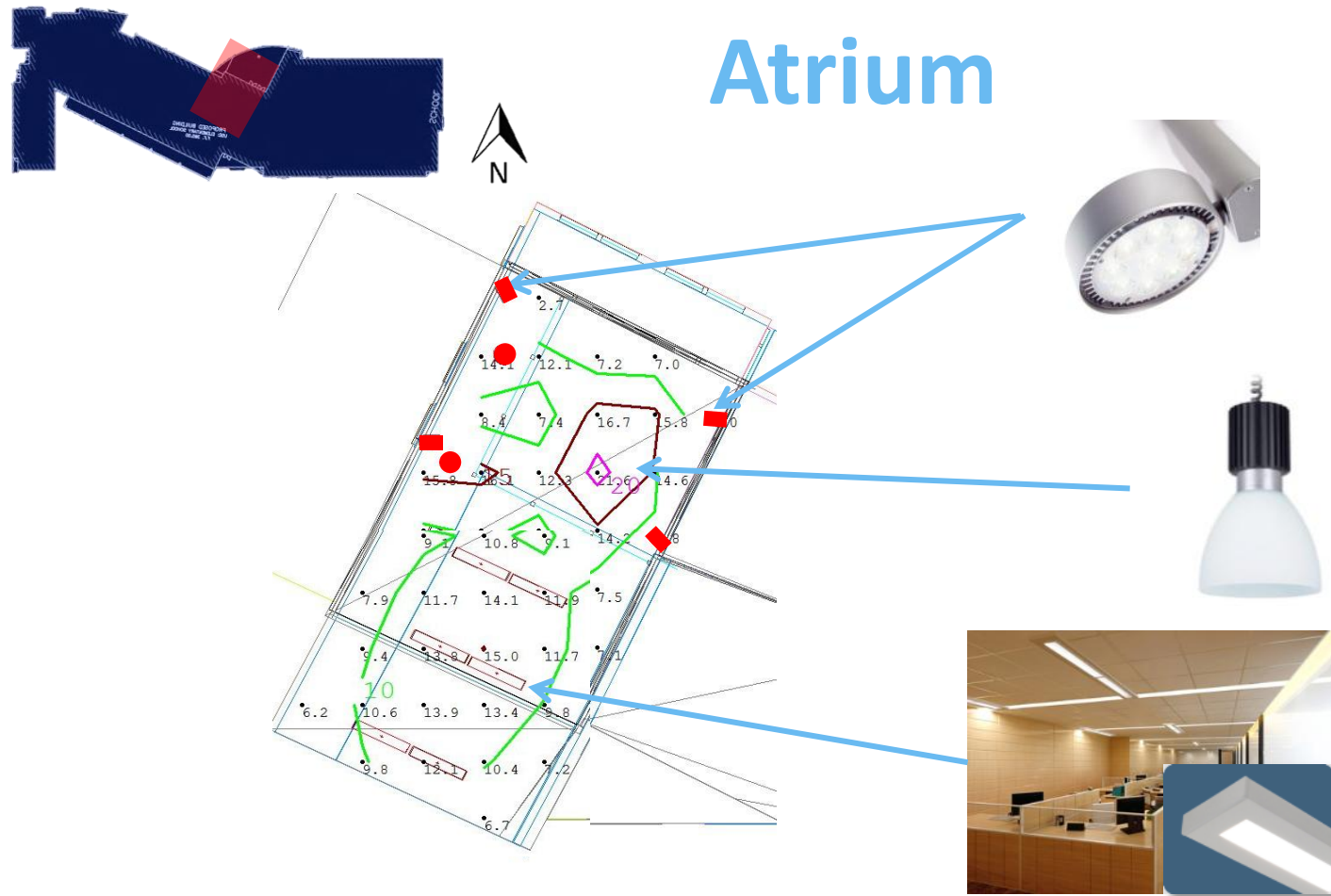


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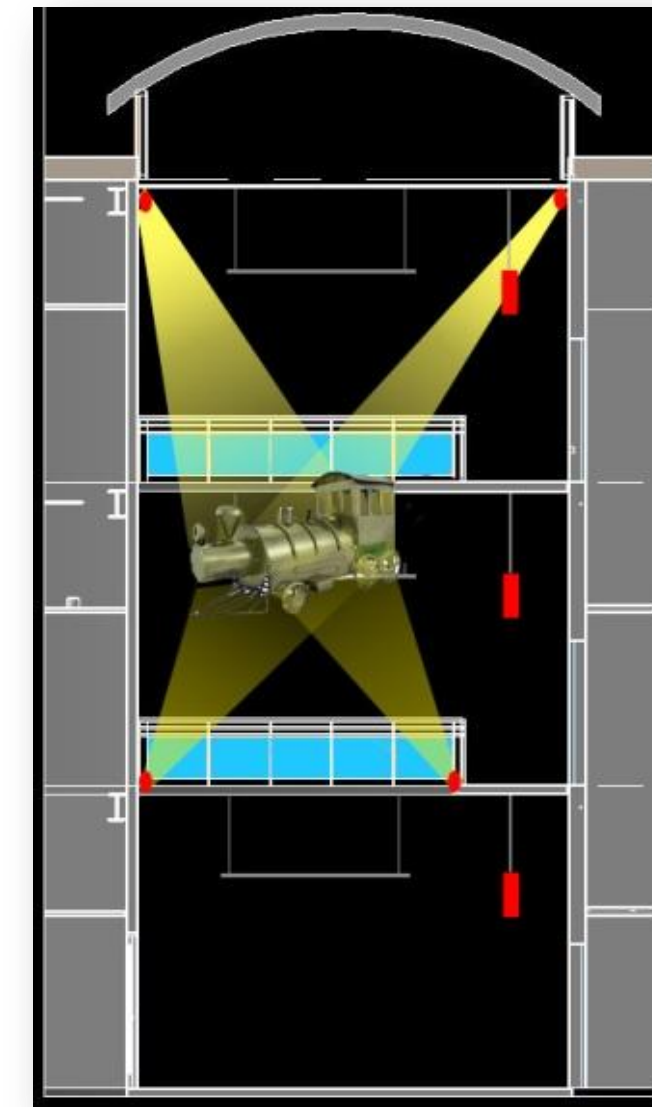
Lighting Design Details:

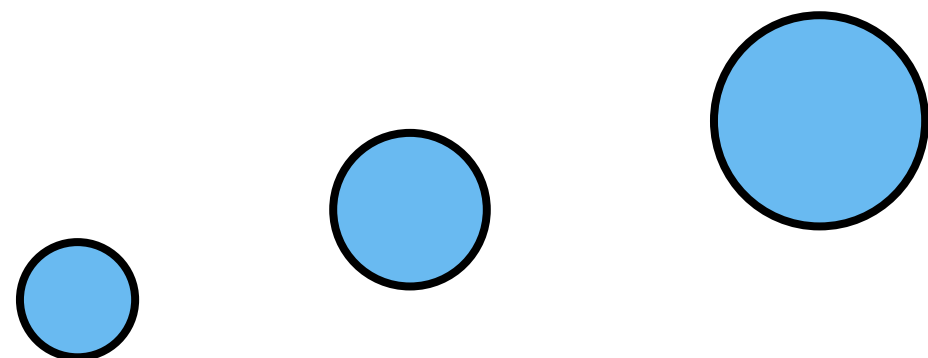
- **LED spotlights** highlight art work from above (38' AFF) and below (14' AFF)
- **Occupancy sensors** and **photo sensor** controls and manual switch
- **Decorative pendants** to illuminate walkways to the restrooms

	Lobbies		Criteria	As Designed
Lobbies : Daytime	25-65	Avg. (fc)	10	11
	yrs	Avg:Min	4:1	4:1
Lobbies : Nighttime	25-65	Avg. (fc)	5	5.4
	yrs	Avg:Min	4:1	4:1
Power Density (W/SF)			0.9	0.86



Fixture Description	Mounting	Lamp
LED Spotlight	Surface	15W LED
LED Circular Pendant	Suspended	20W LED
8' Linear Pendant	Suspended	(1) 28W T8

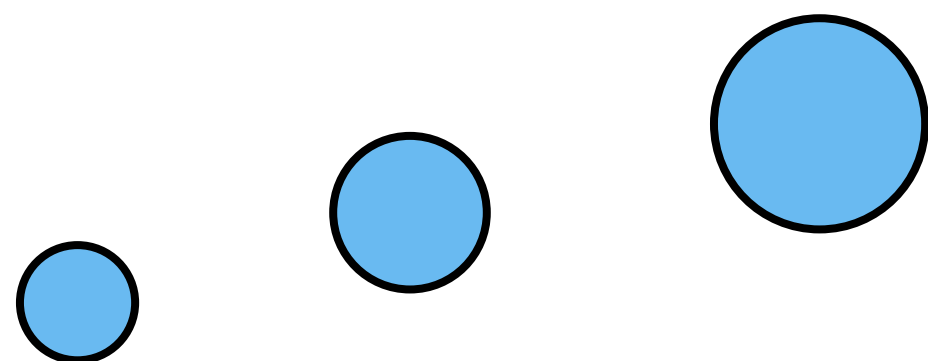




- Reading Rail-Load
- Roof Material Selection
- Cantilevers
- 3 Story Opening – Smoke Control



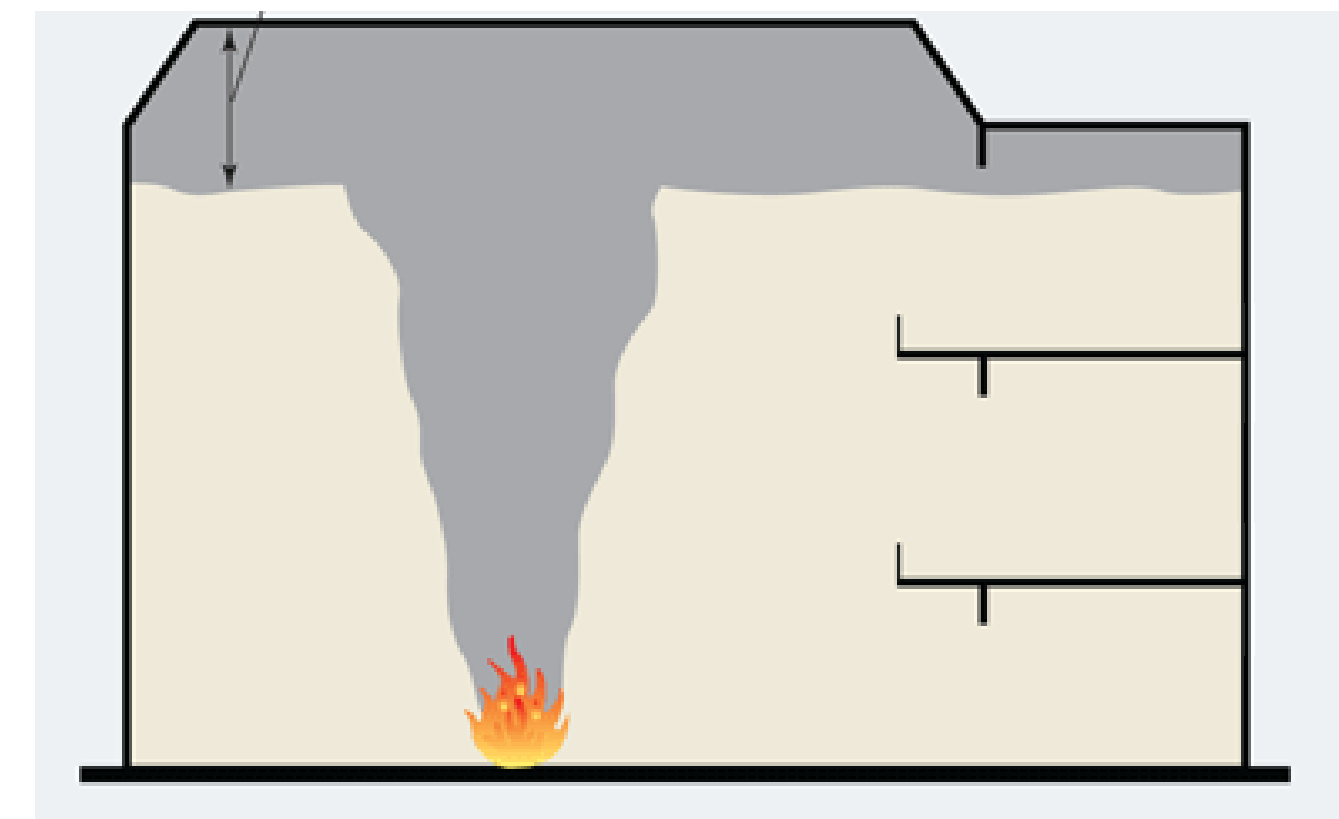
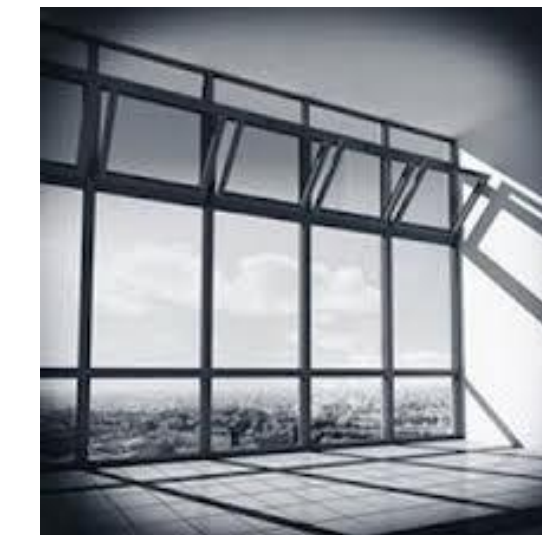
Atrium



- Reading Rail-Load
- Roof Material Selection
- Cantilevers
- **3 Story Opening – Smoke Control**

Smoke Control Options

- Passive vs. Active System
- Exhaust Required
- Automatic Doors

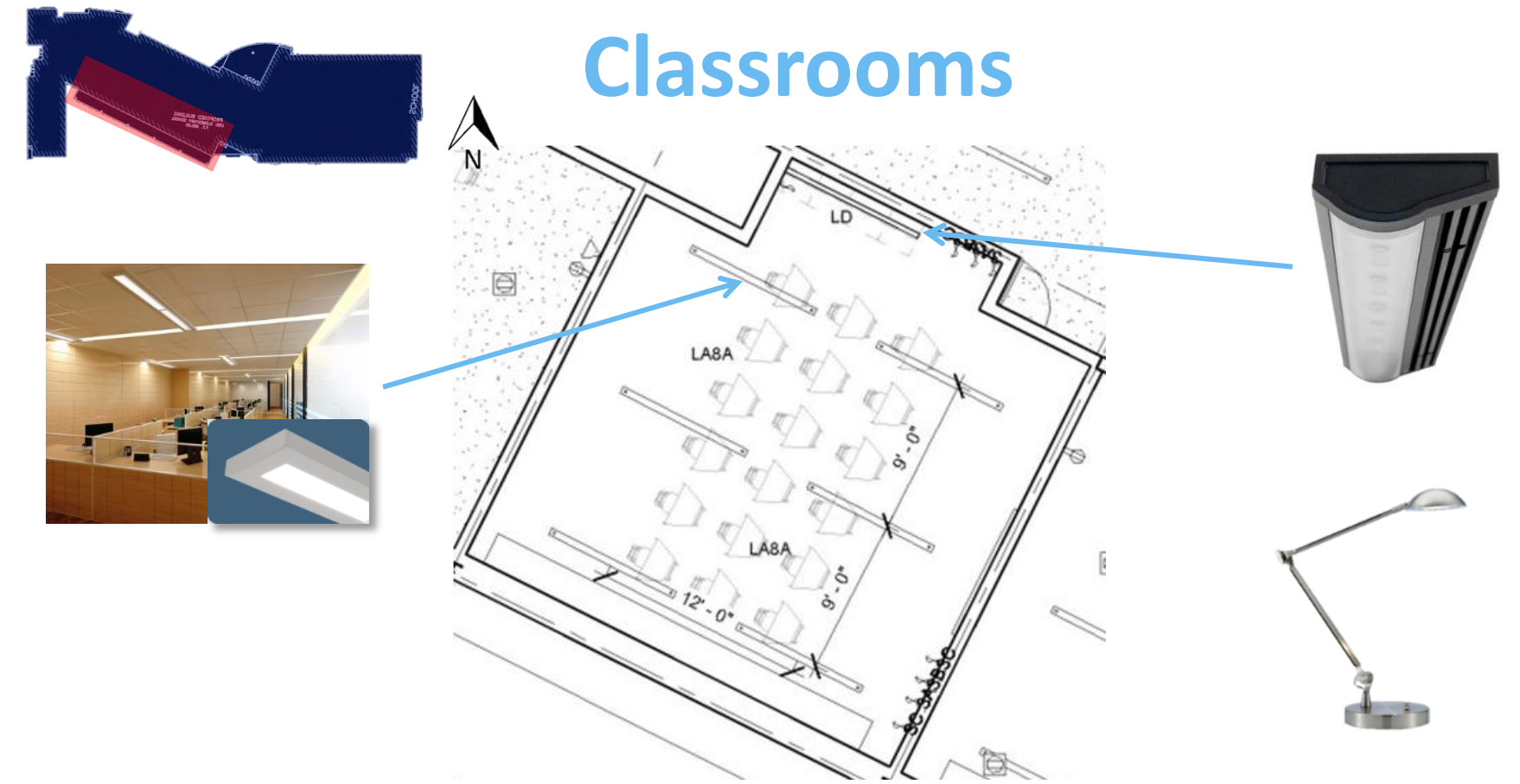


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Lighting Design Details:

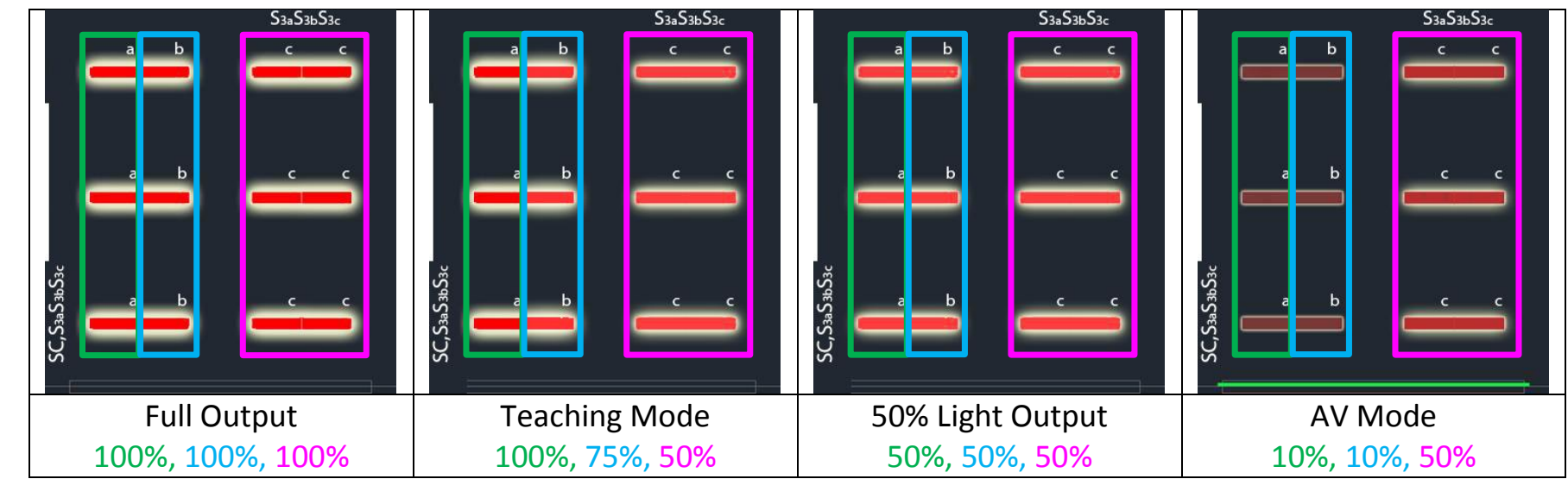
- 14' **floor-to-floor** (exposed ceiling)
- **Linear pendants** suspended 8' AFF with **80%/20%**, uplight/downlight
- **Occupancy sensor, photosensors** and **scene control panel**
- Photosensor controls the **two rows** of fixtures closest **to the window**.
- **Automated roller shades** activated with A/V setting.

	Classrooms		Criteria	As Designed
Classroom	25-65	Avg. (fc)	40	38
	yrs	Avg:Min	2:1	2:1
Whiteboard	25-65	Avg (Vert.)	30	27.2
	yrs	Avg:Min	3:1	2.2:1
Power Density (W/SF)			1.24	1.15



Fixture Description	Mounting	Lamp
8' Linear Pendant	Suspended	(2) 28W T8
Undercabinet LED Strip	Surface	10W/LF LED
LED Desk Lamp	Surface	10W LED

Classroom Scene Settings



Total Classroom Energy Savings from Photosensors

28,360 kWh/year
\$1,900/year

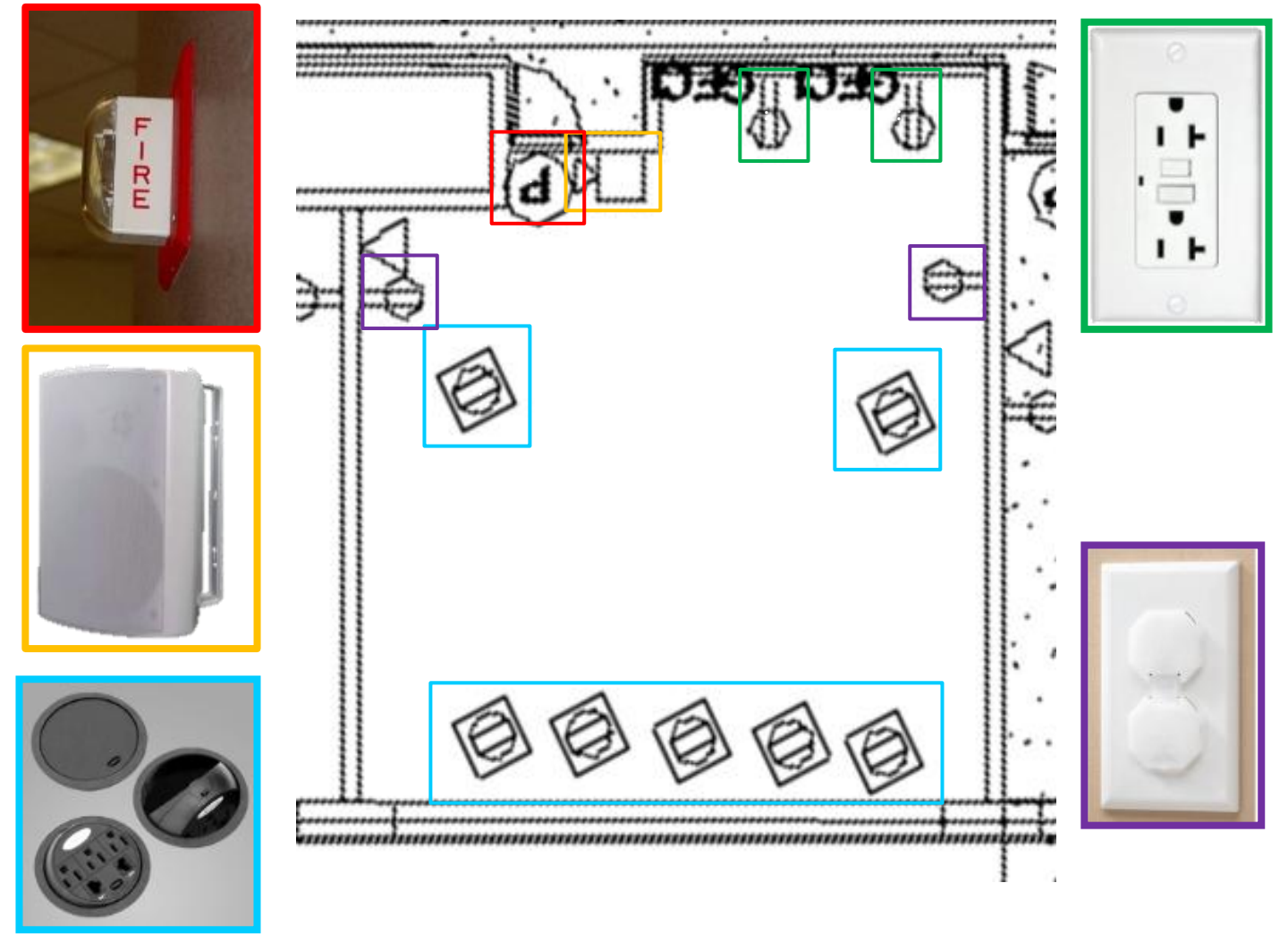
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General Rules Followed:

- 7 under floor duplex receptacles
- 2 GFCI receptacles over the sink area
- 2 convenience receptacles

Classroom Electrical & Fire Alarm System

Typical Classroom Layout



Typical Classroom Equipment

Type	Quantity	Wattage
Computer	42	200
Projector	42	230
Television	48	158
Screen	48	n/a
Motorized Shades	130	n/a
Printer/Copy/Fax Machine	4	1104
Phone	48	n/a
Window Break Devices	130	n/a



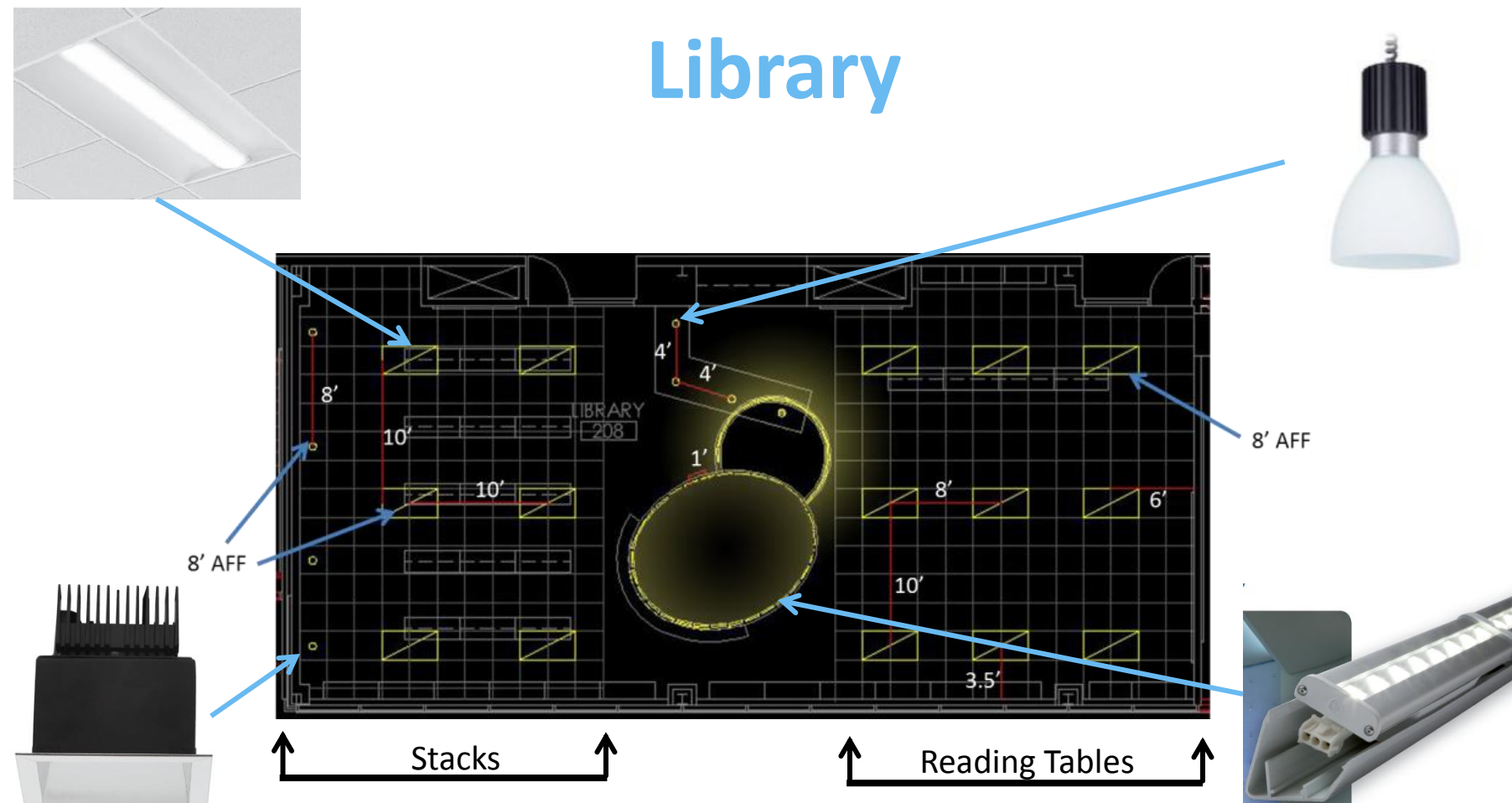
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Lighting Design Details:

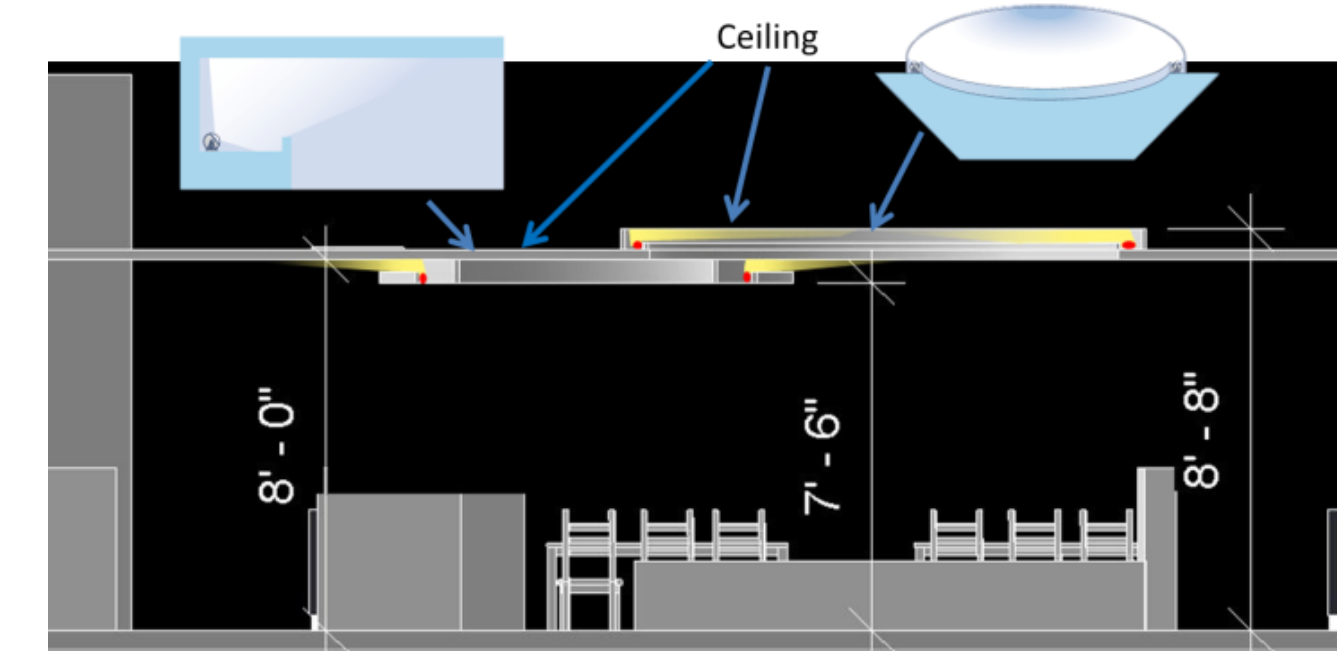
- **LED cove lighting** design separates stacks and reading area
 - 8' drop ceiling
- **Gypsum** ceiling in cove area
 - 2'x2' **ceiling tiles** elsewhere
- **LED pendants** over librarian desk for additional light

Library	Criteria	As Designed
Book Stacks : General @ Floor	<25 yrs Avg. (fc) Avg:Min	10 13.1 2:1
Book Stacks : Shelving @ 2.5' AFF	<25 yrs Avg. (fc) Avg:Min	15 18.5 2:1
Lending Desk : Staffed Area	25-65 yrs Avg. (fc) Avg:Min	50 55 1.2:1
Reading Areas	<25 yrs Avg. (fc) Avg:Min	25 26 1.7:1
Power Density (W/SF)		0.93 0.57

Library



Fixture Description	Mounting	Lamp
2'x4' Volumetric	Recessed	28W T8
6"X6" LED Downlight	Recessed	27W LED
LED Cove Lighting	Surface	6.8W/LF LED
LED Circular Pendant	Suspended	20W LED



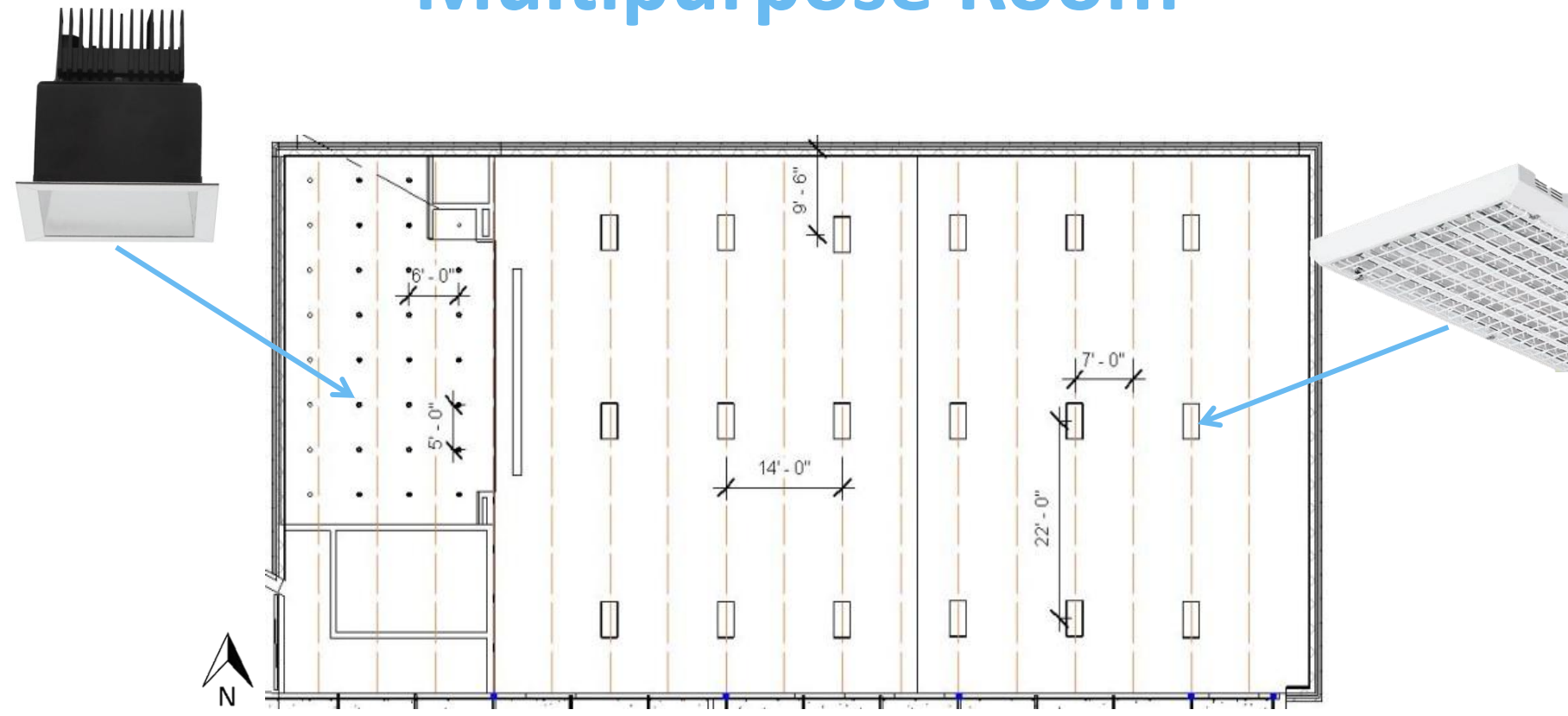
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Lighting Design Details:

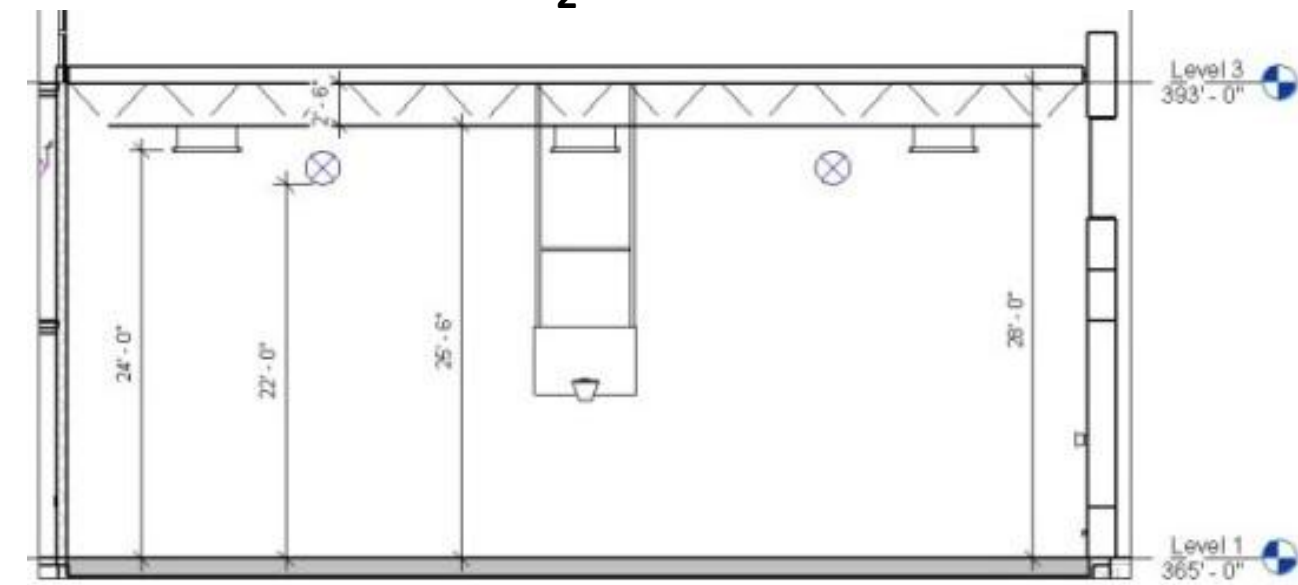
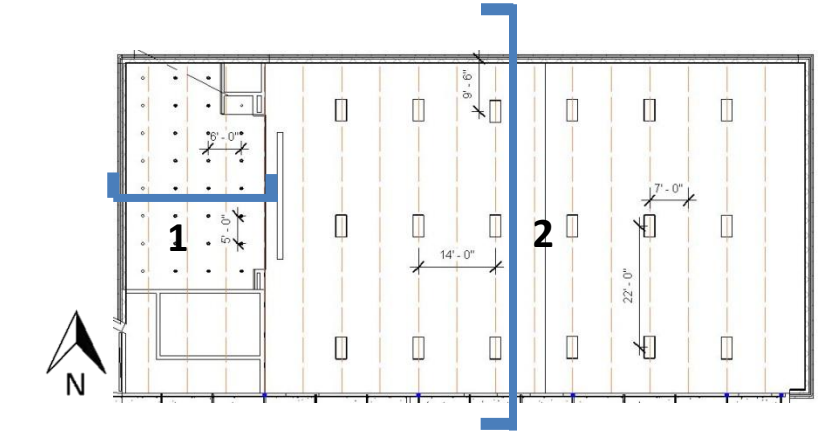
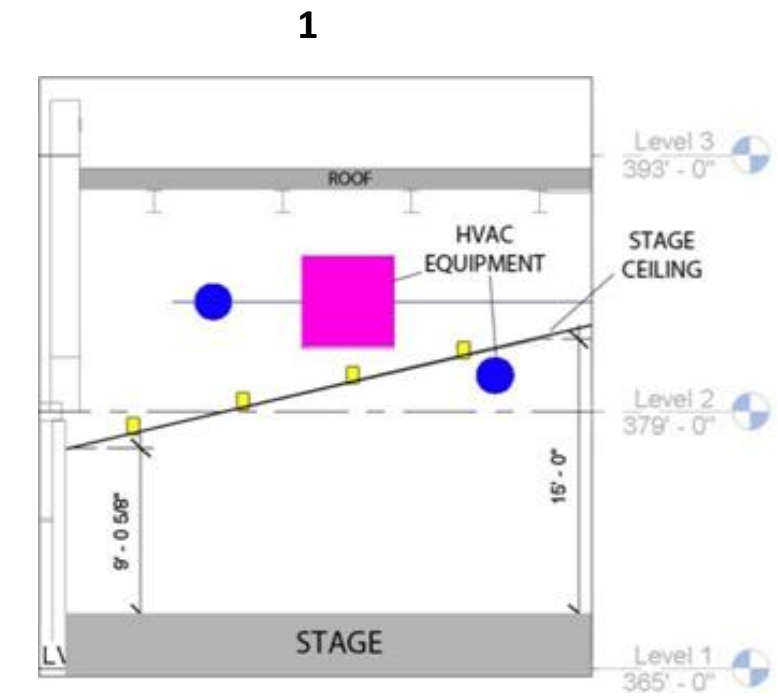
- Gym fixtures **mounted to 32" trusses**
- **LED downlights** use for ambient stage lighting
- Set of **theatrical lighting spotlights** can be spec'd
- **Additional lighting** can be added by request of the owner

Multi-Purpose Room	Criteria	As Designed
Assembly : A/V No Notes	<25 yrs Avg. (fc) 0.5	3.2
Assembly : Speaker/Panel	<25 yrs Avg:Min 2:1	1.3:1
Phys. Ed	<25 yrs Avg. (fc) 25	32
Cafeteria	<25 yrs Avg:Min 3:1	2.3:1
Basketball - Class 3	25-65 yrs Avg. (fc) 50	49
Power Density (W/SF)	Avg:Min 3:1	1.3:1
	1.2	0.97

Multipurpose Room



Fixture Description	Mounting	Lamp
Protected Gym Luminaire	Suspended	(6) 54W T5HO
6"x6" LED Downlight	Recessed	27W LED



Multipurpose Room

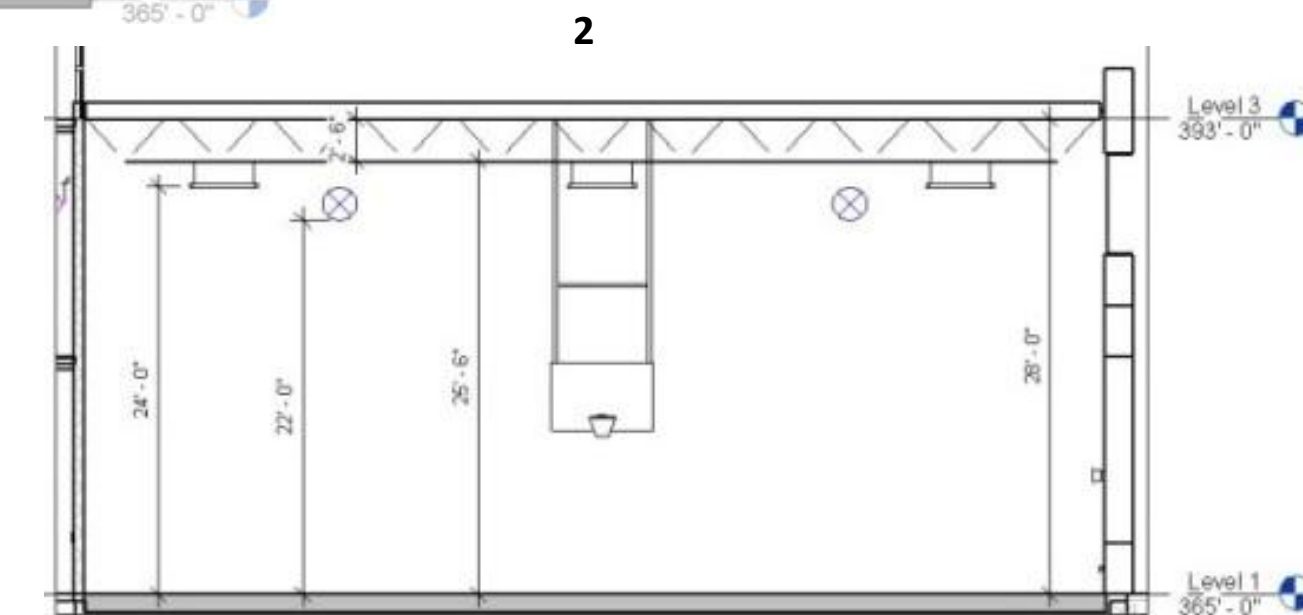
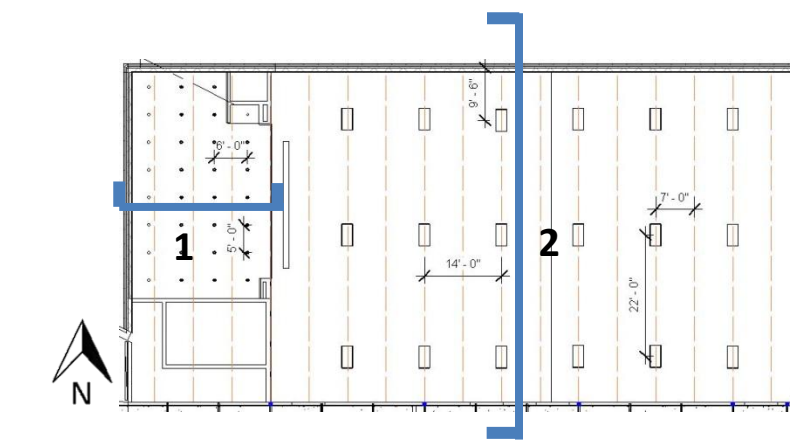
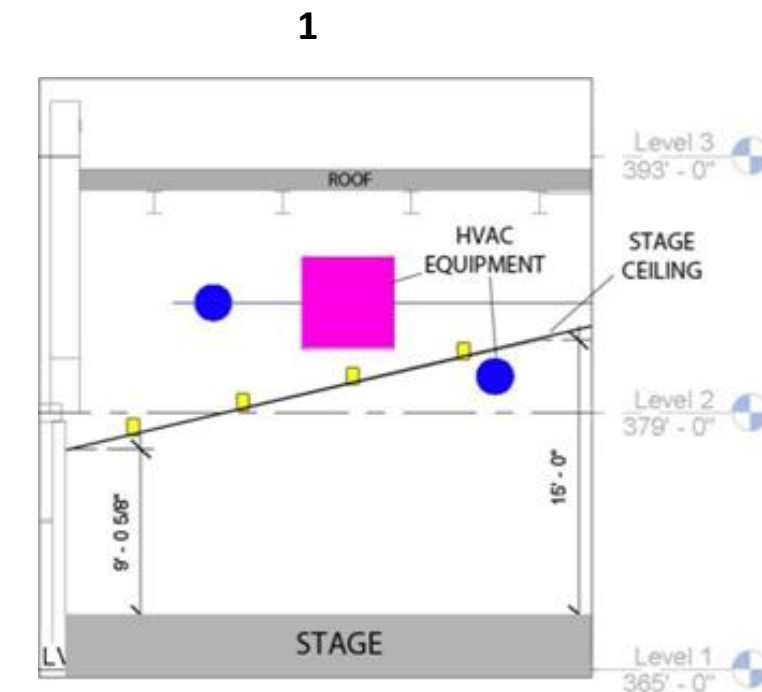
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 - **Multipurpose Room**

Lighting Design Details:

- One **scene control panel** on each side of mobile partition
- Each panel controls half of the fixtures
 - 2 lamp **electronic ballasts** are used
 - Different light levels are reached by **switching**
- Occupancy sensors and photosensors

Multi-Purpose Room	Criteria	As Designed
Assembly : <25 yrs	Avg. (fc) 0.5	3.2
A/V No Notes	Avg:Min 2:1	1.3:1
Assembly : <25 yrs	Avg. (fc) 25	32
Speaker/Panel	Avg:Min 3:1	2.3:1
Phys. Ed <25 yrs	Avg. (fc) 25	32
	Avg:Min 3:1	2.3:1
Cafeteria <25 yrs	Avg. (fc) 7.5	14
	Avg:Min 3:1	2.3:1
Basketball - Class 3 25-65 yrs	Avg. (fc) 50	49
	Avg:Min 3:1	1.3:1
Power Density (W/SF)	1.2	0.97

	Light Levels: 49 fc	All 6 Lamps On Activity: Amateur/Rec Leagues	Light Levels: 32 fc	4 Lamps On Activity: Physical Education	
	Light Levels: 14 fc	2 Lamps On Activity: Cafeteria Lunch		Light Levels: 3.2 fc	2 Lamps On in 4 Fixtures, Shades Down Activity: A/V Presentation



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 - *Multipurpose Room*
- Phase 2 Design

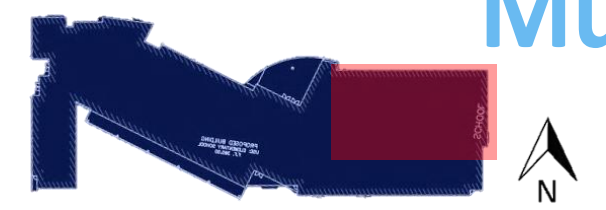
Skylight Design Details:

- **Add/Alternate:** (12) 4'x4' fixed skylights in 28' exposed roof
- Skylights more **evenly distribute** daylight
- Horizontal **motor shades** are necessary

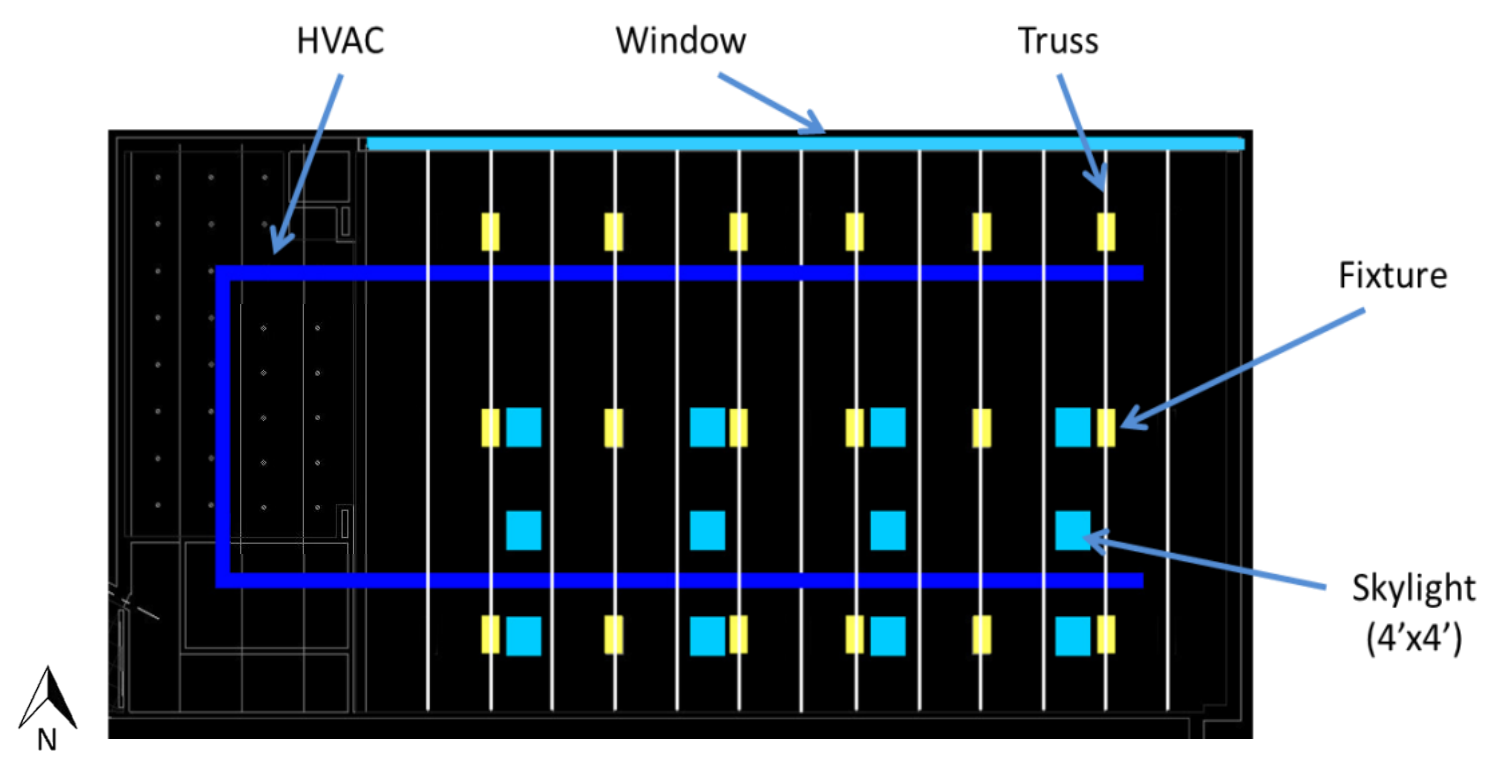
Original Gymnasium Window



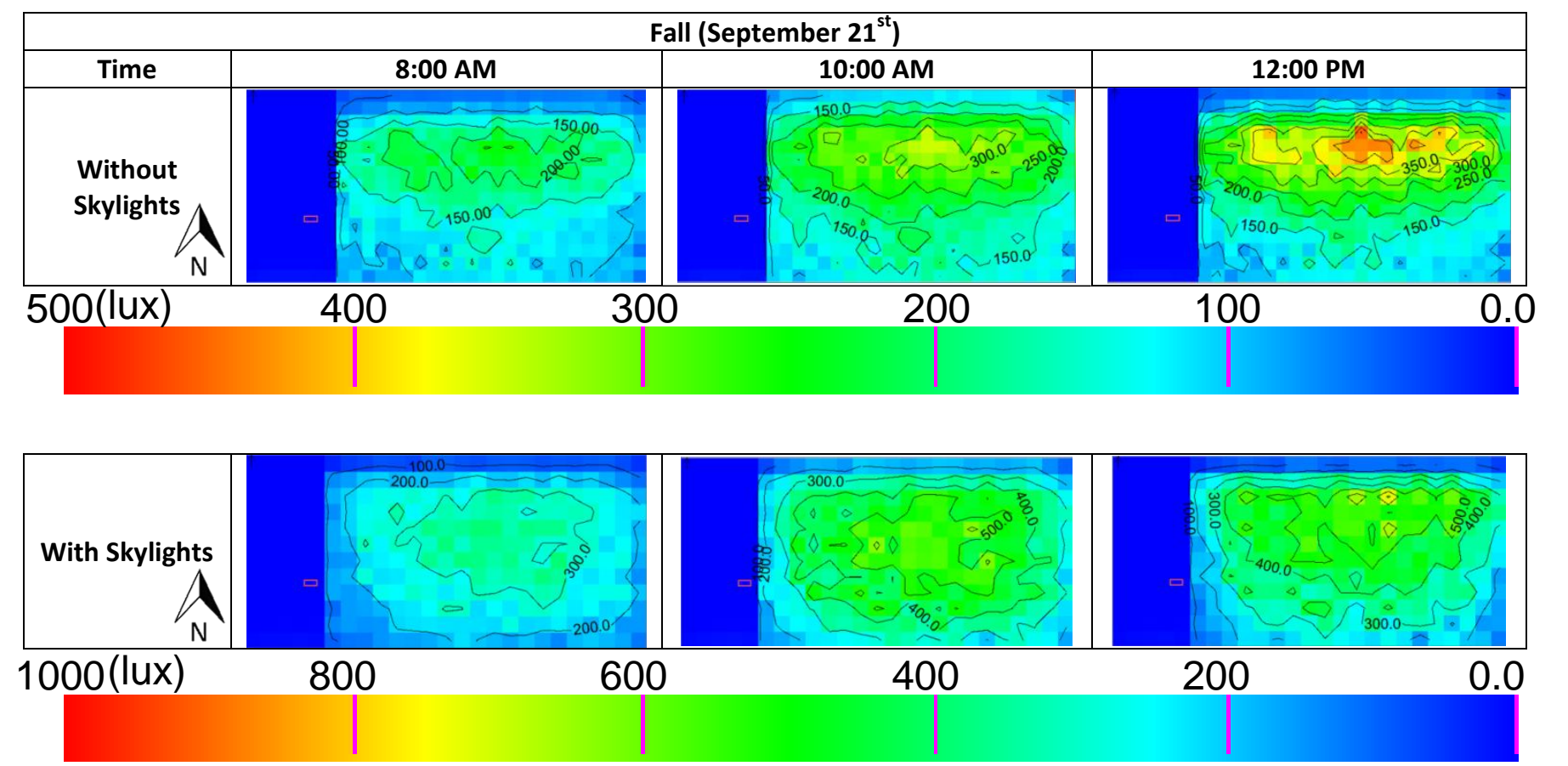
Multipurpose Room



Skylight Layout



Skylight Analysis – Partly Cloudy Sky



Energy Savings from Switching Electric Light

1,790 kWh/year
\$120/year

- Introduction
- Phase 1 Design
- Phase 2 Design

General Assumptions Made:

- **Electrical System Overview**

- Natatorium
- Clinic

For Clinic:

- Existing Mechanical and Electrical rooms could be used
- Basement distribution equipment still functional
- Upper floors will remain un-renovated until further design

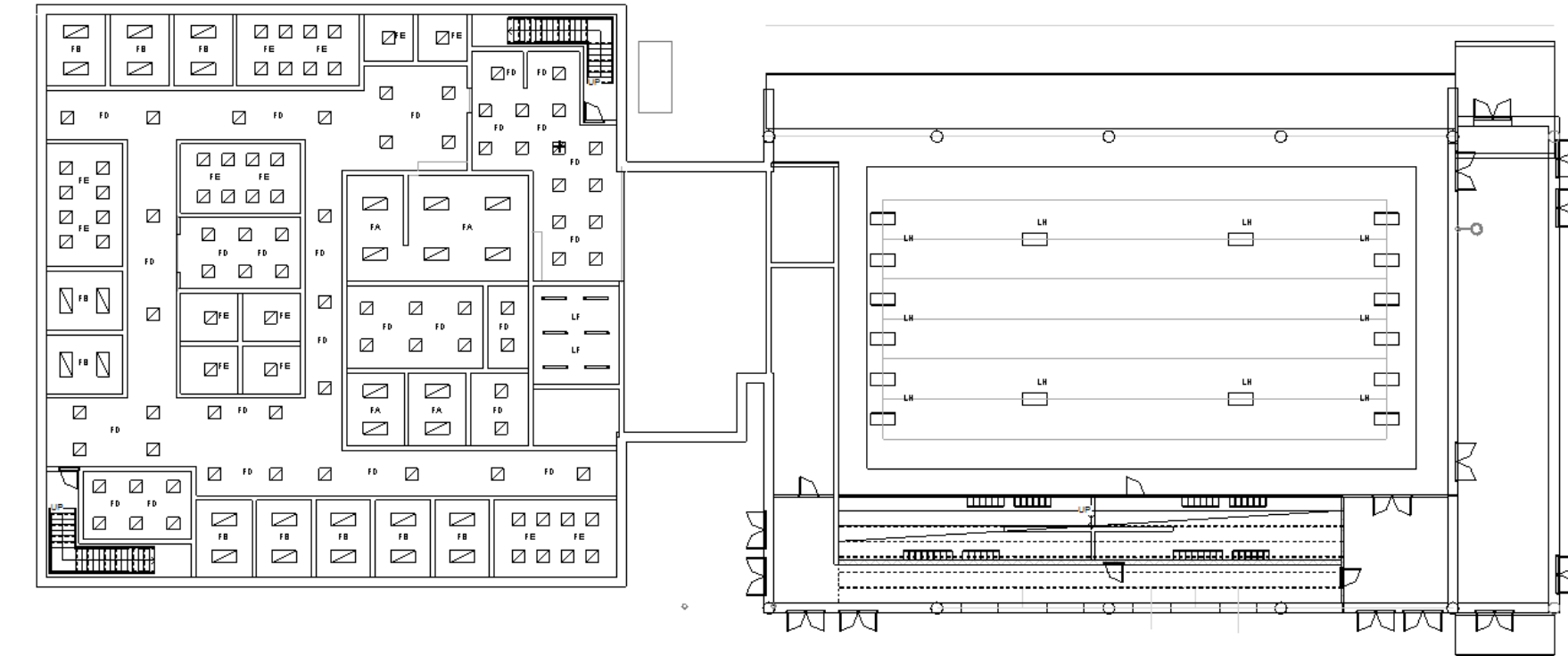
For Natatorium:

- All new equipment needed for pool will be located in the basement of the existing clinic
- Existing distribution equipment still functional /able to supply desired load

Phase 2 – Electrical System Overview

Total Building Load
109.8 kVA

Clinic	kVA	Natatorium/Parking	kVA
Lighting Load	1.9	Lighting Load	44.2
Power Load	30.0	Power Load	33.5
Emergency Loads: Life Safety	1.3	Emergency Loads: Life Safety	1.8
Emergency Loads: Critical	30.0	Emergency Loads: Critical	0



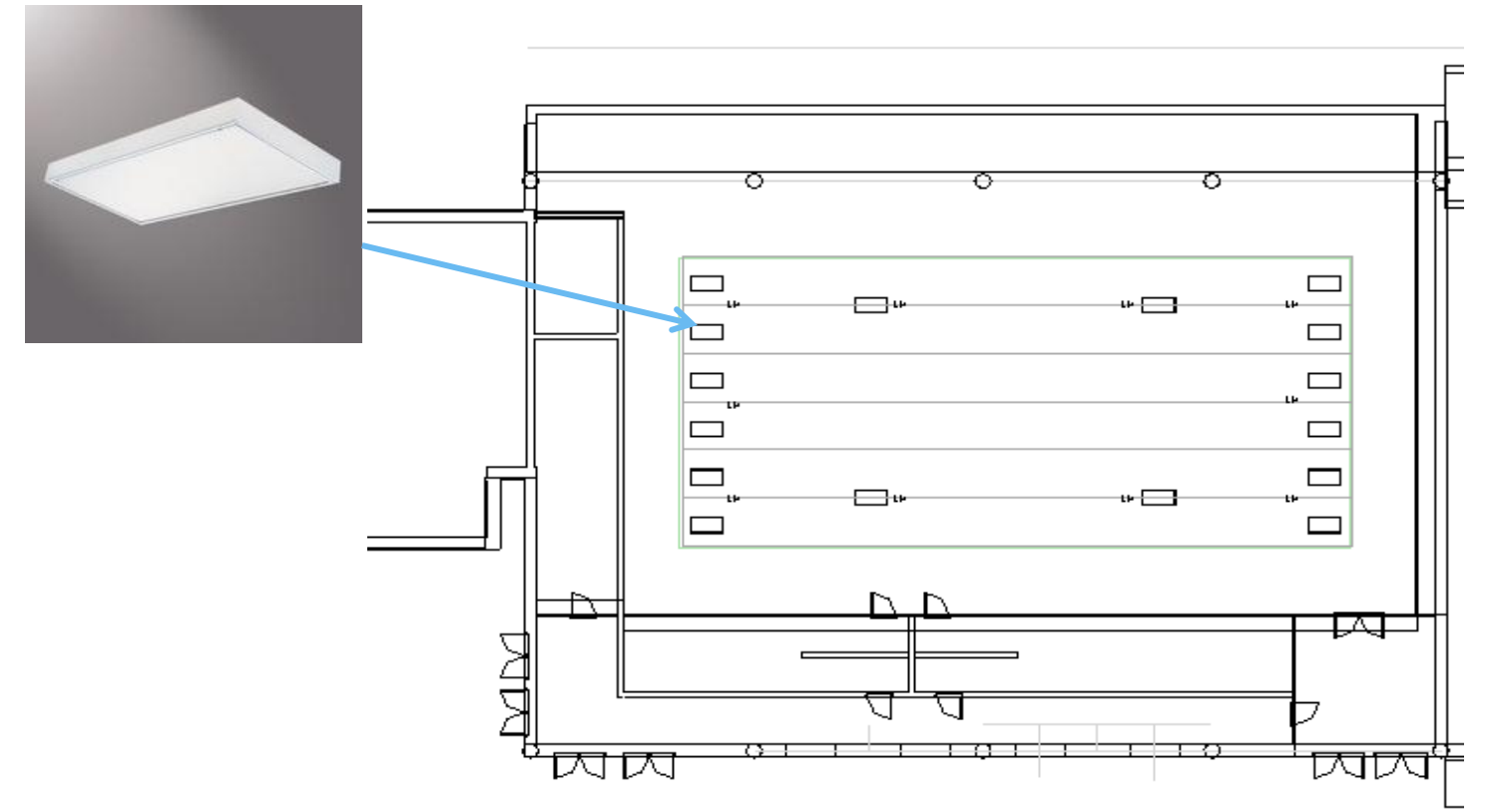
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- **Phase 2 Design**
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 - **Natatorium**
 - Clinic

Lighting Design Details:

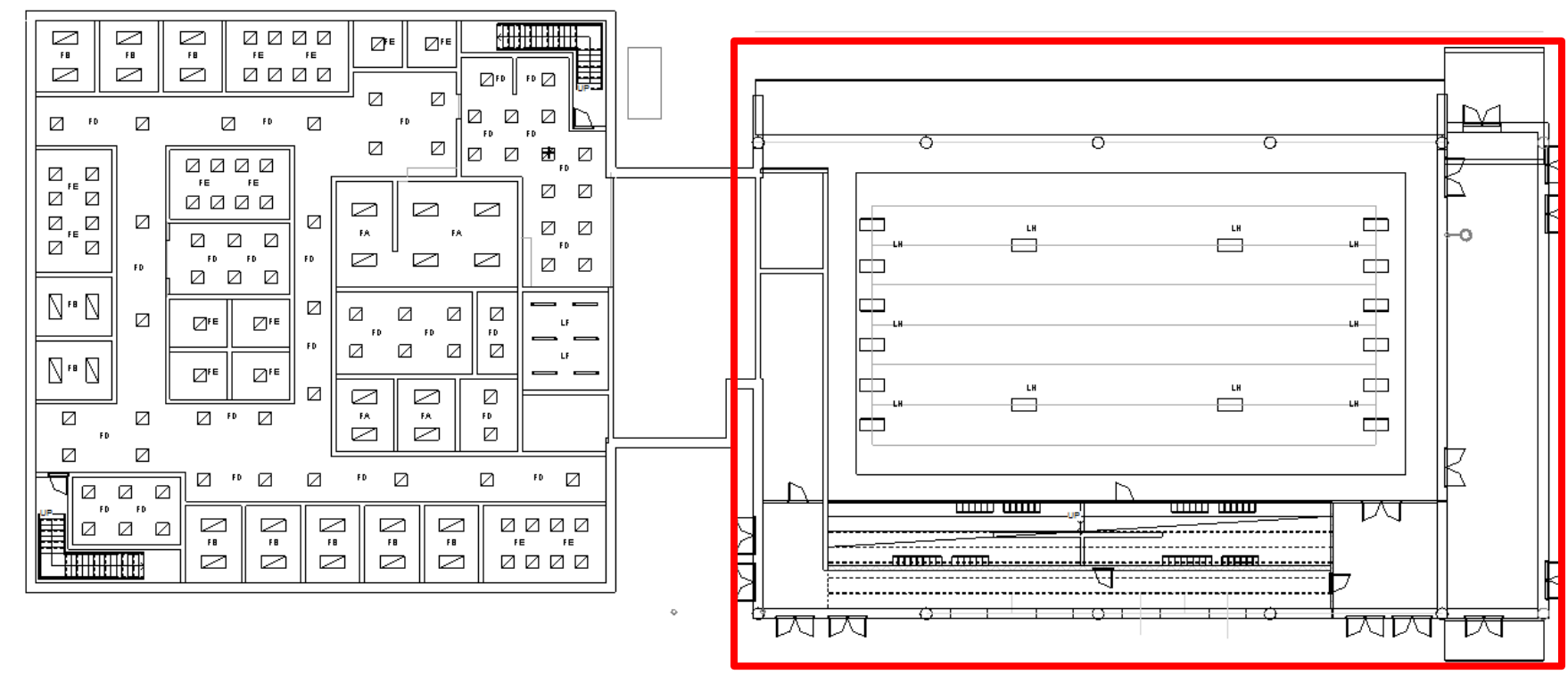
- **Watertight fixtures** suspended **24'** above pool deck
- Fixture layout also provides adequate light levels in **spectator seating** above locker rooms
- Fixtures **controlled** from separate control room
- **Lift** used to perform maintenance

Pool	Criteria	As Designed
Water Surface	Avg. (fc)	31
	Avg:Min	2:1
Deck Surface	Avg. (fc)	22
	Avg:Min	2.5:1
Turning Lanes	Avg. (fc)	48
	Avg:Min	1.3:1
Power Density (W/SF)	1.2	1.03

Phase 2 - Natatorium



Fixture Description	Mounting	Lamp
Watertight Luminaire	Suspended	(6) 54W T5HO



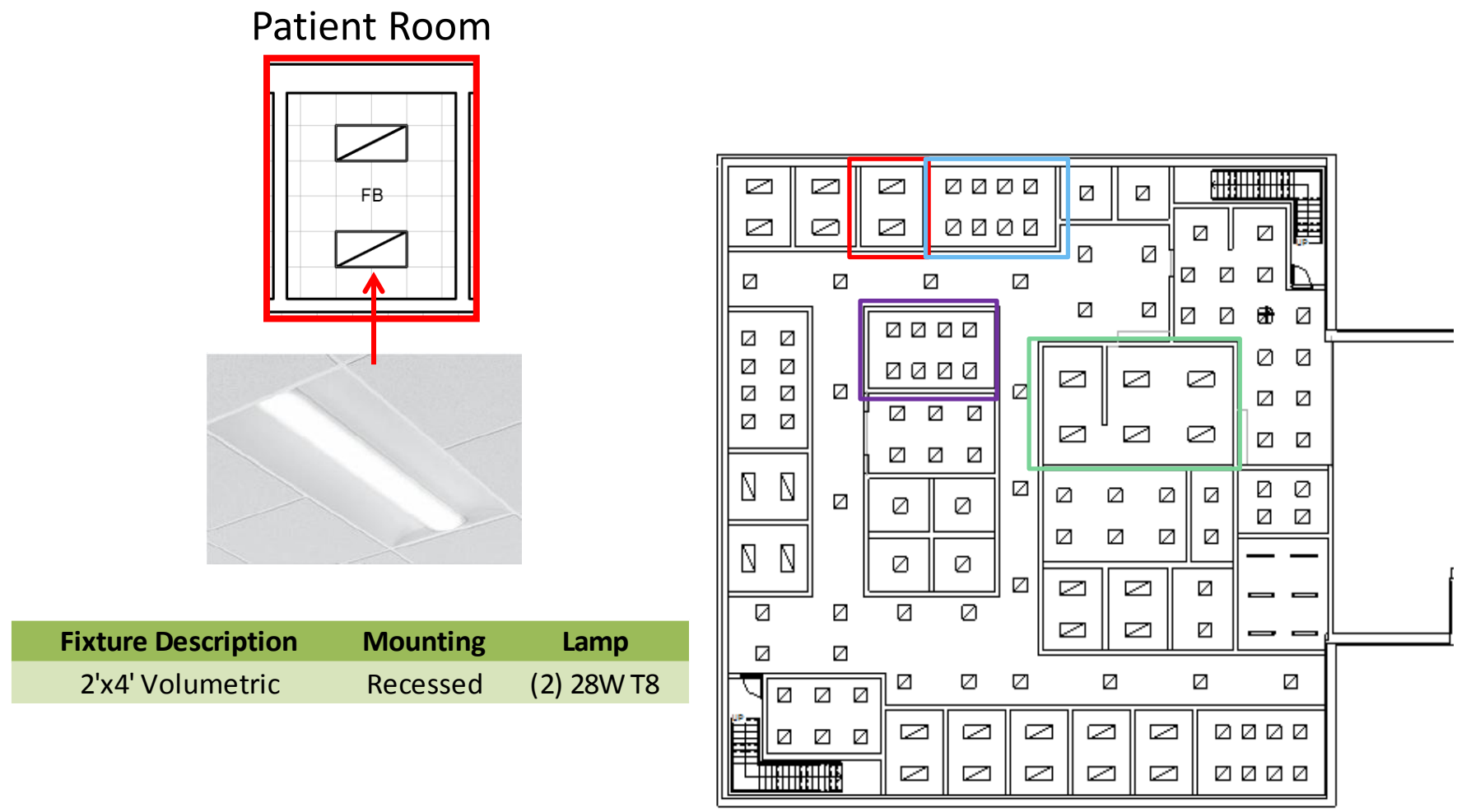
- Introduction
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- **Phase 2 Design**
 - Electrical System Overview
 - Natatorium
 - *Clinic*

Lighting Design Details:

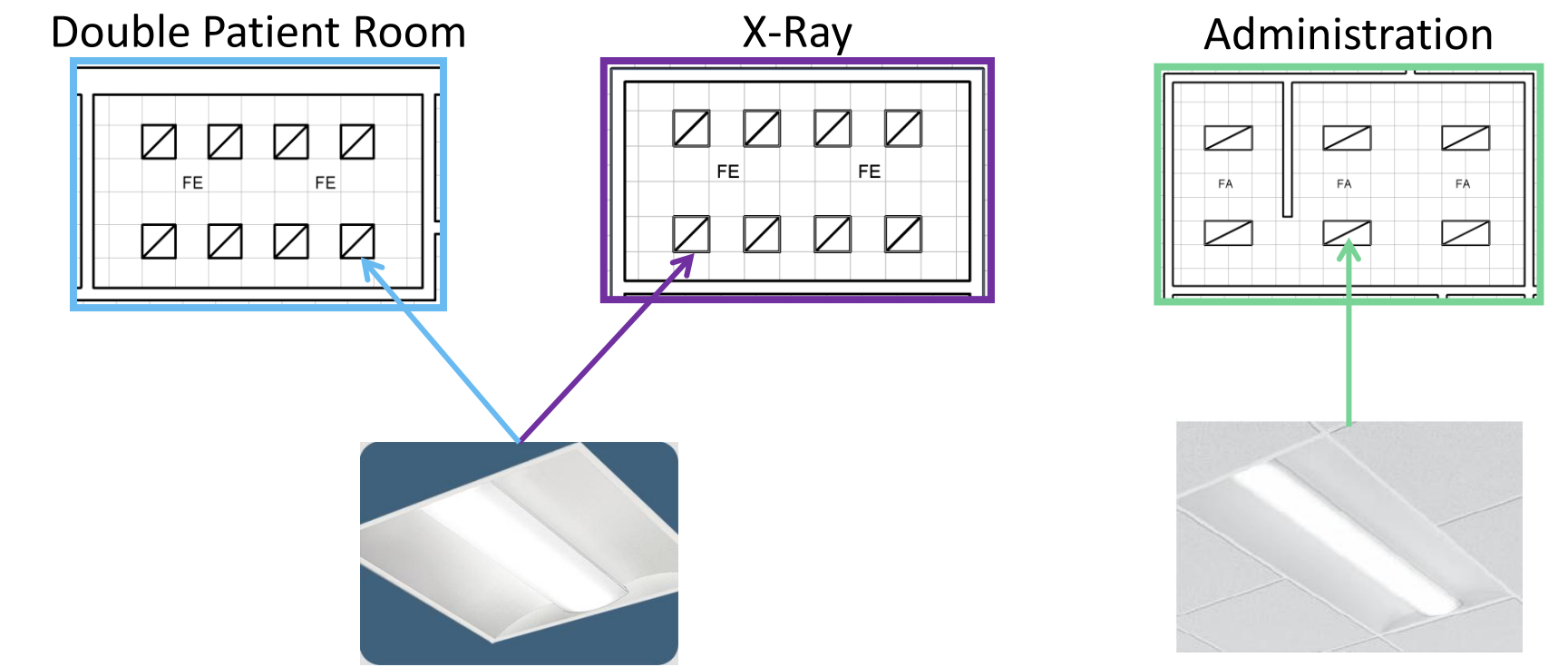
- **2'x2' tile ceiling** dropped at **8' AFF** allowing for **6' plenum space**

Clinic		Criteria As Designed	
Individual	Avg. (fc)	50	50
Patient Rooms	Avg:Min	2:1	1.7:1
Power Density (W/SF)		1.66	0.99
Double Patient Rooms	Avg. (fc)	50	50.5
	Avg:Min	2:1	1.7:1
Power Density (W/SF)		1.66	1.17
X-Ray	Avg. (fc)	50	50
	Avg:Min	2:1	1.7:1
Power Density (W/SF)		1.11	0.5
Administration	Avg. (fc)	30	31
	Avg:Min	2:1	1.9:1
Power Density (W/SF)		0.98	0.5

Phase 2 - Clinic



Fixture Description	Mounting	Lamp
2'x4' Volumetric	Recessed	(2) 28W T8

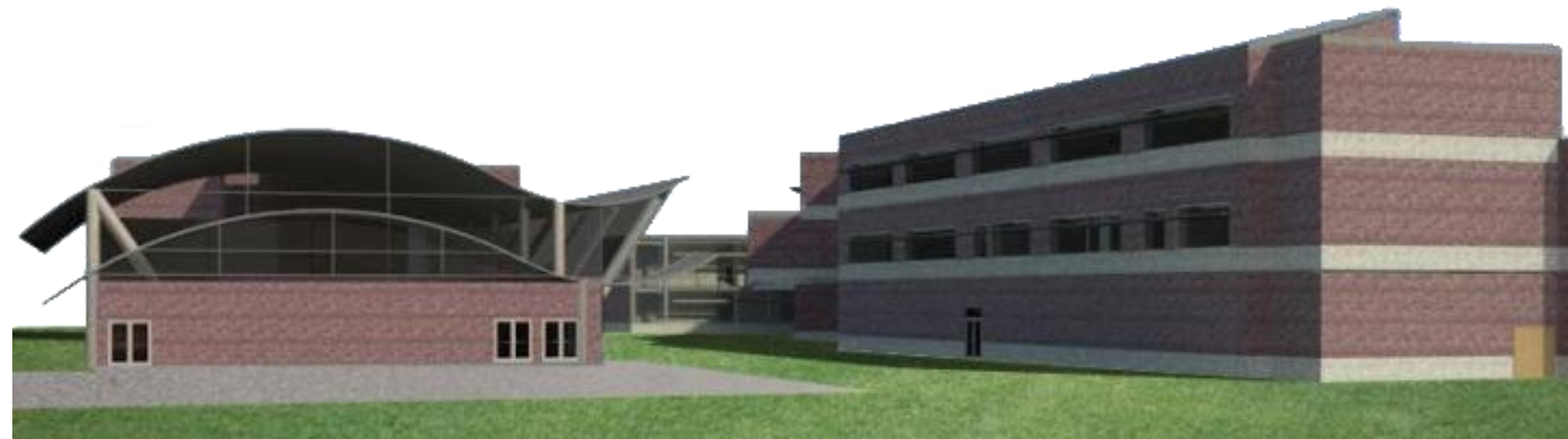
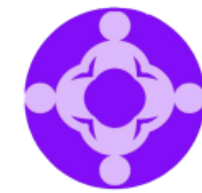


Fixture Description	Mounting	Lamp
2'x2' Volumetric	Recessed	(2) 17W T8

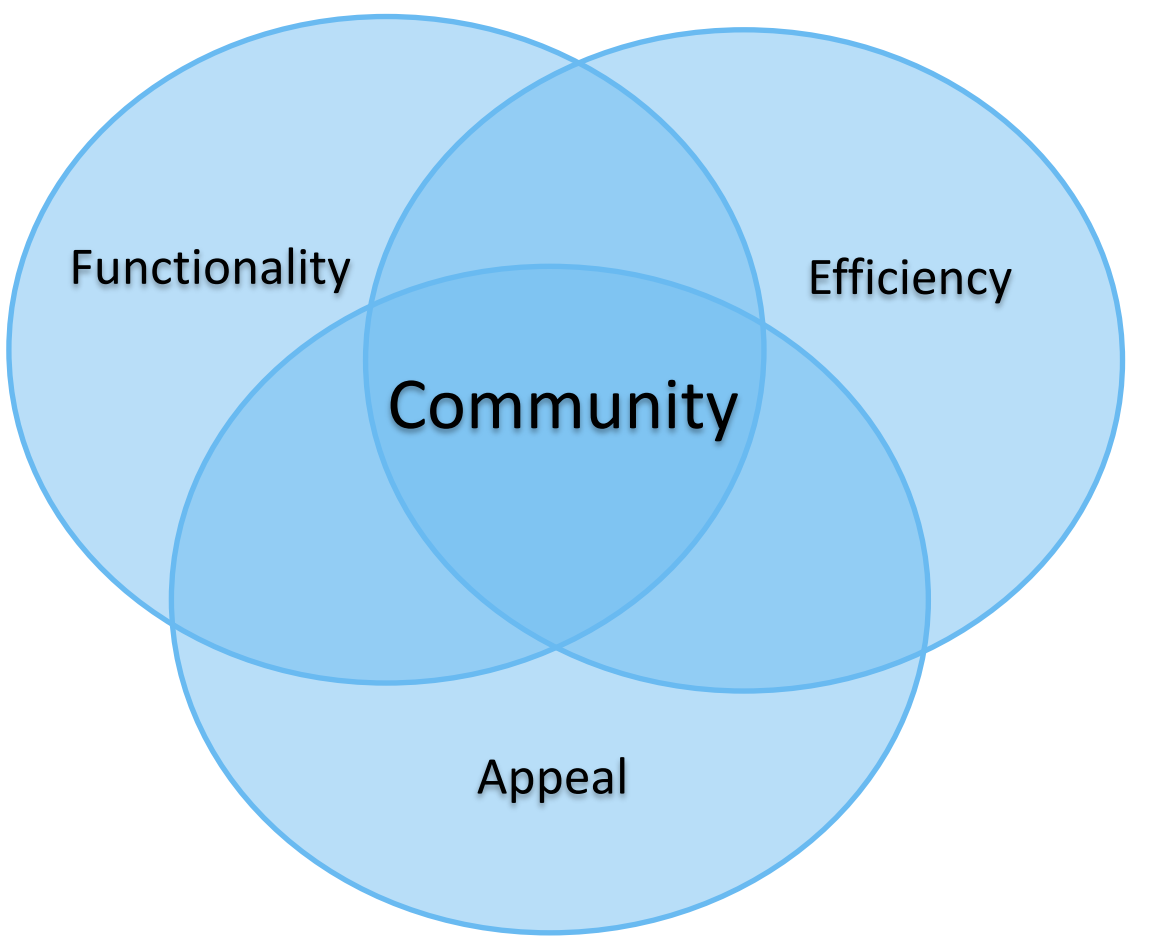
Fixture Description	Mounting	Lamp
2'x4' Volumetric	Recessed	(1) 28W T8



Integration



- *Introduction*
- Phase 1
 - Enclosure
 - Typical Classroom
 - Atrium
 - Corridor
 - Multipurpose Room
- Phase 2
 - Natatorium
 - Clinical Renovation



Integration

Team Goal

To create an innovative, high-performance environment in a way that stimulates involvement in both education and the *Community*

Functionality

Define the critical function of each package and ensure that design meets criteria

Efficiency

Ensure that building engineered systems are efficient in energy usage, as well as upfront and lifecycle cost

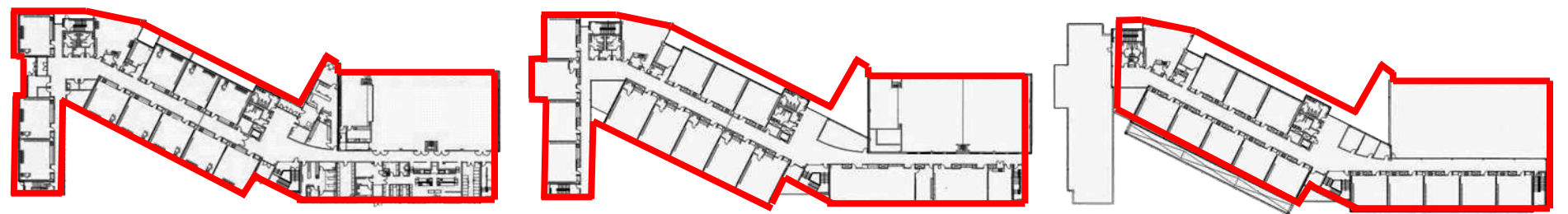
Appeal

Create an appealing building and atmosphere which stimulates a positive learning environment

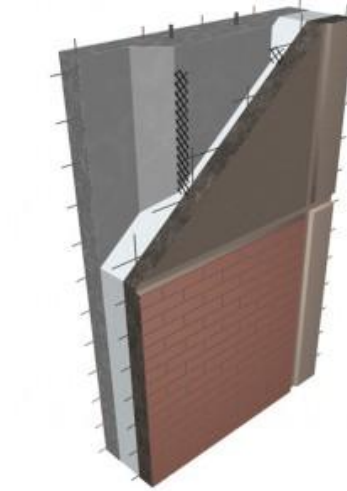
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Enclosure

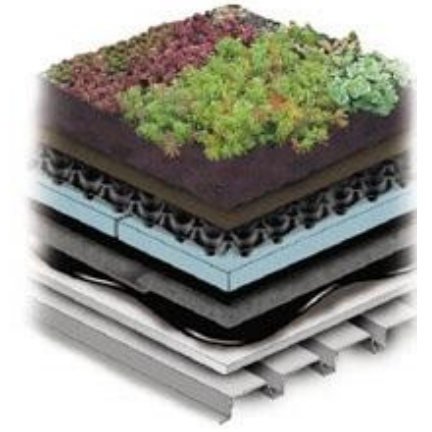
create a functional barrier from exterior elements while maintaining aesthetic appeal & interior comfort



Integrated Design Components



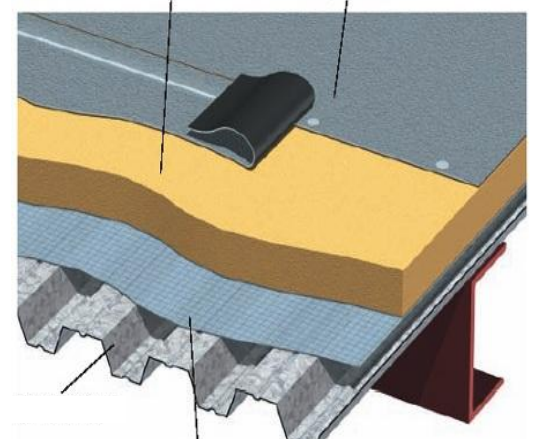
Precast Insulated Panels



Green Roof



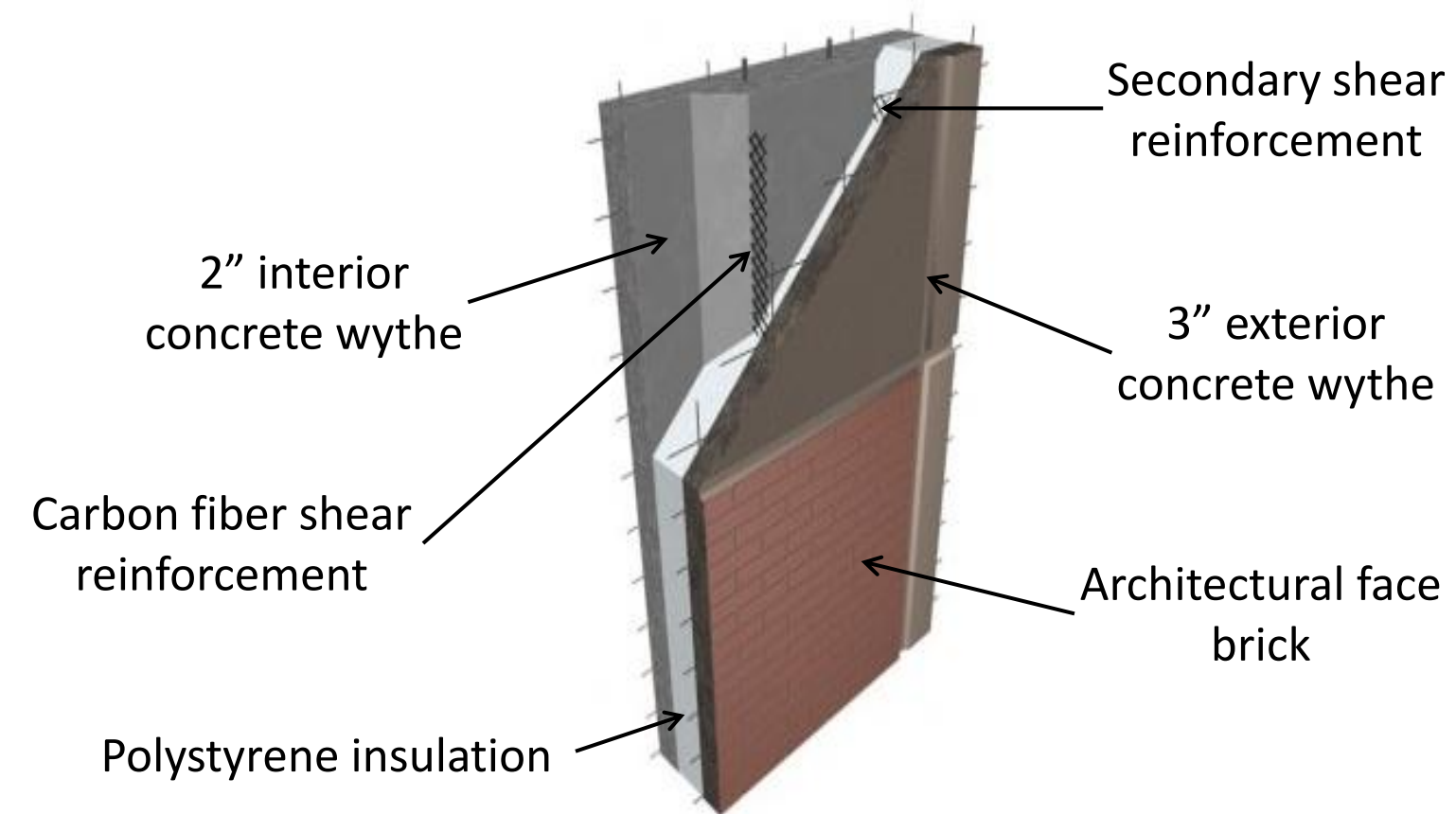
High Performance Glazing and Daylighting Design



Roof

- Introduction
- Phase 1
 - *Enclosure*
 - Typical Classroom
 - Atrium
 - Corridor
 - Multipurpose Room
- Phase 2
 - Natatorium
 - Clinical Renovation

Precast Insulated Panels



Integrated Design Components

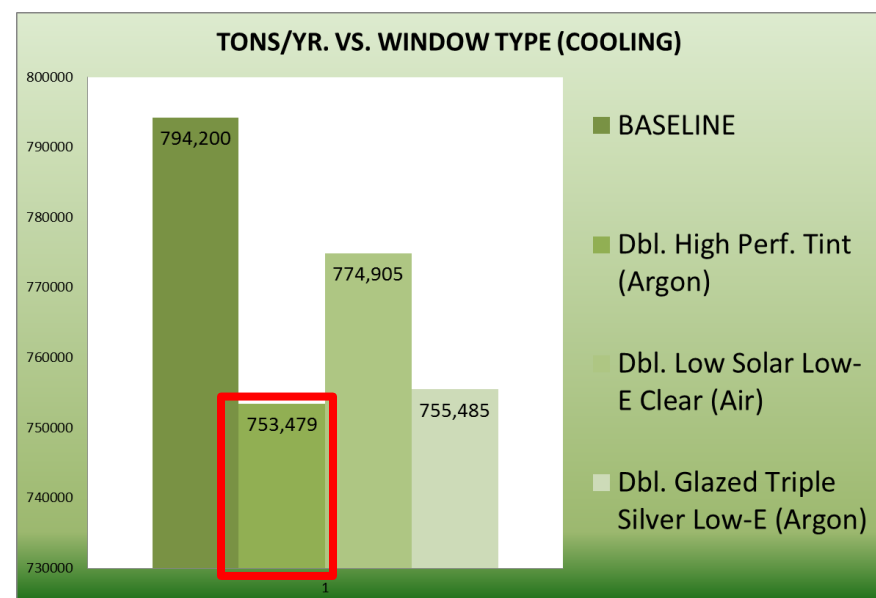
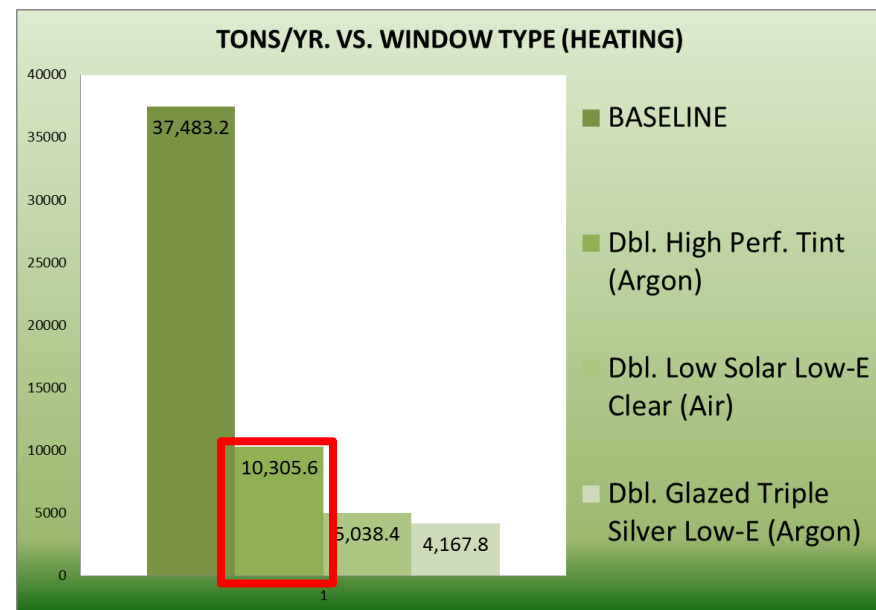
- Meet ASHRAE 90.1 requirements

U-Value = 0.0383

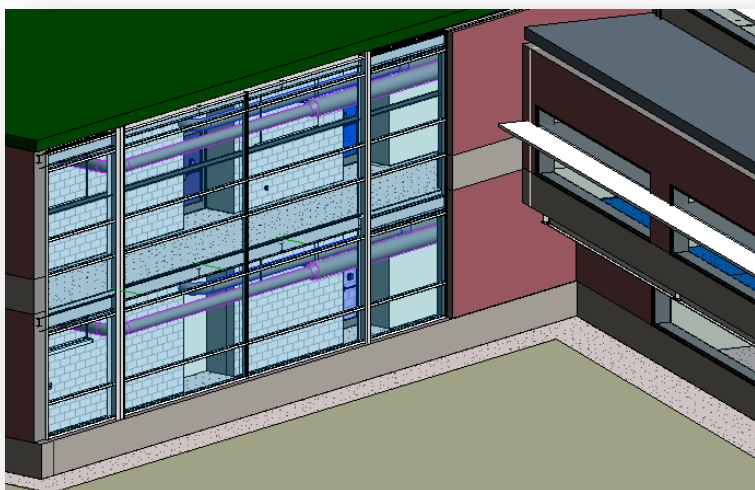
- Optimize constructability
- Light weight → Larger panel size
- Local fabricators

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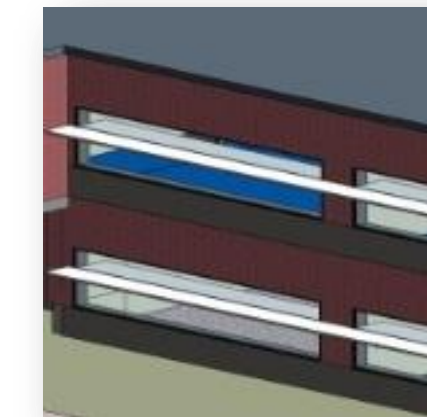


Fenestration Design

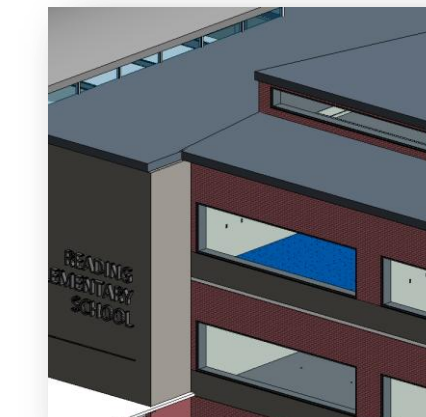


Glazing Types	Assembly U-Value	Assembly SHGC	VT
Double High Performance Tint (Argon)	0.54	0.39	0.607
Double Low Solar Low-E Clear (Air)	0.40	0.382	0.701
Double Glazed Triple Silver Low-E (Argon)	0.35	0.272	0.638

create a functional barrier from exterior elements while maintaining aesthetic appeal & interior comfort



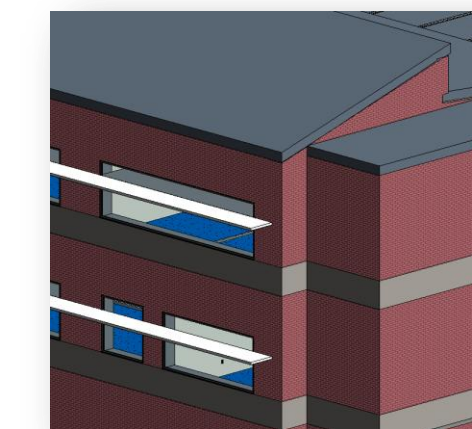
Lightshelves



Clerestories



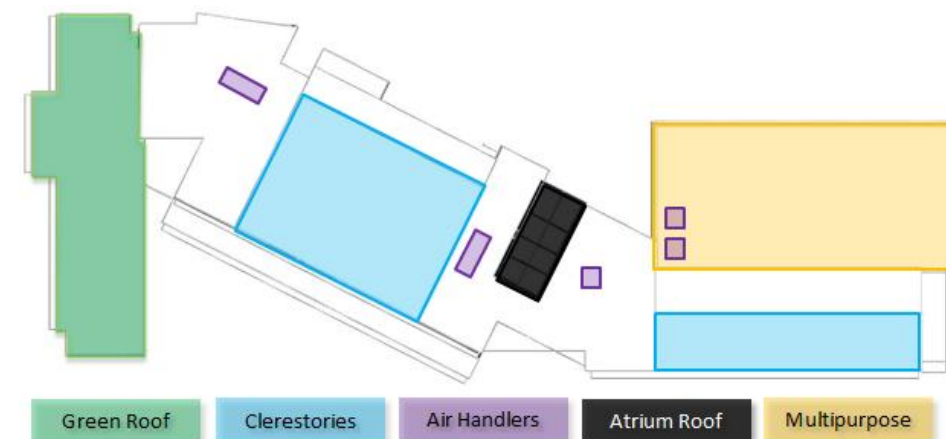
Curtain Walls



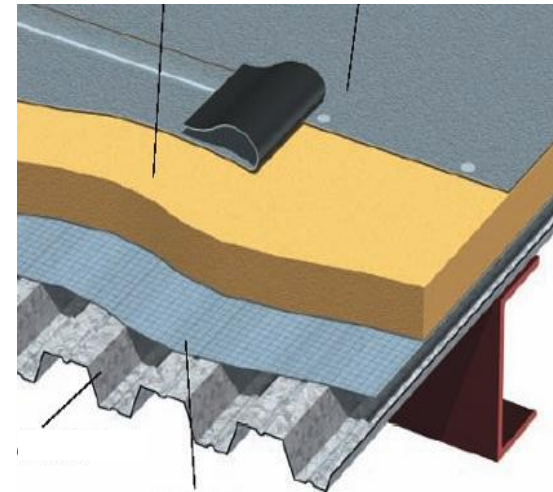
Lightshelves and Clerestories

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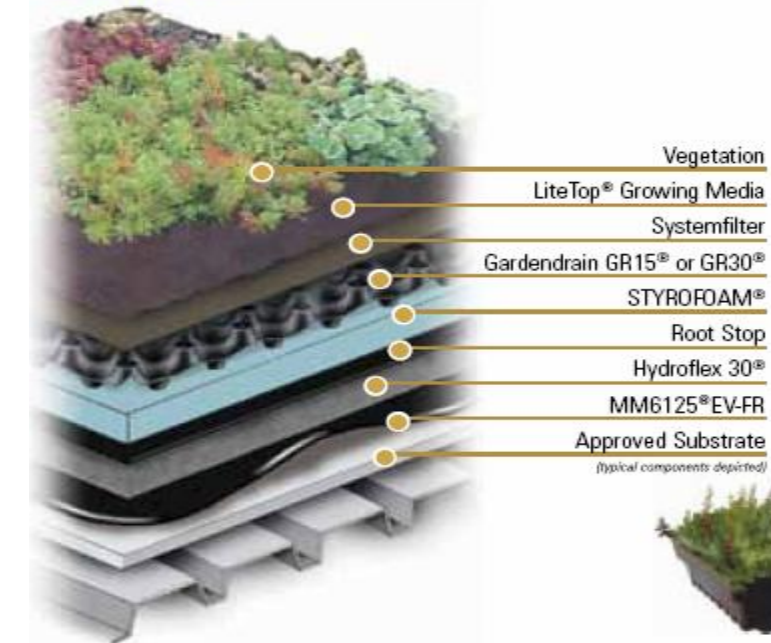
Schematic Roof Plan



Green Roof



EXTENSIVE



create a functional barrier from exterior elements while maintaining aesthetic appeal & interior comfort

Integrated Design Components

- Meet ASCE7 and ASHRAE 90.1 requirements and optimize energy efficiency

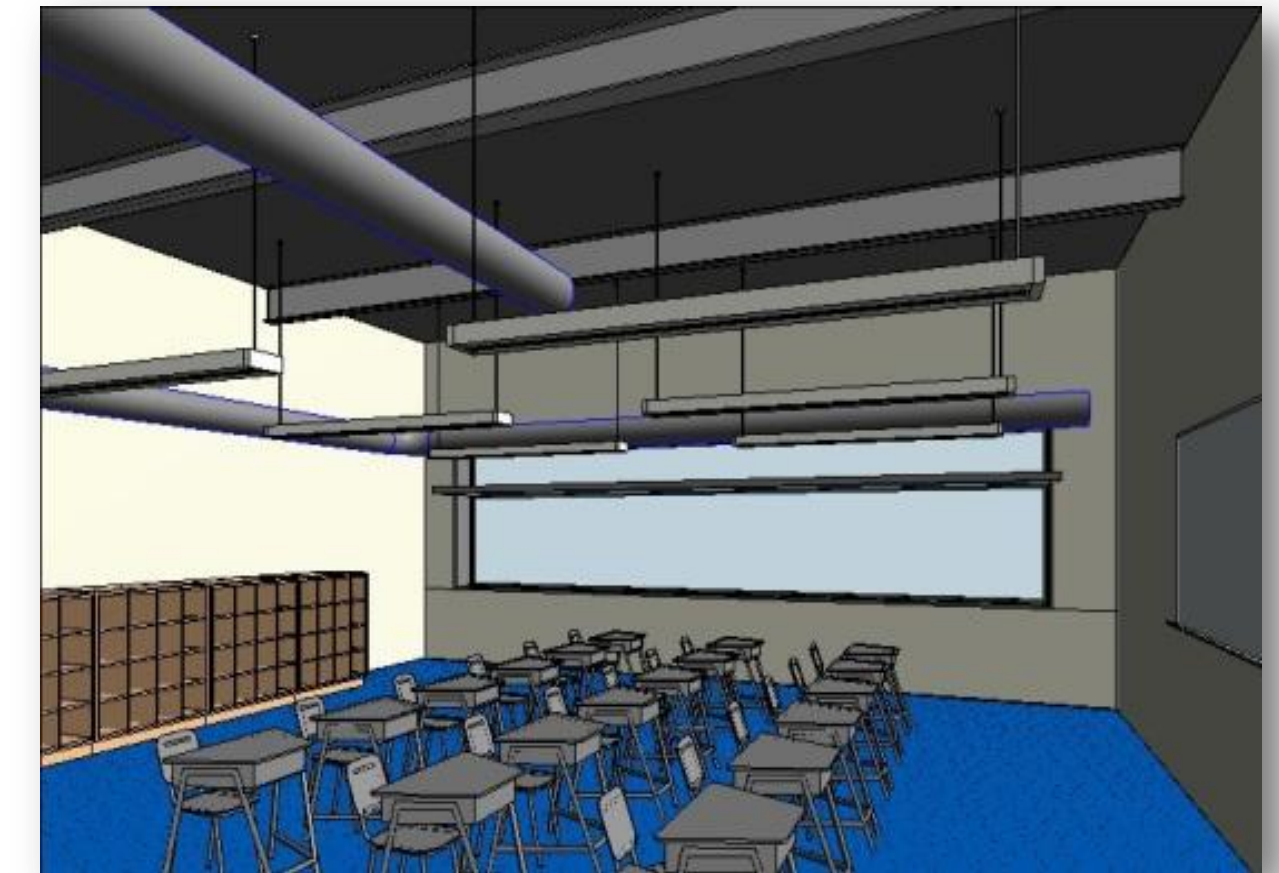
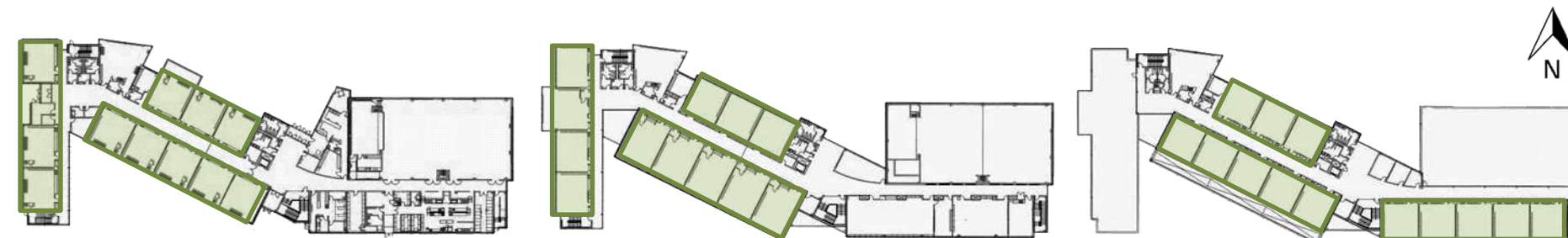
U-Value = 0.0333

- Interactive and unique learning environment
- Constructability
 - Lightweight system
 - Minimal maintenance
 - Open joint assembly
- Minimize additional structure costs

- Introduction
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Typical Classroom

create a stimulating & comfortable learning environment

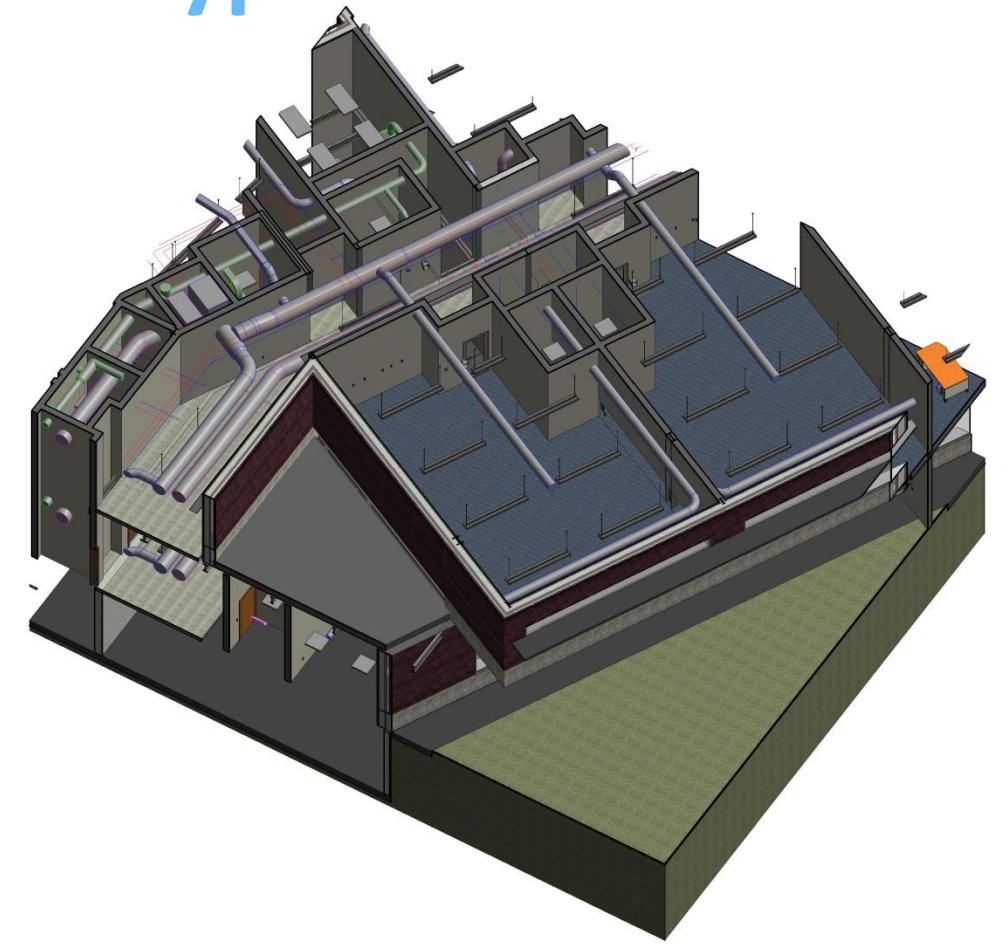


Integrated Design Components

- Systems Spacing
- Constructability

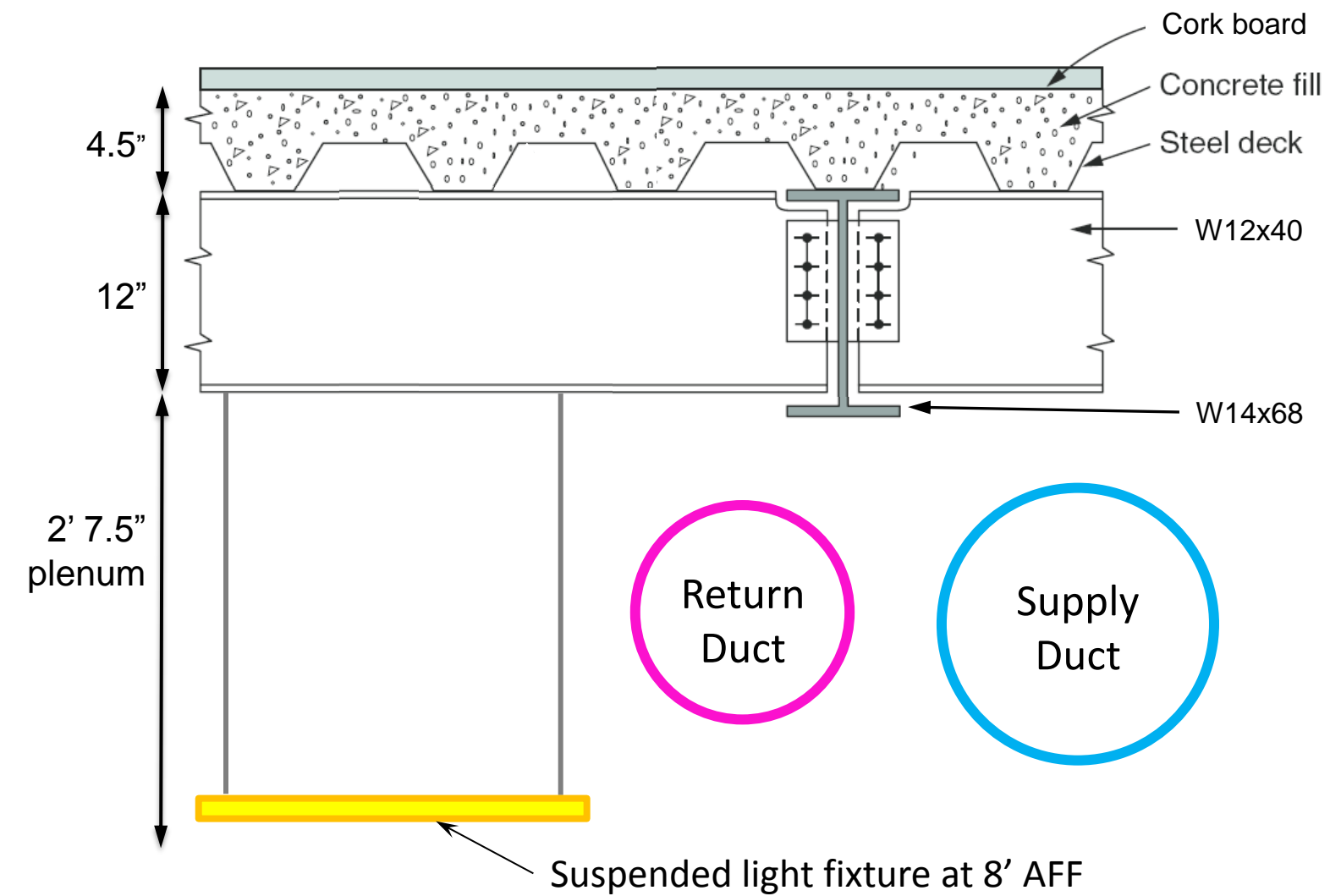
- Introduction
- Phase 1
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Typical Classroom



create a stimulating & comfortable learning environment

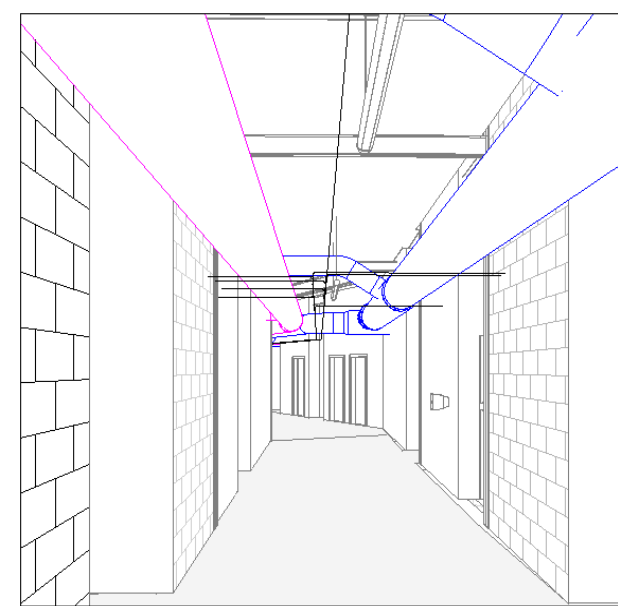
Integrated Design Components



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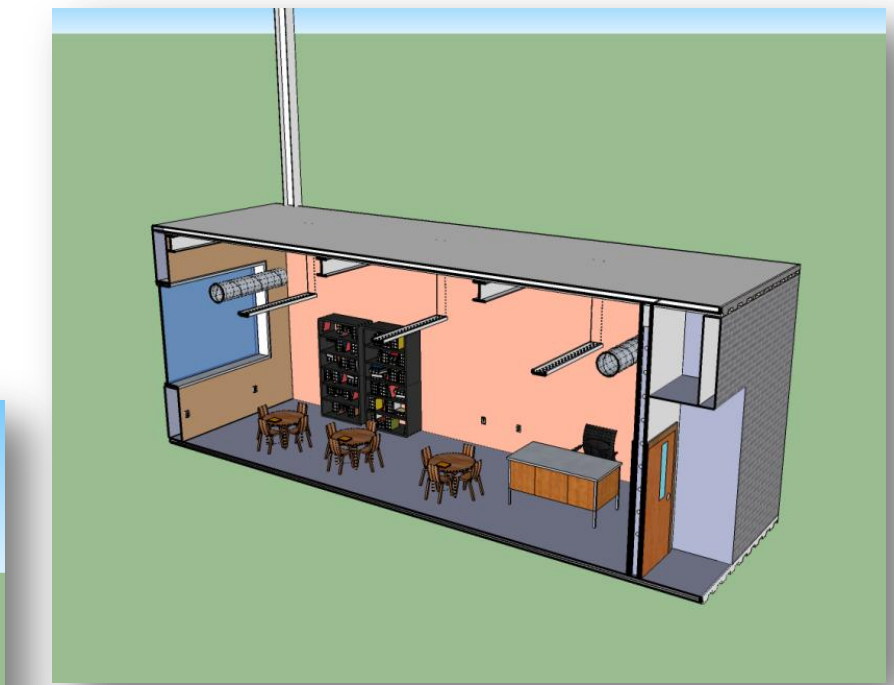
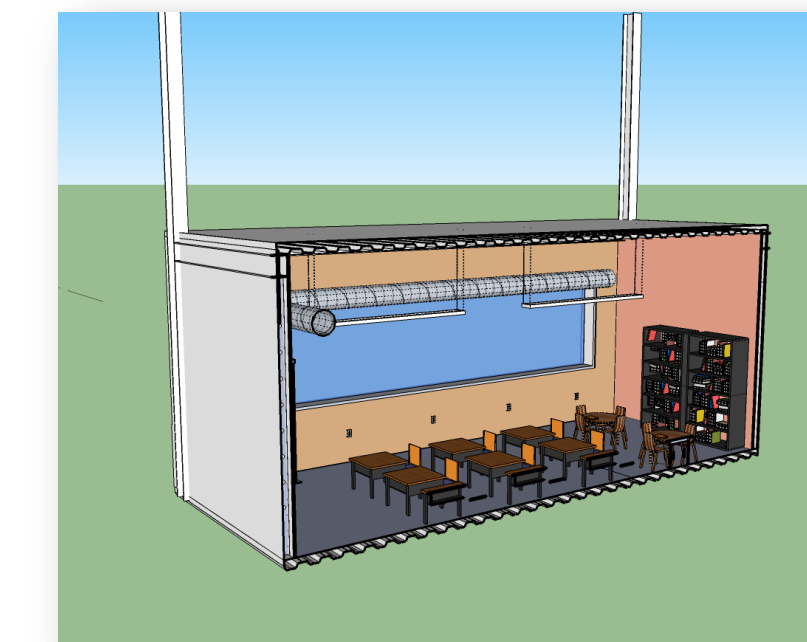
Typical Classroom

Clash Detection



create a stimulating & comfortable learning environment

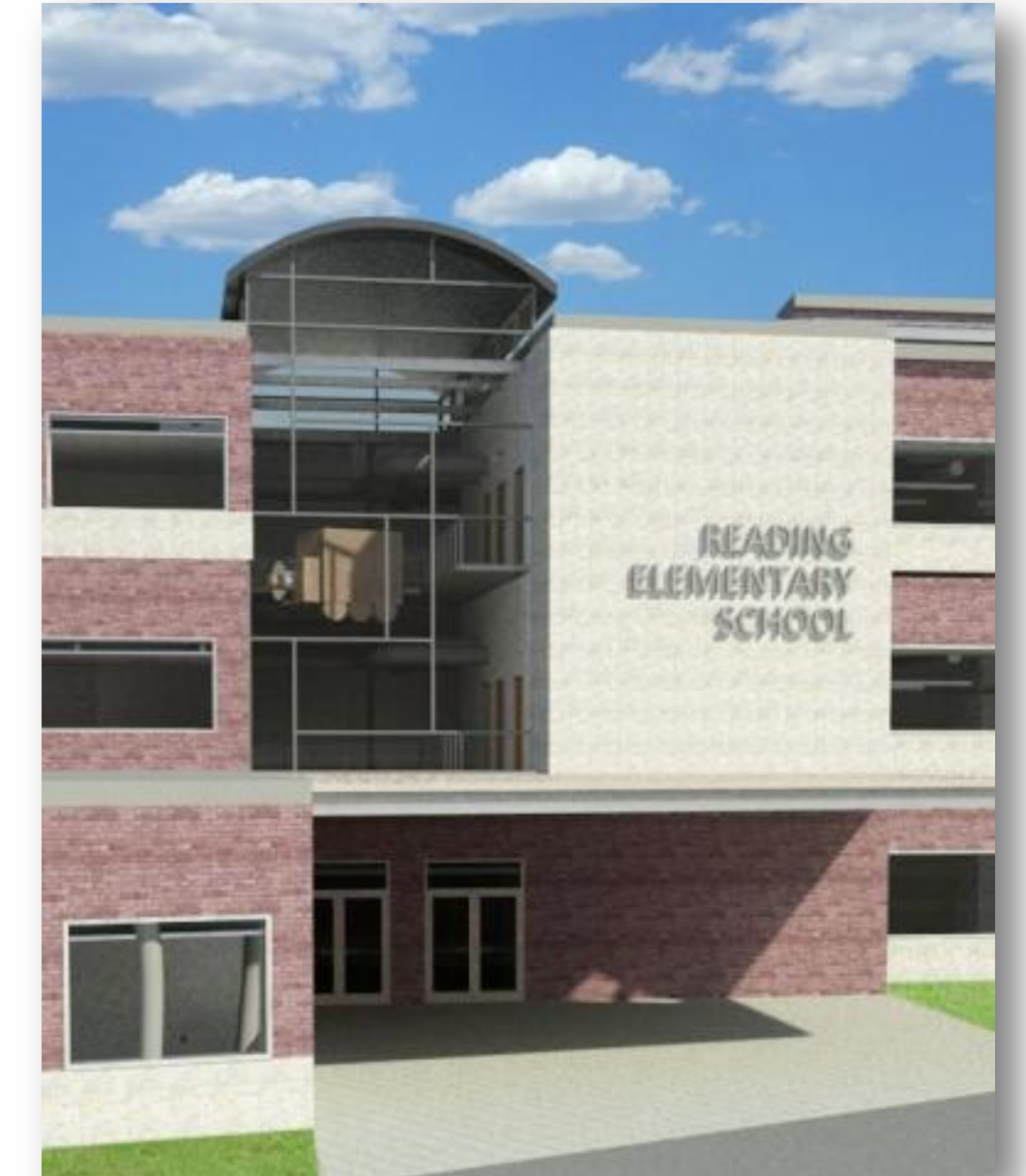
Virtual Mockups



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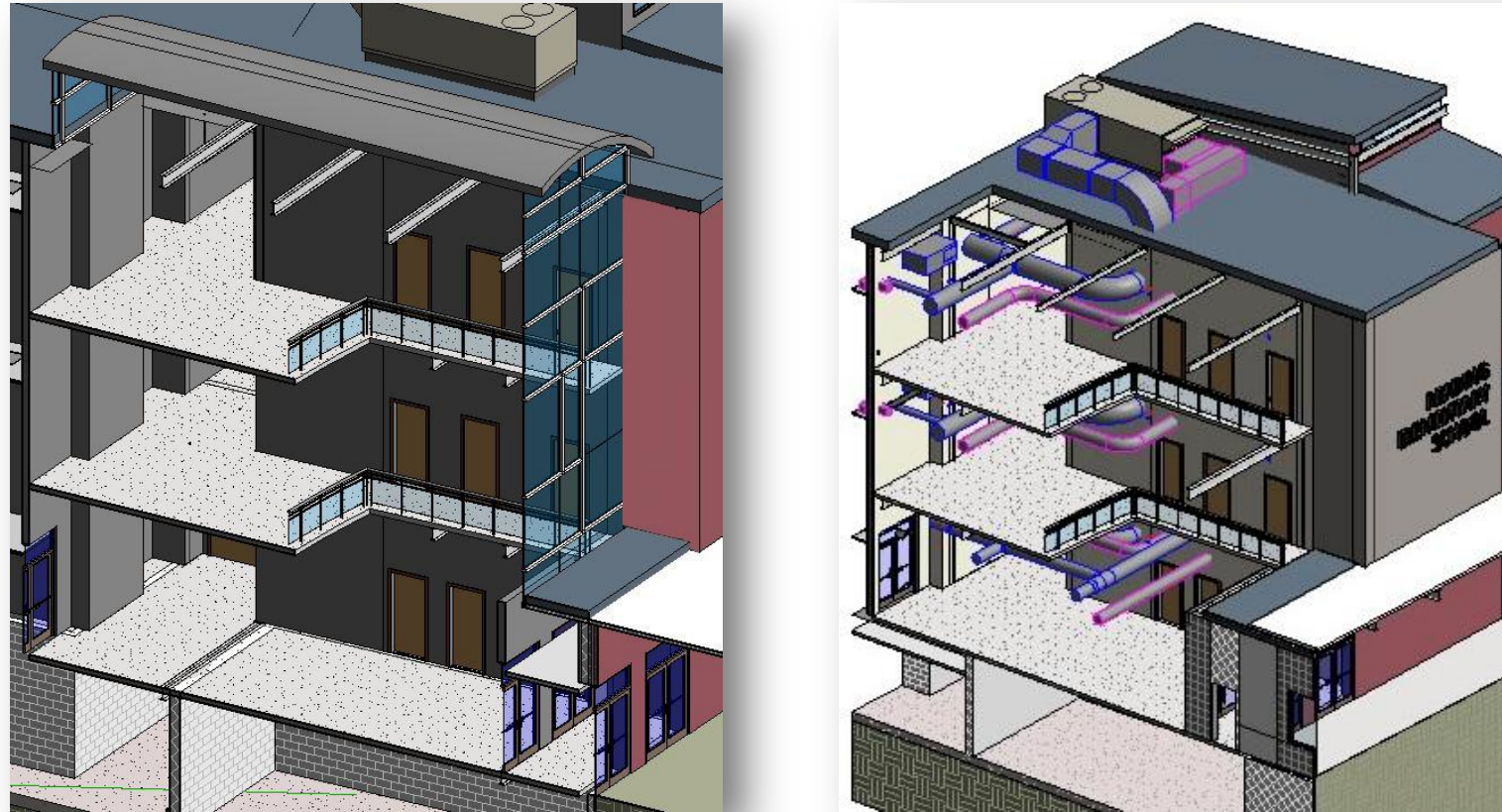
Atrium

create a welcoming & secure entrance for students, faculty, and guests



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Atrium



create a welcoming & secure entrance for students, faculty, and guests

Integrated Design Components

- Architectural appeal
- Material selection
 - *Kalwall* vs. *Opaque*
- Cantilever system design
- Daylighting Influence
- Reading Rail-Load
- Smoke Control System

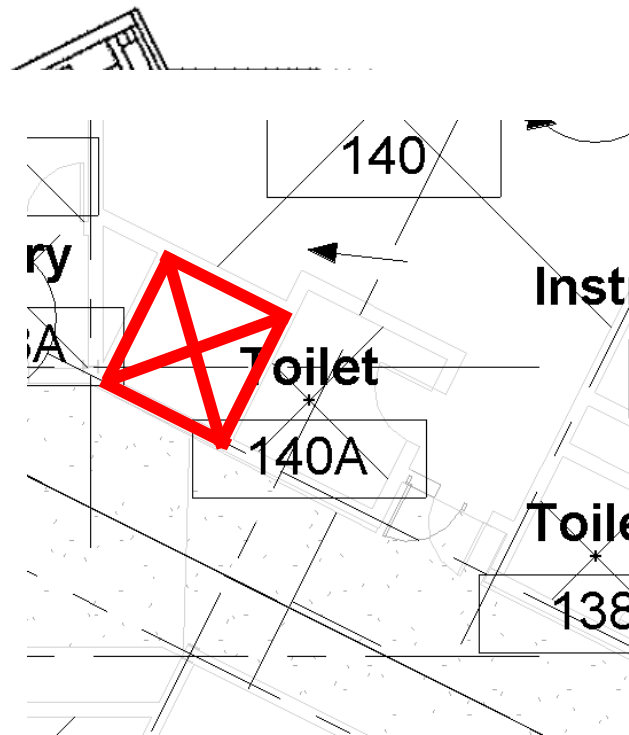
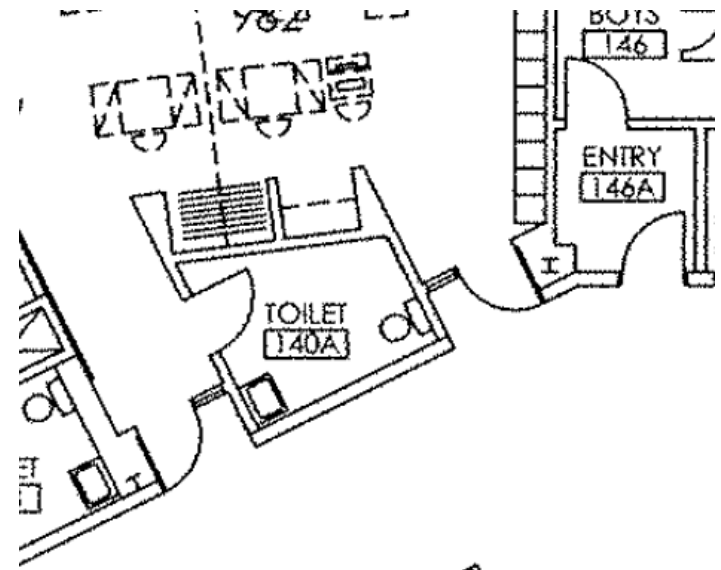
- Introduction
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Corridor

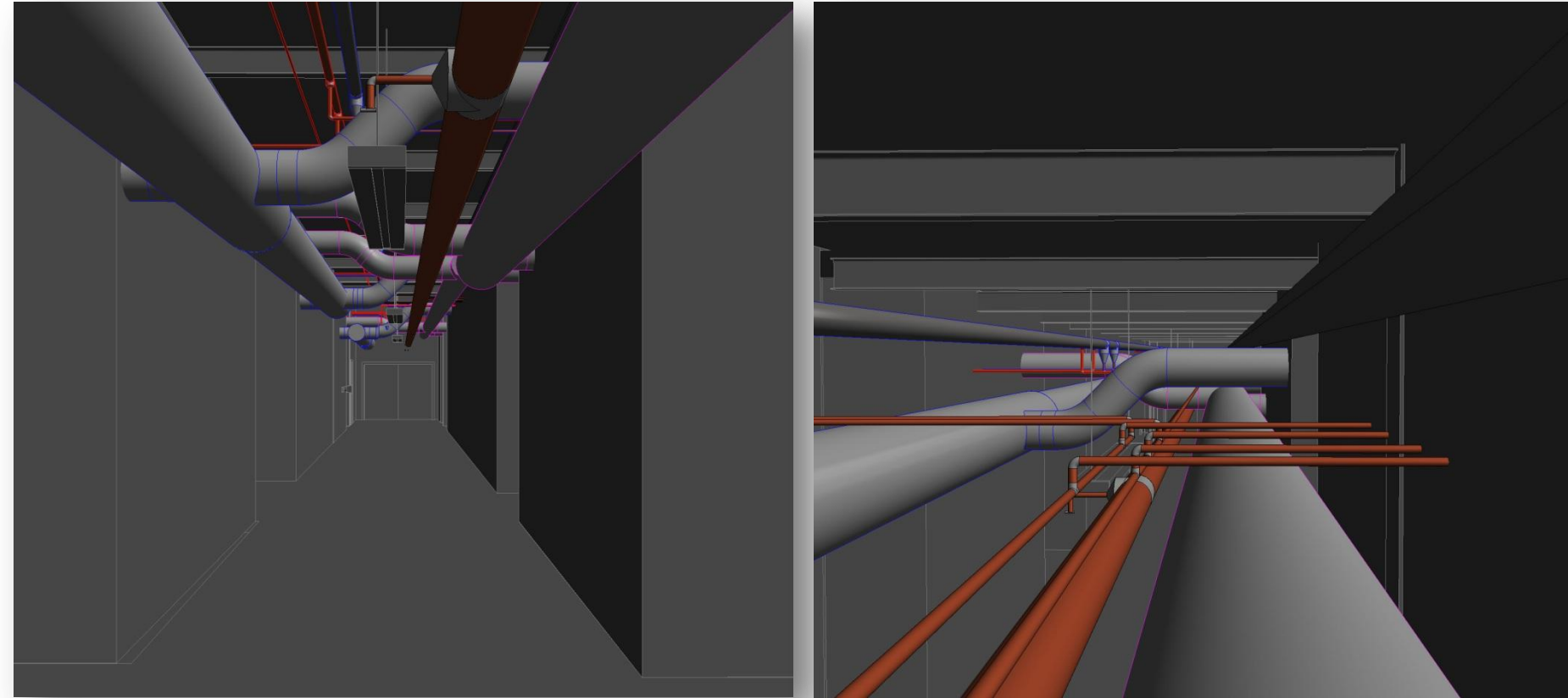
create a space which accommodates traffic flow and major building system components



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Corridor



create a space which accommodates traffic flow and major building system components

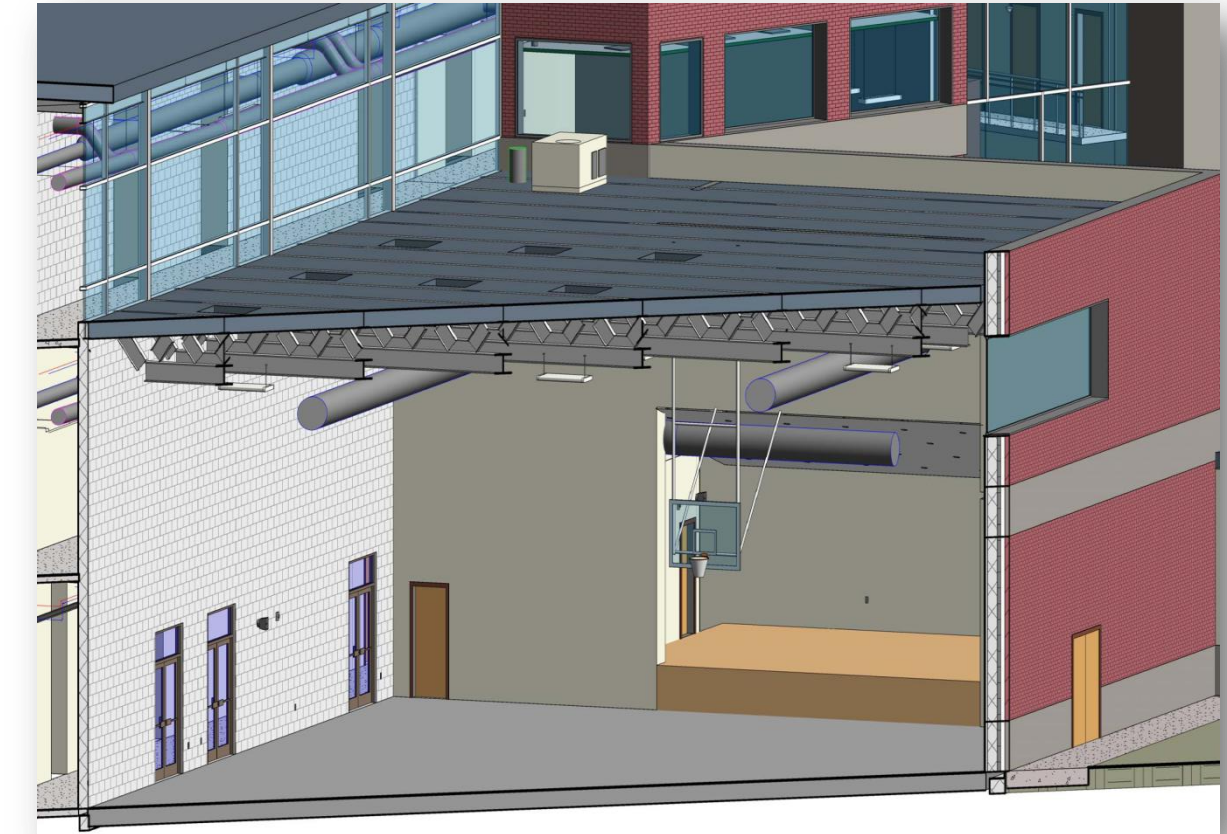
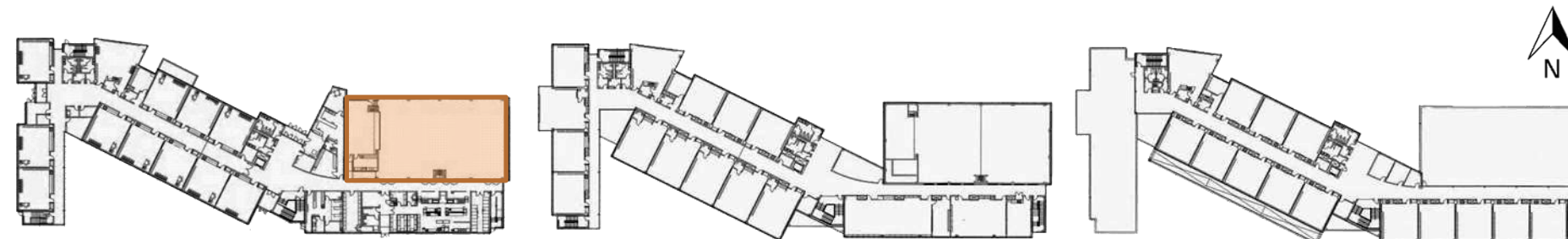
Integrated Design Components

- Plenum space planning
- Exposed ceiling
- Acoustical considerations
- Shaft and heat pump space planning

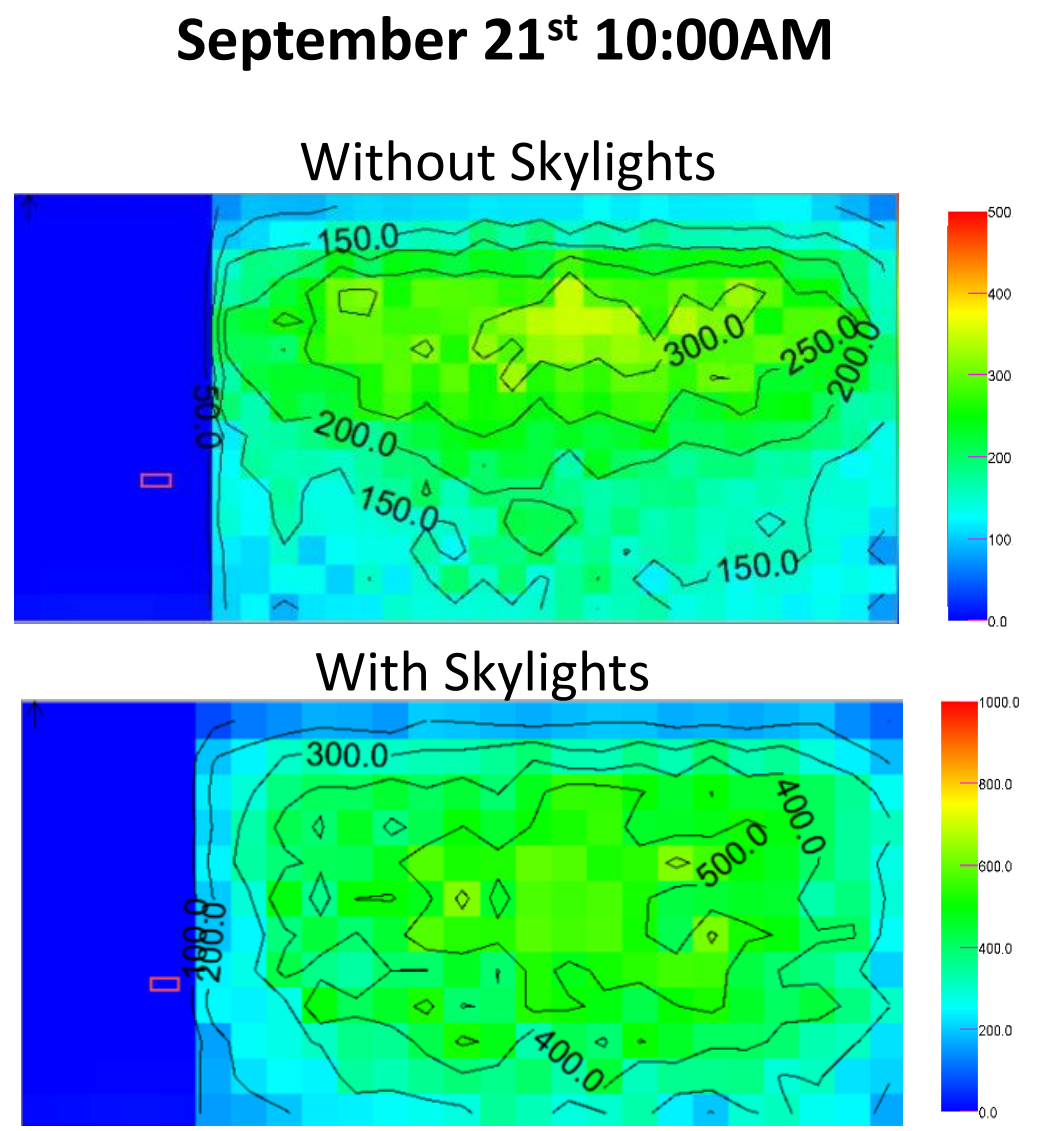
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Multipurpose Room

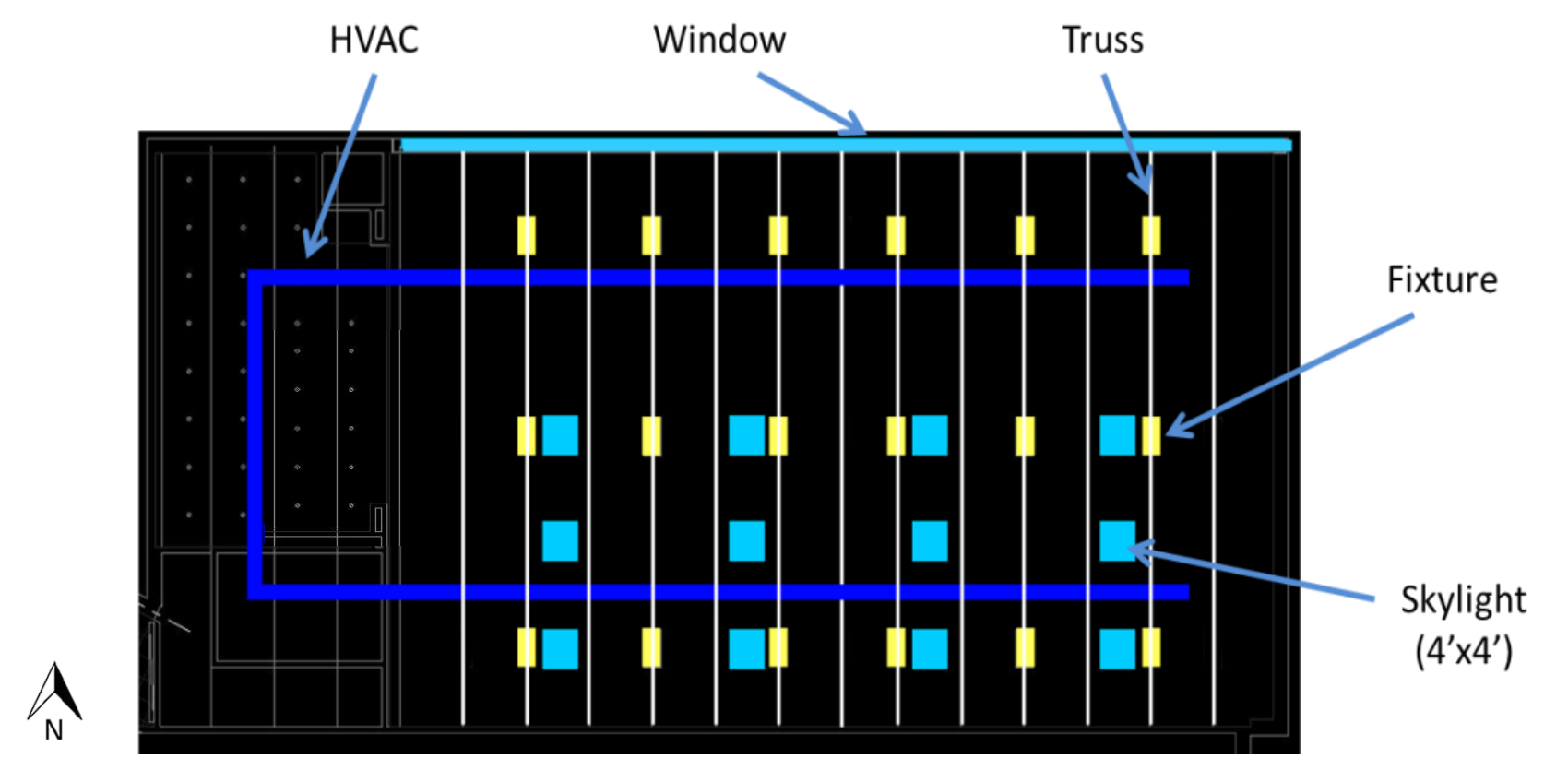
create a flexible space for school and community use



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Multipurpose Room



Integrated Design Components

- Long span trusses
- Duct work coordination and air distribution
- Daylighting considerations

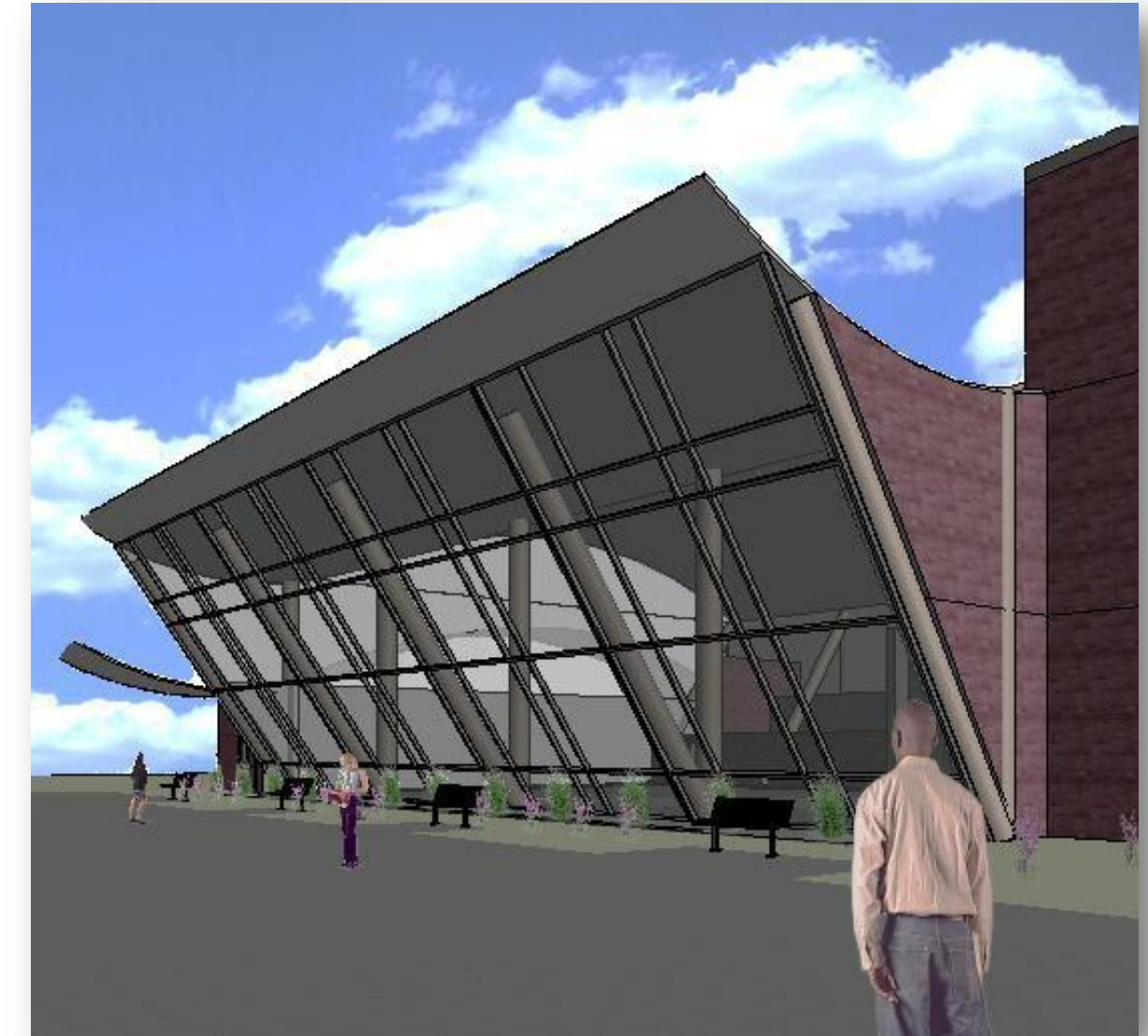
create a flexible space for the school and community

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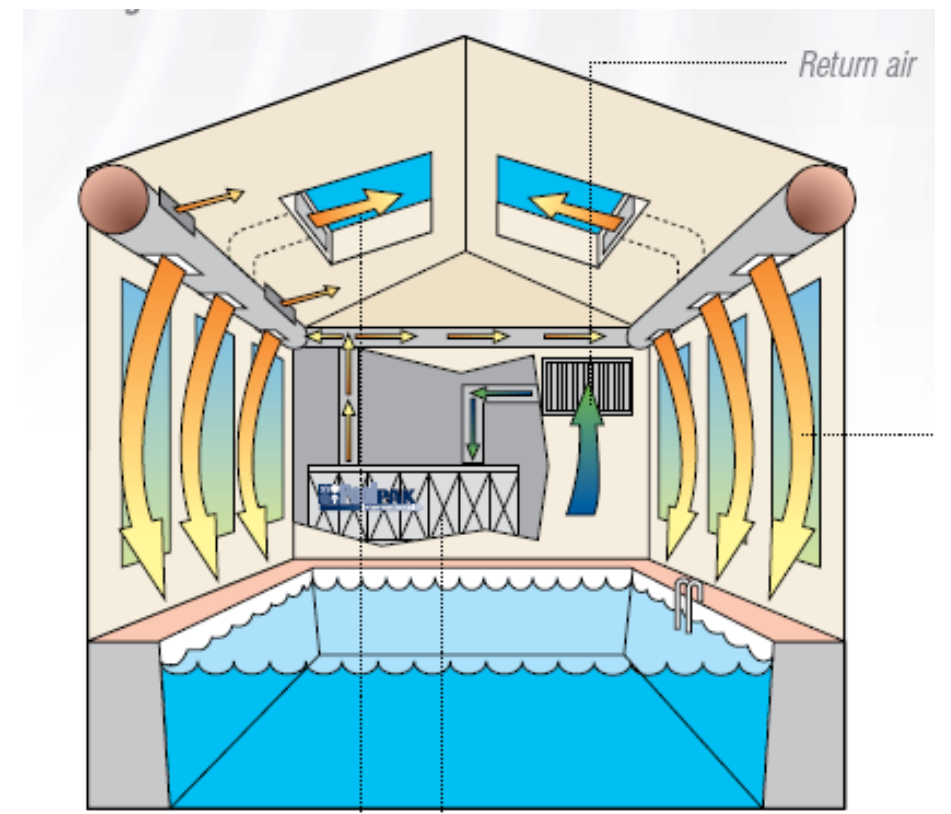
Natatorium

Proposed as Add/Alternate, \$3M budget and 3 month schedule

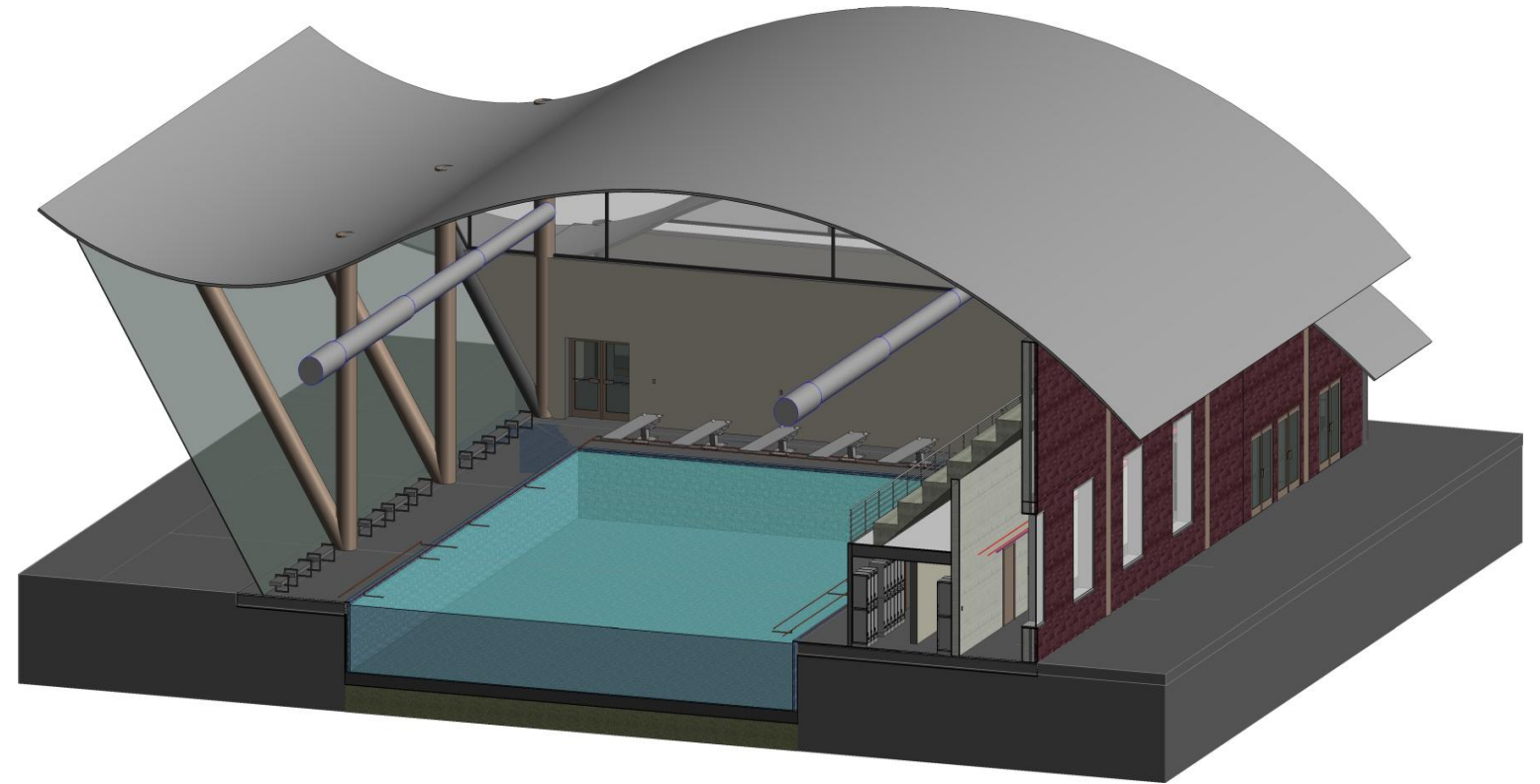
create a recreational building to encourage healthy living and community involvement



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Natatorium



create a recreational building to encourage healthy living and community involvement

Integrated Design Components

- Temperature and humidity design considerations
- Innovative roof design
- Suspended light fixtures meet multiple criteria

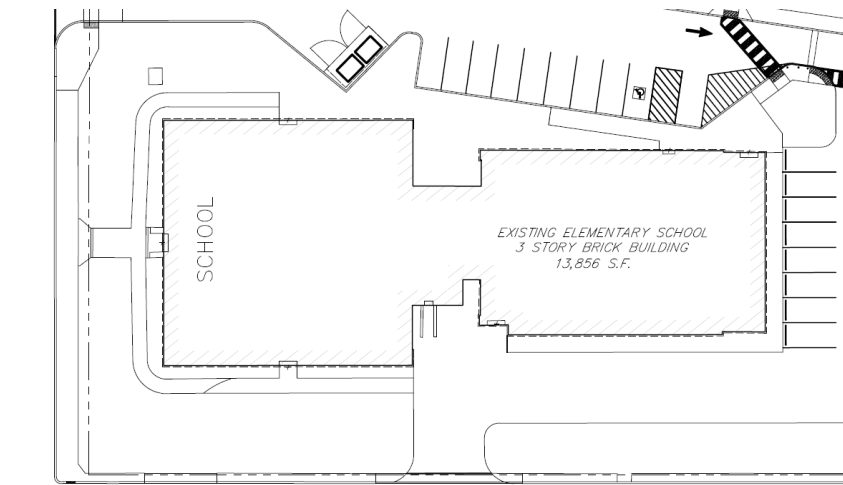
Pool	Criteria	As Designed
Water Surface	Avg. 30	31
	Avg:Min 3:1	2:1
Deck Surface	Avg. 10	22
	Avg:Min 4:1	2.5:1
Turning Lanes	Avg. 50	48
	Avg:Min 1.7:1	1.3:1
Power Density	1.2	1.03

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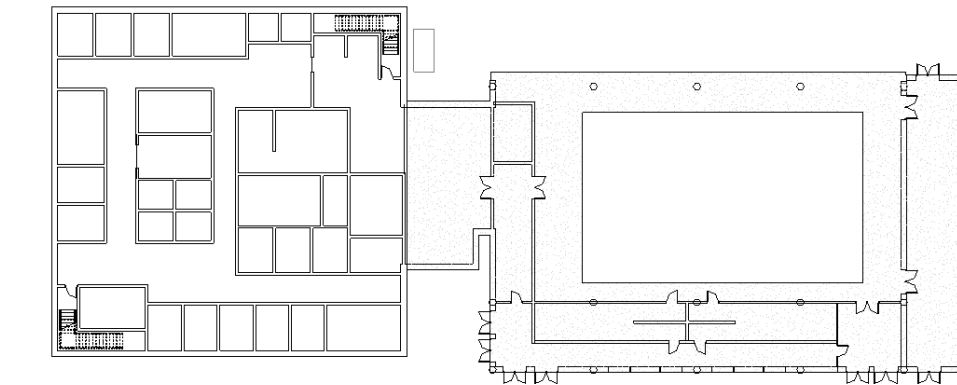
Clinic Renovation

Included with Add/Alternate, \$3M budget and 3 month schedule

create a functional community clinic while
repurposing usable site assets



Original School Footprint

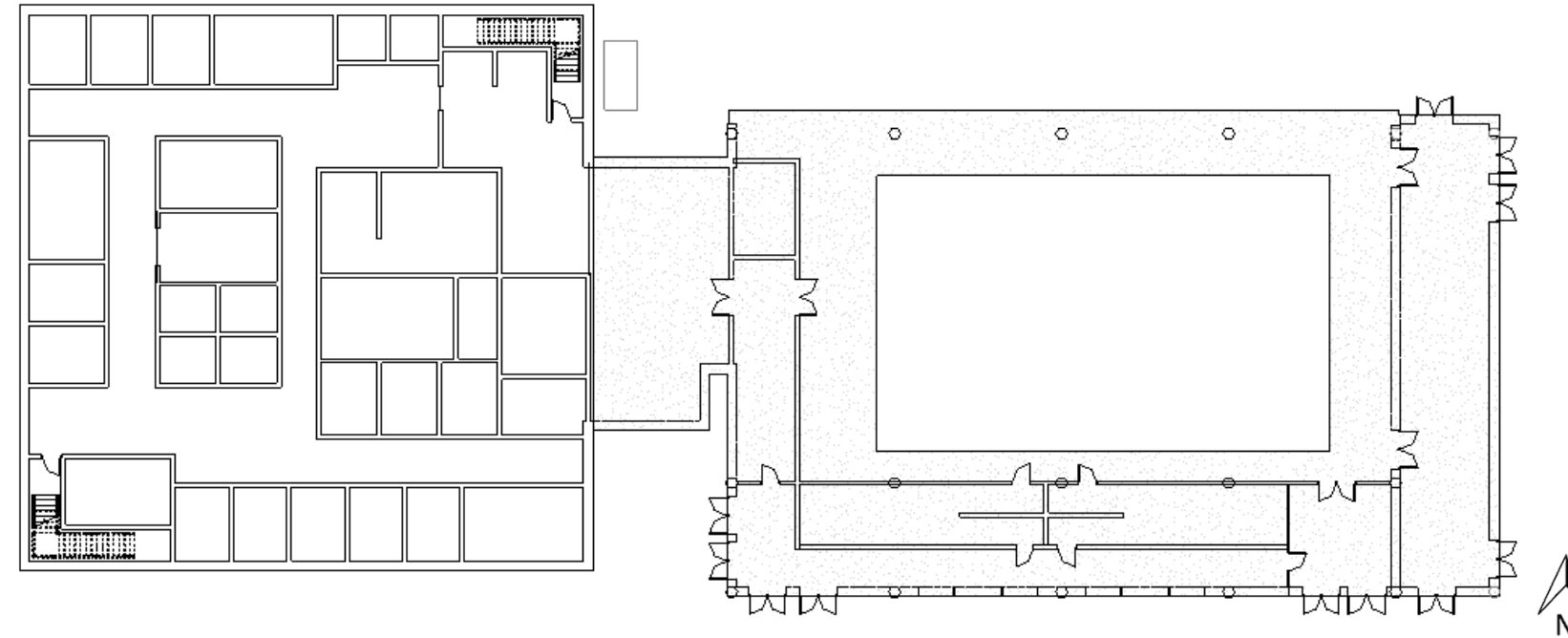


Clinic renovation floor plan

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Clinic Renovation

Included with Add/Alternate, \$3M budget and 3 month schedule



create a functional community clinic while
repurposing usable site assets

Design Considerations

- Security benefits of isolating 24 hour clinic open to public
- Limits potential for spreading of germs to students
- Asbestos Abatement Plan
- Result: Effective and sustainable reuse of original elementary school

In Loving Memory



Patrick J. Zuza

creation.

