creation.

AEI Team #04-2013

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Jeff Sopinski
Emily Wychock
Pat Zuza

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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

PENNSTATE 1855

Project Overview

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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

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.

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

1. Construction & Design issues related to a high performance building
2. Address Security for Reading, Pennsylvania
3. LEED Certified
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1. **Innovative Building Systems** Approach
2. Population:88,000 **5th largest city** in Pennsylvania
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   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
- Master Plan
- Site Orientation
- Security Measures
- LEED Certification

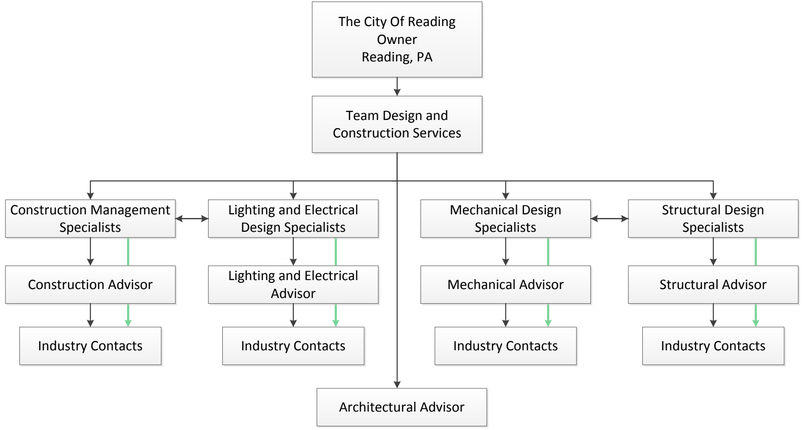
The Process

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

The Process



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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
	Structural	2	8 hrs/wk	8
Model Review	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	2	1 hr/wk	16
Structural Analysis & Design	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
3D Coordination	Structural	2	4 hrs/wk	3
	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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    - *BIM Objectives & Uses*
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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	Daysim	Daylighting and Electrical Analysis	CostWorks	RSMeans CostWorks	Construction Estimation
	Bentley RAM	Structural System Design	ORACLE PRIMAVERA	Oracle P6	Construction Scheduling
AGi32	AGi32	Lighting Calculations	3ds max	3ds Max	3D Model Rendering
ETABS	ETABS	Lateral Structural System Design		Autodesk Navisworks	3D Coordination & 4D Modeling
	Microsoft Excel	Mechanical & Structural Calculations & Estimate Organizational Tool			

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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

BIM Execution Planning

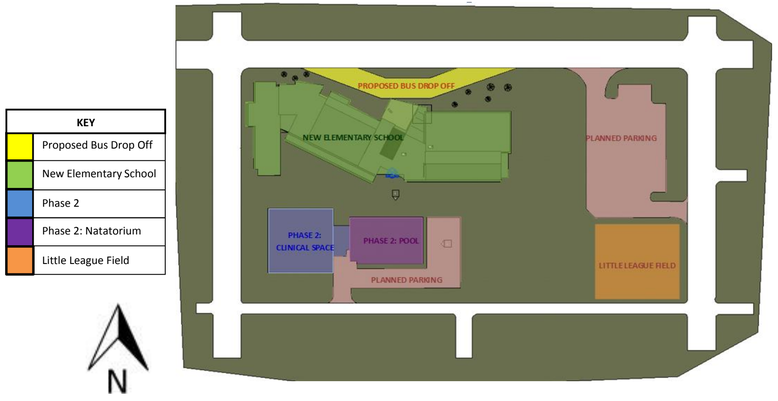
- The Challenge
- The Process
- *Master Plan*
  - Construction Phase 1
  - Construction Phase 2
- Site Orientation
- Security Measures
- LEED Certification

Master Plan

Reading Elementary

Phase 1 – New Construction

Phase 2 – Renovate Existing School for Pool and Clinical Space



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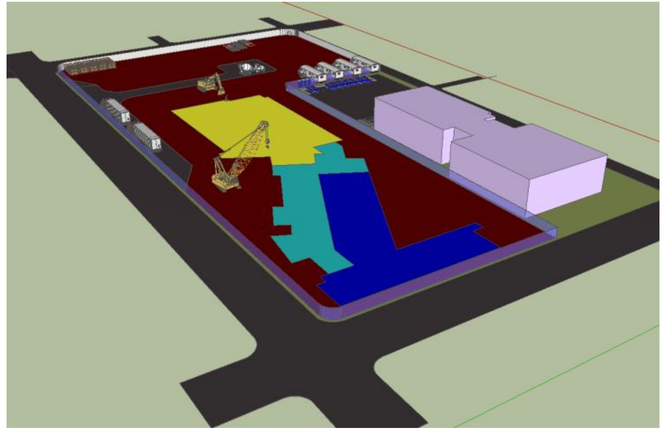
Phase 1

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

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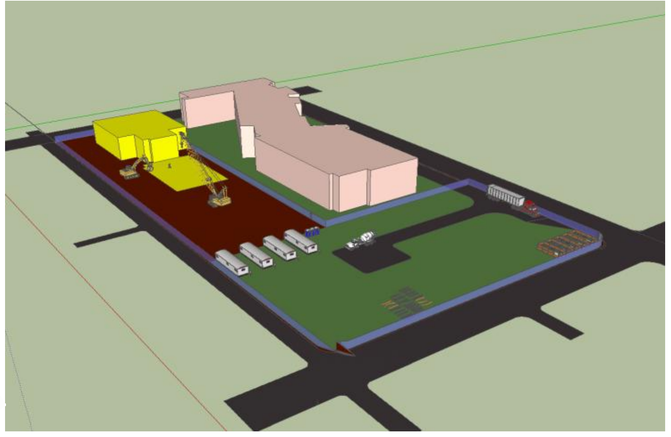
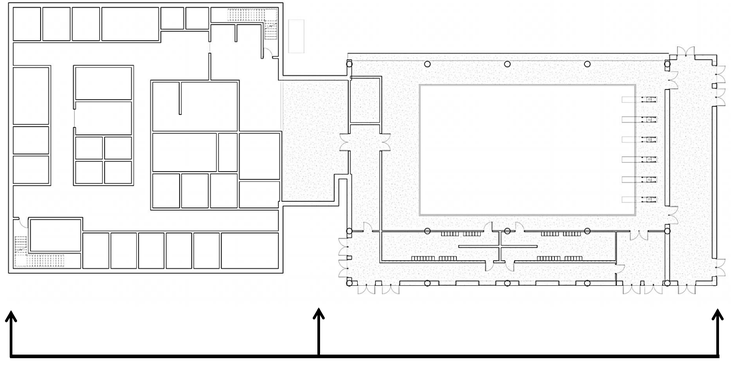
Phase 2

Renovation



Clinic and Natatorium Plan



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

Finished Master Plan

Reading School District

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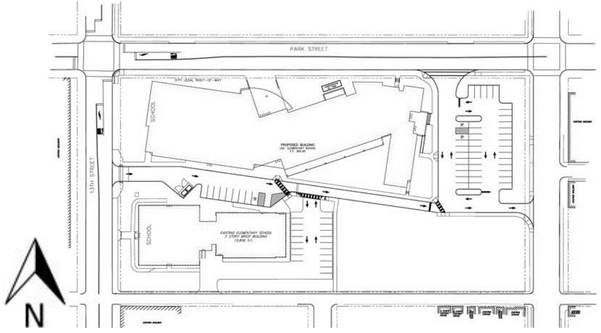
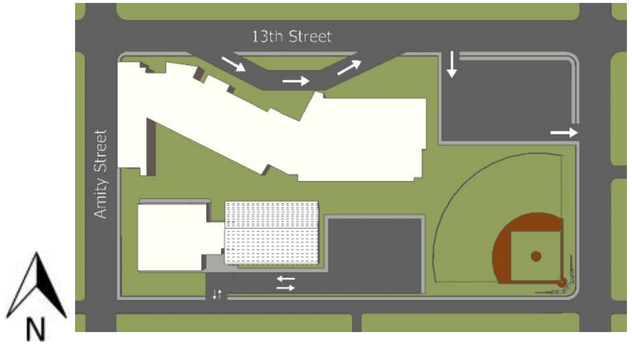
- The Challenge
- The Process
- Master Plan
- *Site Orientation*
- Security Measures
- LEED Certification

Site Orientation





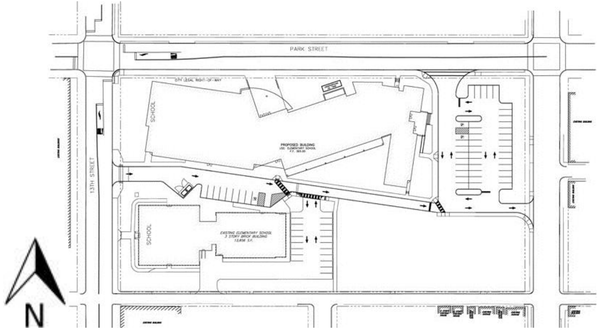
- **Project Location:**

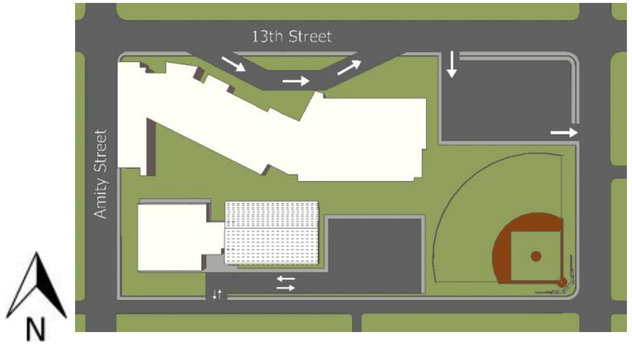
  Amity & 13th Streets

- **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

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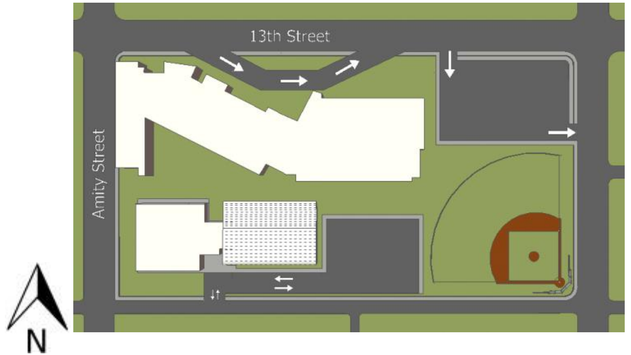
- Multipurpose space near parking
- Daylighting For Perimeter Classrooms
- Maximize Outdoor Space
- Eliminate Interior Bus Loop
- Security and Safety



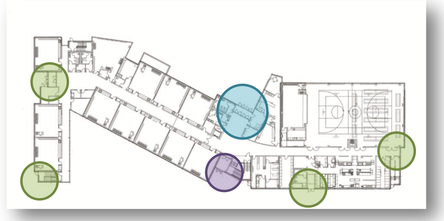
Integration Minute

- 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)

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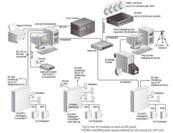
Security Cameras	Topaz Access Control	Card Readers	Glass Break Sensor
			
Vandal Resistant Security Cameras	Building Control System	Building Access Control	Acoustic and PIR Glass Break Sensor and Transmitter

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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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

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Design Process

Objective

↓

Criteria

↓

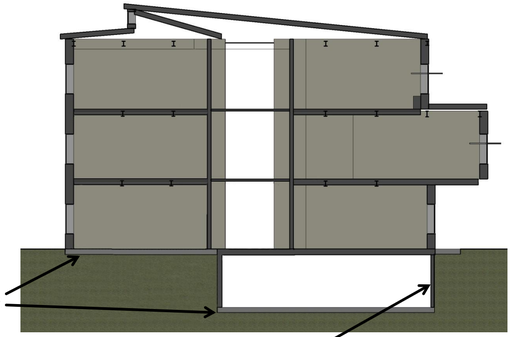
Calculations and Decision Making

↓

Results

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

Foundation



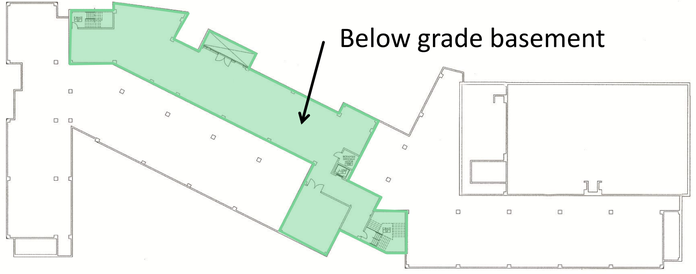
Design Criteria

- 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

- Design Process
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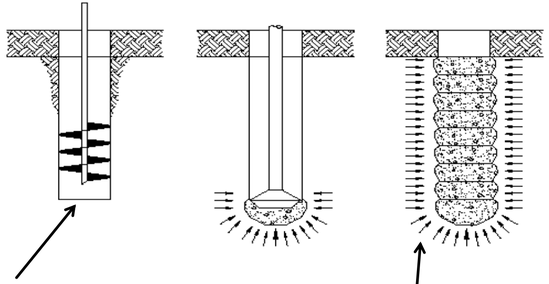
Pier Construction Process



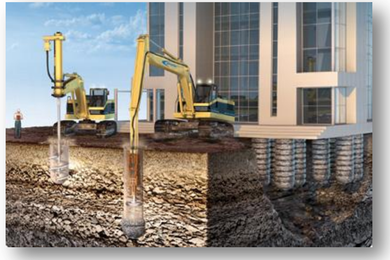
30” diameter shaft
Average depth of 12’

120 kip capacity

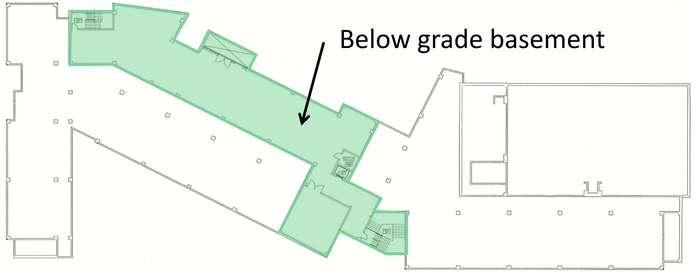
Foundation

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



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Gravity System

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

Design Criteria

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

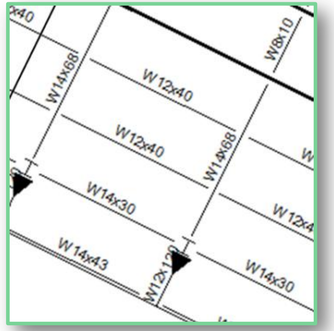
Steel* vs. *Concrete

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

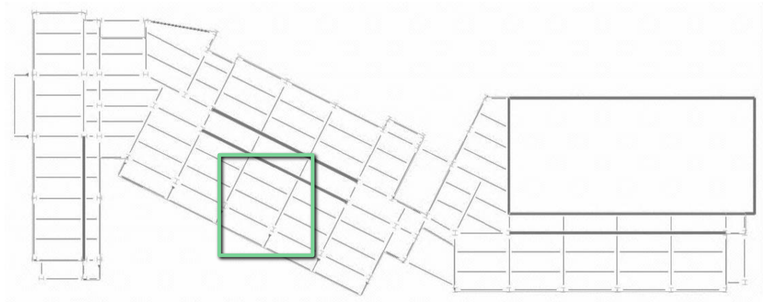
Snow Loads (psf)		
Ground	p_g =	30.0
Flat Roof	p_f =	22.7
1:12 sloped roof	p_{s1} =	22.7
1:4 sloped roof	p_{s2} =	22.7

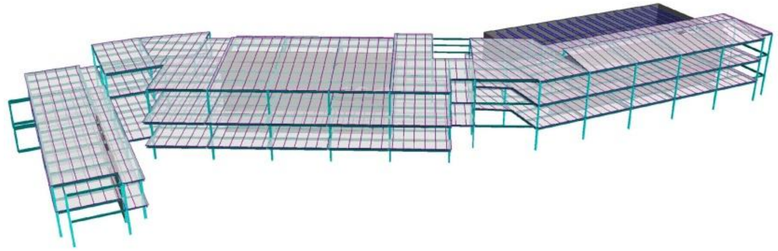
Gravity System

Typical Classroom



Framing Layout





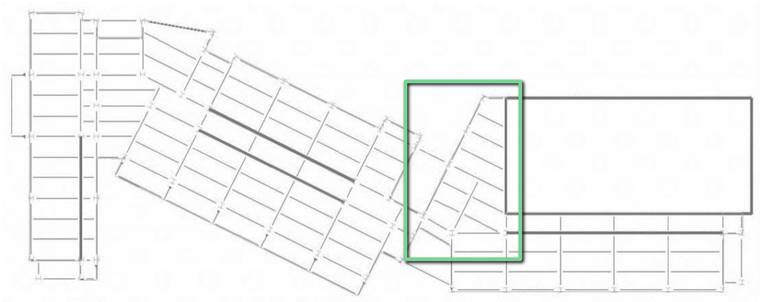
- Typical columns W10x33 and W14x61
- Beams range from W8x10 to W16x67
- Typical bay size 28x30
- 14 ft story height

creation.

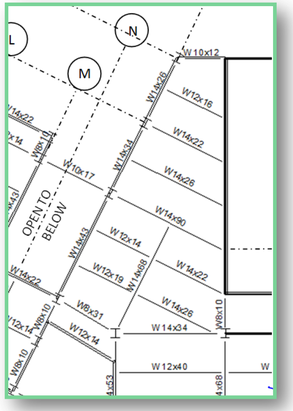
- Design Process
- Phase 1
  - Foundation
  - Gravity System
    - Analysis
    - *Framing System*
    - Floor System
    - Atrium
  - Lateral System
  - Enclosure
- Phase 2
  - Clinic
  - Natatorium
- Conclusion

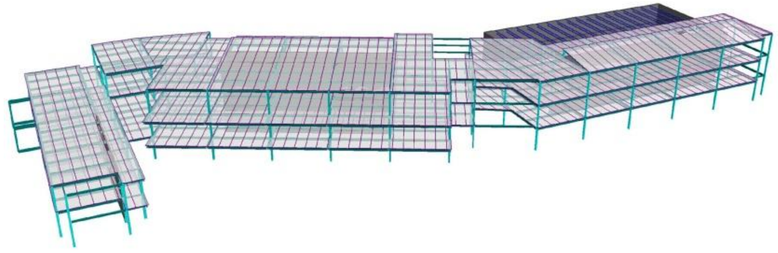
Gravity System

Framing Layout



Administration





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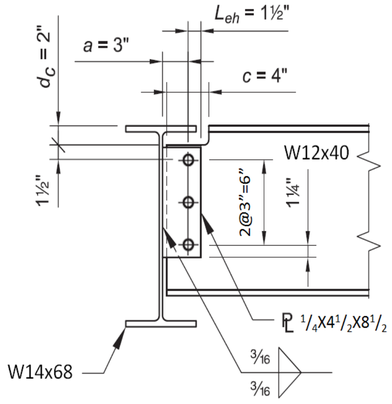
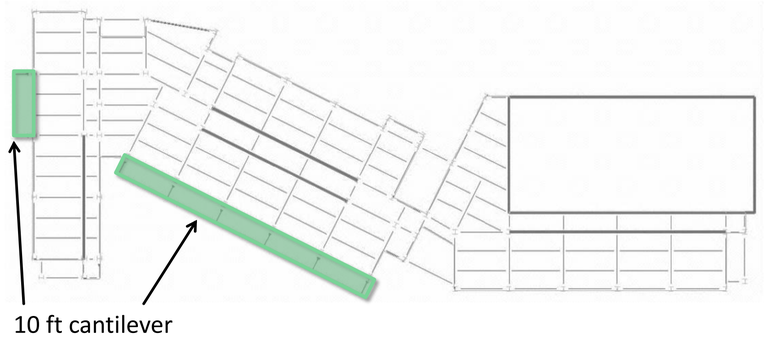
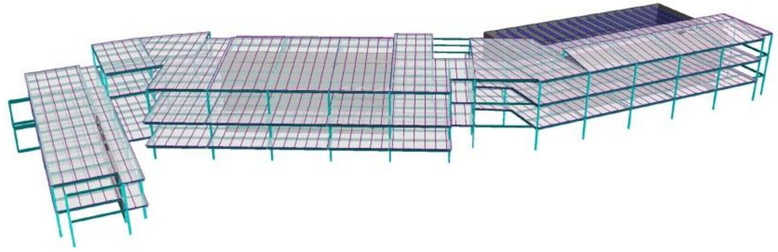
Gravity System

Typical Shear Connection



Framing Layout





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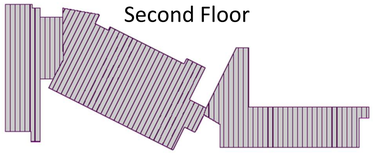
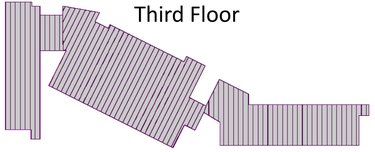
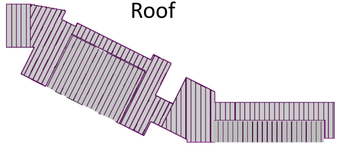
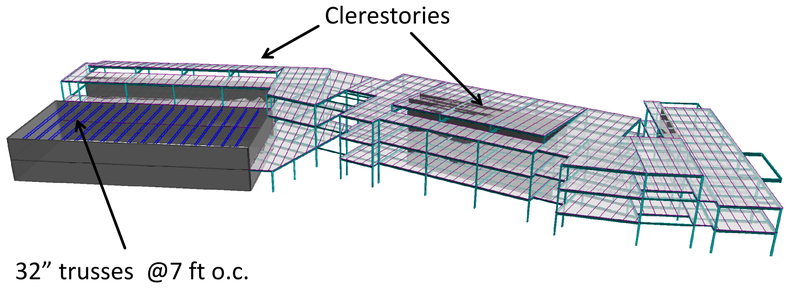


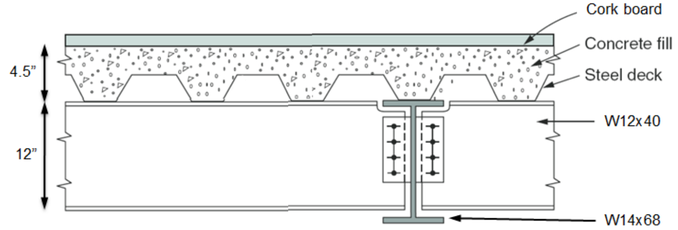




Gravity System



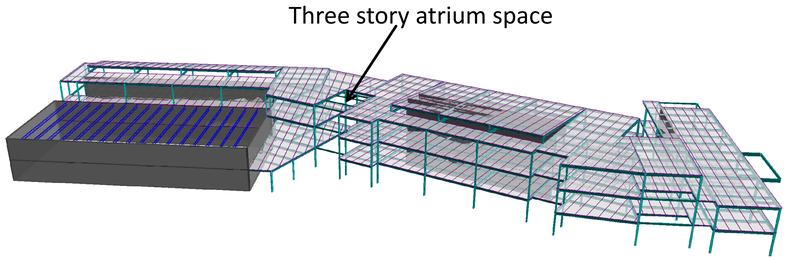
Decking		
Typical Floor	2VLI20	4.5” Composite Deck w/o Studs
Typical Flat or Sloped Roof	1.5BA16	Metal Non-composite
Green Roof	2VLI18	5.5” Composite Deck w/o Studs
Multipurpose Room Roof	1.5BA20	Metal Non-composite



creation.

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

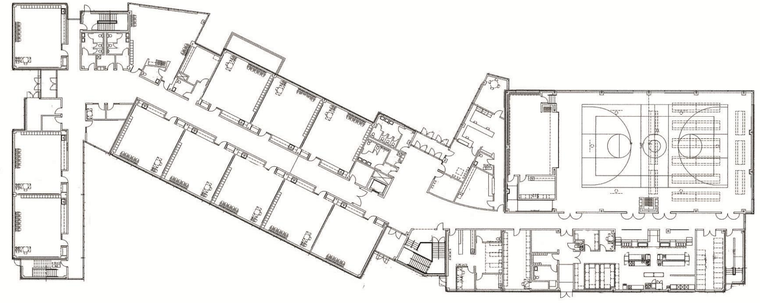
- Design Process
- **Phase 1**
  - Foundation
  - Gravity System
  - *Lateral System*
    - Braced Frames
    - Shear Walls
  - Enclosure
- Phase 2
  - Clinic
  - Natatorium
- Conclusion

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)	Overturning Moment (k-ft)
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
Multipur-pose	N/S	678	1890
	E/W	29	812

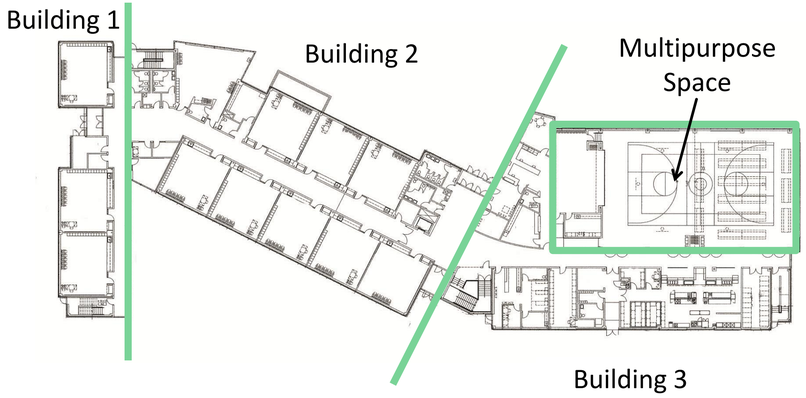
Lateral System

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

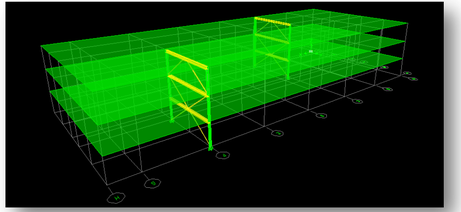
First Floor Plan



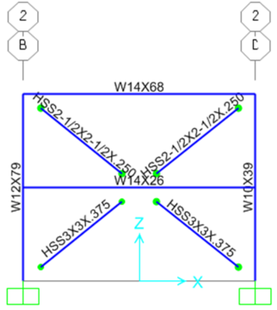
creation.

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

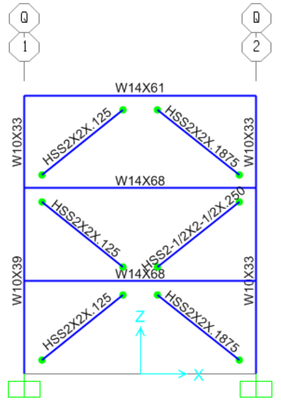
ETABS Model Building 2



Braced Frames

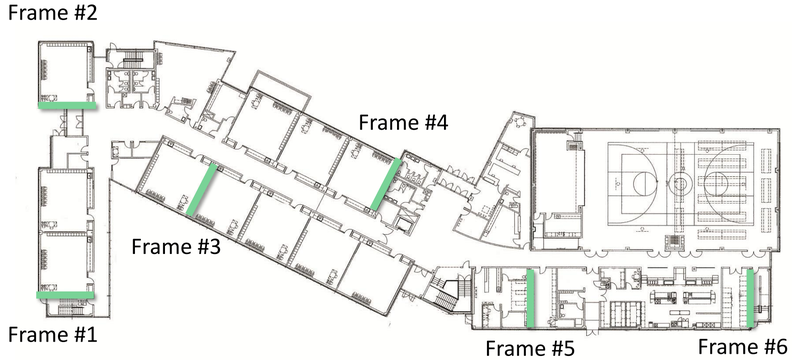


Frame #2
Building 1



Frame #5
Building 3

First Floor Plan



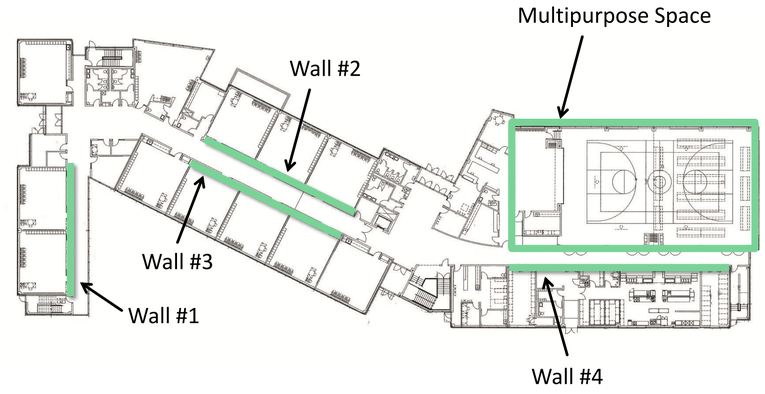
- Design Process
- Phase 1
  - Foundation
  - Gravity System
  - Lateral System
    - Braced Frames
    - *Shear Walls*
  - Enclosure
- Phase 2
  - Clinic
  - Natatorium
- Conclusion

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

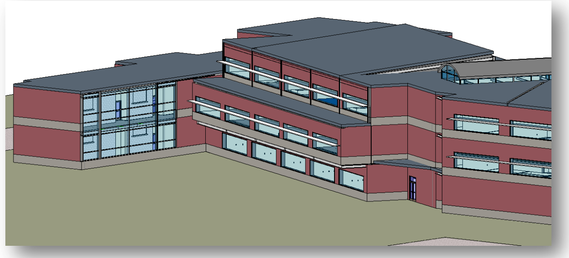
Masonry Properties		
Shear Wall	10” stacked block, fully grouted	f’c = 1500 psi
Multipurpose Space	10” stacked block, fully grouted	f’c = 1500 psi

First Floor Plan



creation.

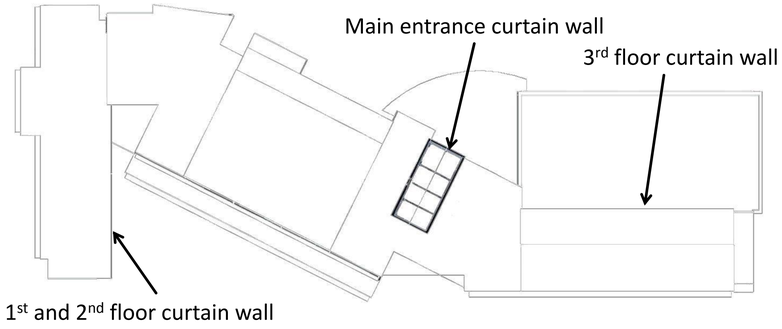
- Design Process
- Phase 1
  - Foundation
  - Gravity System
  - Lateral System
  - Enclosure
    - *Walls*
    - Roof
- Phase 2
  - Clinic
  - Natatorium
- Conclusion



Brick & Limestone

Glass curtain wall

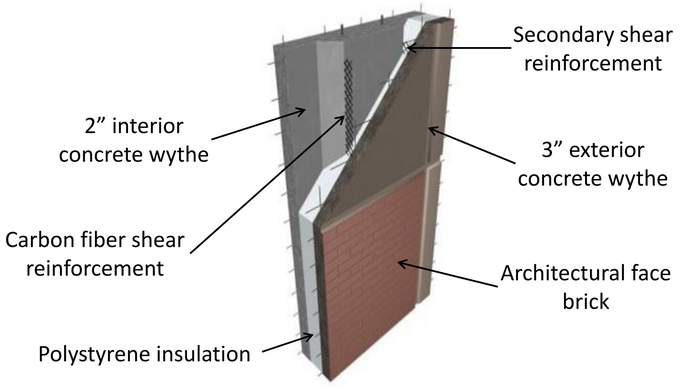
Enclosure



Design Criteria

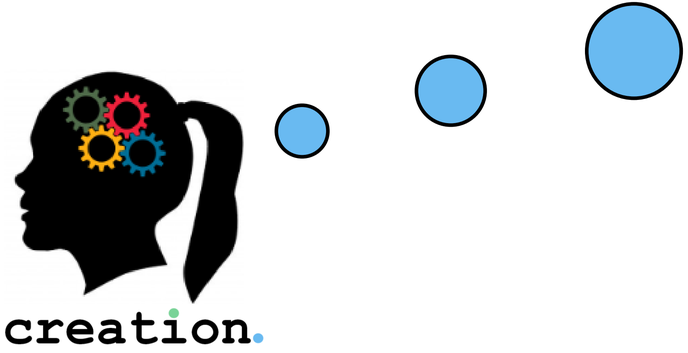
- Utilize prefabricated assemblies
- Efficient connection to superstructure
- Resist wind, snow, and earthquake loads

Precast Panels

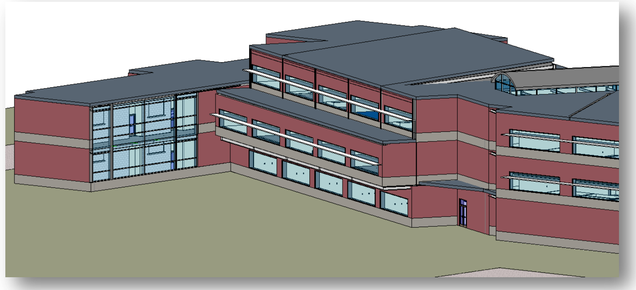


creation.

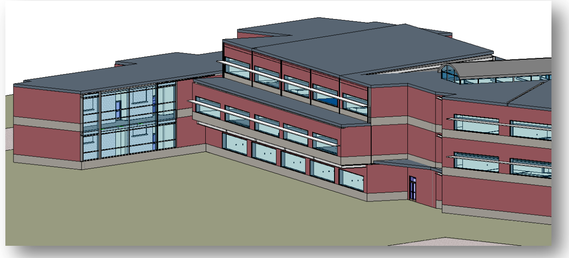
Enclosure



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



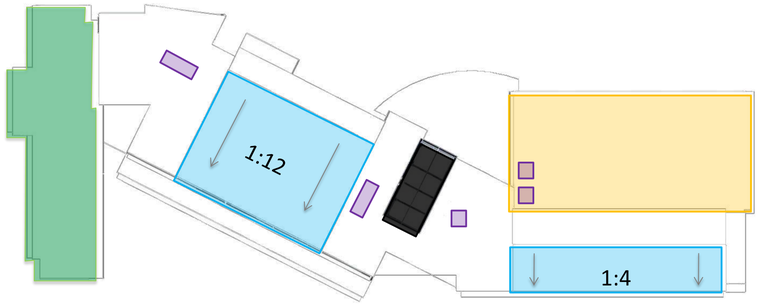
- Design Process
- Phase 1
  - Foundation
  - Gravity System
  - Lateral System
  - Enclosure
    - Walls
    - *Roof*
- Phase 2
  - Clinic
  - Natatorium
- Conclusion



Brick & Limestone

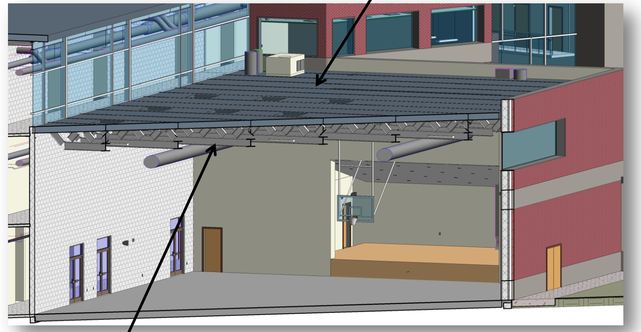
Glass curtain wall

Enclosure



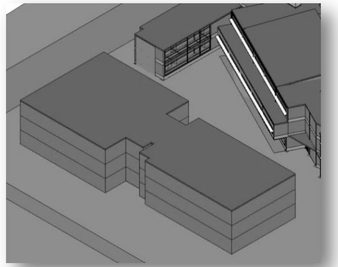
Green Roof | Air Handlers | Atrium Roof | Clerestories | Multipurpose

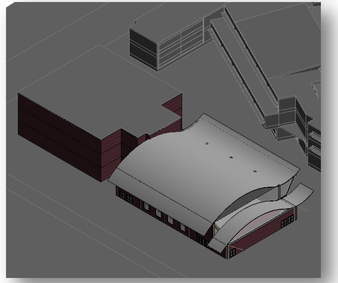
Insulated roof prevents joist movement due to temperature change



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

creation.



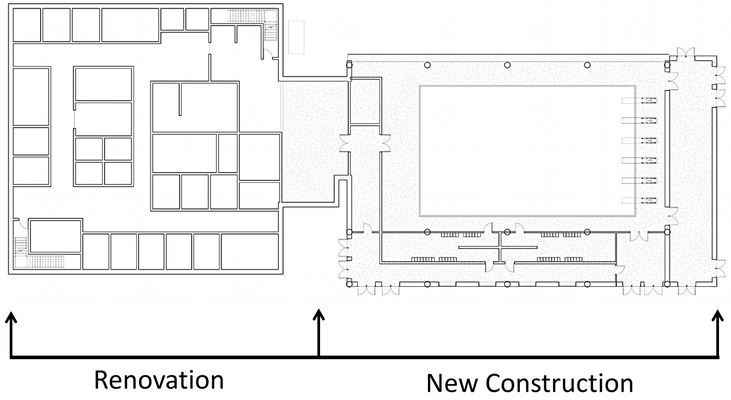


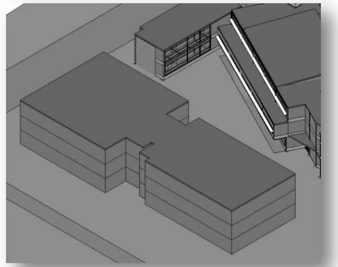
Phase 2

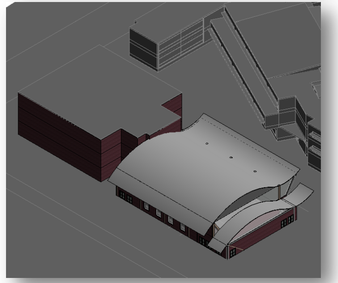
Design Criteria

- 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





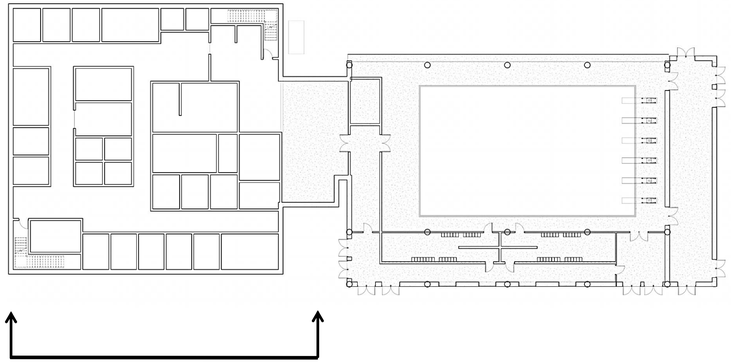


Clinic

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

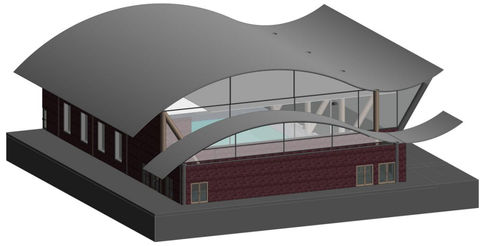
Clinic and Natatorium Plan



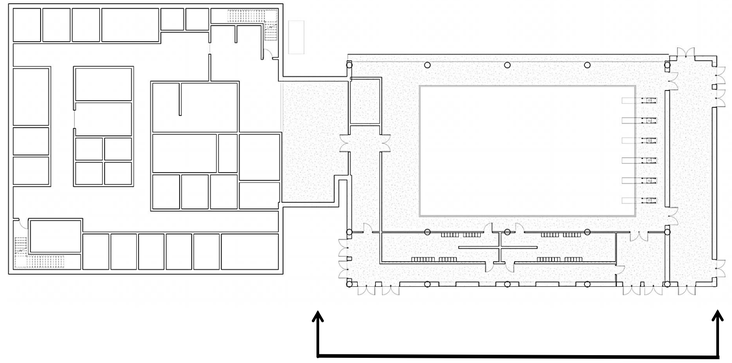
- Design Process
- Phase 1
  - Foundation
  - Gravity System
  - Lateral System
  - Enclosure
- **Phase 2**
  - Clinic
  - *Natatorium*
- Conclusion

Natatorium

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

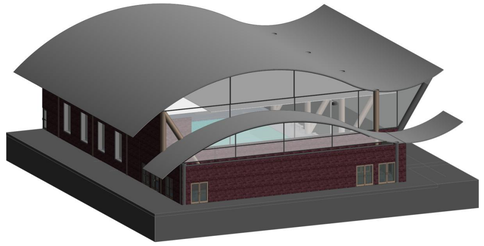


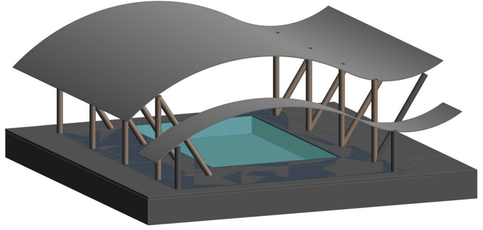
Clinic and Natatorium Plan

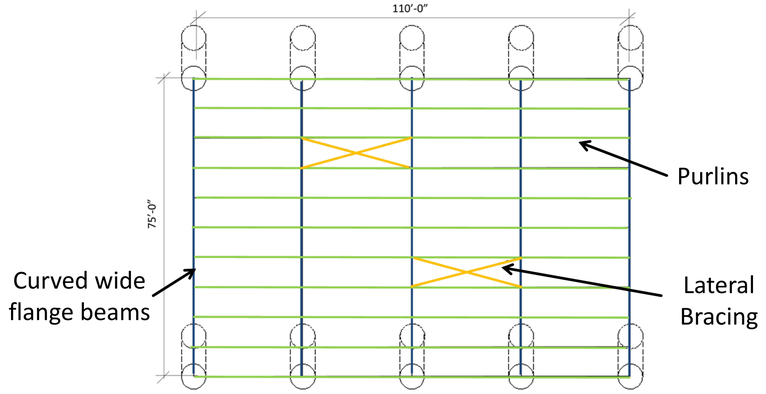


- Design Process
- Phase 1
  - Foundation
  - Gravity System
  - Lateral System
  - Enclosure
- **Phase 2**
  - Clinic
  - *Natatorium*
- Conclusion

Natatorium



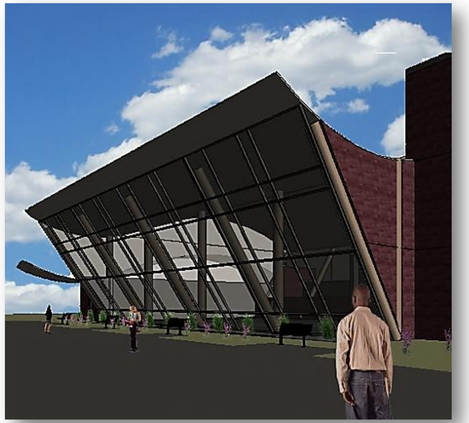




Natatorium

creation.

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



Integration Minute

Mechanical Systems

creation.

Introduction

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%

*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

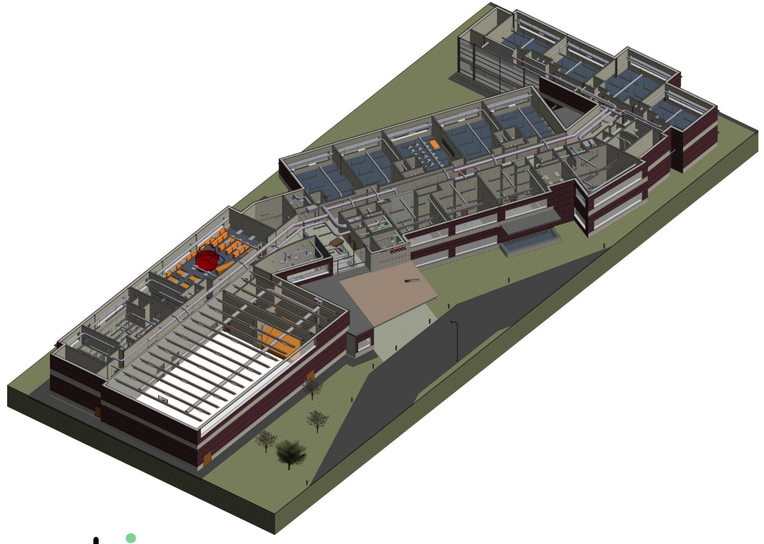
VRV with Heat Recovery

Total energy reduction of 13%

Natatorium

All- encompassing AHU

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

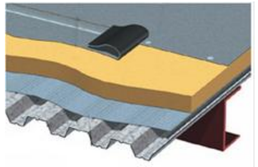


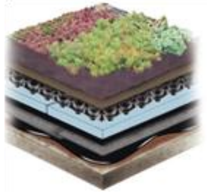
creation.

Construction Phase 1

Reading Elementary School

Roof



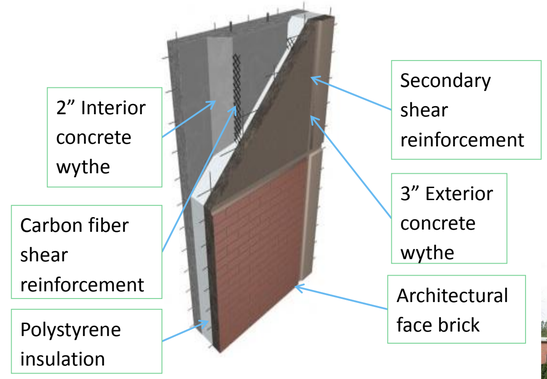


ENCLOSURE DESIGN

REDUCED ENERGY CONSUMPTION BY: 15%

	ASHRAE 90.1	ASHRAE 50% 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



creation.

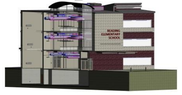
- Introduction
- **HVAC Design**
  - **Construction Phase 1**
    - Enclosure Design
    - *System Design*
      - *Airside System*
      - Waterside System
  - Construction Phase 2
- Plumbing Design
- Conclusion

SYSTEM CONSIDERATIONS

Critical Zones

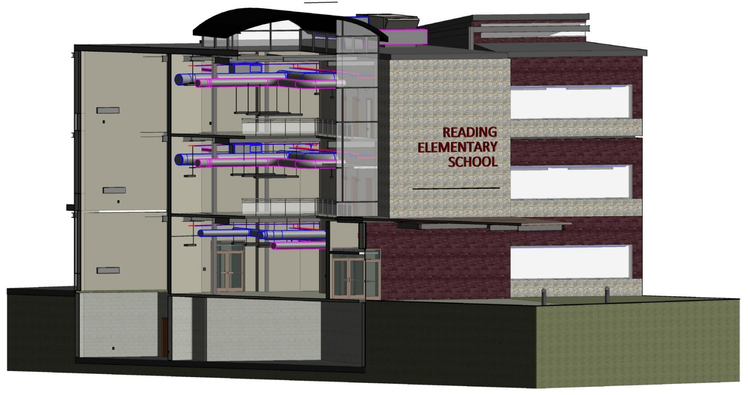
SYSTEM CONSIDERATIONS

Critical Zones



Atrium

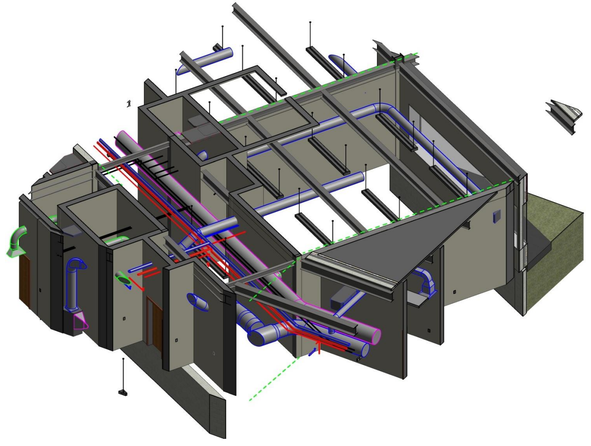
Atrium

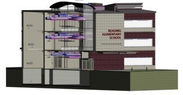


SYSTEM CONSIDERATIONS

Classroom

Critical Zones





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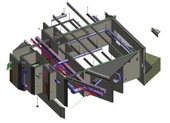


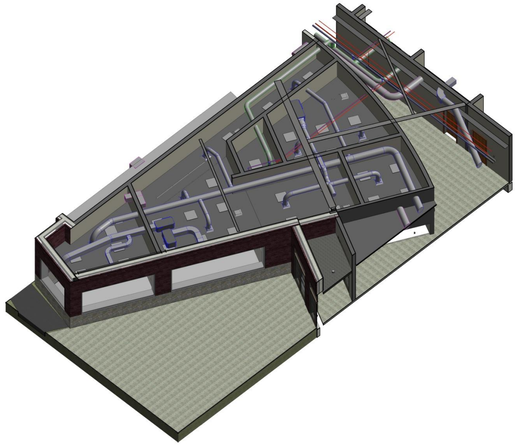
Classroom

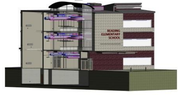
creation.

Administration

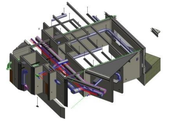
SYSTEM CONSIDERATIONS

Critical Zones

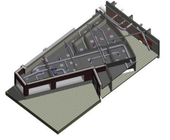




Atrium



Classroom



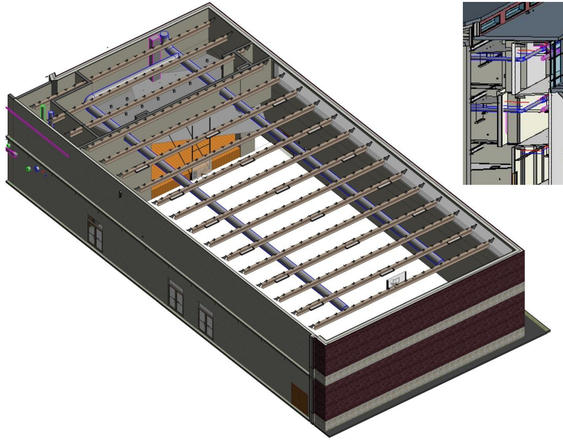
Administration

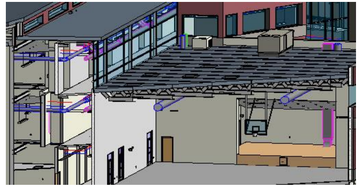
creation.

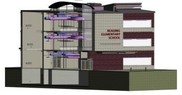
SYSTEM CONSIDERATIONS

Multipurpose Facility

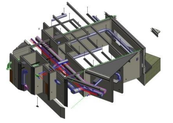
Critical Zones



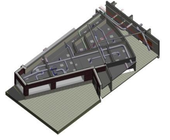




Atrium



Classroom



Administration

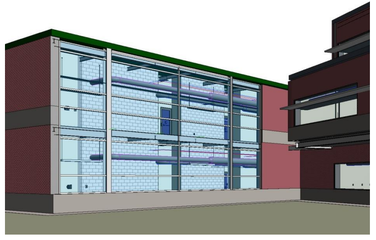
Multipurpose Facility

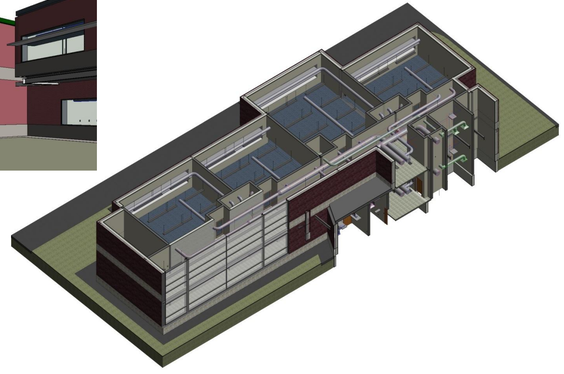
- Introduction
- HVAC Design
  - Construction Phase 1
    - Enclosure Design
    - *System Design*
      - *Airside System*
      - Waterside System
  - Construction Phase 2
- Plumbing Design
- Conclusion

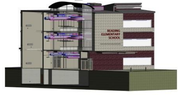
SYSTEM CONSIDERATIONS

Critical Zones

Corridor







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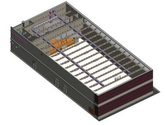
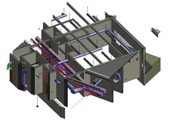
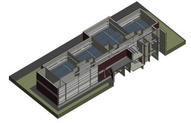


Multipurpose Facility



Classroom



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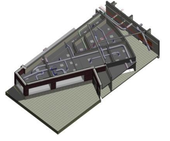
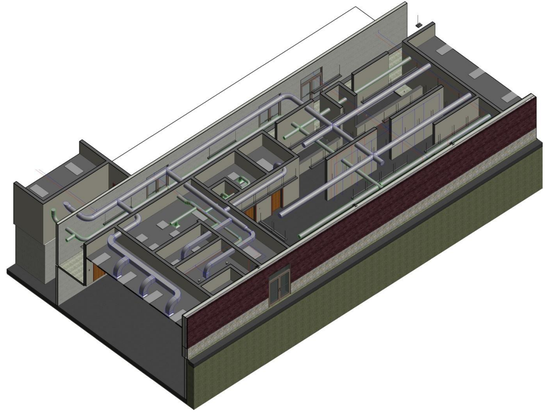


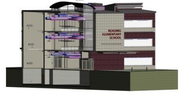
Administration

SYSTEM CONSIDERATIONS

Kitchen

Critical Zones





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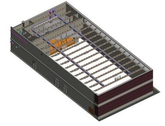
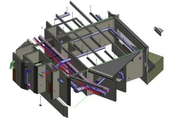
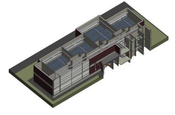


Multipurpose Facility



Classroom



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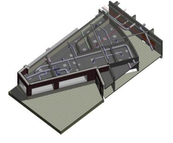
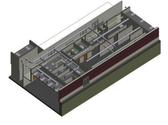


Administration



Kitchen

creation.

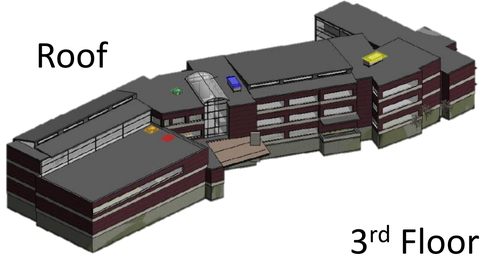
VENTILATION DESIGN

Ventilation CFM

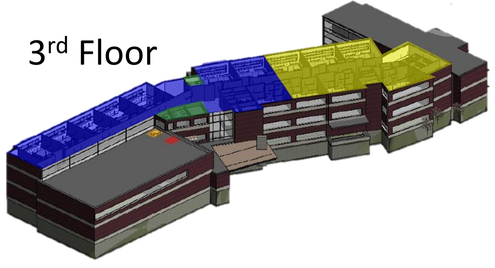
ZONE 1	6,718
ZONE 2	944
ZONE 3	1,937
ZONE 4	12,927
ZONE 5	13,470

Total Ventilation : 35,996 CFM

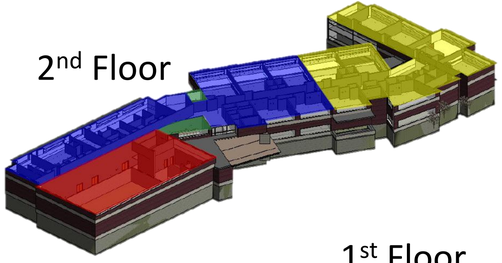
Roof



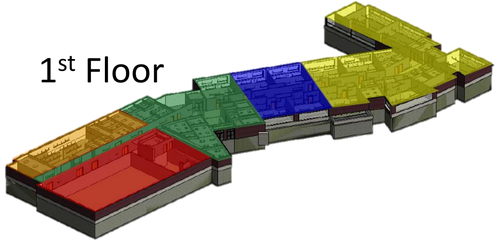
3rd Floor



2nd Floor



1st Floor



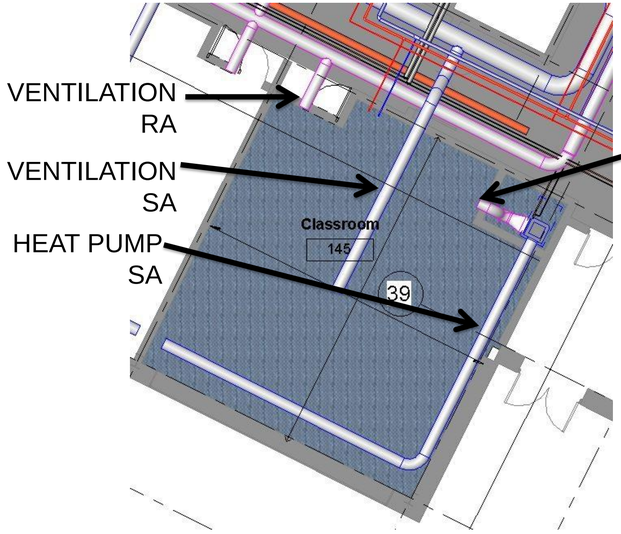
AIRSIDE DESIGN

Dedicated Outdoor Air System

NEUTRAL SUPPLY AIR CONDITION (~70ºF)
- Wastes sensible cooling done by the AHU
- Takes all the latent load

COLD SUPPLY AIR CONDITION (~55ºF)
- 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
- CO_2 Sensors
- Outdoor Air Economizer



Total Heat Pumps: 61

SPLIT SYSTEM SCHEMATIC

creation.

Classroom

creation.

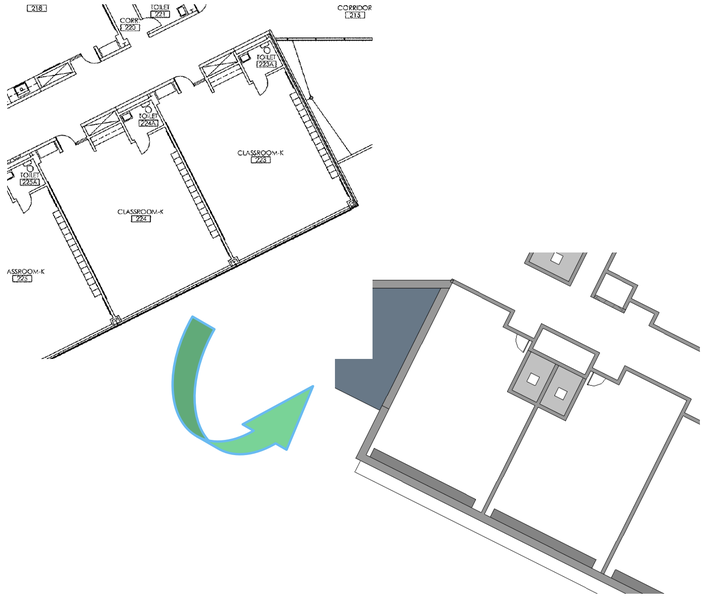
- **System Placement Coordination**
- Window Sizing
- Beam Depths
- Braced Frame
- Fire Alarm and Announcements
- Heat Pump Closet vs. Architecture

Integration Minute

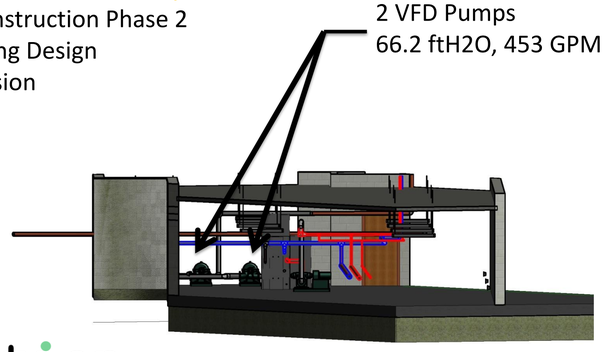
Classroom

creation.

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



Integration Minute



WATERSIDE DESIGN

Ground Source Heat Pump System

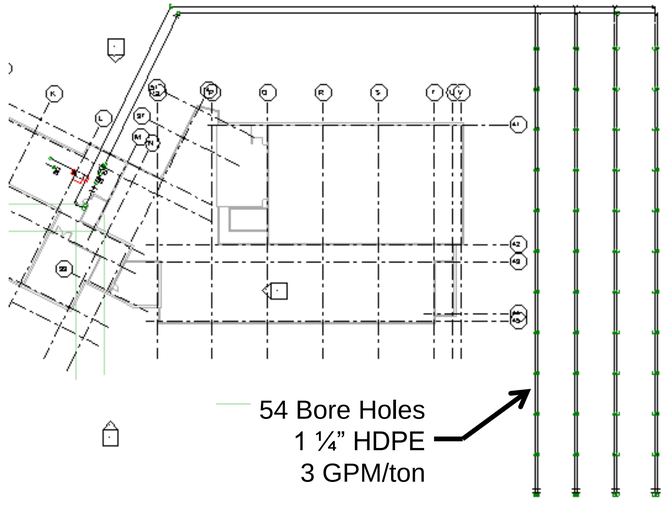
COOLING

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

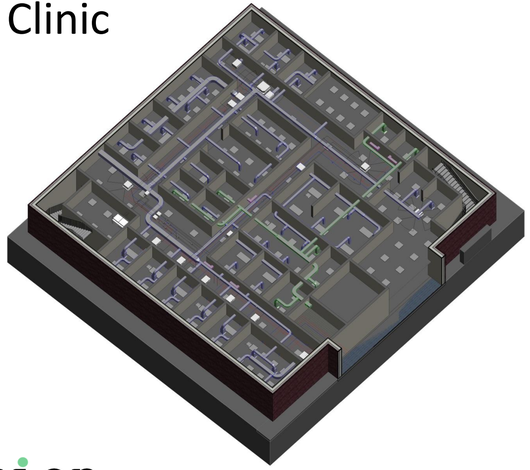
HEATING

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

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

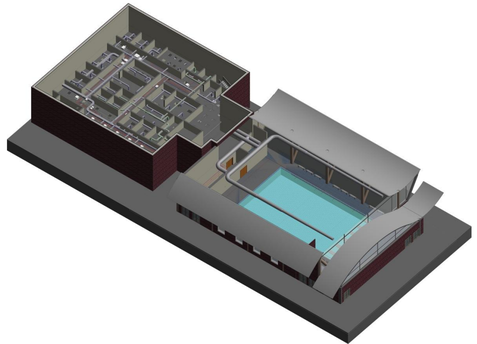


Clinic

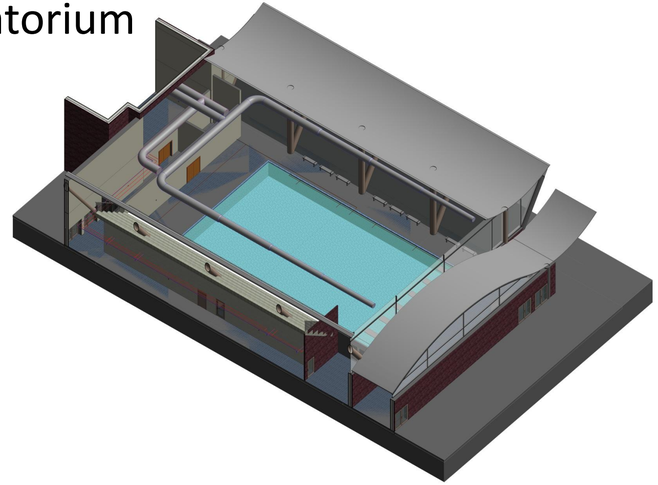


Construction Phase 2

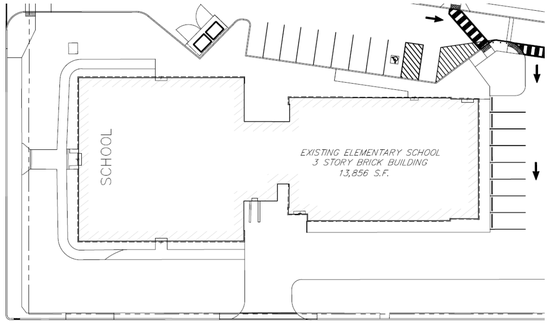
Clinic and Natatorium



Natatorium



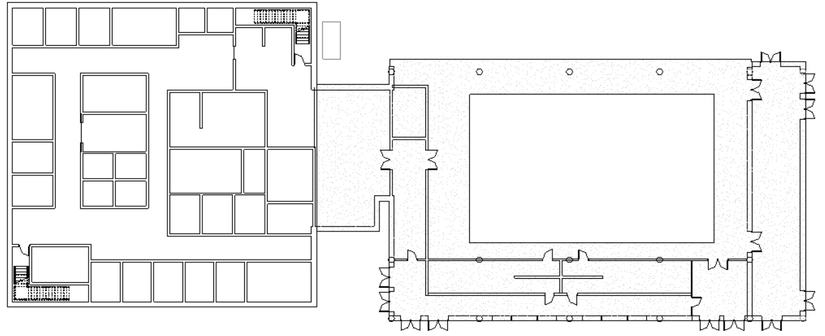
creation.



PHASE 2 ASSUMPTIONS

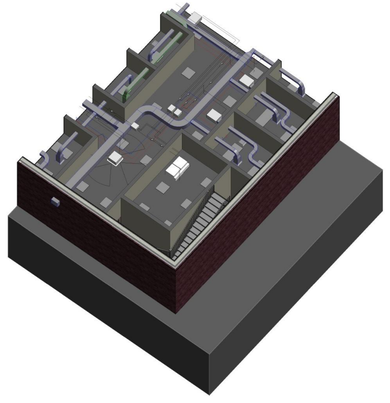
Key Mechanical Assumptions:

- **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**



CLINIC

Variable Refrigerant Volume System with Heat Recovery



Pros of System:

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

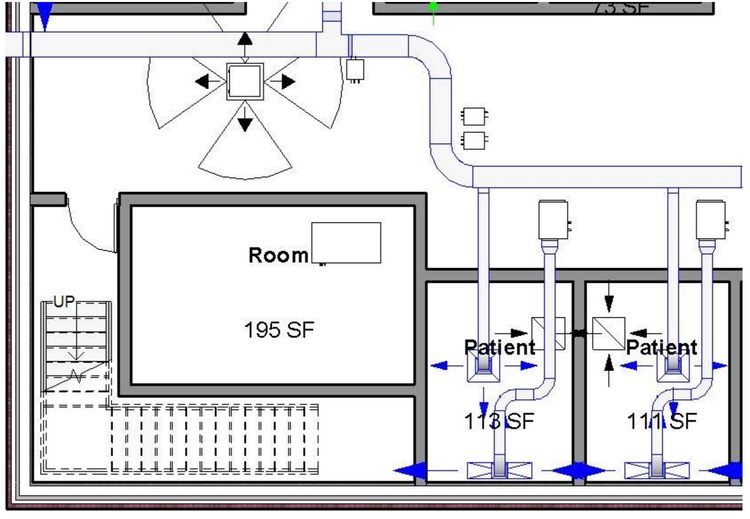
System Components:

100% Outdoor Air Processing Unit
Indoor Condensing Unit
Fan Coils

creation.

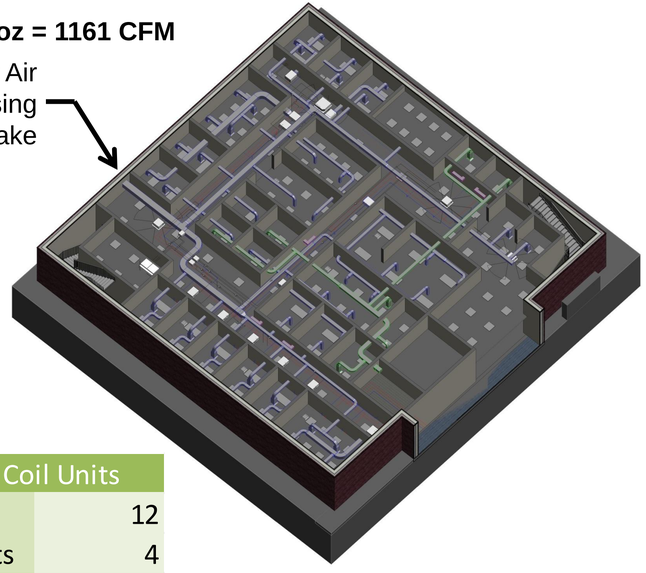
Ventilation Rates		
	Rp(CFM/per)	Ra (CFM/SF)
Patient	25	0
Double Patient	25	0
XRAY	25	0.3
Nurse Station	7.5	0.3
Med Storage	5	0.6
Soiled Utitlity	5	0.6
Clean Supply	10	0.6
Office	5	0.3
Break Room	5	0.3
Office Supply	5	0.3
Front Desk	5	0.3
Room 24	5	0.06
Lavatory	5	0.06
Storage Closet	0	0.6
Electrical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

AIRSIDE DESIGN



Total Voz = 1161 CFM

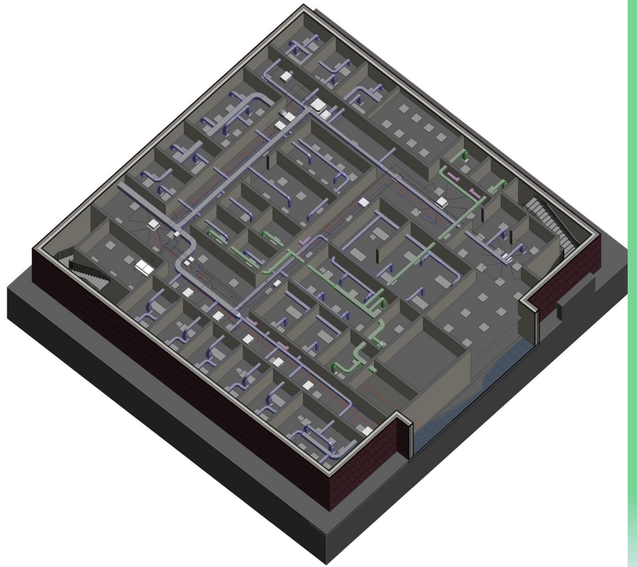
Outdoor Air Processing Unit Intake



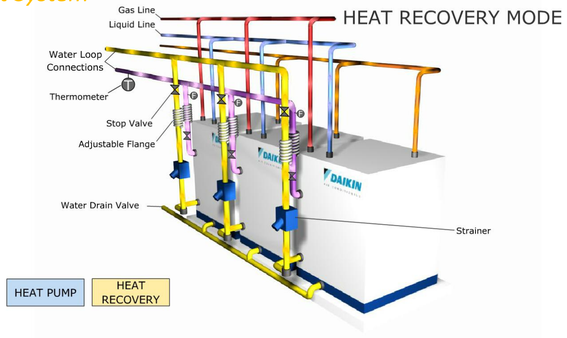
Fan Coil Units	
Boxes	12
Cassetts	4

Clinic

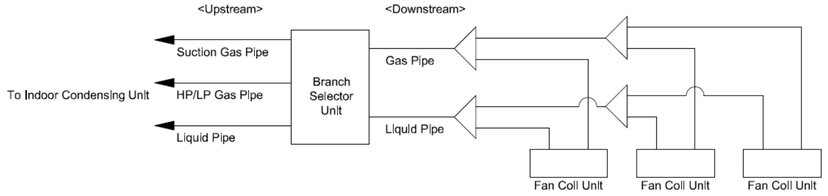
- Retrofit – tie into existing water loops
- Space
- Little disruption
- Time of construction
- Growth
- Use of existing power equipment



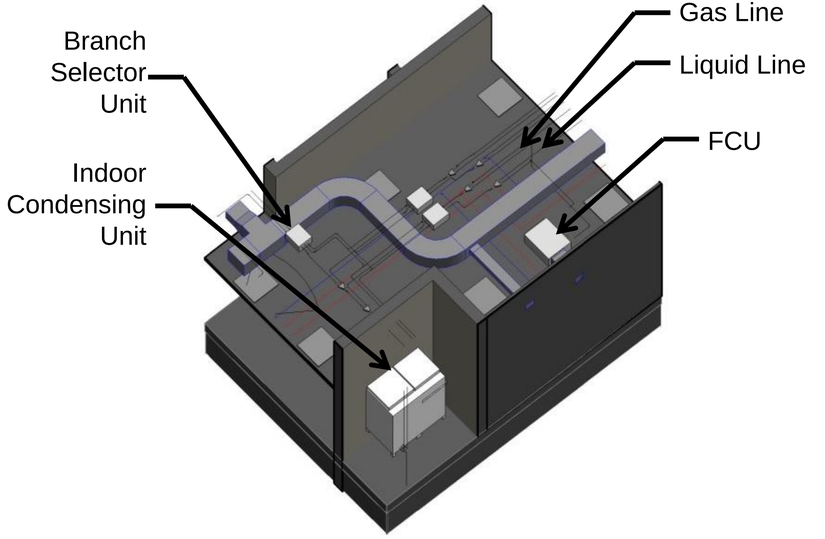
Integration Minute



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



creation.

creation.

Ventilation

Pool Area Ventilation: 2400 CFM
Spectator Ventilation: 2260 CFM

Exhaust

Pool Area Exhaust: 2640 CFM
Spectator Exhaust: 2490 CFM

Moisture Load

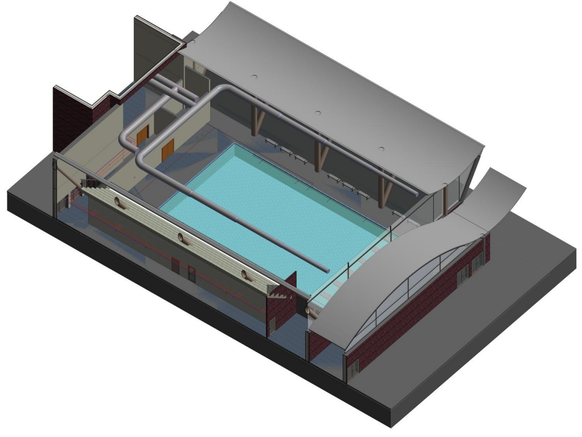
Day (active): 51 Lb/hr
Night (inactive): 0 Lb/hr

Evaporation Rate

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

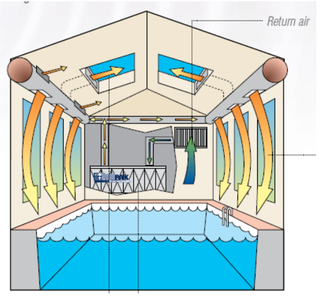
NATATORIUM

All-encompassing AHU



Duct Design

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



Surface Temperature

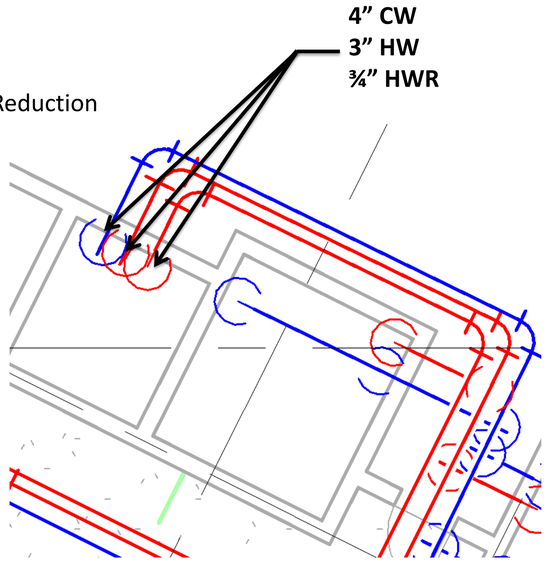
Heating: 59°F
Cooling: 84°F

AHU Provides:

Ventilation
Dehumidification
Heat Recovery

Pool Savings

$3,850/year



PLUMBING DESIGN

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**

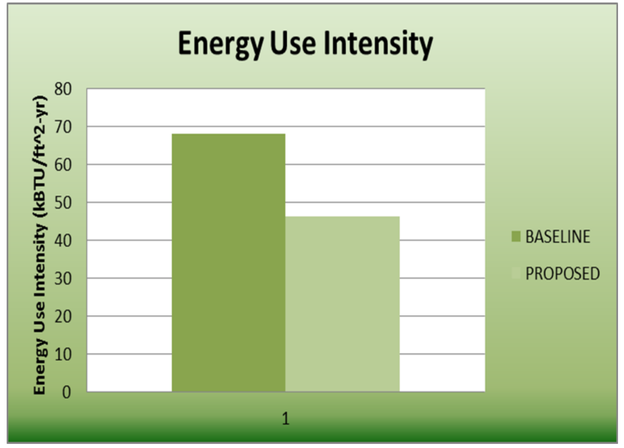
WATER USE REDUCTION

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

creation.

- 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

Clinic

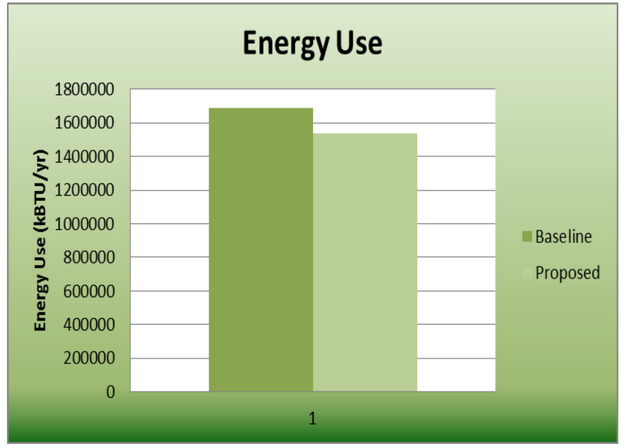
VRV with Heat Recovery

Total energy reduction of 13%

Natatorium

All- encompassing AHU

Total savings 1,398MMBTH or $3,850



creation.

Lighting/Electrical Systems

creation.

creation.

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

WEATHERPROOF ENCLOSURE

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	948	226	58	115	11313	
62	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*
  - Site & Façade Lighting
  - Enclosure
  - Atrium
  - Classrooms
  - Library
  - Multipurpose Room
- Phase 2 Design

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

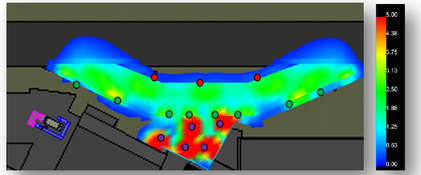
- **Introduction**
- Phase 1 Design
  - Electrical System Overview
  - Lamp Comparison
  - *Site & Façade Lighting*
  - Enclosure
  - Atrium
  - Classrooms
  - Library
  - Multipurpose Room
- Phase 2 Design

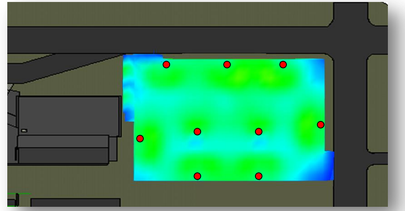
Site & Façade Lighting

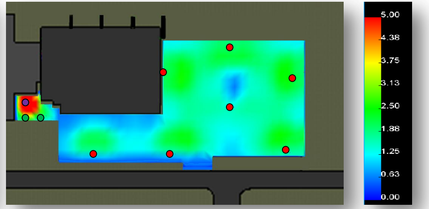
Fixture Description	Mounting	Lamp
18' Mounting Street Lamp	Pole	89W LED
Canopy Light	Surface	37W LED
LED Bollard	Pole	10W LED
Wall Pack	Wall	26W LED
In Ground Spot Light	In Ground	9W LED







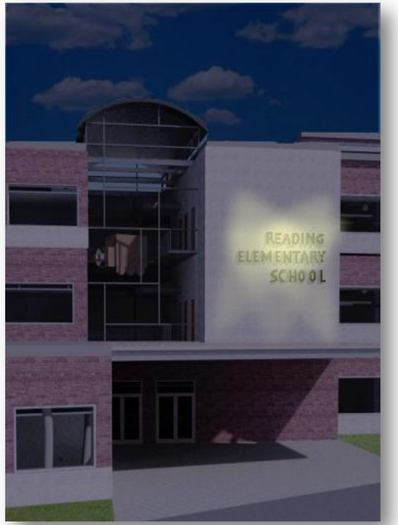




Clinic Parking		Criteria	As Designed
Horizontal Parking Lot Illuminance	Avg. (fc)	0.8	1.66
	Max. (fc)	--	2.8
	Min. (fc)	0.2	0.3
	Max:Min	20:1	9:01
Vertical Parking Lot Illuminance @ 5'	Avg. (fc)	0.5	0.9
	Max. (fc)	--	2.5
	Min. (fc)	0.1	0.2
Power Density (W/SF)		0.06	0.053

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



creation.

- **Introduction**
- Phase 1 Design
  - Electrical System Overview
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  - *Enclosure*
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  - Library
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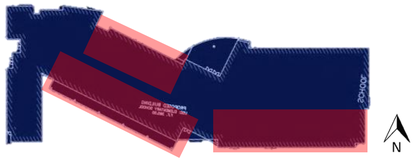
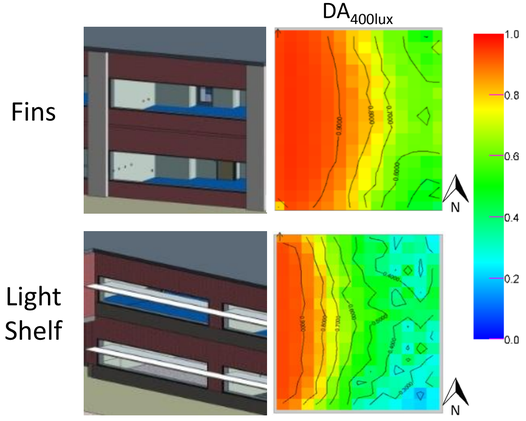
Clerestory Analysis



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

Enclosure

West Classroom Analysis



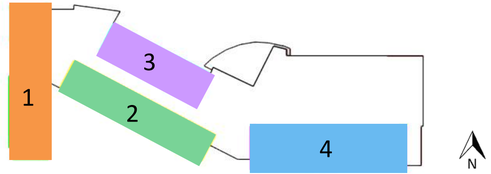
Direct Sunlight Penetration

800 hrs/ school year
50% of the year

Direct Sunlight Penetration

540 hrs/ school year
33% of the year

Final Static Shading Solutions

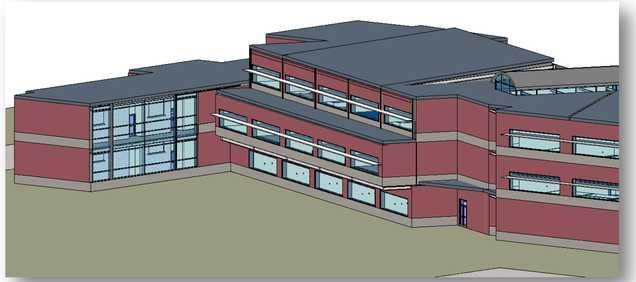


1. Lightshelves
2. Lightshelves
3. Clerestories
4. Lightshelves and Clerestories

creation.

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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Integration Minute

- **Introduction**
- Phase 1 Design
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  - *Atrium*
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  - Library
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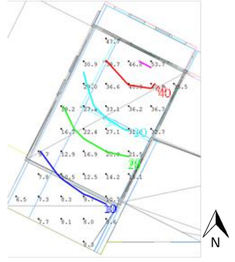
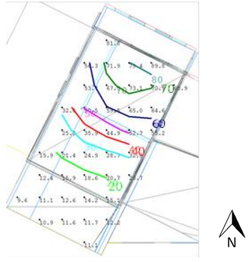
Atrium

December 21st @ Noon



Avg. Illuminance: **25 fc**

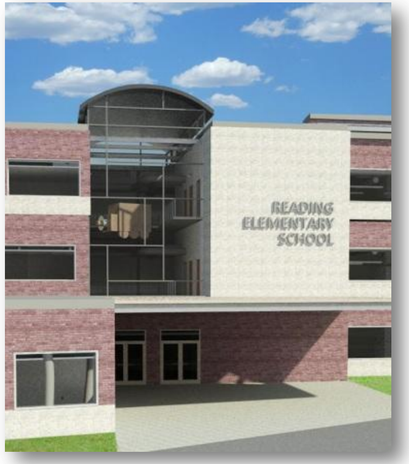
June 21st @ Noon



Avg. Illuminance: **53 fc**

Target Avg. Illuminance: 10 fc

Note: All calculations were analyzed with a Partly Cloudy Sky



creation.

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- Phase 1 Design
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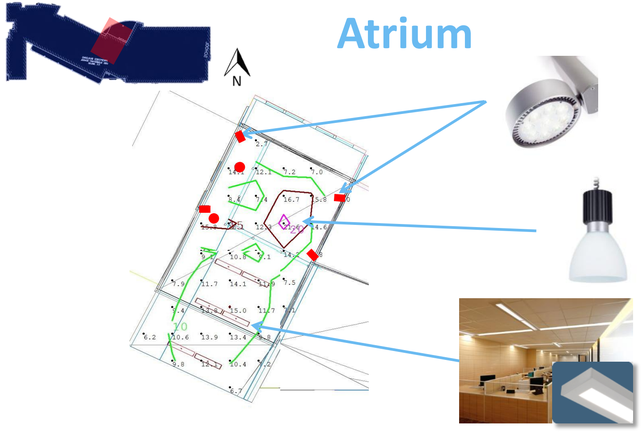
Lighting Design Details:

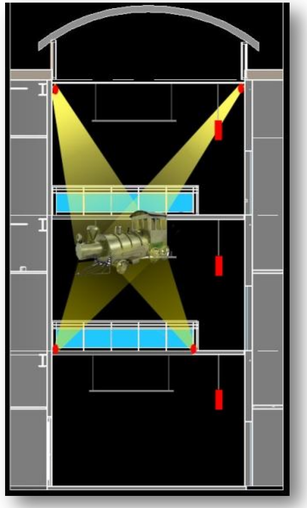
- **LED spotlights** highlight art work from above (38’ AFF) and below (14’ AFF)
- **Occupancy sensors** and **photo sensor** controls and manual switch
- **Decorative pendants** to illuminate walkways to the restrooms

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

Atrium



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

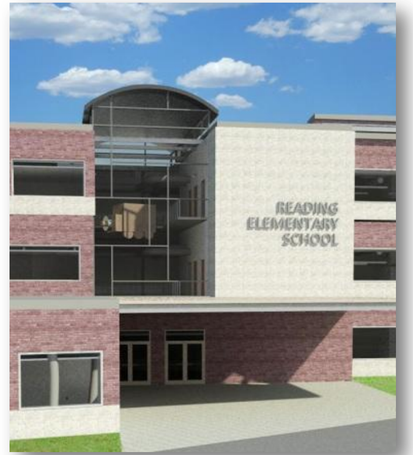


creation.

Atrium

creation.

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



Integration Minute

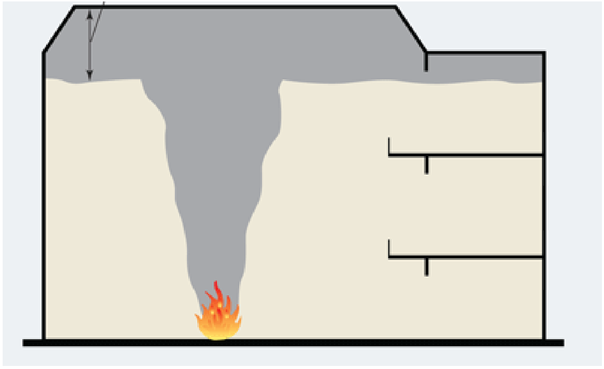
Atrium

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

creation.

Smoke Control Options

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



Integration Minute

- **Introduction**
- Phase 1 Design
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  - Atrium
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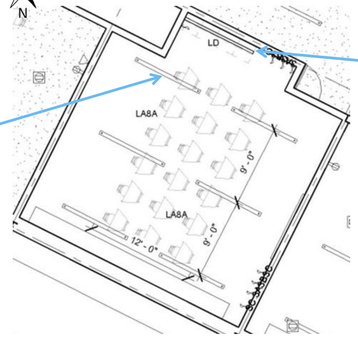
Lighting Design Details:

- 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.

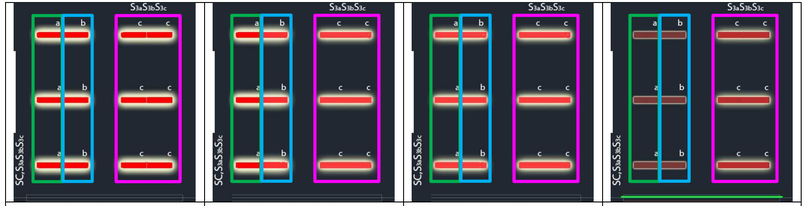
Classrooms			Criteria	As Designed
Classroom	**25-65 yrs**	**Avg. (fc)**	40	38
		Avg:Min	2:1	2:1
Whiteboard	**25-65 yrs**	**Avg (Vert.)**	30	27.2
		Avg:Min	3:1	2.2:1
Power Density (W/SF)			1.24	1.15

Classrooms



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

creation.

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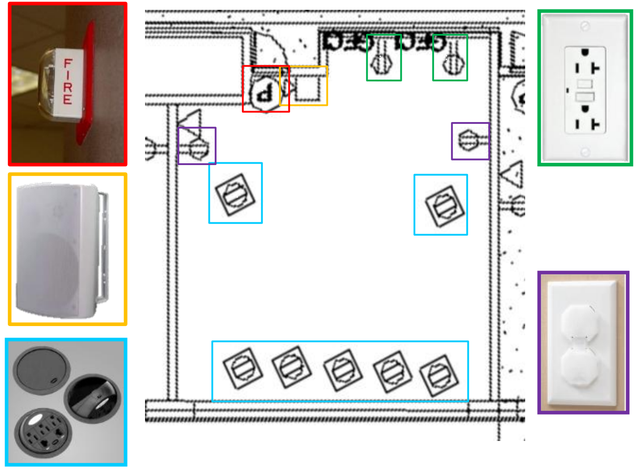
Classroom Electrical & Fire Alarm System

General Rules Followed:

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

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

creation.

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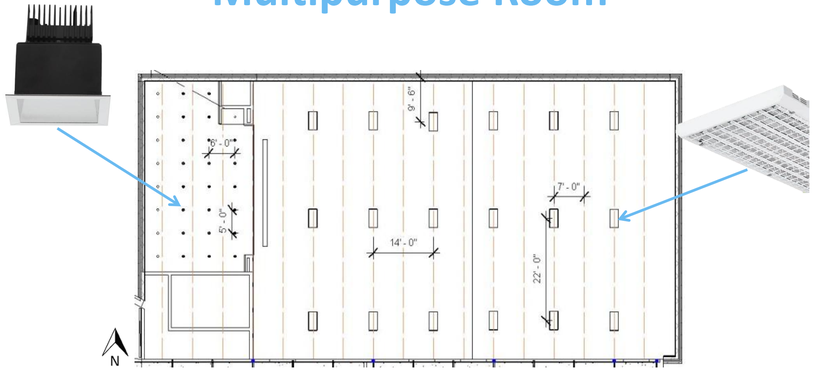
Lighting Design Details:

- 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

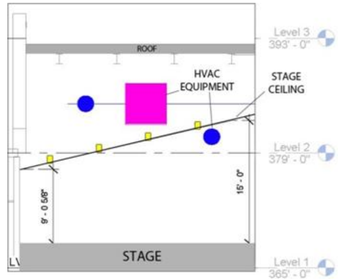
Multi-Purpose Room			Criteria	As Designed
Assembly : A/V No Notes	<25 yrs	Avg. (fc)	0.5	3.2
		Avg:Min	2:1	1.3:1
Assembly : Speaker/Panel	<25 yrs	Avg. (fc)	25	32
		Avg:Min	3:1	2.3:1
Phys. Ed	<25 yrs	Avg. (fc)	25	32
		Avg:Min	3:1	2.3:1
Cafeteria	<25 yrs	Avg. (fc)	7.5	14
		Avg:Min	3:1	2.3:1
Basketball -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

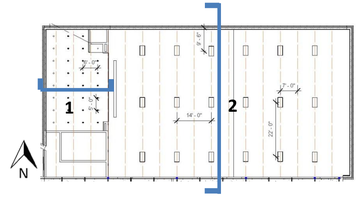
Multipurpose Room



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

1





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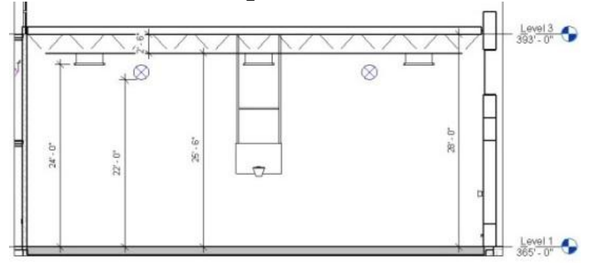

creation.

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- Phase 1 Design
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  - *Multipurpose Room*
- Phase 2 Design

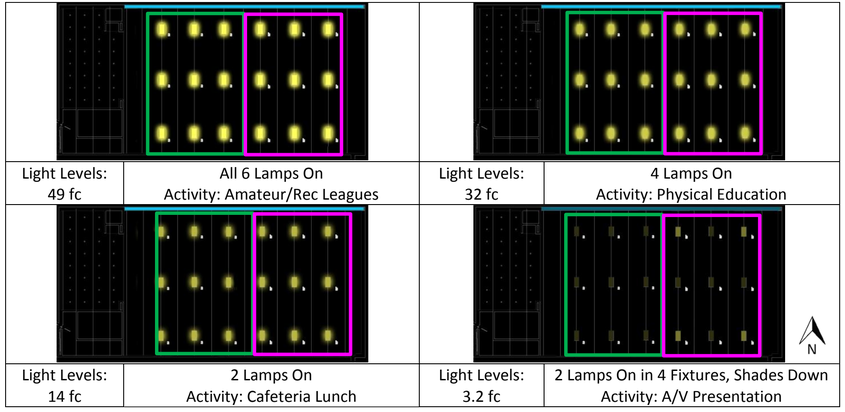
creation.

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 : A/V No Notes	<25 yrs	Avg. (fc)	0.5	3.2
		Avg:Min	2:1	1.3:1
Assembly : Speaker/Panel	<25 yrs	Avg. (fc)	25	32
		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

Multipurpose Room



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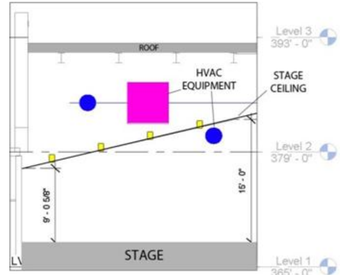

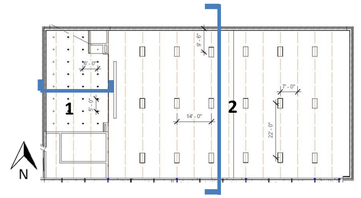

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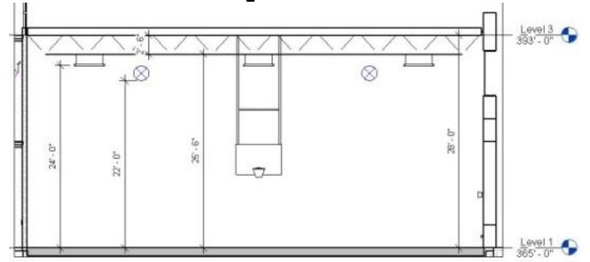


Phase 2 – Electrical System Overview

General Assumptions Made:

For Clinic:

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

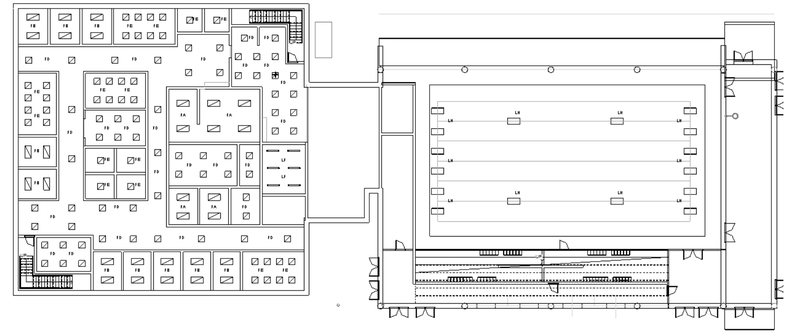
For Natatorium:

- 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

Total Building Load
109.8 kVA

Clinic	kVA
Lighting Load	1.9
Power Load	30.0
Emergency Loads: Life Safety	1.3
Emergency Loads: Critical	30.0

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



creation.

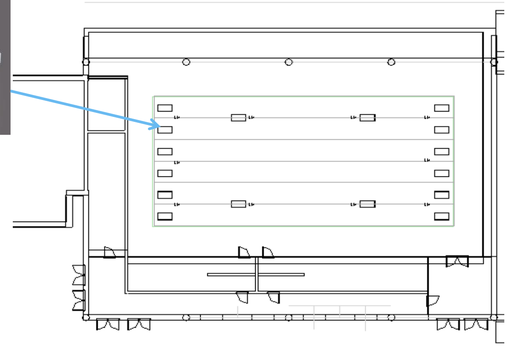
- **Introduction**
- Phase 1 Design
- **Phase 2 Design**
  - Electrical System Overview
  - *Natatorium*
  - Clinic

Phase 2 - Natatorium

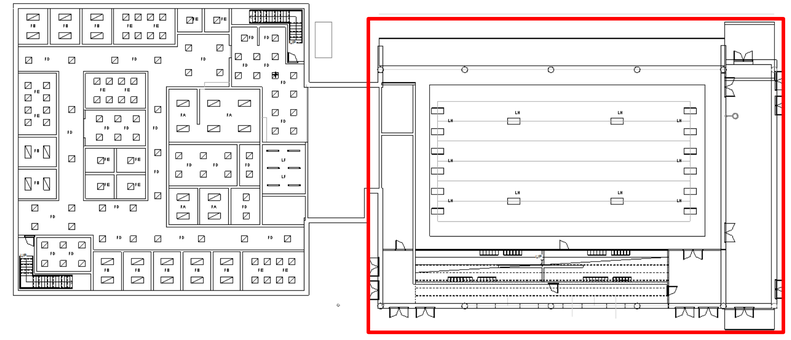
Lighting Design Details:

- **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)**	30	31
	Avg:Min	3:1	2:1
Deck Surface	**Avg. (fc)**	10	22
	Avg:Min	4:1	2.5:1
Turning Lanes	**Avg. (fc)**	50	48
	Avg:Min	1.7:1	1.3:1
Power Density (W/SF)		1.2	1.03



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



creation.

- **Introduction**
- Phase 1 Design
- **Phase 2 Design**
  - Electrical System Overview
  - Natatorium
  - *Clinic*

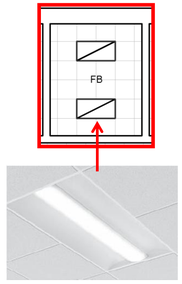
Phase 2 - Clinic

Lighting Design Details:

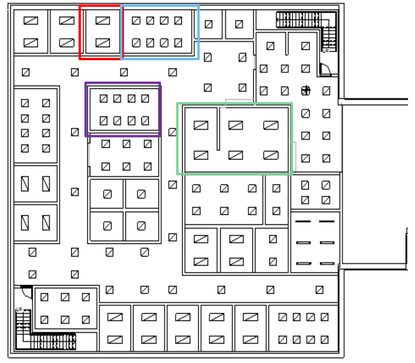
- **2'x2' tile ceiling** dropped at **8'** AFF allowing for **6' plenum space**

Clinic		Criteria	As Designed
Individual Patient Rooms	Avg. (fc)	50	50
	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

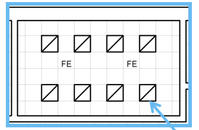
Patient Room



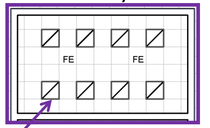
Fixture Description	Mounting	Lamp
2'x4' Volumetric	Recessed	(2) 28W T8

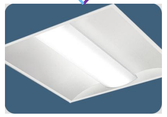


Double Patient Room



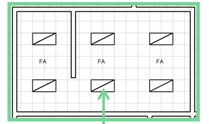
X-Ray





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

Administration

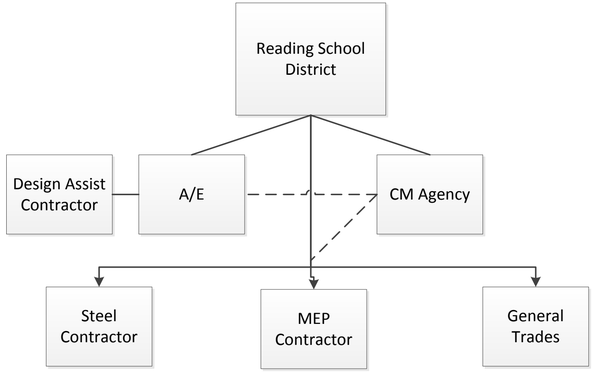


Fixture Description	Mounting	Lamp
2'x4' Volumetric	Recessed	(1) 28W T8

creation.

Construction Planning

creation.



Project Delivery Method

Pennsylvania Standard: Multiple Prime with CM Agency

Proposed Delivery Method: CM Agency with Multiple Prime Design-Assist Subcontractors

Alternative Project Delivery Benefits

- Constructability Reviews
  - Renovation savings
- Value Engineering
- Up front investment for long-term savings

Phase 1

Reading Elementary

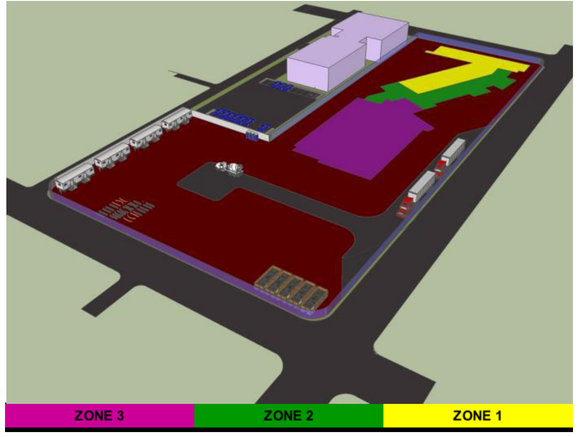
Project Budget - New Elementary School			
Division/Subdivision	**Base Cost**	**%**	**SF Cost**
Bidding Requirements	$ 462,400.00	2.89%	$ 4.74
General Requirements	$ 976,000.00	6.10%	$ 10.01
Concrete	$ 844,800.00	5.28%	$ 8.66
Masonry	$ 1,905,600.00	11.91%	$ 19.54
Metals	$ 1,793,600.00	11.21%	$ 18.40
Woods & Plastics	$ 182,400.00	1.14%	$ 1.87
Thermal & Moisture Protection	$ 571,200.00	3.57%	$ 5.86
Doors & Windows	$ 723,200.00	4.52%	$ 7.42
Finishes	$ 1,651,200.00	10.32%	$ 16.94
Specialities	$ 275,200.00	1.72%	$ 2.82
Equipment	$ 688,000.00	4.30%	$ 7.06
Furnishings	$ 454,400.00	2.84%	$ 4.66
Conveying Systems	$ 160,000.00	1.00%	$ 1.64
Plumbing	$ 992,000.00	6.20%	$ 10.17
HVAC	$ 2,160,000.00	13.50%	$ 22.15
Electrical	$ 2,160,000.00	13.50%	$ 22.15
Total Building Budget	**$ 16,000,000.00**	**100.00%**	**$ 164.10**

Budget

- Preliminary Budget: $19M (SF Estimate)
- Reading School District Allocated Funds 2009-2010: $215M
- Proposed Budget: **$19M**
  - **$16M** new school construction

Phase 1

Reading Elementary

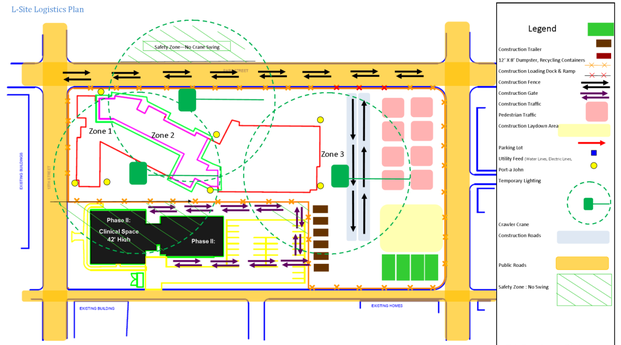


Schedule

- NTP: June 3, 2013
- Substantial Completion: May 22,2014
- Phase 1 broken into 3 zones to maximize productivity

Phase 1

Reading Elementary



N

Site Logistics: Phase 1	Reading Elementary School Project AEI Team #04-2013	Update: 4 Date: 2/20/13

Logistics

- Student Safety in neighboring school
- Precast panel crane locations
- Efficient use of laydown and material storage areas

creation.

Phase 1

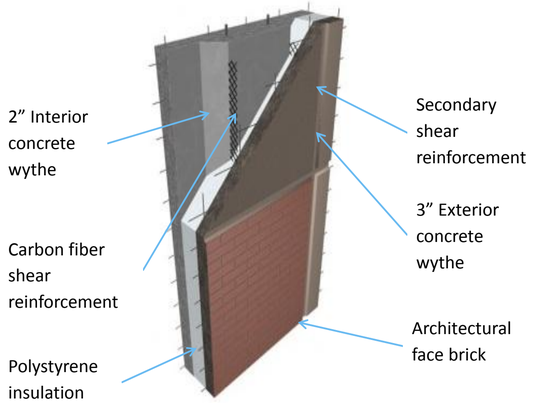
Reading Elementary

Rammed Aggregate Pier Foundation

- Considerable constructability benefits over micropiles and spread footing
- 20% cost savings → $617,600
- Sinkhole Contingency Plan
- Combined Micropile/RAP Foundation

Phase 1

Reading Elementary

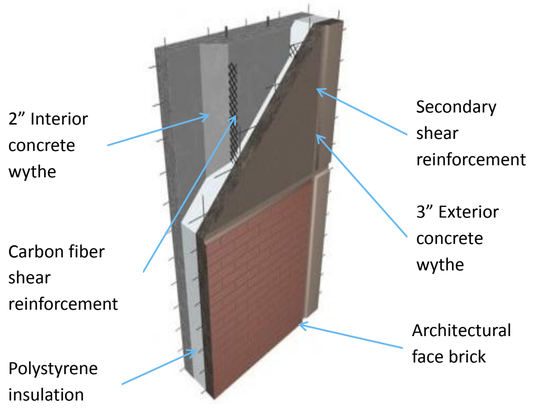


Precast Insulated Panels

- Non-loadbearing insulated wall panels
- 14’ height typical length 28’
- 35,000 lb load
  - Critical for crane sizing
- 25 day erection schedule
- Local fabricator for easy coordination

Phase 1

Reading Elementary



Construction Influence:

- Panel Sizing &Contractor Selection
- Crane Sizing &Pick Planning
- Site Logistics Planning
- Panels: $1,233,840
- Glazing: $711,987 (w/o bulletproof)

Supported by Structural Steel:

- Beams, columns, braced frames, detailing, CMU walls
- $1,139,660

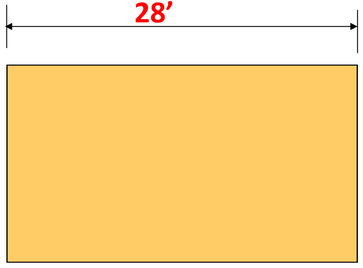
- Project Overview
- Phase 1
  - Budget
  - Schedule
  - Logistics
  - RAP Foundation
  - Precast Insulated Panels
  - Green Roof
- Phase 2
- Conclusion

Crane pick schedule
Logistics plan

Phase 1

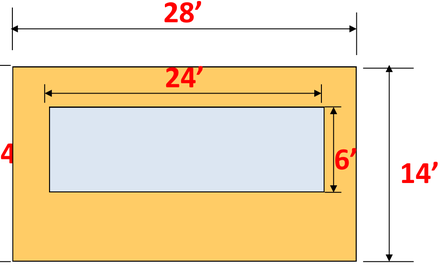
Panel Erection Strategy

Case 1: Solid Panel

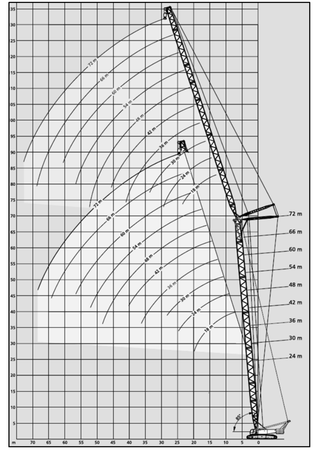


Panel Weight= 14’*28’ = 392 SF
392 SF * 90 lbs/ft2
= 35,000lbs

Case 2: Panel with Largest Glass Area



Panel Weight=14’*28’ = 392 SF
6’*24’ = 144 SF Glass
392-144 = 248 SF Concrete
248 * 90 lbs/ft2 + 248 * 5 lbs/ft2
= 25,000



DEMAG CC1500

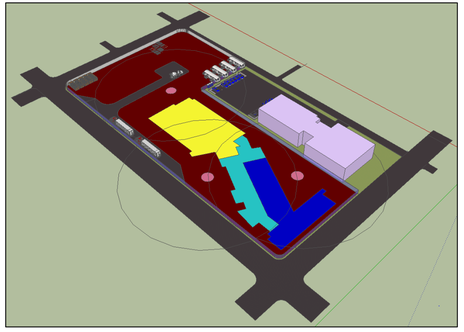
creation.

Crane pick schedule
Logistics plan

creation.

Phase 1

Strategic Crane Planning



Crane Sizing

- Radius:
46 m = 150.9 ft.

- Critical Pick: 35,000lbs at 140 ft

- Capacity:
17.5 tons (46m) = 35,000 lb

- Crane Selected:
46m Boom with 42m Jib

54 m	Main boom · Hauptausleger · Flèche principale					
	Radius Ausladung Portée	Fly jib · Hilfsausleger · Fléchette				
	m	18,0	24,0	30,0	36,0	42,0
	15	53,3	-	-	-	-
	16	51,3	-	-	-	-
	17	49,5	44,5	-	-	-
	18	47,7	42,8	-	-	-
	19	46,1	41,4	37,0	-	-
	20	44,6	40,0	35,7	-	-
	21	43,4	39,1	34,8	31,3	-
	22	42,2	38,2	33,9	30,4	-
SW	23	41,1	37,3	33,2	29,8	26,0
	24	40,1	36,4	32,5	29,1	25,5
	26	-	34,8	31,2	28,1	24,5
	28	-	33,3	29,9	27,1	23,7
	30	-	31,8	28,7	26,1	23,0
	34	-	-	26,5	24,2	21,5
	38	-	-	-	22,6	20,1
	42	-	-	-	21,0	18,8
	46	-	-	-	-	17,5
	50	-	-	-	-	-

First Level: 1170 LF
Second Level: 1235 LF
Third Level: 982 LF
Total LF: 3387 LF

→ **150 Panels**

Pick Schedule

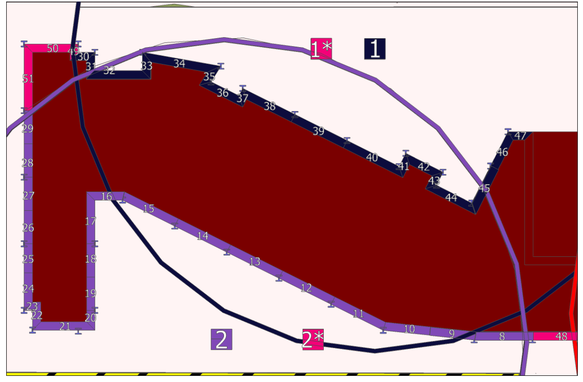
3400 LF = 150 Picks

6 Panels a Day for 25 Days

Reference: http://www.loadlifter-solutions.com/pages/international_pcc/

Phase 1

Strategic Crane Planning



Panel Erection Calculations

Crane Location	Panel Number	Panel Length [FT]	Panel Weight [LB]	Pick Distance [FT]
3	1	8	9968	43
3	2	25	31150	40.5
3	3	10	12460	46
3	4	3	3738	52
3	5	26	32396	65
3	6	28	34888	92
3	7	28	34888	120
2	8	28	34888	130
2	9	22	27412	106
2	10	22	27412	85
2	11	28	34888	62
2	12	28	34888	40
2	13	28	34888	37
2	14	28	34888	46
2	15	28	34888	66
2	16	16	19936	83
2	17	23	28658	78
2	18	16	19936	67
2	19	16	19936	61
2	20	8	9968	59
2	21	26	32396	71
2	22	10	12460	85
2	23	5	6230	87
2	24	16	19936	91
2	25	14	17444	96

Crane Location	Panel Number	Panel Length [FT]	Panel Weight [LB]	Pick Distance [FT]
2	27	16	19936	109
2	28	16	19936	120
2	29	16	19936	130
1	30	8	9968	135
1	31	9	11214	131
1	32	27	33642	119
1	33	8	9968	105
1	34	32	39872	89
1	35	7	8722	76
1	36	19.5	24297	72
1	37	4	4984	63
1	38	28	34888	53
1	39	28	34888	42
1	40	28	34888	47
1	41	7	8722	53
1	42	16	19936	56
1	43	7	8722	65
1	44	23.5	29281	76
1	45	22	27412	81
1	46	17	21182	75
1	47	10	12460	75
2*	48	28	34888	113
1*	49	4	4984	114
1*	50	22	27412	125
1*	51	28	34888	136

creation.

Phase 1

Reading Elementary

Green Roof

- Required for AEI Competition
- Minimal energy or cost savings
- Light weight 4” occupiable green roof for learning opportunities
- Low maintenance

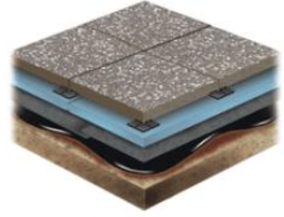
creation.

Phase 1

Reading Elementary

Green Roof

- American Hydrotech
- 3”-4” Medium
- Rainwater stored in drainage layer
- Ultimate Assembly for Terrace Space



http://www.hydrotechusa.com/assemblies/ultimate-assembly

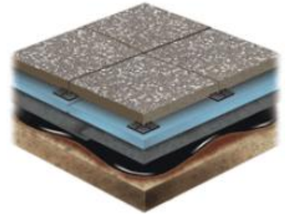
Roof

creation.

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

Construction Influence

- $125,000 – Green Roof
- $1,394,638 – Remaining Roofing
- Creating an Educational Space
- Placement and Drainage



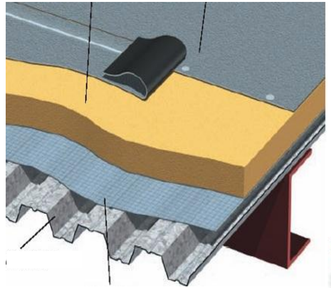
http://www.hydrotechusa.com/assemblies/ultimate-assembly

Integration

Roof

creation.

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



Photovoltaic Panels

20+ Year

Payback Period

Integration Minute

creation.

Phase 2

Reading Elementary

Project Budget - Renovation			
Division/Subdivision	**Base Cost**	**%**	**SF Cost**
Bidding Requirements	$ 86,700.00	2.89%	$ 4.34
General Requirements	$ 183,000.00	6.10%	$ 9.15
Concrete	$ 278,400.00	9.28%	$ 13.92
Masonry	$ 357,300.00	11.91%	$ 17.87
Metals	$ 306,300.00	10.21%	$ 15.32
Woods & Plastics	$ 34,200.00	1.14%	$ 1.71
Thermal & Moisture Protection	$ 107,100.00	3.57%	$ 5.36
Doors & Windows	$ 135,600.00	4.52%	$ 6.78
Finishes	$ 219,600.00	7.32%	$ 10.98
Specialities	$ 51,600.00	1.72%	$ 2.58
Equipment	$ 129,000.00	4.30%	$ 6.45
Furnishings	$ 85,200.00	2.84%	$ 4.26
Conveying Systems	$ 30,000.00	1.00%	$ 1.50
Plumbing	$ 186,000.00	6.20%	$ 9.30
HVAC	$ 405,000.00	13.50%	$ 20.25
Electrical	$ 405,000.00	13.50%	$ 20.25
Total Building Budget	**$ 3,000,000.00**	**100.00%**	$ 150.00

Budget

- **$3M** proposed Add-Alternate
- Total project budget: **$19M** (including $16M school new construction)
- Natatorium new construction in assumed current gymnasium footprint
- Clinic renovation on 1st floor current elementary school with opportunity for future expansion

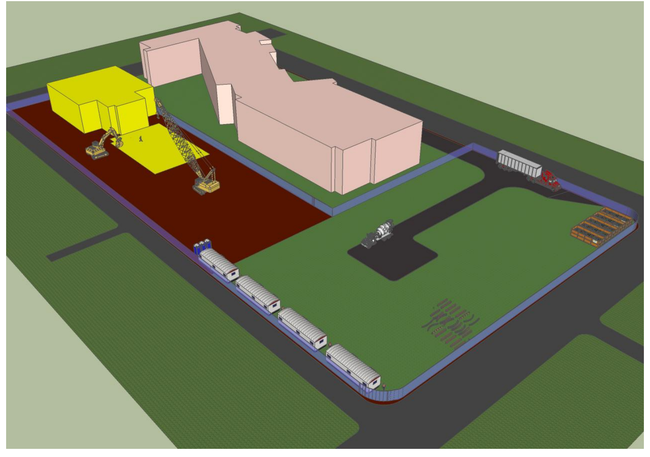
N

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



Schedule

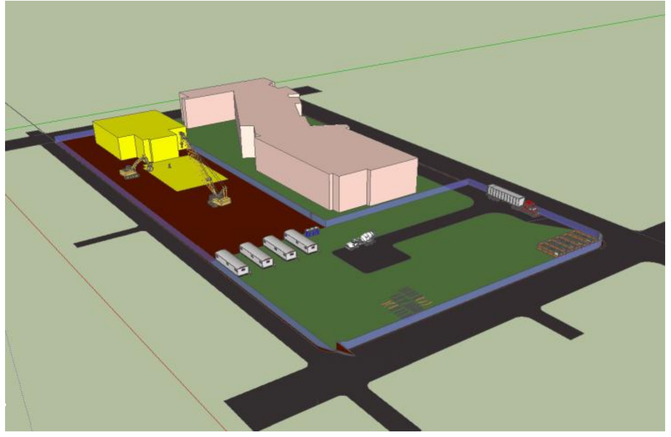
- NTP: June 2, 2014
- Substantial Completion: September 5, 2014
- Parade of trades from new construction contractors

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



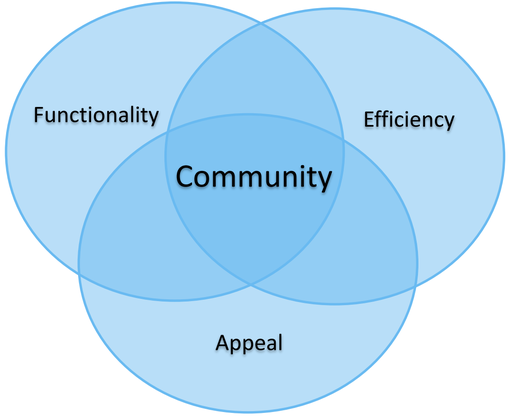
Renovated Conditions

- **Asbestos abatement**
  - PA Dept. of Environmental Protection (DEP)
  - Notify 5 days prior to disturbing
  - Remove all asbestos detected before demolition
  - Notify EPA 10 days before removing asbestos
  - >35cubic feet utilized NESHAP
- **Demolition scheduled in 2 week window**

Integration

creation.

- *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

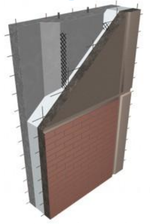
Appeal

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

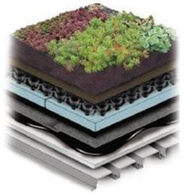
Enclosure

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

Integrated Design Components

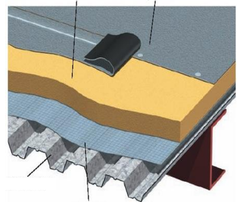


Precast Insulated Panels



Green Roof

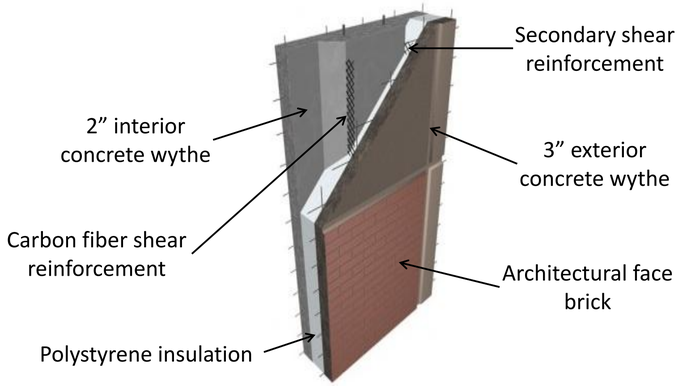
High Performance Glazing and Daylighting Design



Roof

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

Precast Insulated Panels



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

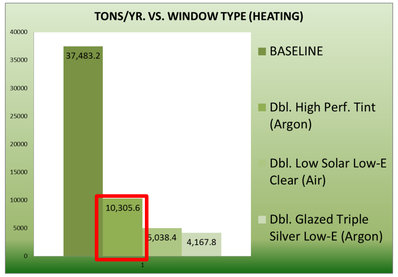
Integrated Design Components

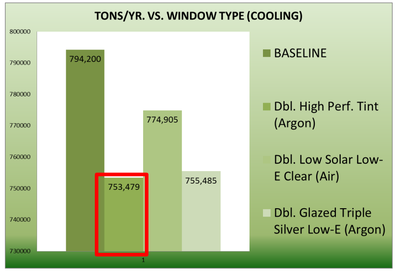
- Meet ASHRAE 90.1 requirements

  U-Value = 0.0383

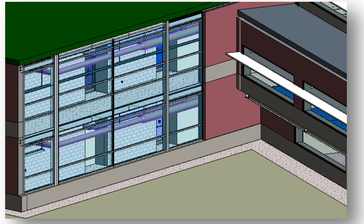
- Optimize constructability
- Light weight → Larger panel size
- Local fabricators

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



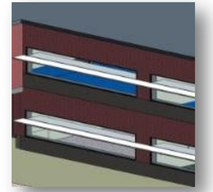


Fenestration Design

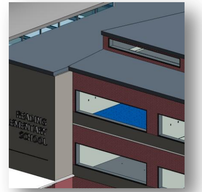


Glazing Types	Assembly U-Value	Assembly SHGC	VT
Double High Performance Tint (Argon)	0.54	0.39	0.607
Double Low Solar Low-E Clear (Air)	0.40	0.382	0.701
Double Glazed Triple Silver Low-E (Argon)	0.35	0.272	0.638

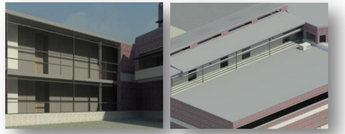
create a functional barrier from exterior elements while maintaining aesthetic appeal & interior comfort



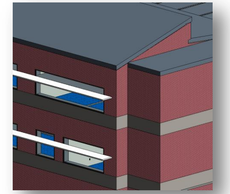
Lightshelves



Clerestories



Curtain Walls



Lightshelves and Clerestories

creation.

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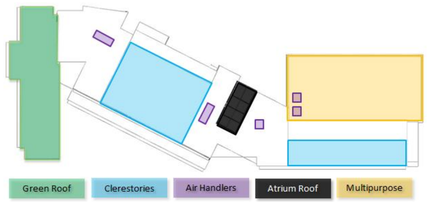
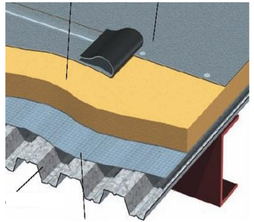
  - Multipurpose Room
- Phase 2
  - Natatorium
  - Clinical Renovation

Schematic Roof Plan



Green Roof



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

creation.

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- **Phase 1**
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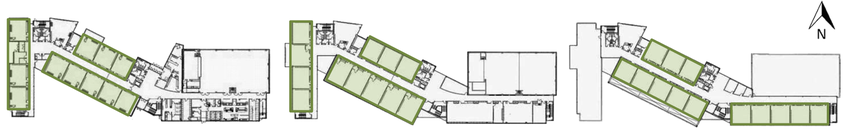
Typical Classroom

create a stimulating & comfortable learning environment



Integrated Design Components

- Systems Spacing
- Constructability

- Introduction
- **Phase 1**
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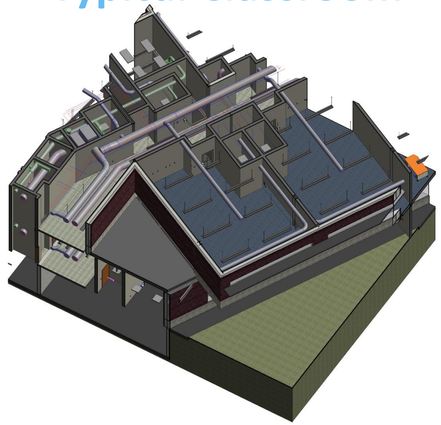
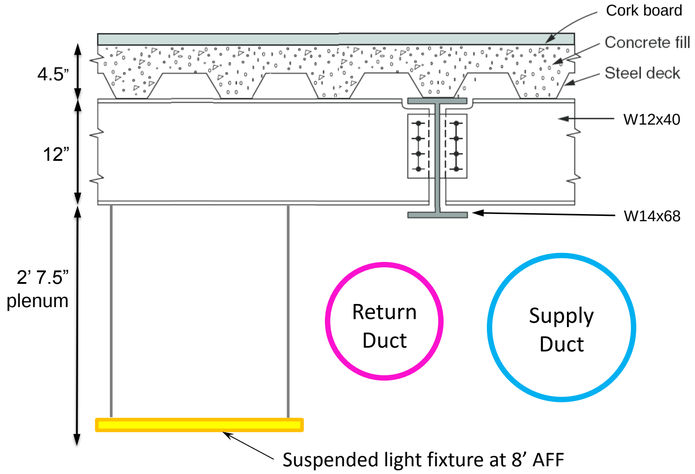
creation.

Typical Classroom



create a stimulating & comfortable learning environment

Integrated Design Components



- Introduction
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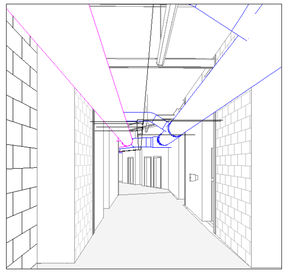
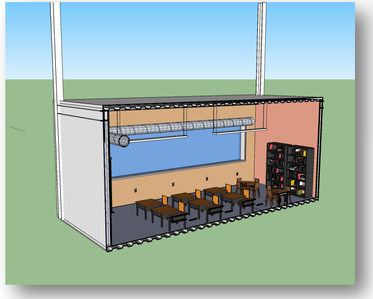
Typical Classroom

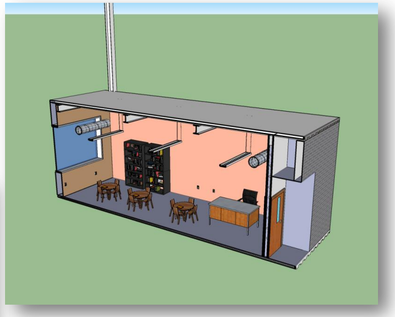
Clash Detection



create a stimulating & comfortable learning environment

Virtual Mockups





creation.

- Introduction
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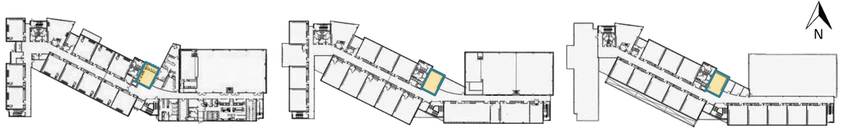
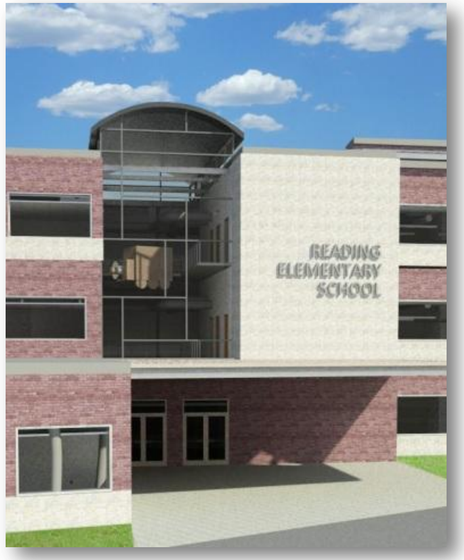
Atrium

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





- Introduction
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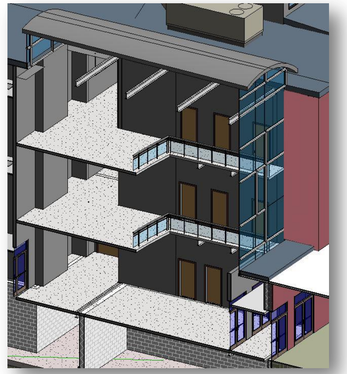
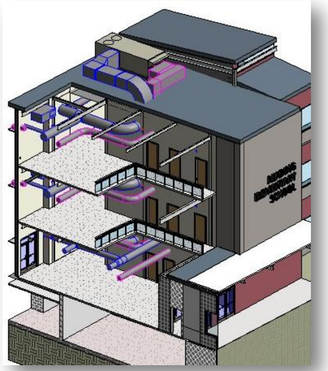
Atrium





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
- **Phase 1**
  - Enclosure
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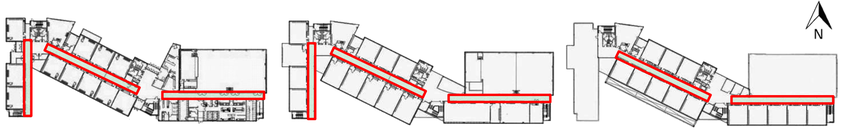
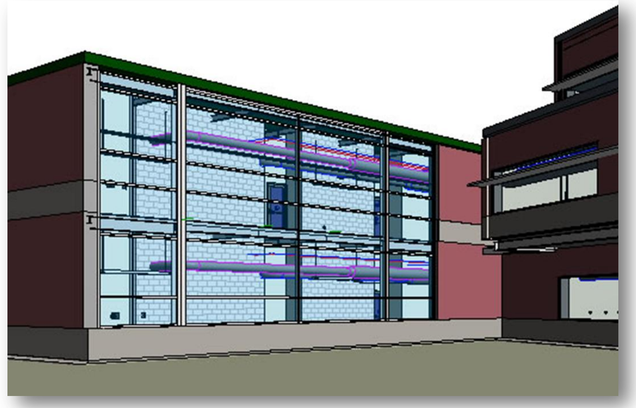
Corridor

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





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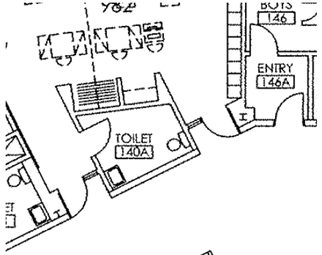
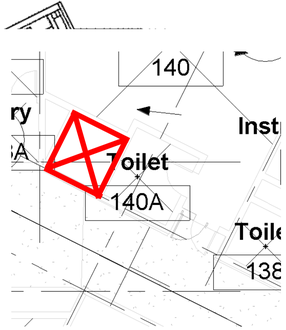
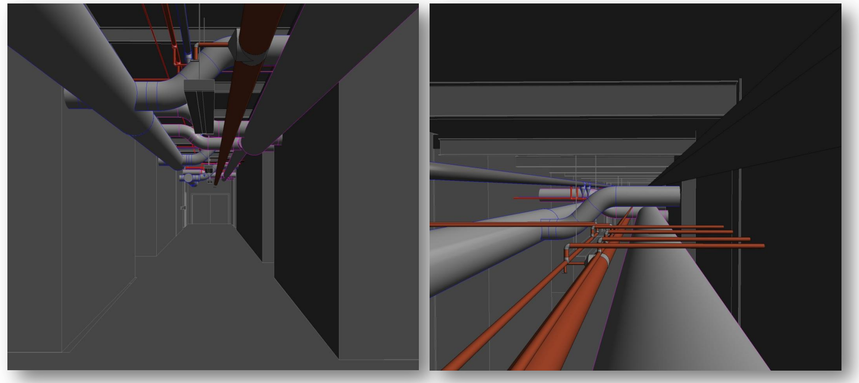




Corridor



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

creation.

- Introduction
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  - Enclosure
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  - Corridor
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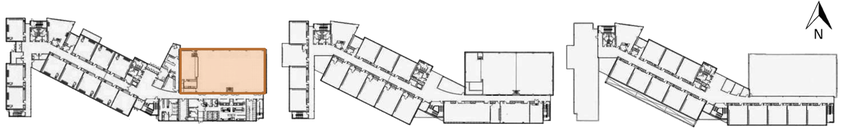
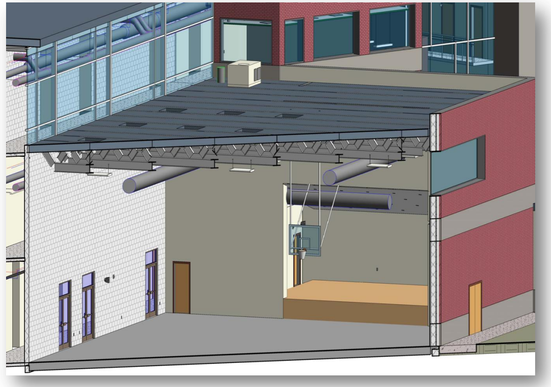
Multipurpose Room

create a flexible space for school and community use





creation.

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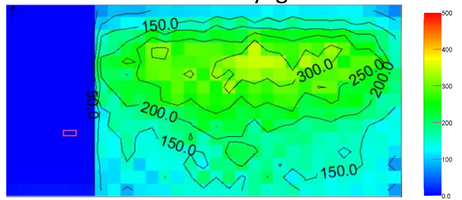
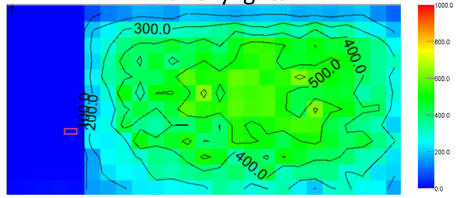
September 21st 10:00AM

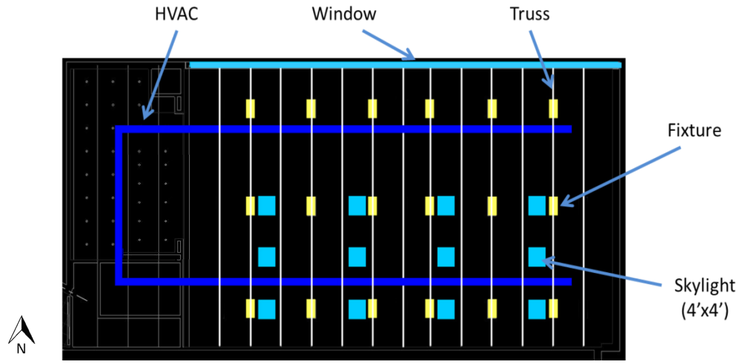
Without Skylights



With Skylights



Multipurpose Room



create a flexible space for the school and community

Integrated Design Components

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

creation.

- Introduction
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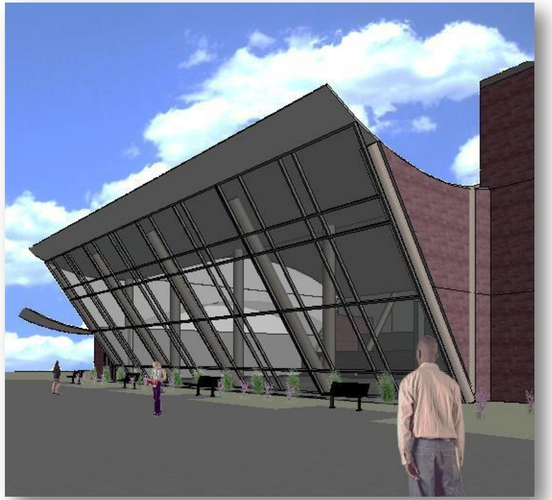
Natatorium

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

create a recreational building to encourage healthy living and community involvement



creation.

- Introduction
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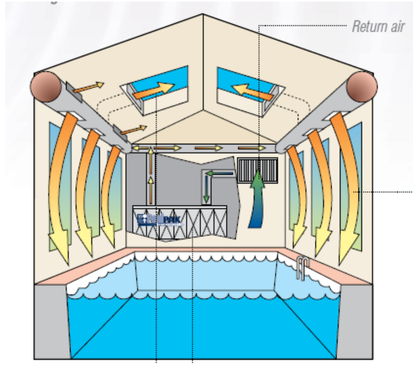
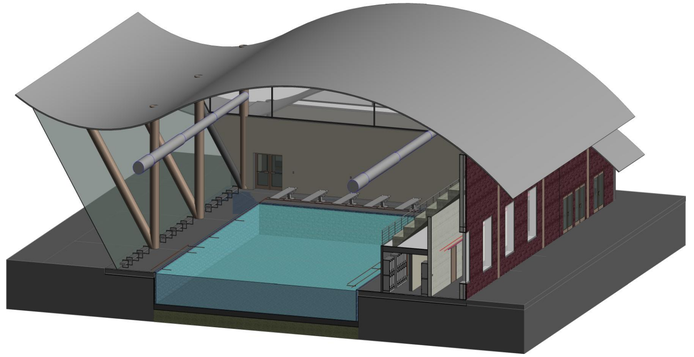


Natatorium



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

creation.

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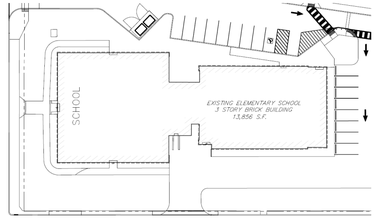
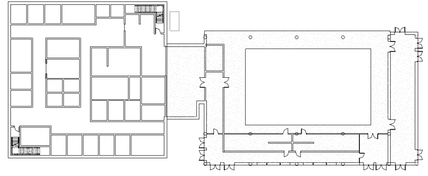
Clinic Renovation

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

- Introduction
- Phase 1
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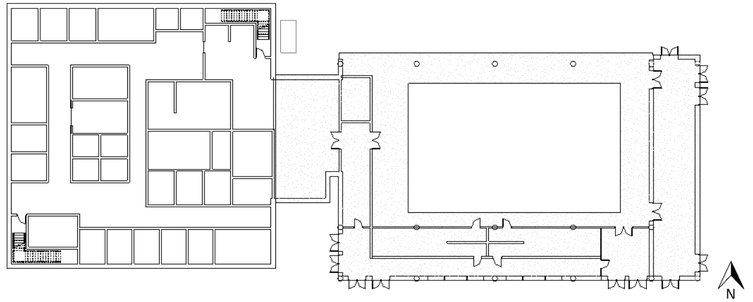
creation.

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.