# AEI Student Design Competition

## Team 2020-03

**April 15, 2020**

GOLIATH engineering

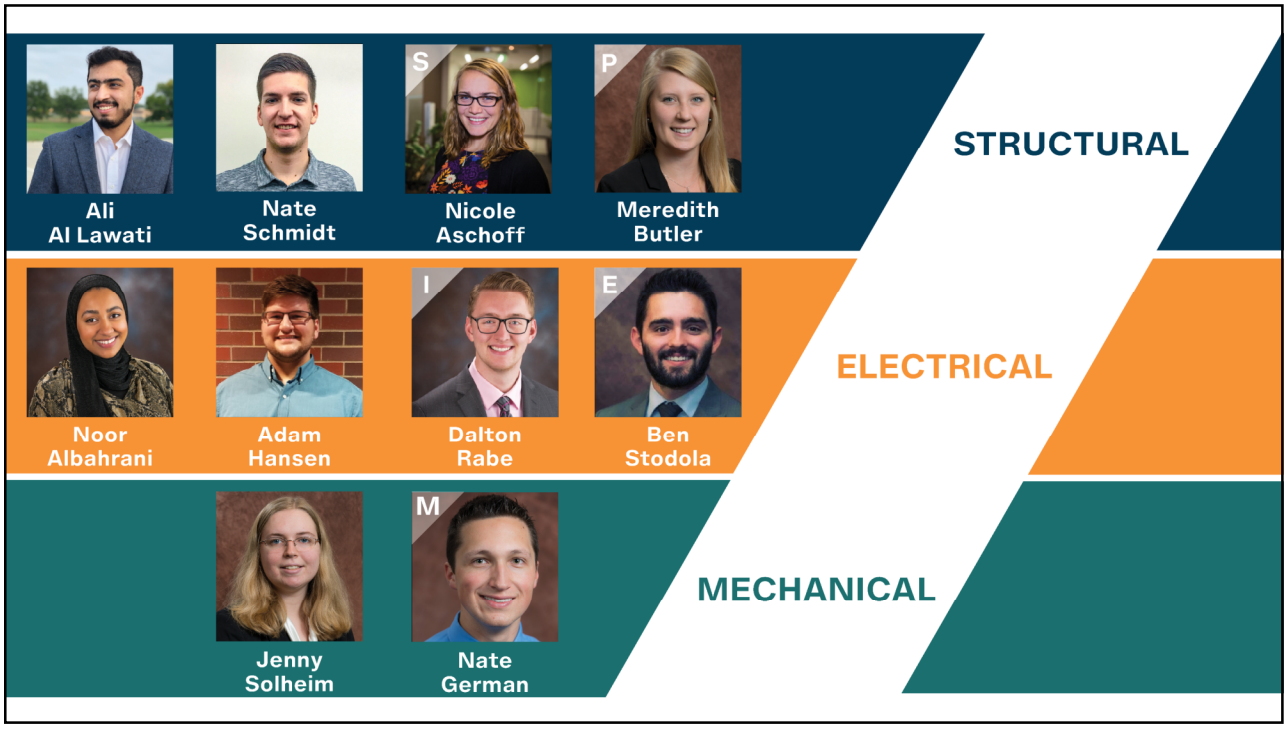
**Integration**

**Structural**

**Electrical**

**Mechanical**

**Challenge #2 : Building Envelope**



DR3

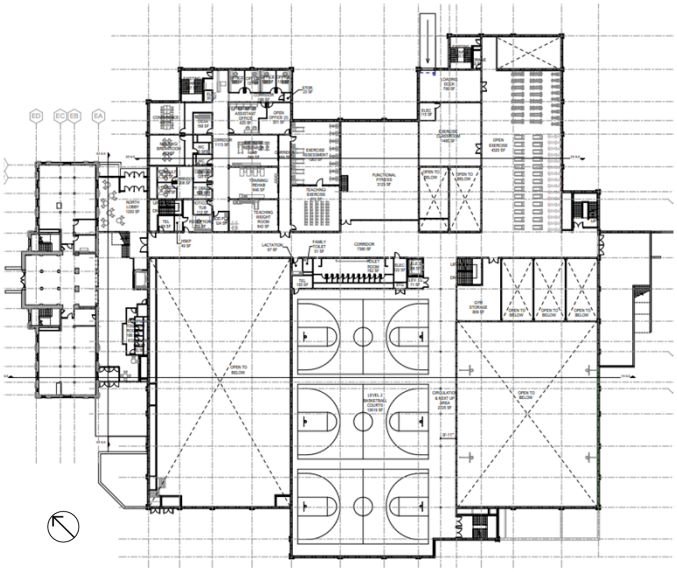
# War Memorial Hall

3

## Project Description

**Virginia Tech University**

- 1924 Head House
- 1972 addition
- Over 200,000 sq. ft
- $45 million



INTRO | SITE | ENVELOPE | INTEGRATION | DISCIPLINE | SUMMARY

DR13

# Presentation Overview

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- INTRODUCTION
- SITE
- BUILDING ENVELOPE CHALLENGE
- INTEGRATED SPACES
- DISCIPLINE SPECIFICS
- DESIGN SUMMARY

INTRO | SITE | ENVELOPE | INTEGRATION | DISCIPLINE | SUMMARY

## Slide 3

**DR3** Possibly make a better graphic for this slide like the Team Roster and Project Goals
Dalton Rabe, 3/8/2020

## Slide 4

**DR13** Background is made. Just needs to be inserted
Dalton Rabe, 3/10/2020

# War Memorial Hall

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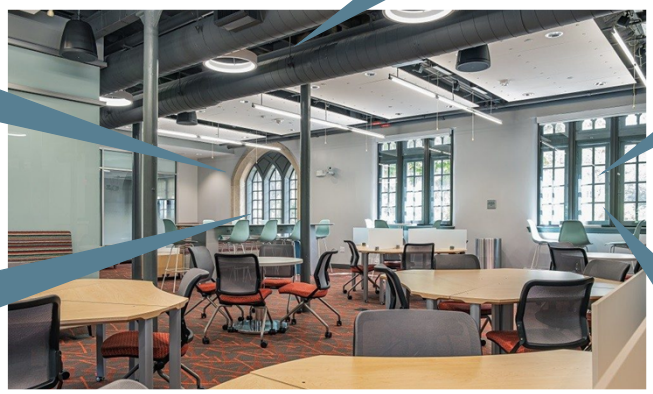
## Client's Requests

LEED Silver

30% Façade Energy Improvement



sDA 40%

MB9

Façade Design Integrates 1924 Head House

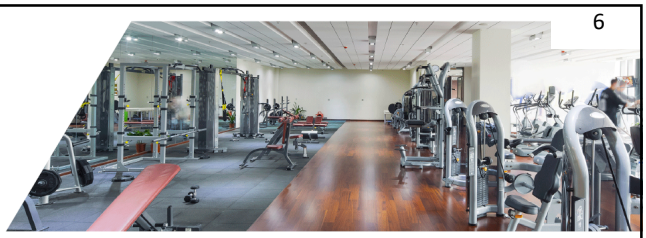
Natural Ventilation Strategies

Sandy Hall on Virginia Tech Campus

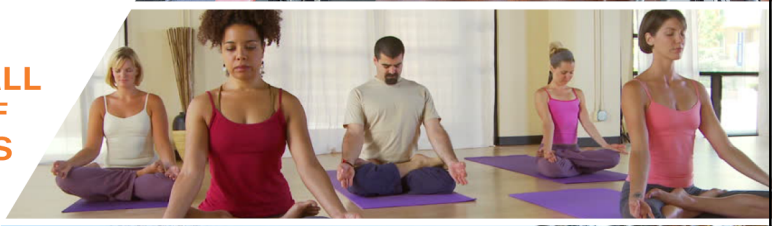
INTRO | SITE | ENVELOPE | INTEGRATION | DISCIPLINE | SUMMARY

6

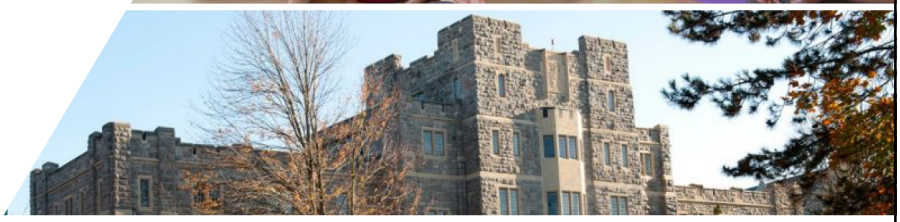
**UPDATE THE USER EXPERIENCE**



**PROMOTE ALL FORMS OF WELLNESS**



**CREATE A HEART OF CAMPUS**



INTRO | SITE | ENVELOPE | INTEGRATION | DISCIPLINE | SUMMARY

**Slide 5**

**MB9** mess with opacity or outline for callout boxes
Meredith Butler, 3/8/2020

## Codes & Standards



General:

- 2015 Virginia Construction Code with Amendments
- 2015 IECC – Virginia Revisions



Structural:

- ASCE 7-10 – Minimum Design Loads
- AISE Steel Construction Manual 14th Edition
- AIC 318-14

Electrical:

- 2014 NFPA 70
- IES Handbook 10th Edition

Mechanical:

- 2015 International Swimming Pool & Spa Code
- Applicable ASHRAE Standards
- Indoor Swimming Pools - ASHRAE
- Geothermal Heating & Cooling – ASHRAE




# SITE

## Site Orientation

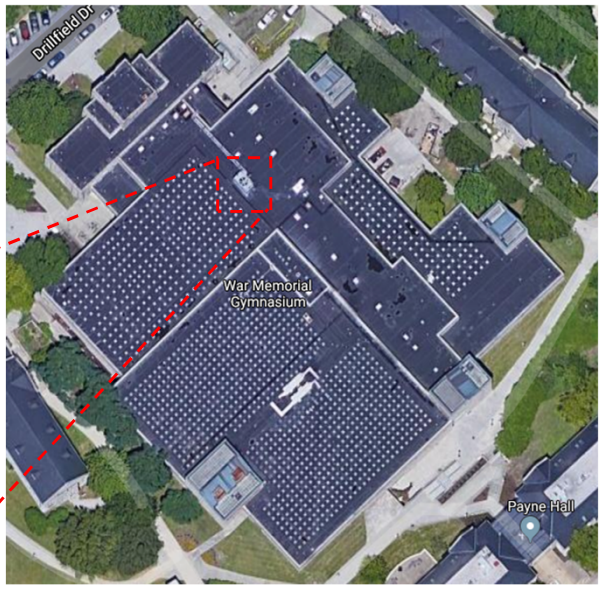
9

45° West of North

- North façades have eastern and western sun exposure.
- Southern facades glare potential due to low angles of the sun.

**Not Provided at Site**

District Chilled Water






## Central Plant Utilities

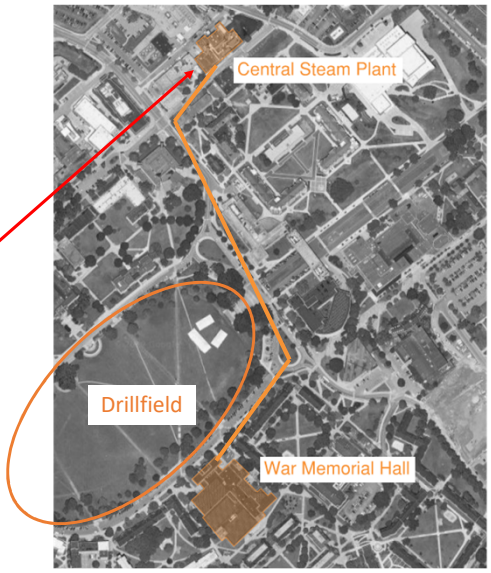
10

https://www.facilities.vt.edu/energy-utilities/central-steam-plant.html

**Provided at Site**

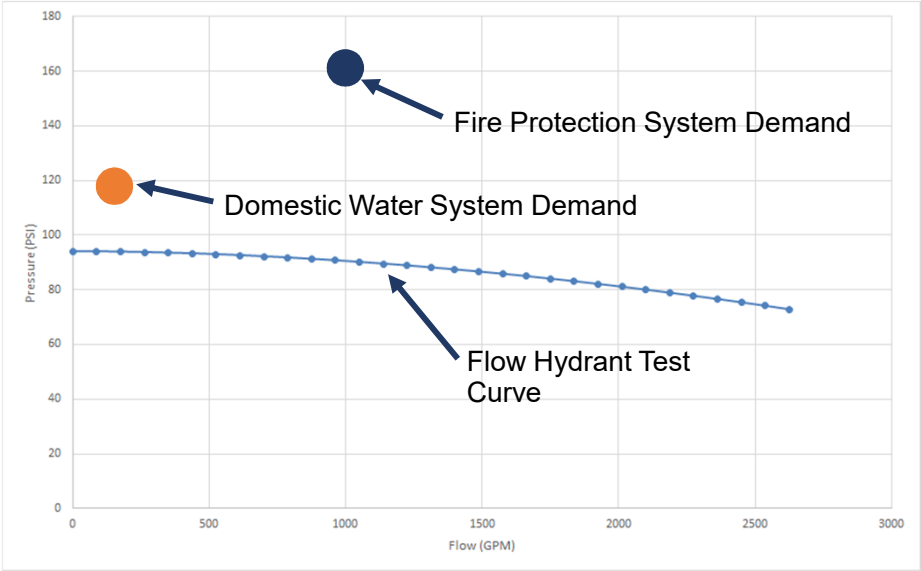
High Pressure Steam

12.47 kV 3-Phase



## Hydrant Flow Test

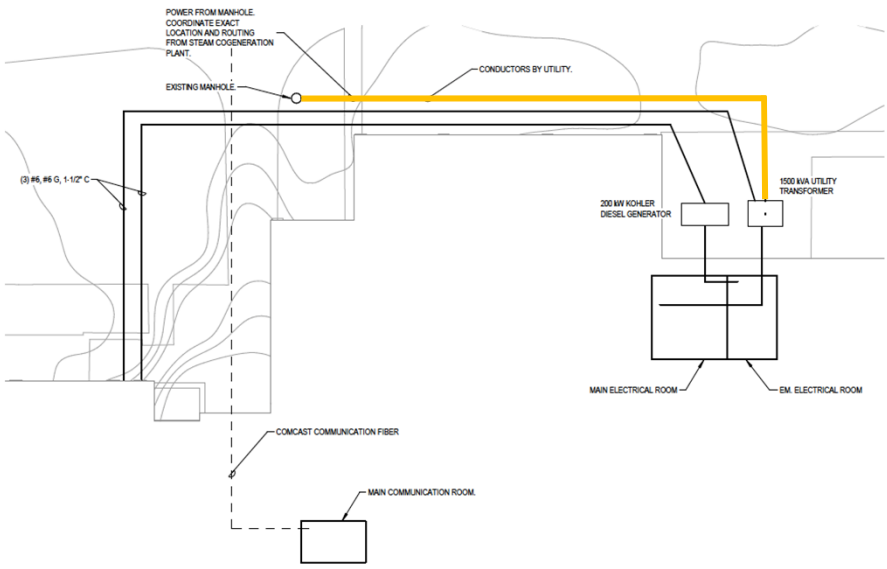
11

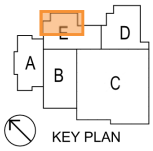





## Electrical Site Plan

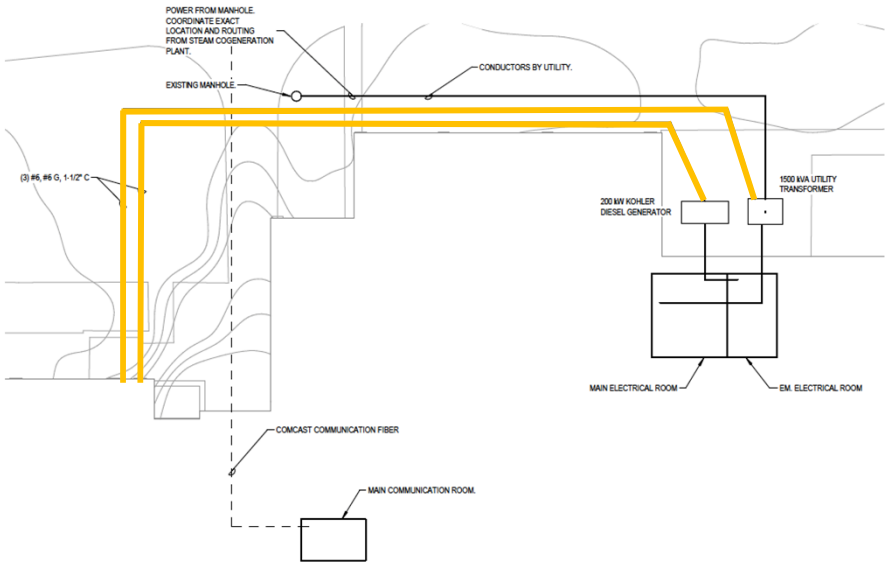
12

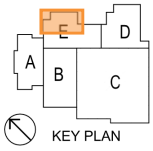


# Electrical Site Plan

13

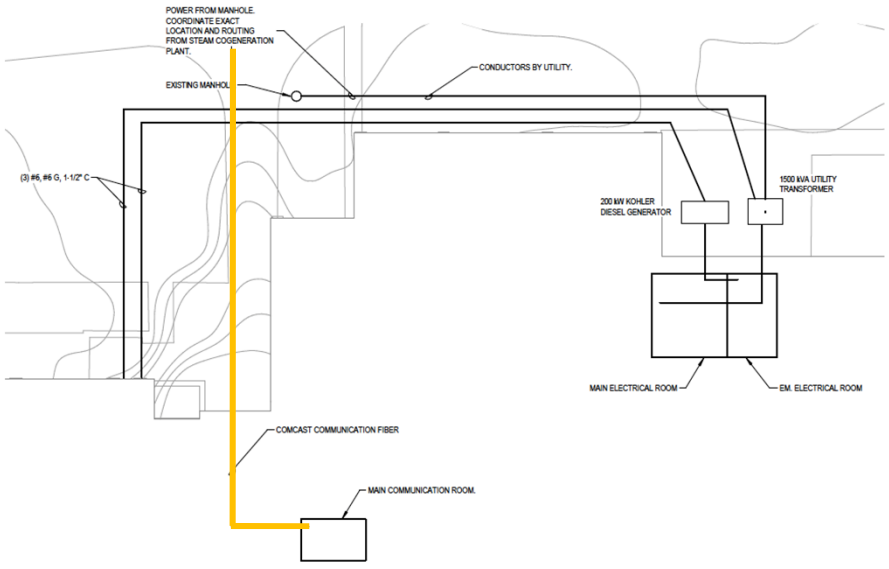


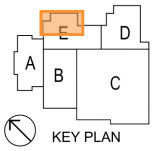




INTRO | SITE | ENVELOPE | INTEGRATION | DISCIPLINE | SUMMARY

# Electrical Site Plan

14

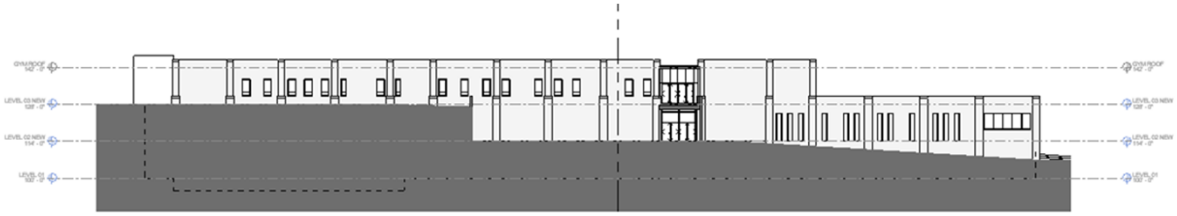


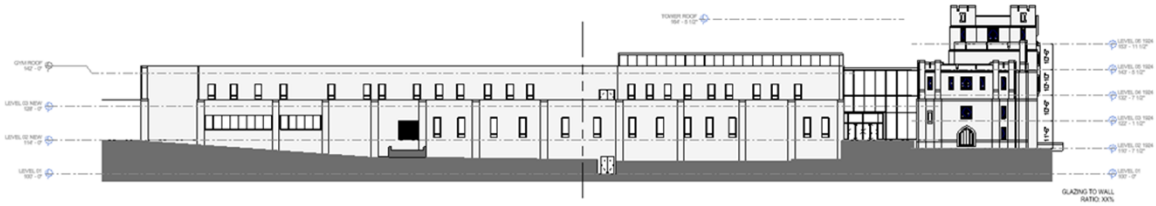

INTRO | SITE | ENVELOPE | INTEGRATION | DISCIPLINE | SUMMARY

## Retaining Wall Site Plan

15



South Elevation

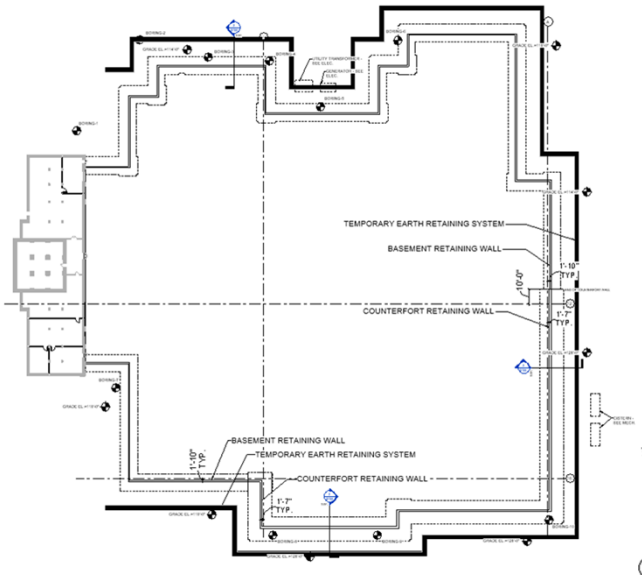


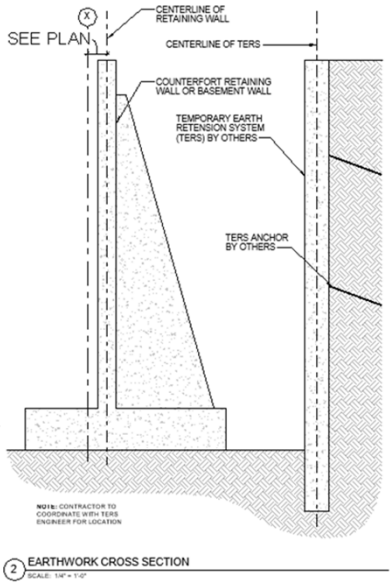
East Elevation



## Retaining Wall Site Plan

16




## Geotechnical and Geothermal

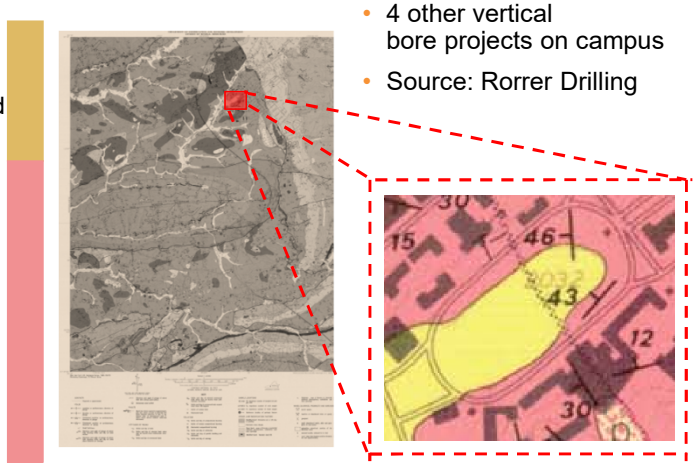
17

Geotechnical report

- Soil composition: disintegrated rock
- Allowable soil bearing: 6,000 PSF
- Frost depth: 2.5ft
- Lateral earth pressure: 42psf/ft

45'-60' Silt, clay, & sand

240'-255' loose limestone




- 4 other vertical bore projects on campus
- Source: Rorrer Drilling

(2015) Department of Conservation and Economic Development

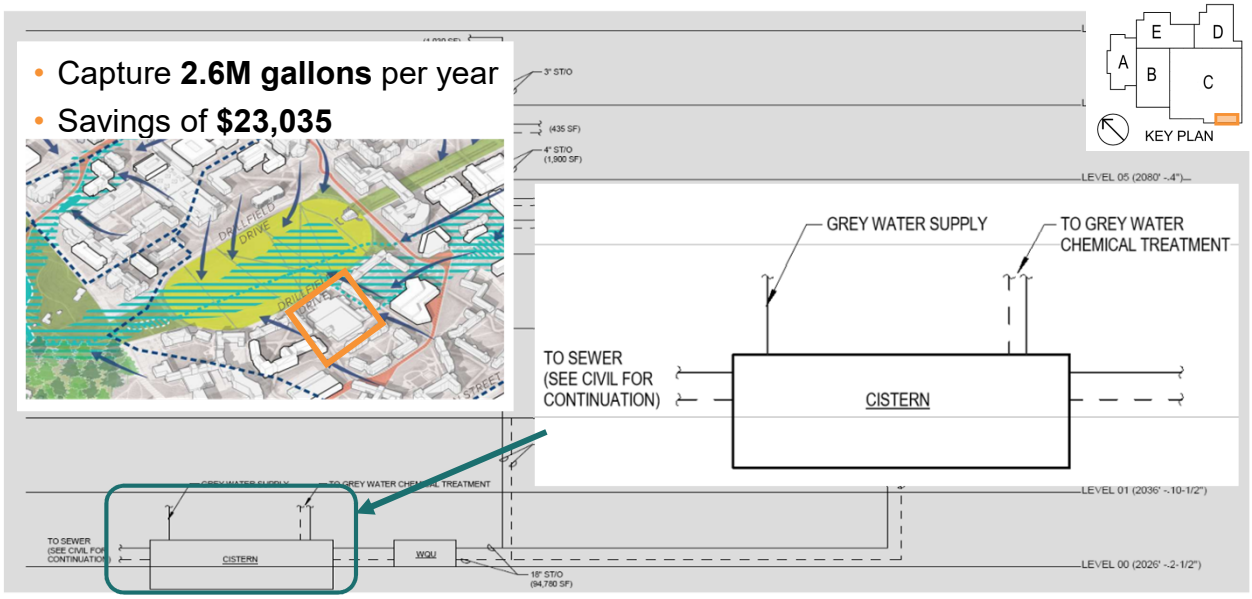


## Rainwater Harvesting

18

- Capture **2.6M gallons** per year
- Savings of **$23,035**



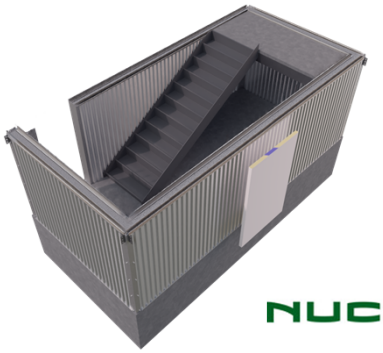


# Construction Considerations

19

## RediCor

- Worker safety on site
- Ease of installation
- Minimize construction time



NUCOR


INTRO | SITE | ENVELOPE | INTEGRATION | DISCIPLINE | SUMMARY

MB8

BUILDING
ENVELOPE
CHALLENGE

**Slide 20**

**MB8** update title to "Building Envelope Challenge"
Meredith Butler, 3/8/2020

## Lighting Concept

21

Virginia Tech invents the **FUTURE** but does not forget the **PAST**



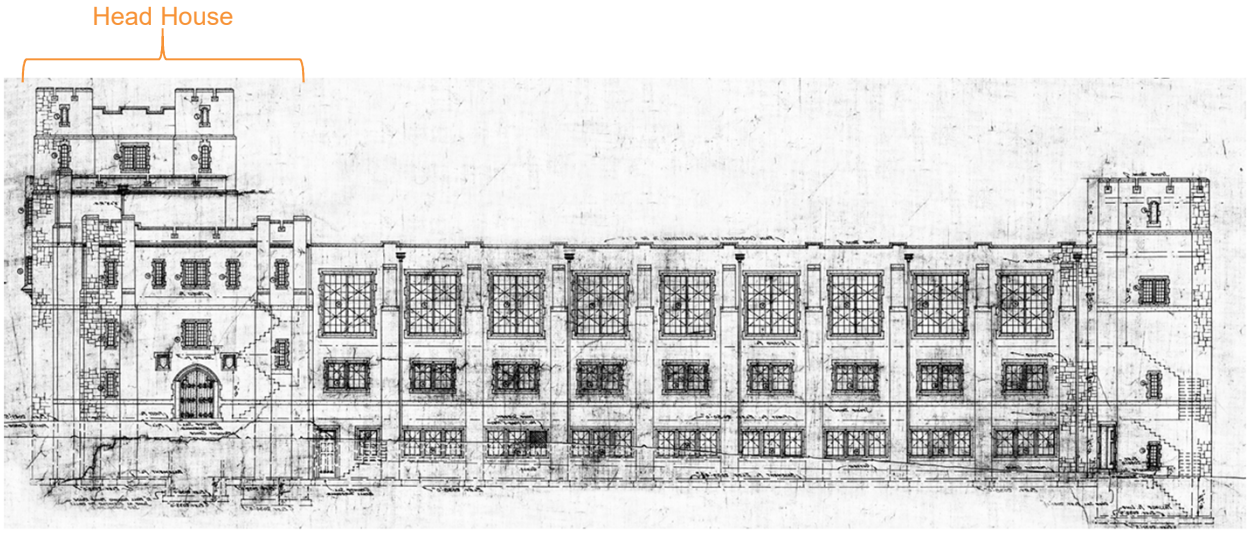




INTRO | SITE | ENVELOPE | INTEGRATION | DISCIPLINE | SUMMARY

## Façade

22

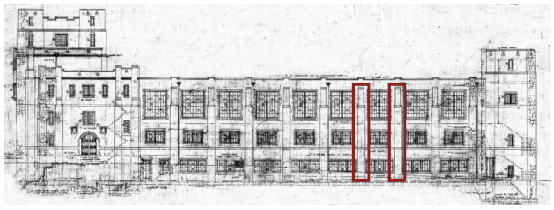


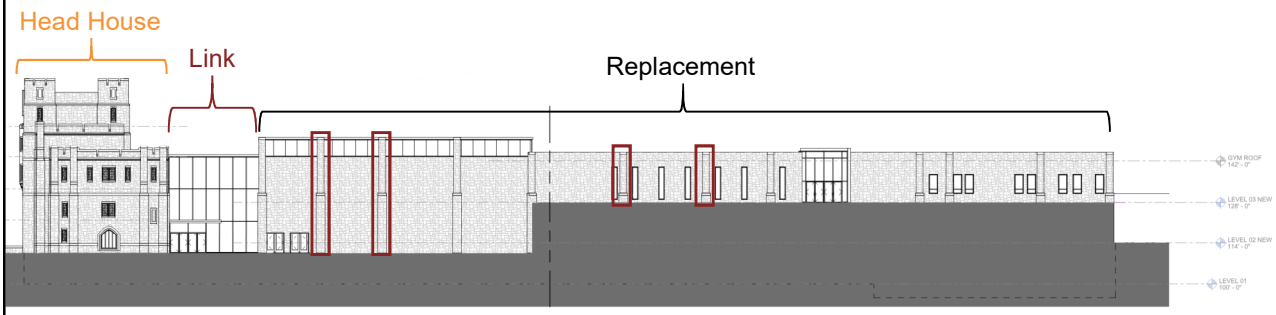

Original 1924 West Elevation

INTRO | SITE | ENVELOPE | INTEGRATION | DISCIPLINE | SUMMARY

## Façade

23



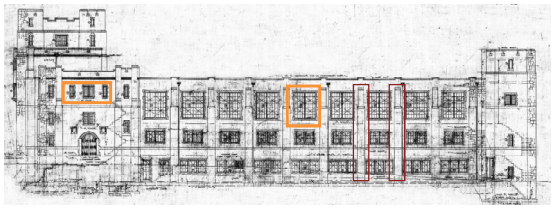


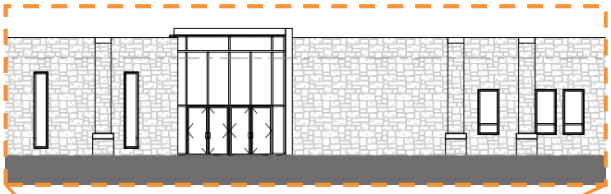

West Elevation

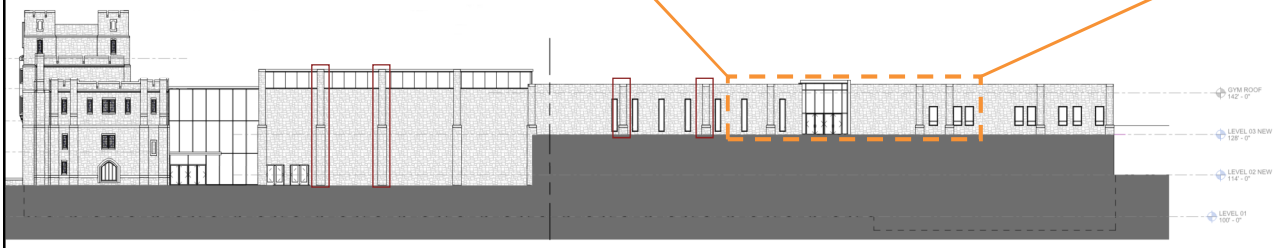


## Façade

24







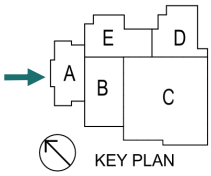
West Elevation

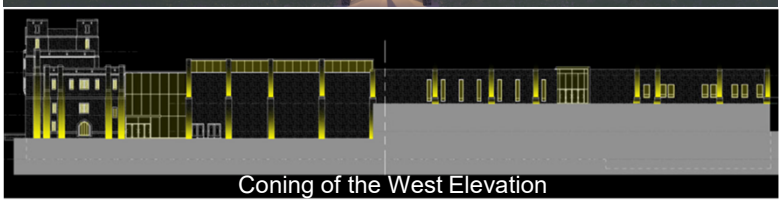
## Façade Lighting

25

Lantern effect
- Façade preservation
- Enhances windows
- Draws people inwards

Uplighting
- Enhance vertical elements



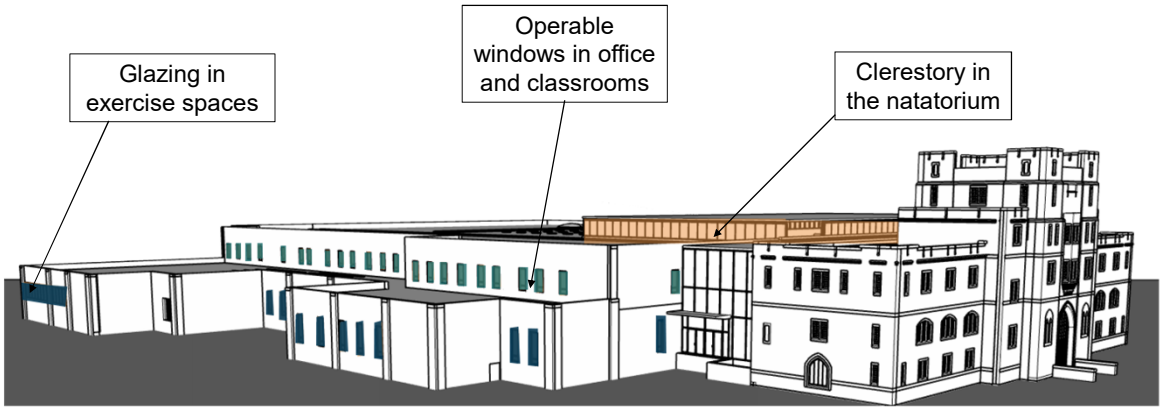






## Daylighting

26

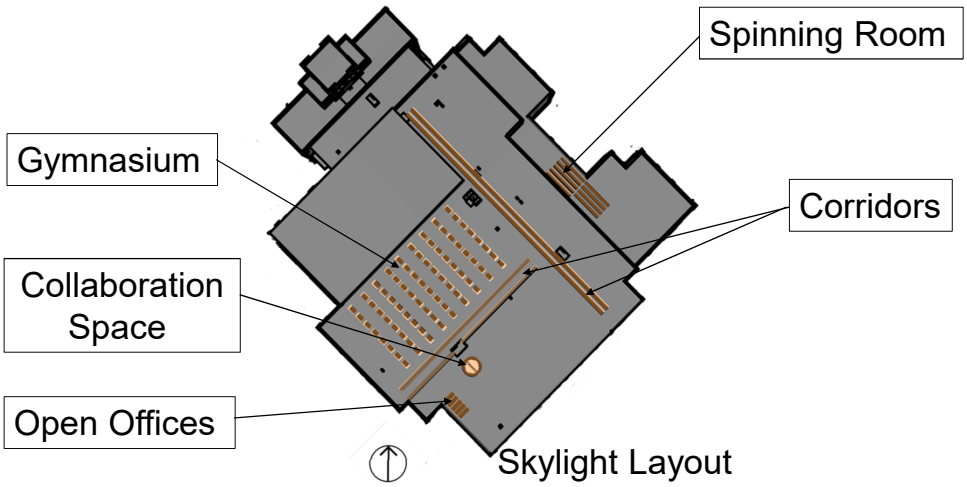
Addition of Glazing



# Daylighting

27

## Addition of Skylights





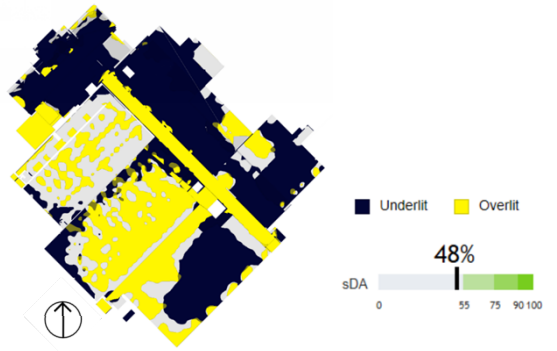

# Daylighting

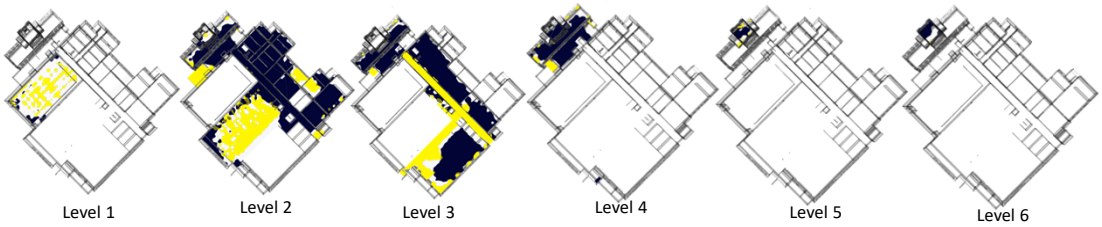
28

## Analysis

Spatial daylight autonomy

- sDA of existing building: 17%
- sDA of the Goliath's Design: 48%



# Daylighting

29

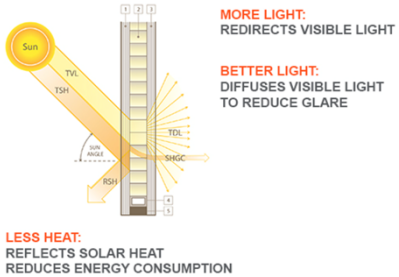
## Glare Mitigation

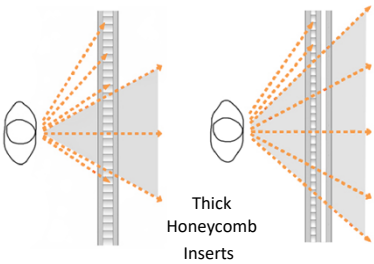
### Honeycomb glass

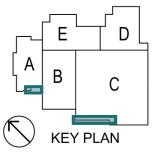
- Thin inserts to maximize view to the outdoor
- Reduces HVAC load

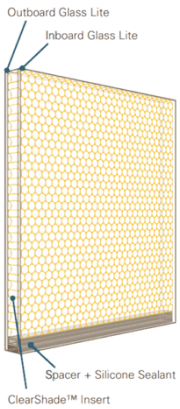
### Automated shading

- Classrooms and offices



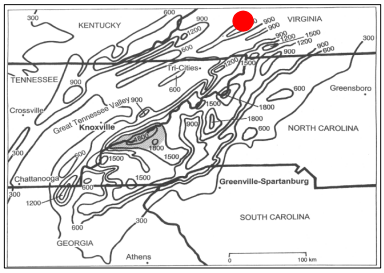



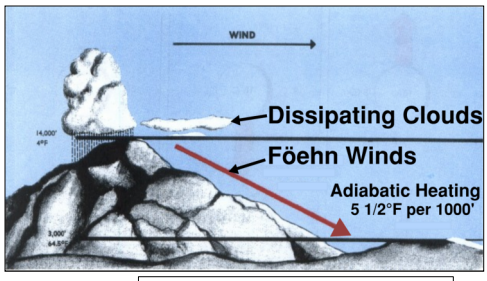

INTRO | SITE | ENVELOPE | INTEGRATION | DISCIPLINE | SUMMARY

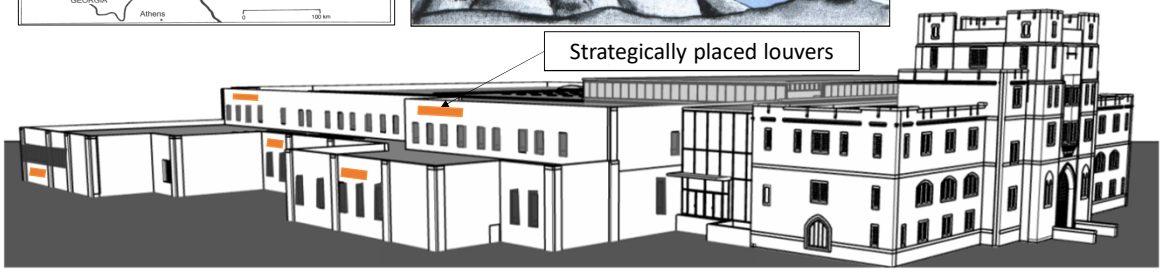
# Natural Ventilation

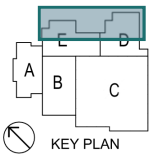
30

## Foehn Wind Capture



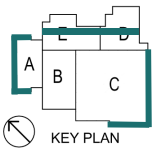




INTRO | SITE | ENVELOPE | INTEGRATION | DISCIPLINE | SUMMARY

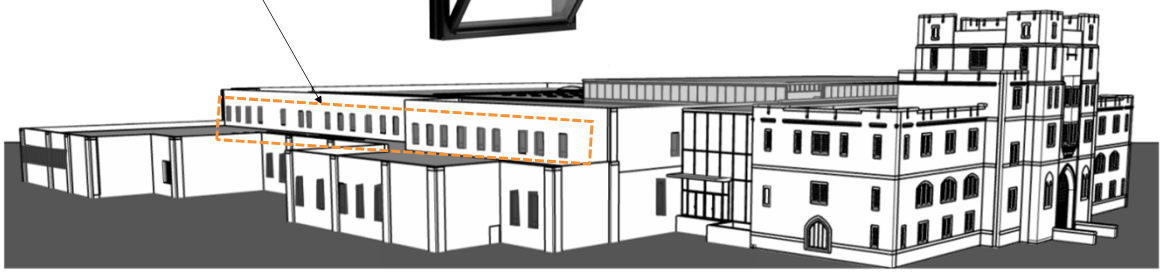
# Natural Ventilation

31

## Operable Windows




Operable windows in office and classrooms

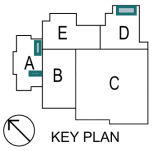




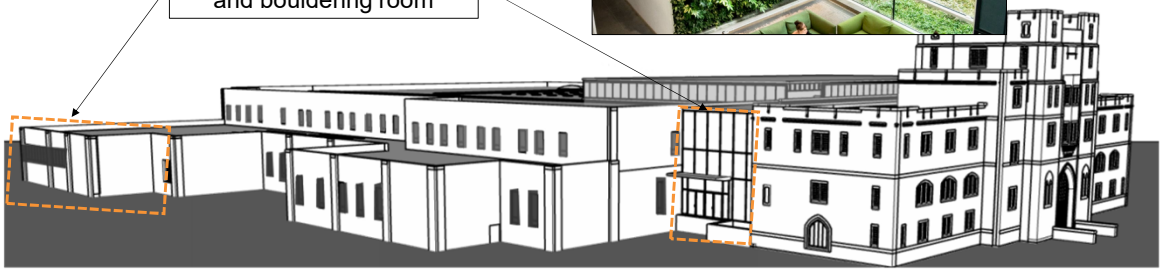
# Natural Ventilation

32

## Active Green Walls



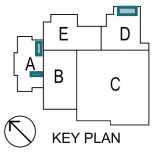

Active green walls in Link and bouldering room



# Natural Ventilation

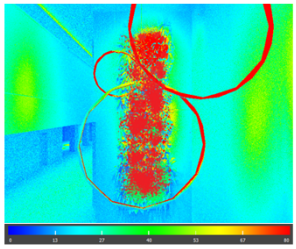
33

## Green Wall Supplemental Lighting




### Plants selection

- Upright growing habits
- East entrance and bouldering room requires 25 to 80 footcandles
- West entrance requires 80 to 400 footcandle
- Recommended illuminance for 12 to 15 hours a day



| Light Level | Location in the Building | Artificial Light |
|---|---|---|
| Intense Light | Unshaded light for most of the day | Range of 400fc to 600fc for 12 to 15 hours |
| Bright Light | Direct sun from south or west exposure where 2 or hours of direct sun | Range of 400 fc to 600 fc for 12 to 15 hours per day |
| Medium Light | Direct Light in morning and afternoons | Range of 80 fc to 400 fc for 12 to 15 hours per day |
| Low Light | North and east daylight exposure | Range of 25 fc to 80 fc for 12 to 15 hours per day |

Philodendron hederaceum

Sparkling Sarah

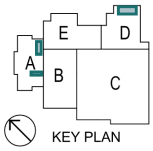
Cutlass



# Natural Ventilation

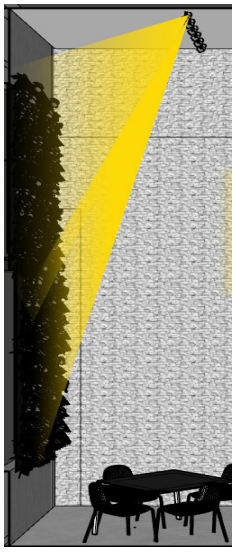
34

## Green Wall Supplemental Lighting




### Lamp beam angle

- 30° beam angle is used toward the top of the wall
- 15° beam angle is used for half of the wall



NorbBOTANIC White LED Grow Light CCT 5000K

Juno Compatible PAR 38 Lamps

# Façade Intervention

35

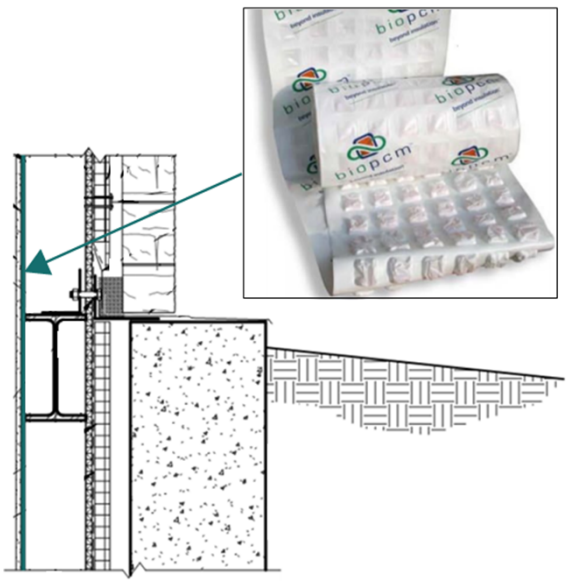
## Phase Change Insulation

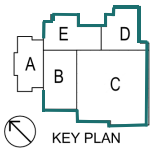
### Locations

- 1972 replacement
- In addition to normal insulation in wall assembly

### Benefits

- Shifts peak times
- Made from renewable sources



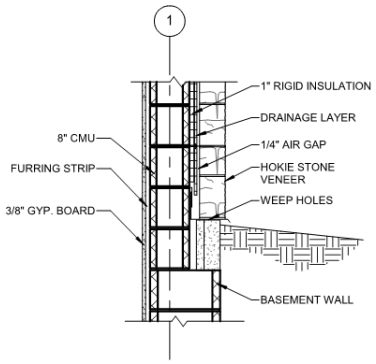





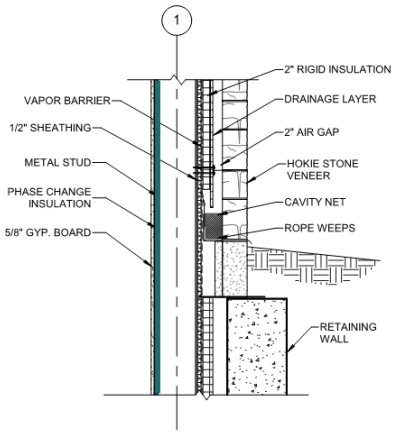

DR5

# Façade Performance

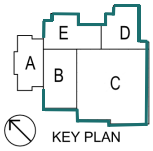
36




1 1972 WALL SECTION 1972
3/4" = 1'-0"




2 PROPOSED WALL SECTION
3/4" = 1'-0"



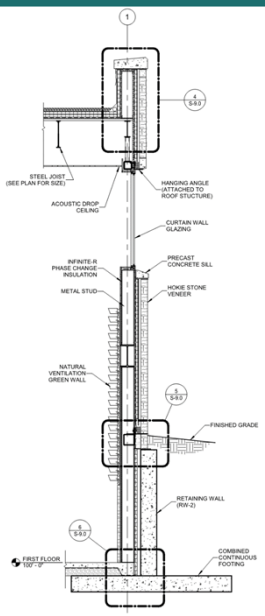

- WTWR: 0.07<0.26
- Energy Savings of 33%
  - 22% from Phase Change Insulation

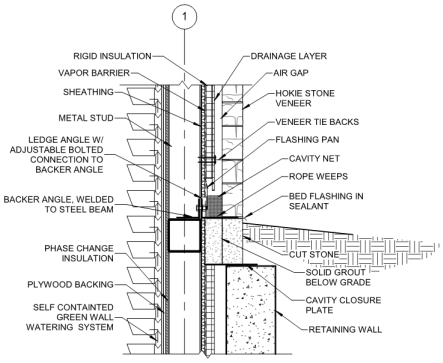
**Slide 36**

**DR5** Why are the bullter points on this side?
Dalton Rabe, 3/8/2020

# Final Wall Section

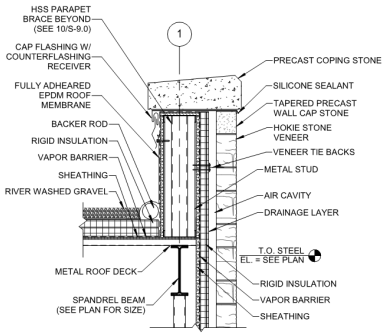




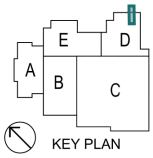

TYP. FACADE AT GRADE

SCALE: 3/4" = 1'-0"




TYP. PARAPET

SCALE: 3/4" = 1'-0"



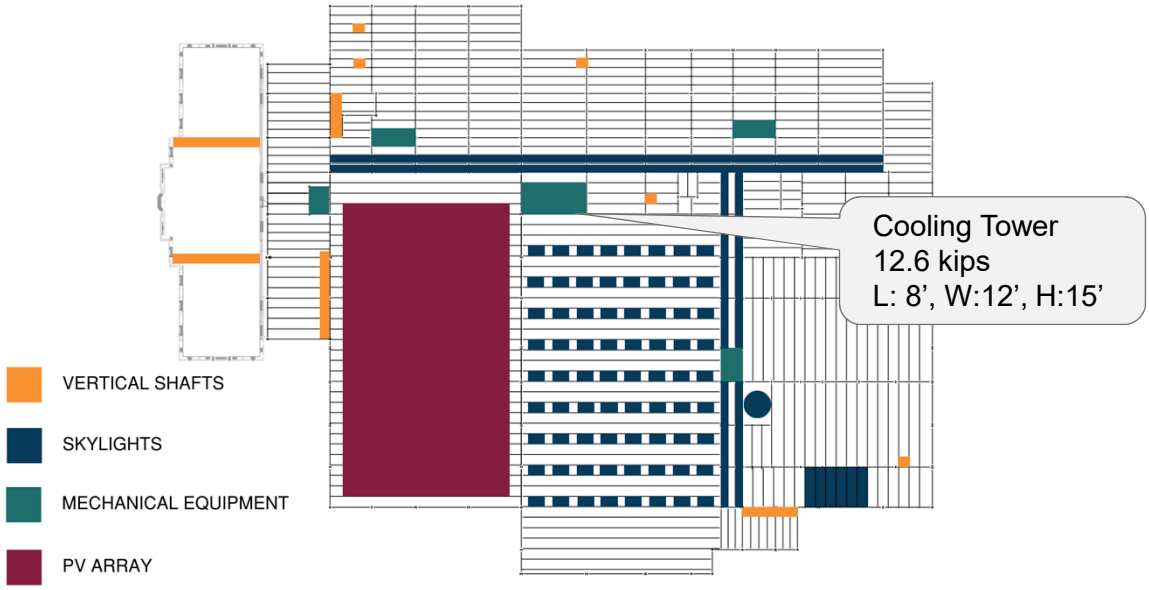

KEY PLAN



INTEGRATED SPACES

## Roof Coordination

39





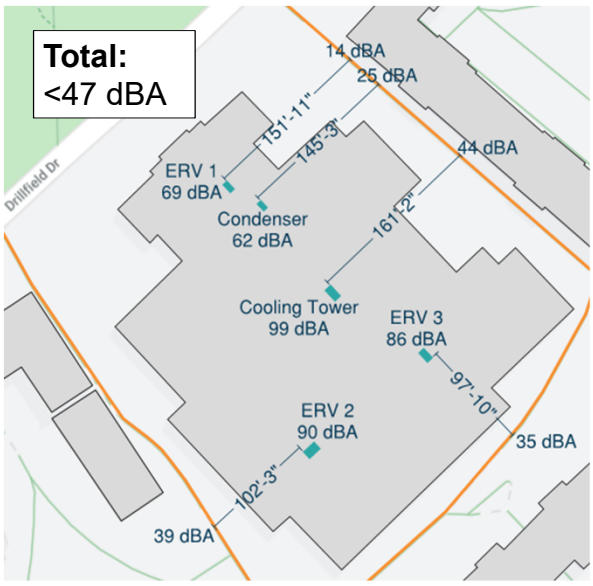

## Roof Coordination

40

### Mechanical Noise

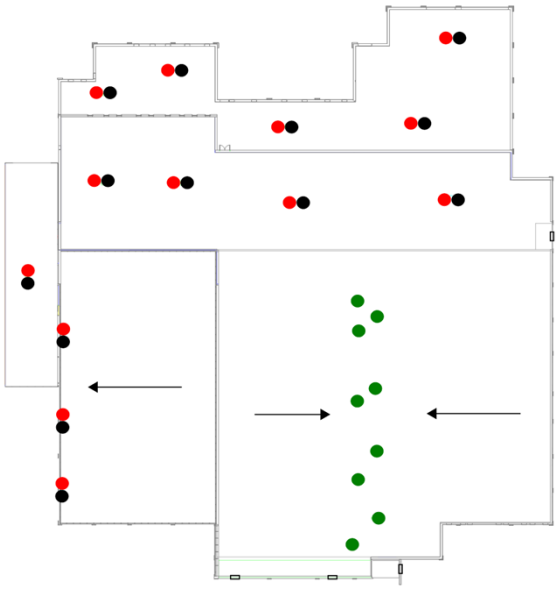
Property line sound level goals:
- Day – 60 dBA
- Night – 50 dBA

Sound barrier walls not needed
- Cost savings
- Improved equipment performance
- Reduced structural load

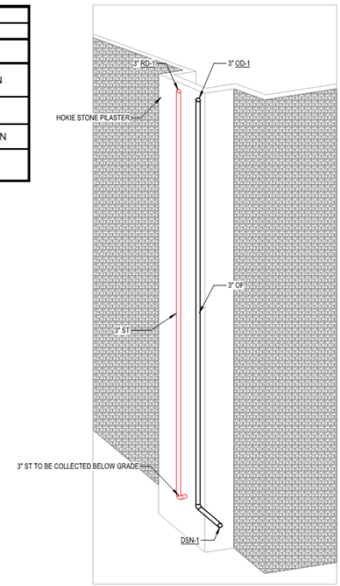


## Storm Drainage Plan

41



| KEY | |
|---|---|
| SYMBOL | TYPE |
| ▭ | SCUPPER |
| ● | SIPHONIC DRAIN |
| ● | STORM DRAIN |
| ● | OVERFLOW DRAIN |
| ← | DIRECTION |

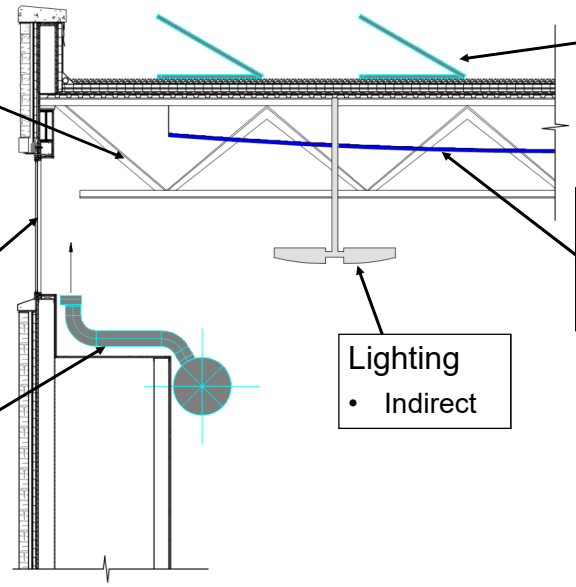



INTRO / SITE / ENVELOPE / INTEGRATION / DISCIPLINE / SUMMARY

DR6

## Natatorium

42



**Structural**
- DLH joist depth

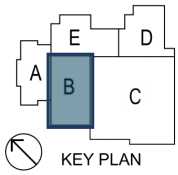
**Daylighting**
- Clerestory
- Frosted glazing

**Mechanical**
- Aluminum duct
- Condensation

**Electrical**
- PV modules

**Acoustics**
- Ceiling baffles
- Acoustical spray

**Lighting**
- Indirect




INTRO / SITE / ENVELOPE / INTEGRATION / DISCIPLINE / SUMMARY

**Slide 42**

**DR6** Adjust to match the Client Goals slide or vice versa?
Dalton Rabe, 3/8/2020

# Natatorium

43

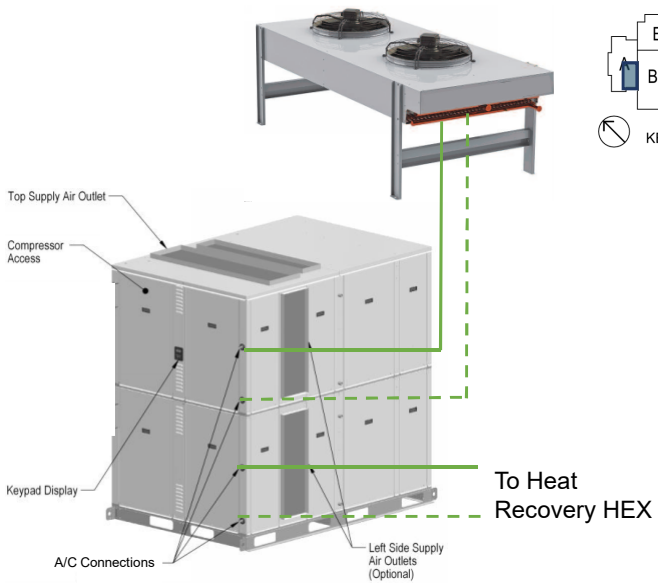
## Natatorium Unit & Condensers

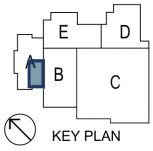
### Natatorium unit

- Designed to maintain 55% RH
- 75-ton total cooling capacity
- 500 MBH heat recovery/heat rejection

### Condensers

- Air-cooled






# Natatorium

44

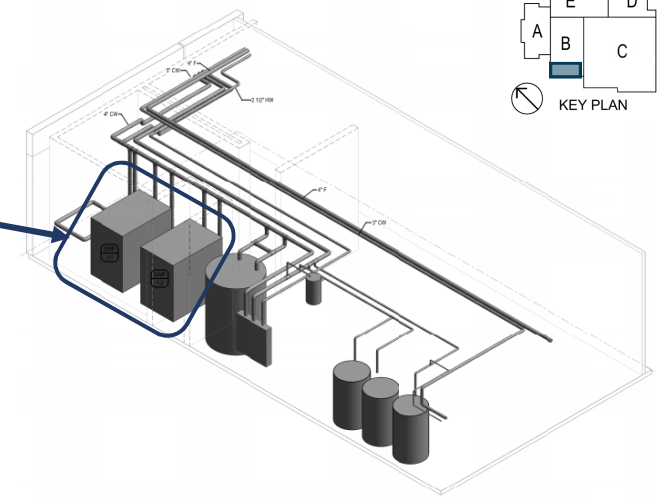
## Natatorium Plumbing

### Pool pumps

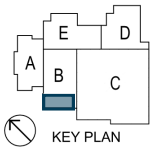
- Full redundancy
- Sized for 6-hour circulation time
  - Section 407.2 2015 ISPSC

### Steam heat exchanger

- 120 GPM capacity
- Sized at partial load because of heat recovery



Natatorium Plumbing Equipment Room Isometric



MB11

# Natatorium

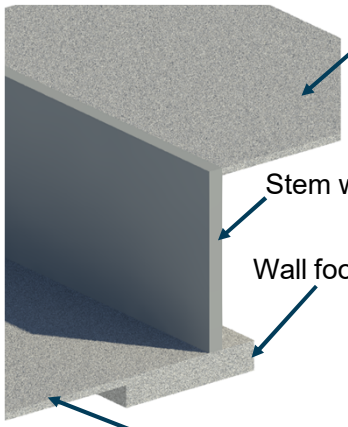
45

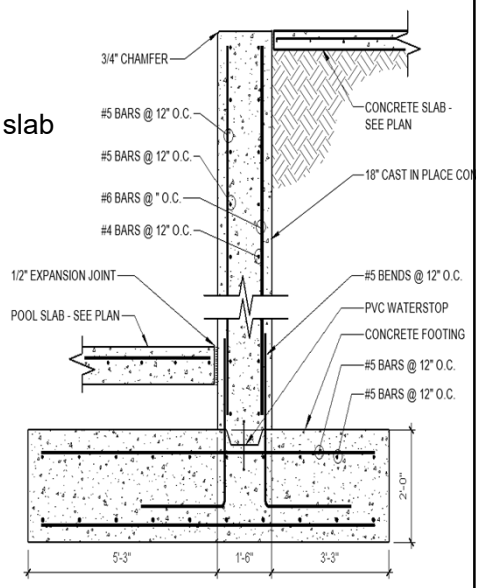
## Pool Foundations

Considered Conditions

8" Reinforced slab
- Minimize cracking and leaking
- Transfer the weight of water to soil

Cantilevered retaining wall




INTRO / SITE / ENVELOPE / INTEGRATION / DISCIPLINE / SUMMARY

DR7

# Natatorium

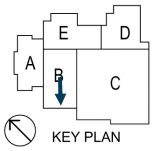
46

## Natatorium Lighting

Indirect lighting
- Minimize glare
- Ease of maintenance

Class IV Illuminance
- 300 Lux required
- 392 Lux achieved

Ametrix Indirect




INTRO / SITE / ENVELOPE / INTEGRATION / DISCIPLINE / SUMMARY

## Slide 45

**MB11** update detail and revit image
Meredith Butler, 3/8/2020

## Slide 46

**DR7** Inconsistent Key Plan
Dalton Rabe, 3/8/2020

MB12

# Natatorium

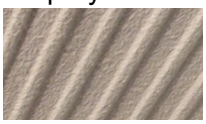
47

## Acoustics

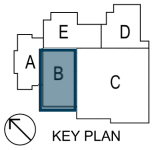
- RT goal: 1.5 sec
- Calculated RT: 1.35 sec

Baffles

Acoustical spray finish



Wall panels



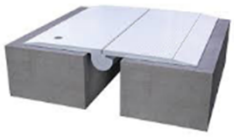

INTRO | SITE | ENVELOPE | INTEGRATION | DISCIPLINE | SUMMARY

DP9 MB13 AL1

# Head House

48

## Expansion Joints

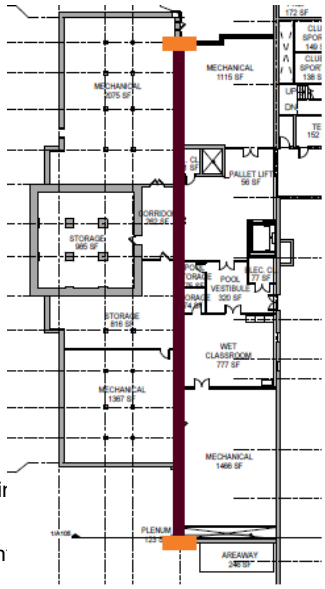


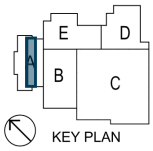
4" Floor Joints

4" Wall Joints

Floor expansion joi

Wall expansion join




INTRO | SITE | ENVELOPE | INTEGRATION | DISCIPLINE | SUMMARY

## Slide 47

**MB12** match large call out style (nat section & client needs)
Meredith Butler, 3/8/2020

## Slide 48

**DR9** Why is the blended picture frame only used here?
Dalton Rabe, 3/8/2020

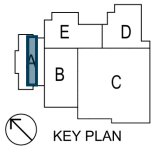
**MB13** update the images
Meredith Butler, 3/8/2020

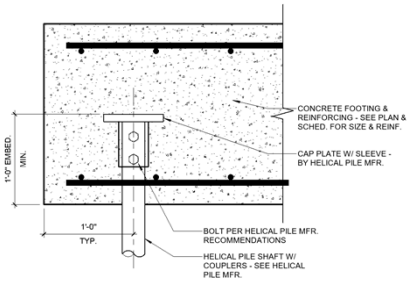
**AL1** DONE
Ali Mujtaba Mohamed Al Lawati, 3/8/2020

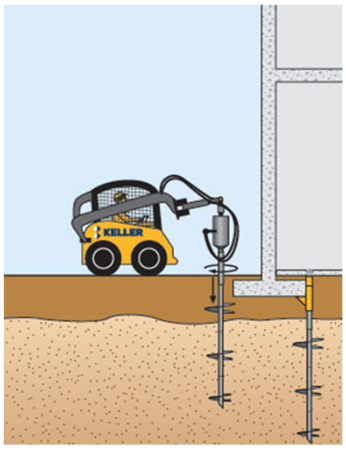
# Head House

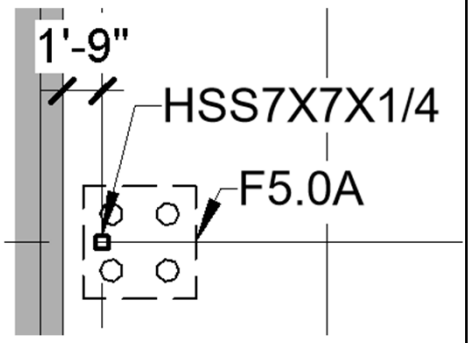
49

## Helical Piles



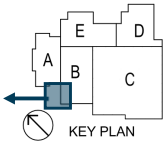

INTRO | SITE | ENVELOPE | INTEGRATION | DISCIPLINE | SUMMARY

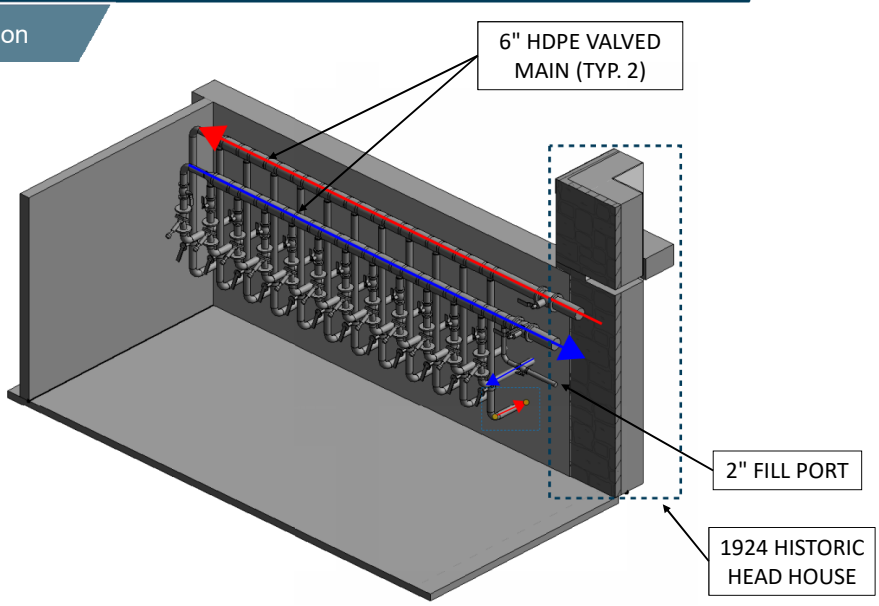
# Head House

50

## Historical Preservation - Foundation

- Optimizing geothermal header location
- Maintaining structural integrity of Head House



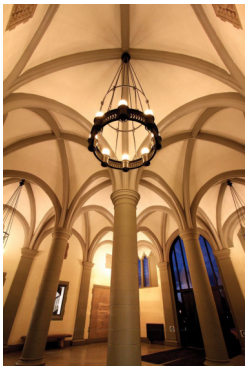

INTRO | SITE | ENVELOPE | INTEGRATION | DISCIPLINE | SUMMARY

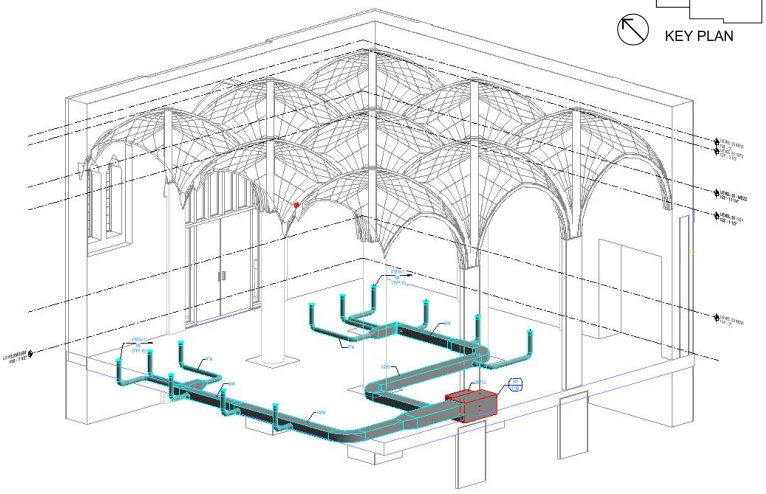
# Head House

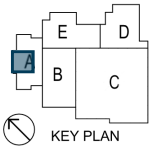
51

## Historical Preservation - Lobby

- No conditioning prior
- Underfloor air









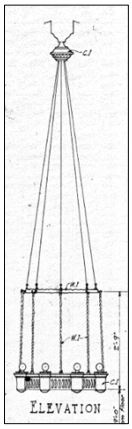

DR10

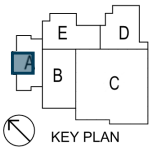
# Head House

52

## Historical Preservation - Lighting

- Keep chandeliers from 1924
- LED replacement lamps



**Slide 52**

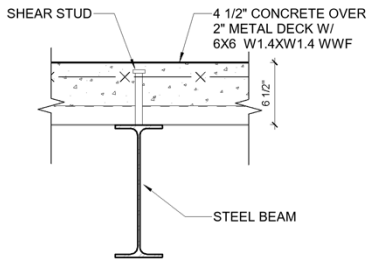
**DR10** inconsistent key plan
Dalton Rabe, 3/8/2020

# STRUCTURAL

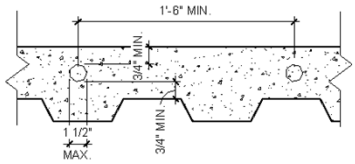
## Structural – Floor System



- NW concrete slab on metal deck
- Composite beams at 9'-3" O.C. maximum for floor system
- Joist at 5'-0" O.C. for roof system

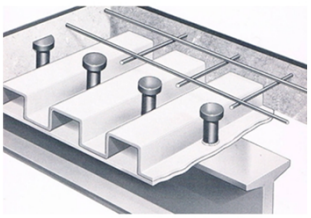



SECTION AT COMPOSITE STEEL BEAM




**DETAILING PER ACI 318, ASCE 3, & SDI

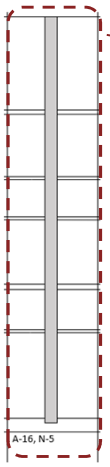
SECTION AT IN SLAB CONDUIT

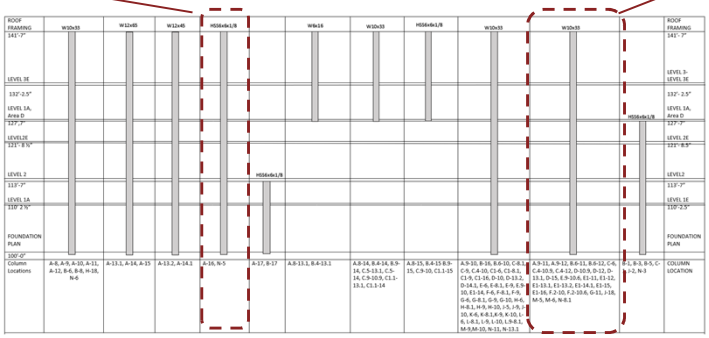


## Structural – Example Columns

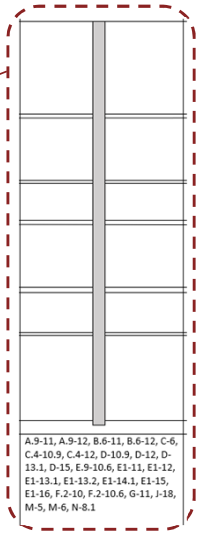
55

HSS6x6x1/4




W10x33



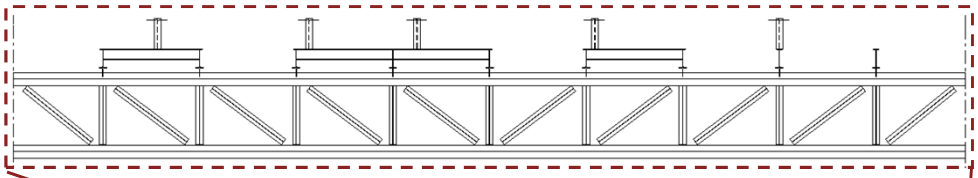


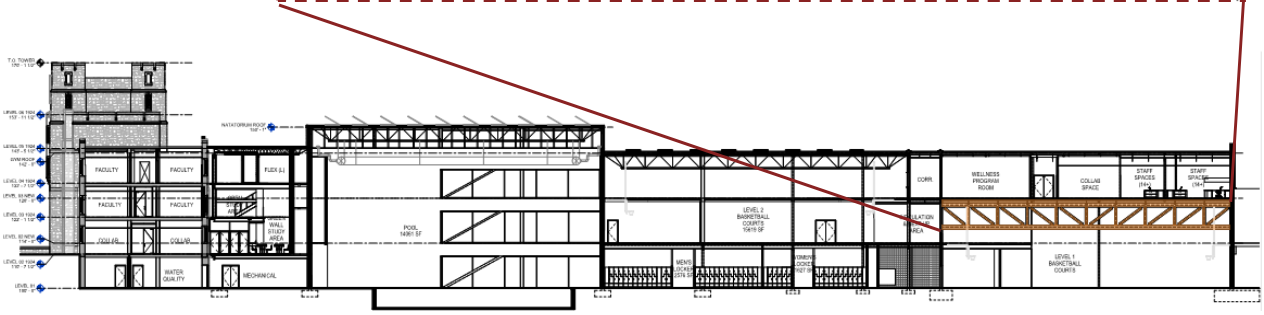

## Structural

56

### Truss

- 91'-2" Span
- Panel points
  - interior 9'-3"
  - end span 8'-7"





# Structural

57

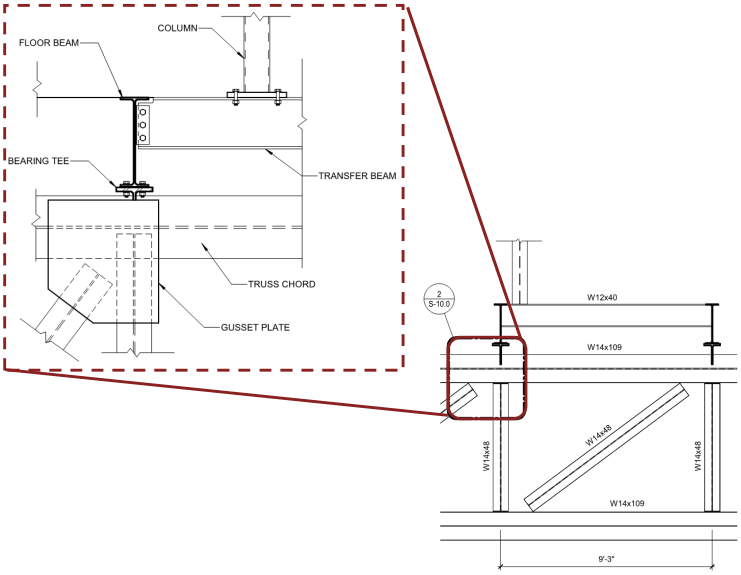
## Transfer Beams Above Truss

### Benefits

- Eliminates moment in chord
  - Axial load member analysis

### Design

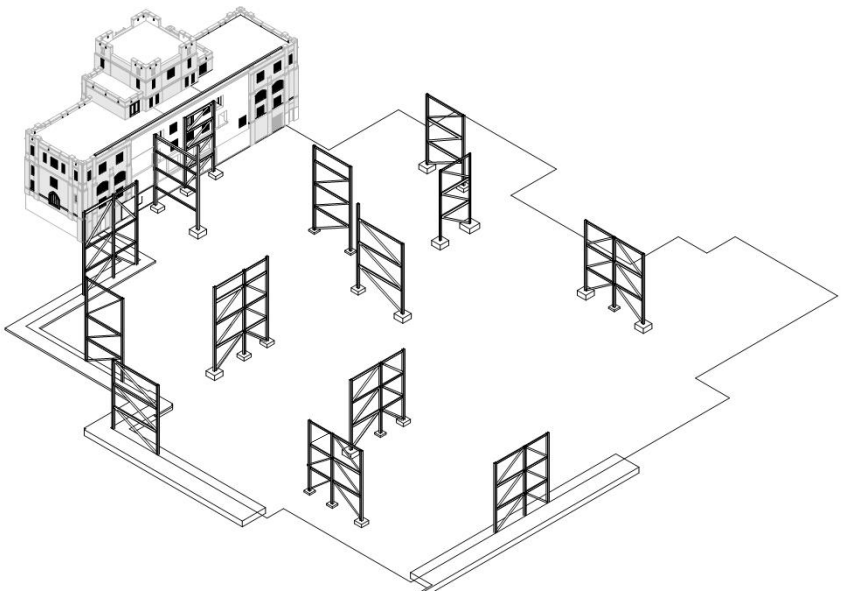
- Span between floor beam where columns bear
- Carries column load to panel points




INTRO | SITE | ENVELOPE | INTEGRATION | DISCIPLINE | SUMMARY

# Structural – Lateral Locations

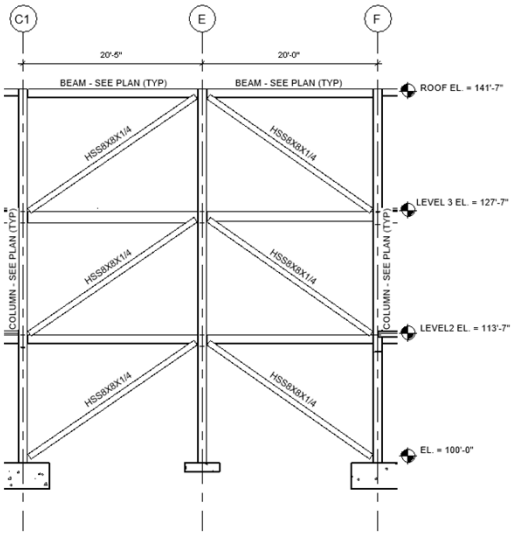
58



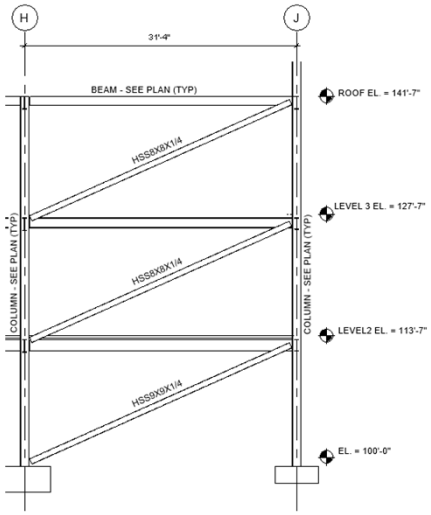
INTRO | SITE | ENVELOPE | INTEGRATION | DISCIPLINE | SUMMARY

## Structural – Typical Lateral Braced Frames

59




2 GRID 6 BRACED FRAME
SCALE: 1/8" = 1'-0"



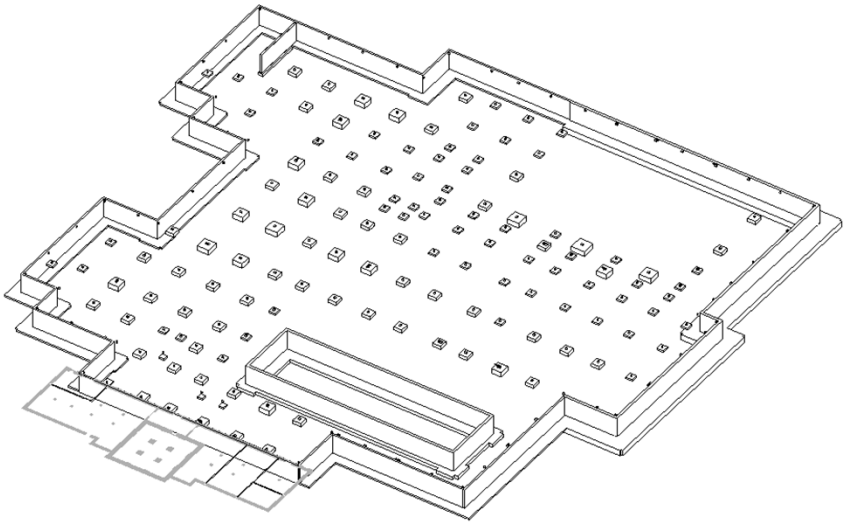

4 GRID 11 BRACED FRAME
SCALE: 1/8" = 1'-0"

INTRO | SITE | ENVELOPE | INTEGRATION | DISCIPLINE | SUMMARY

DR11

## Footing Design

60



Typical sizes:
- 4'x4'
- 5'x5'
- 6'x6'

Footing thickness:
- 12 – 30"

Footing depth:
- 16" below top of slab on grade

INTRO | SITE | ENVELOPE | INTEGRATION | DISCIPLINE | SUMMARY

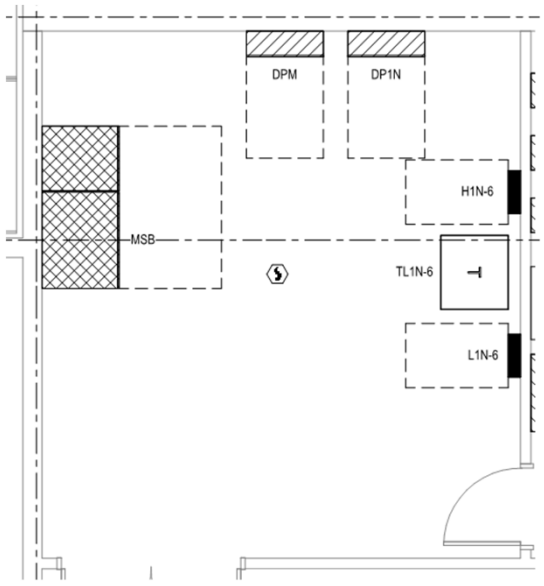
## Slide 60

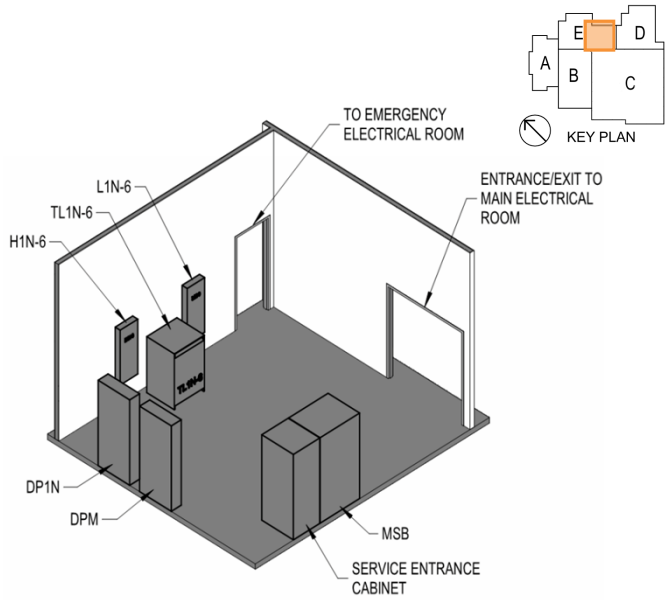
**DR11** Why are bullet points on the right?
Dalton Rabe, 3/8/2020

# ELECTRICAL

## Main Electrical Room

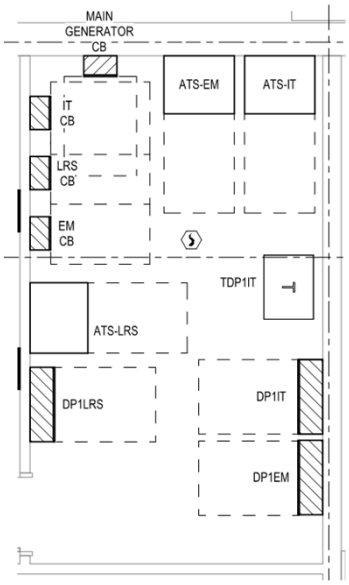
62

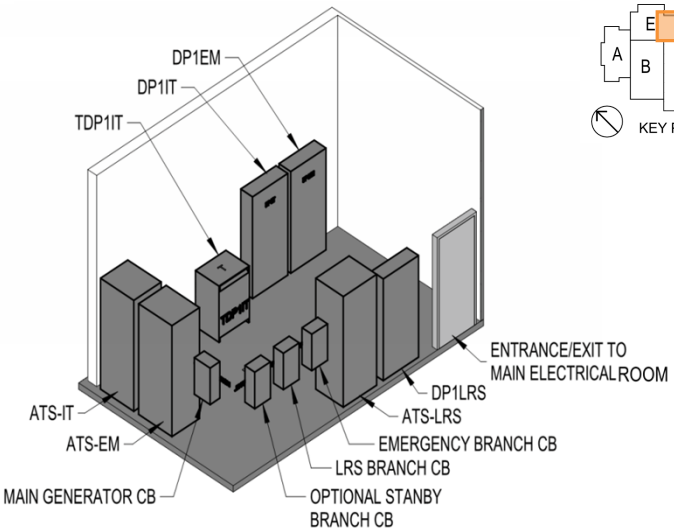


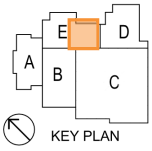



## Emergency Electrical Room

63



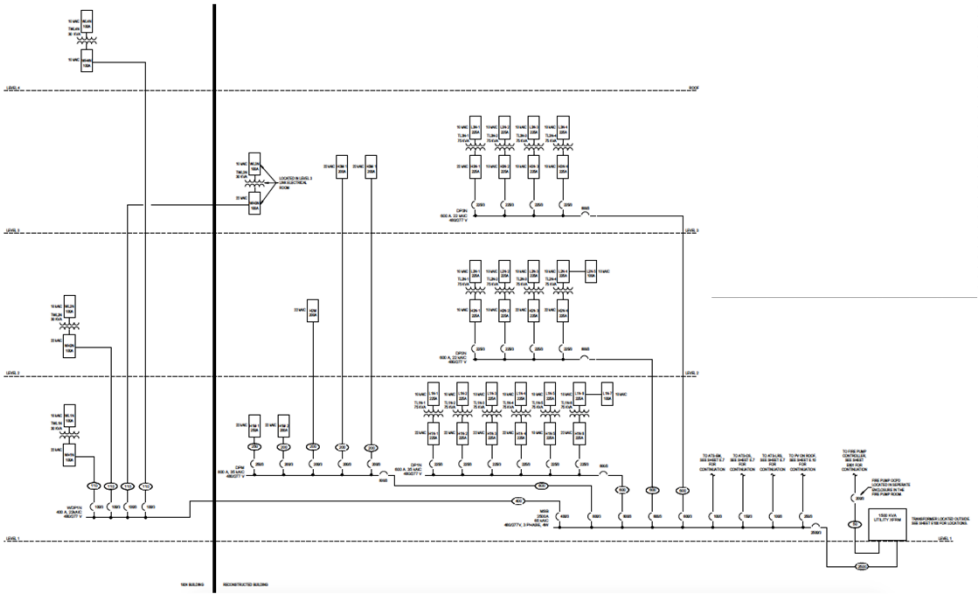




INTRO | SITE | ENVELOPE | INTEGRATION | DISCIPLINE | SUMMARY

## Normal Power One-Line

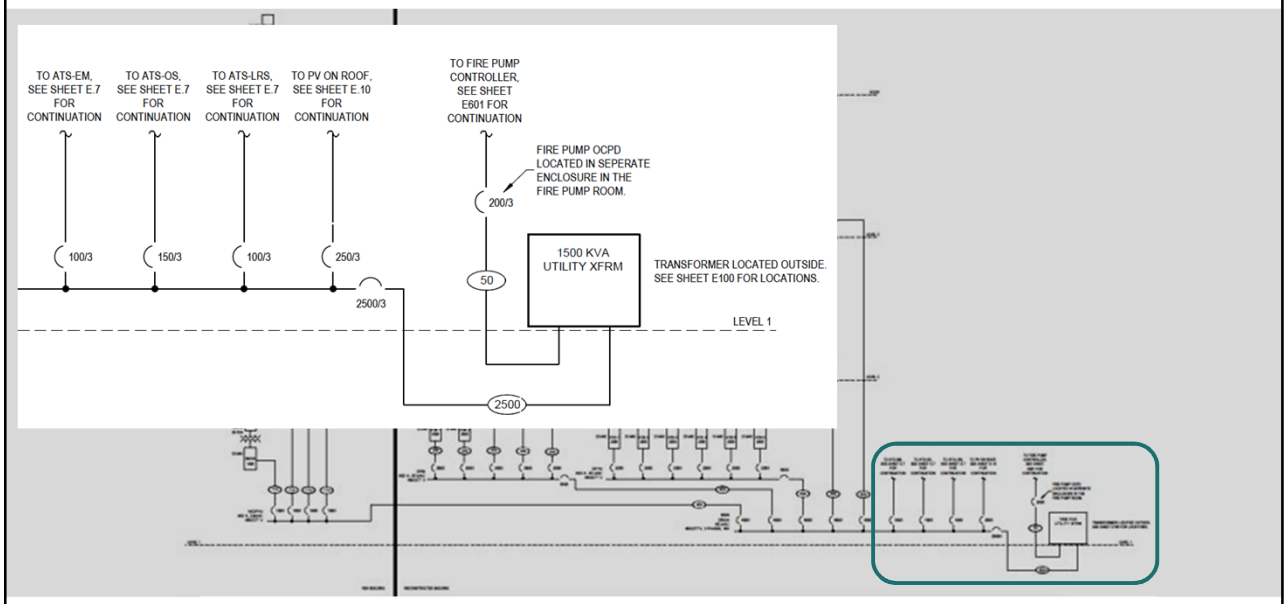
64



INTRO | SITE | ENVELOPE | INTEGRATION | DISCIPLINE | SUMMARY

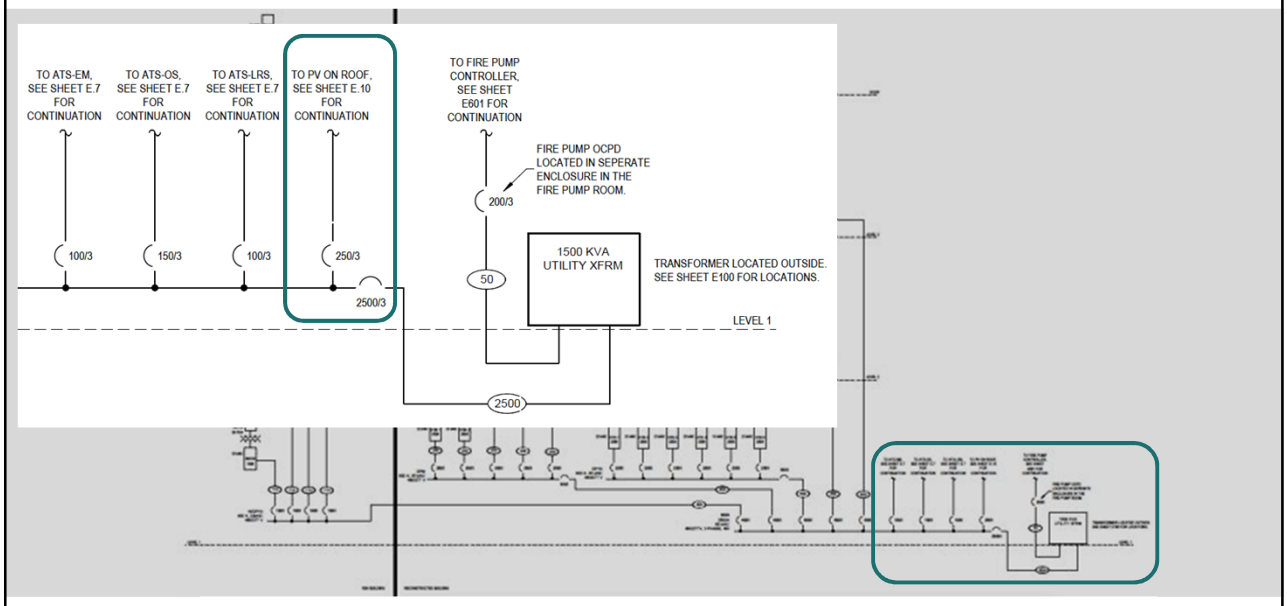
## Normal Power One-Line

65



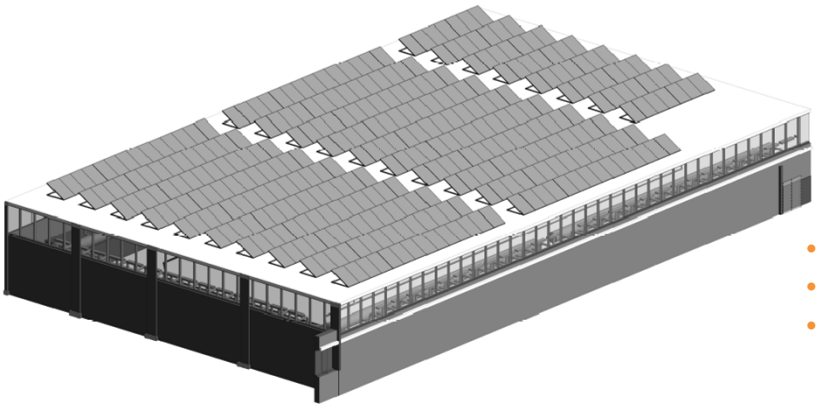

## Normal Power One-Line

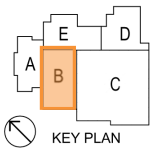
66



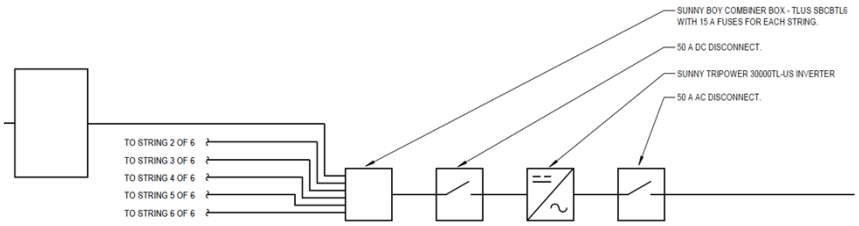
## Normal Power One-Line

67





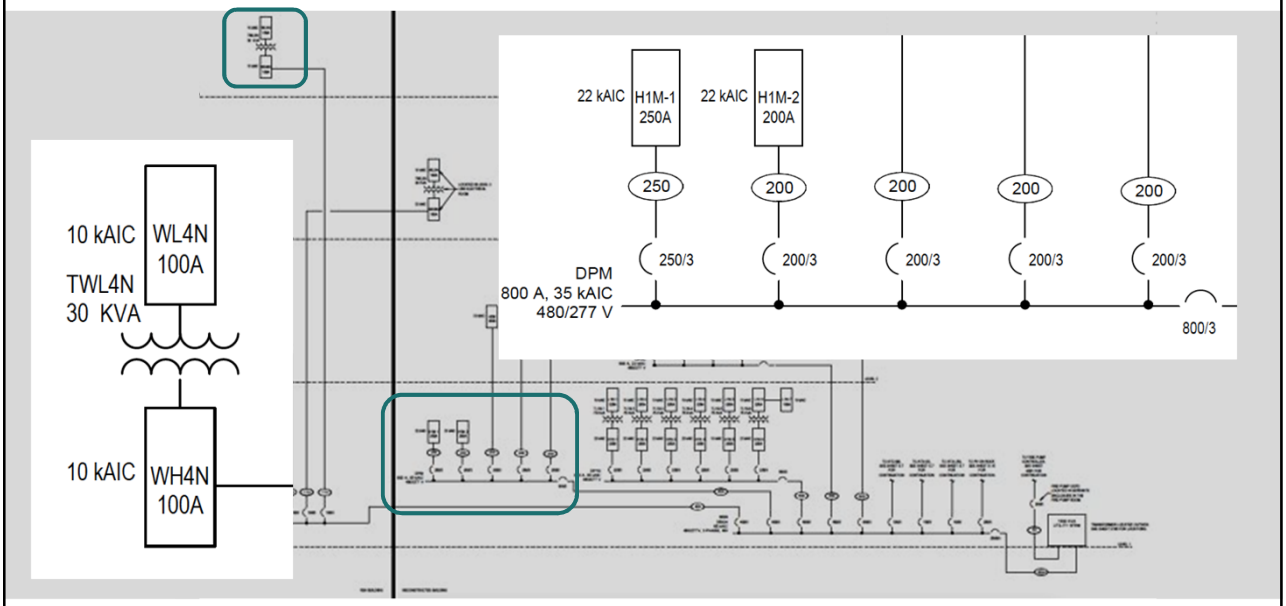

- 336 Photovoltaic modules
- 110,880 Nameplate wattage
- 15 Year payback




INTRO | SITE | ENVELOPE | INTEGRATION | DISCIPLINE | SUMMARY

## Normal Power One-Line

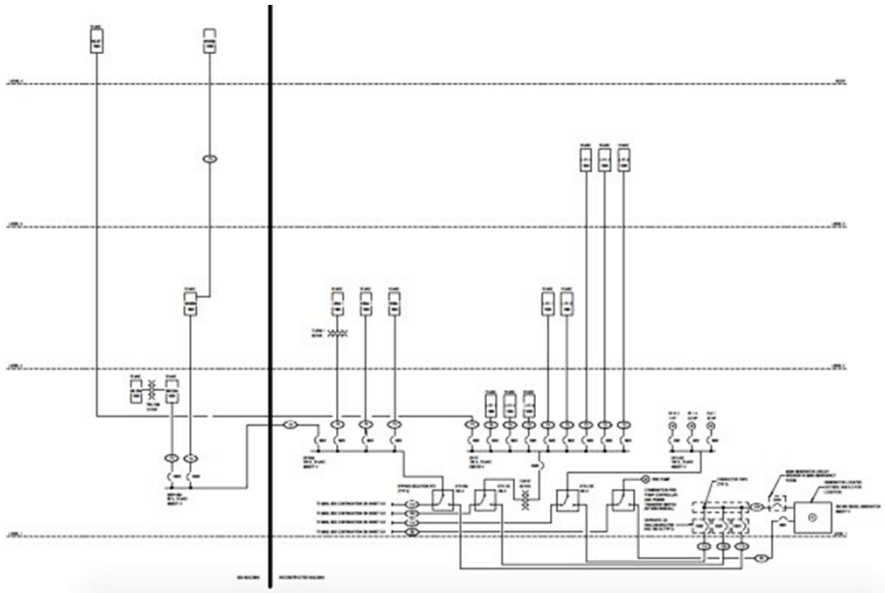
68




INTRO | SITE | ENVELOPE | INTEGRATION | DISCIPLINE | SUMMARY

## Generator Power One-Line

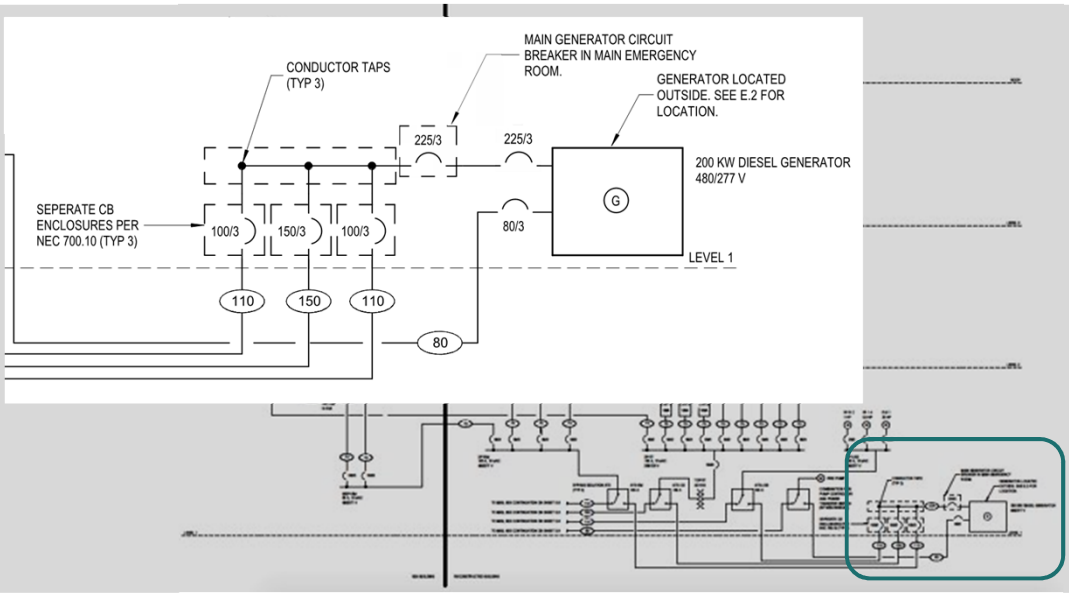
69



INTRO | SITE | ENVELOPE | INTEGRATION | DISCIPLINE | SUMMARY

## Generator Power One-Line

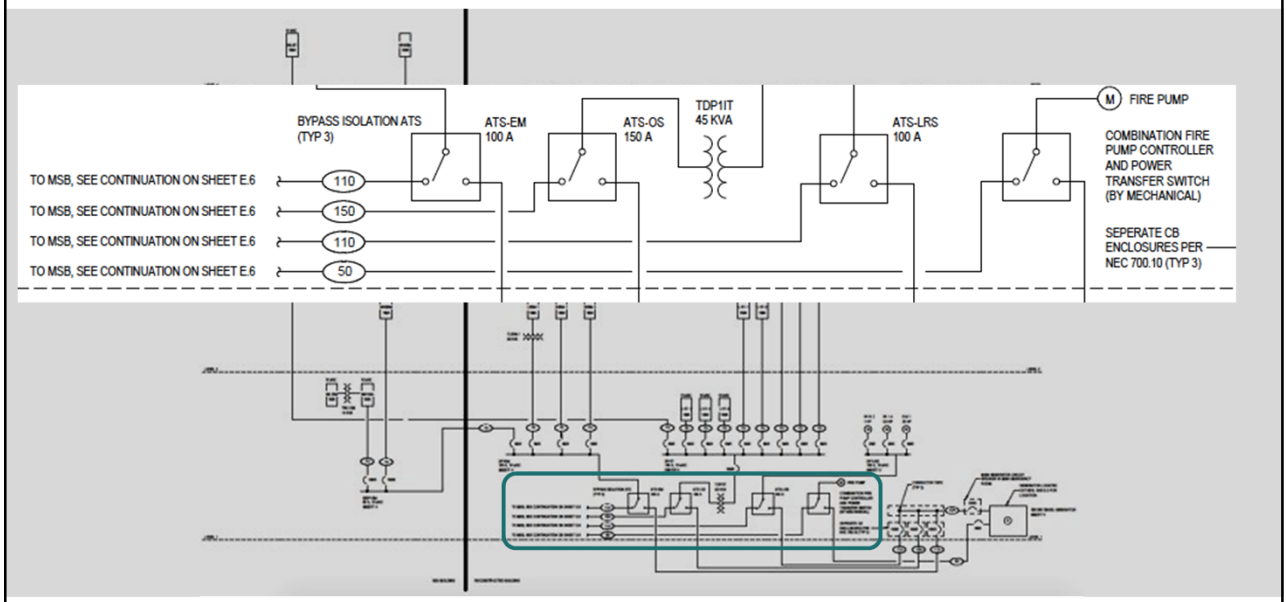
70




INTRO | SITE | ENVELOPE | INTEGRATION | DISCIPLINE | SUMMARY

## Generator Power One-Line

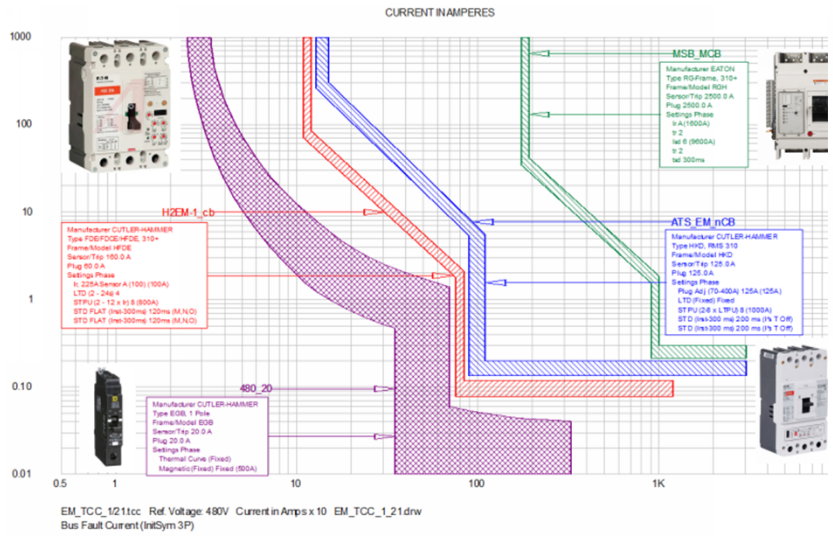
71

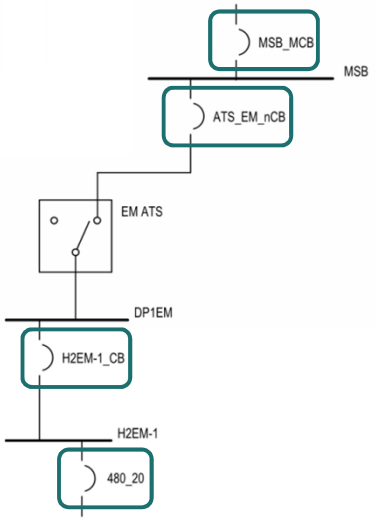



INTRO | SITE | ENVELOPE | INTEGRATION | DISCIPLINE | SUMMARY

## Emergency Branch Selective Coordination

72




INTRO | SITE | ENVELOPE | INTEGRATION | DISCIPLINE | SUMMARY

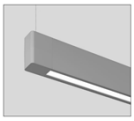
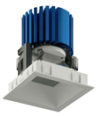
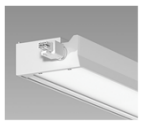
## Lighting Controls

73

Typical Classroom

Layering lighting components
- Ambient lighting
- Task lighting
- Accent lighting

Lighting controls
- Occupancy sensors
- Daylight responsive controls
- Scene controls


INTRO | SITE | ENVELOPE | INTEGRATION | DISCIPLINE | SUMMARY

## Special Systems Overview

74

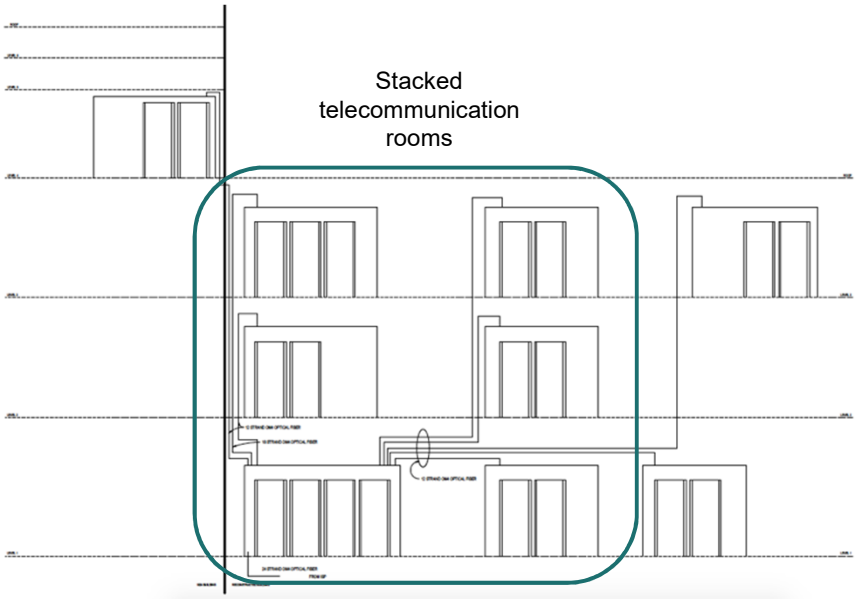
- Communications
- Fire Alarm
- Access Control
- Security
- Audiovisual
- Lightning Protection

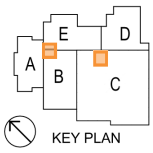
Restriction Access Level 0
Restriction Access Level 1
Restriction Access Level 2
Restriction Access Level 3

INTRO | SITE | ENVELOPE | INTEGRATION | DISCIPLINE | SUMMARY

## Telecommunication Riser Diagram

75

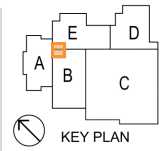



INTRO / SITE / ENVELOPE / INTEGRATION / DISCIPLINE / SUMMARY

## Telecommunication Riser Diagram

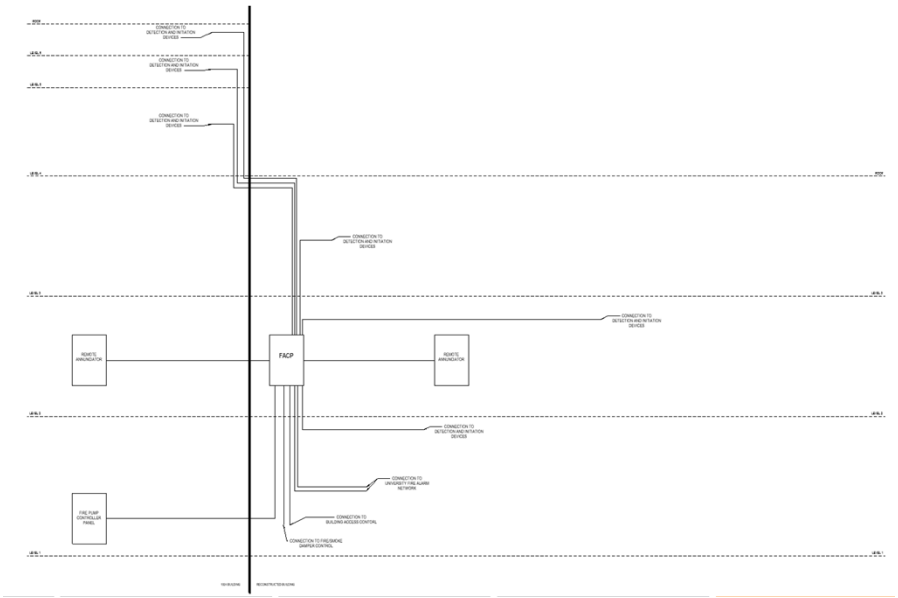
76


INTRO / SITE / ENVELOPE / INTEGRATION / DISCIPLINE / SUMMARY

## Fire Alarm Riser Diagram

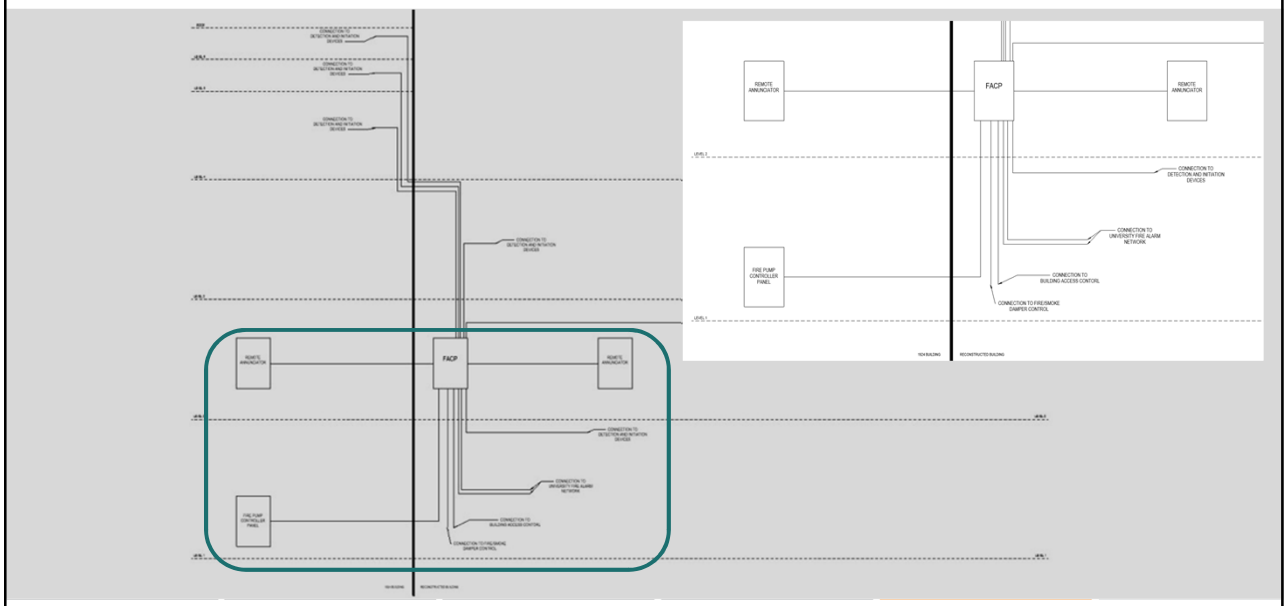
77




INTRO | SITE | ENVELOPE | INTEGRATION | DISCIPLINE | SUMMARY

## Fire Alarm Riser Diagram

78

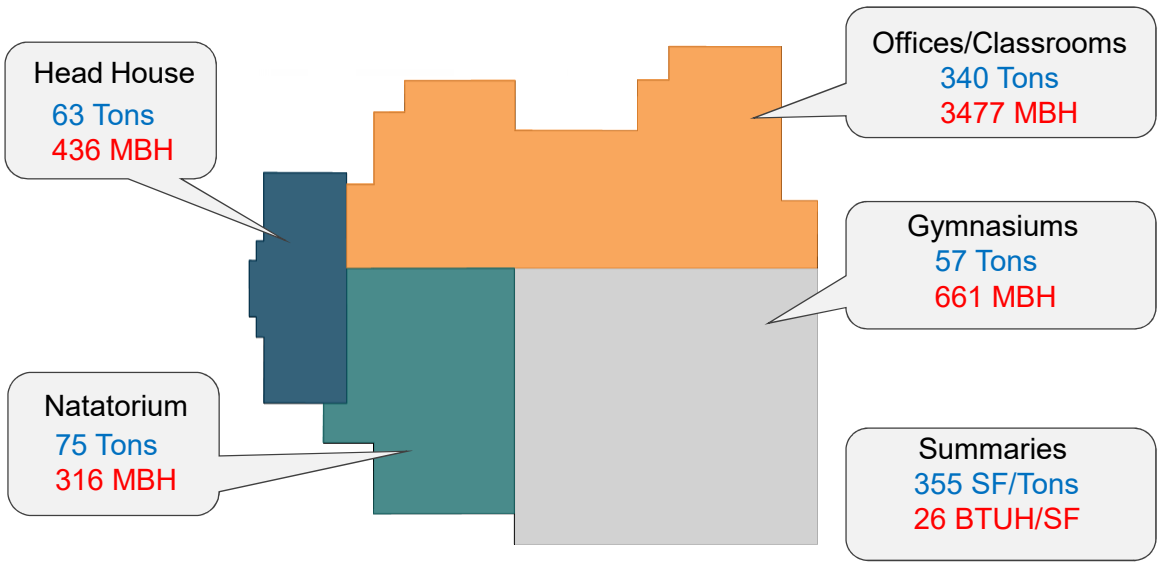



INTRO | SITE | ENVELOPE | INTEGRATION | DISCIPLINE | SUMMARY

# MECHANICAL

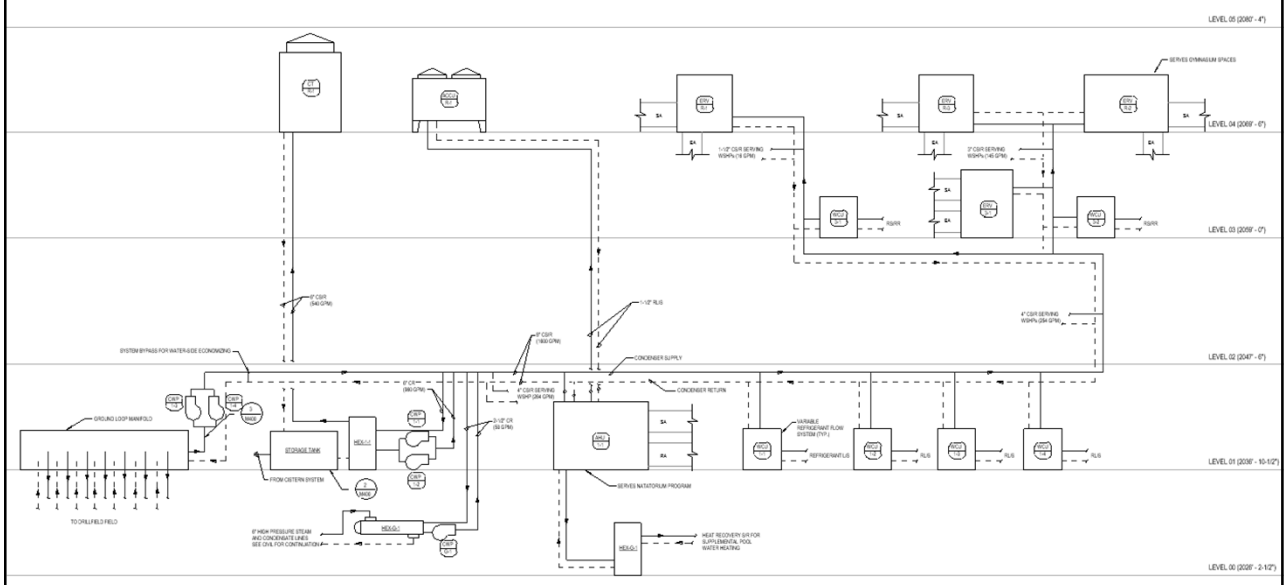
## HVAC Load Calculations

80



## Mechanical System Schematic

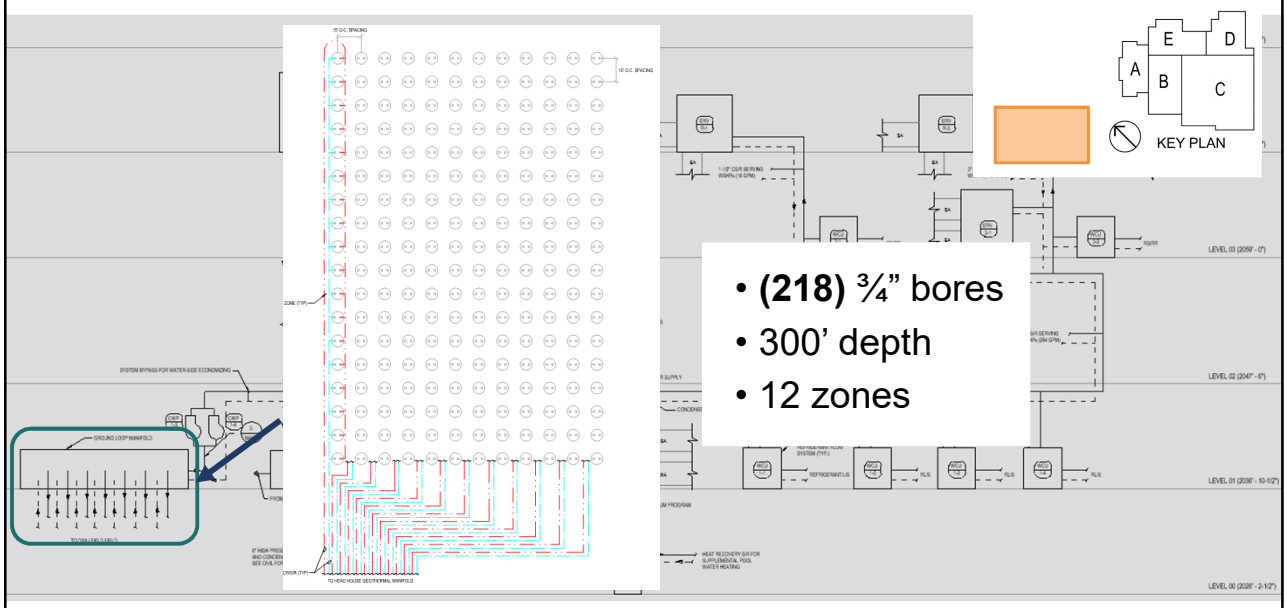
81



INTRO | SITE | ENVELOPE | INTEGRATION | DISCIPLINE | SUMMARY

## Geothermal

82

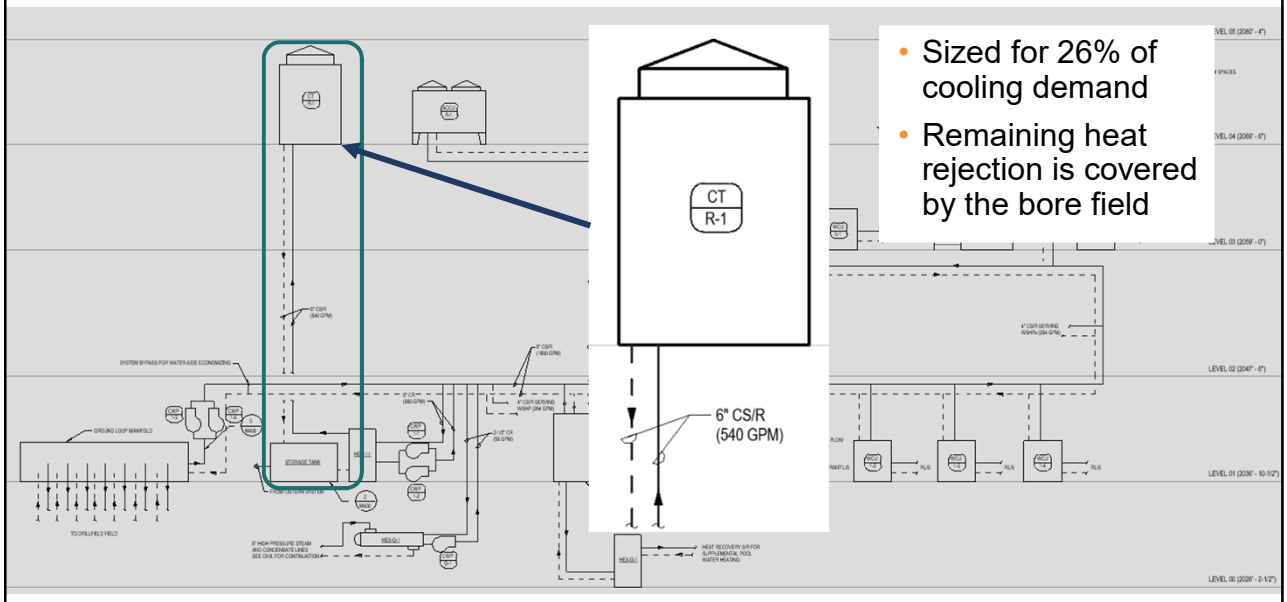



- **(218)** ¾” bores
- 300’ depth
- 12 zones

INTRO | SITE | ENVELOPE | INTEGRATION | DISCIPLINE | SUMMARY

## Cooling Tower

83

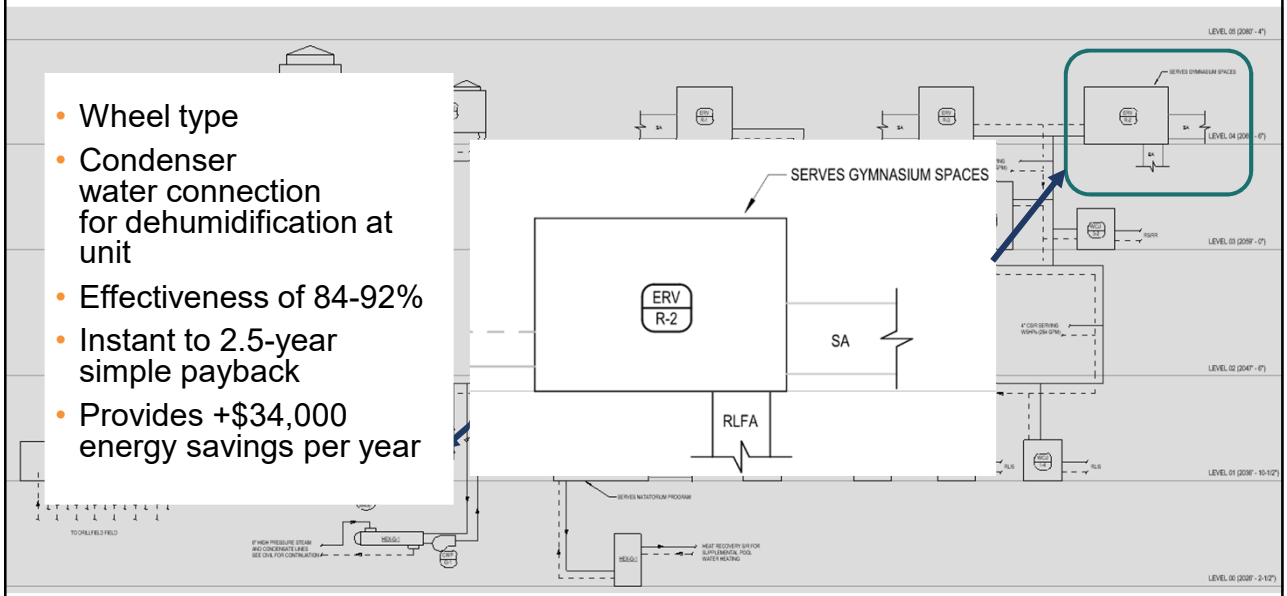



- Sized for 26% of cooling demand
- Remaining heat rejection is covered by the bore field

INTRO | SITE | ENVELOPE | INTEGRATION | DISCIPLINE | SUMMARY

## Energy Recovery Ventilators

84



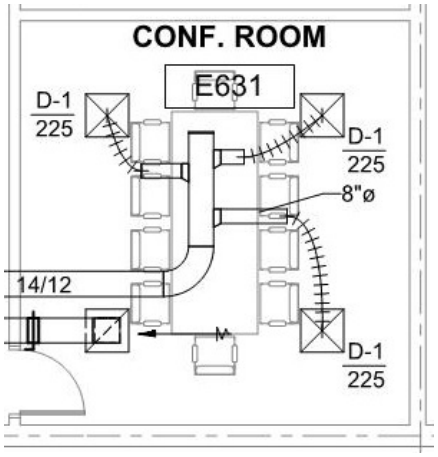

- Wheel type
- Condenser water connection for dehumidification at unit
- Effectiveness of 84-92%
- Instant to 2.5-year simple payback
- Provides +$34,000 energy savings per year

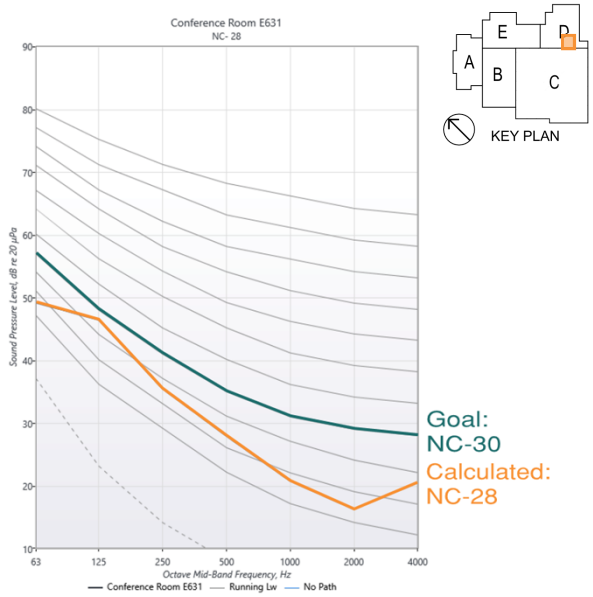
INTRO | SITE | ENVELOPE | INTEGRATION | DISCIPLINE | SUMMARY

## Mechanical Noise

85

- Silencers at intake and discharge of ERVs

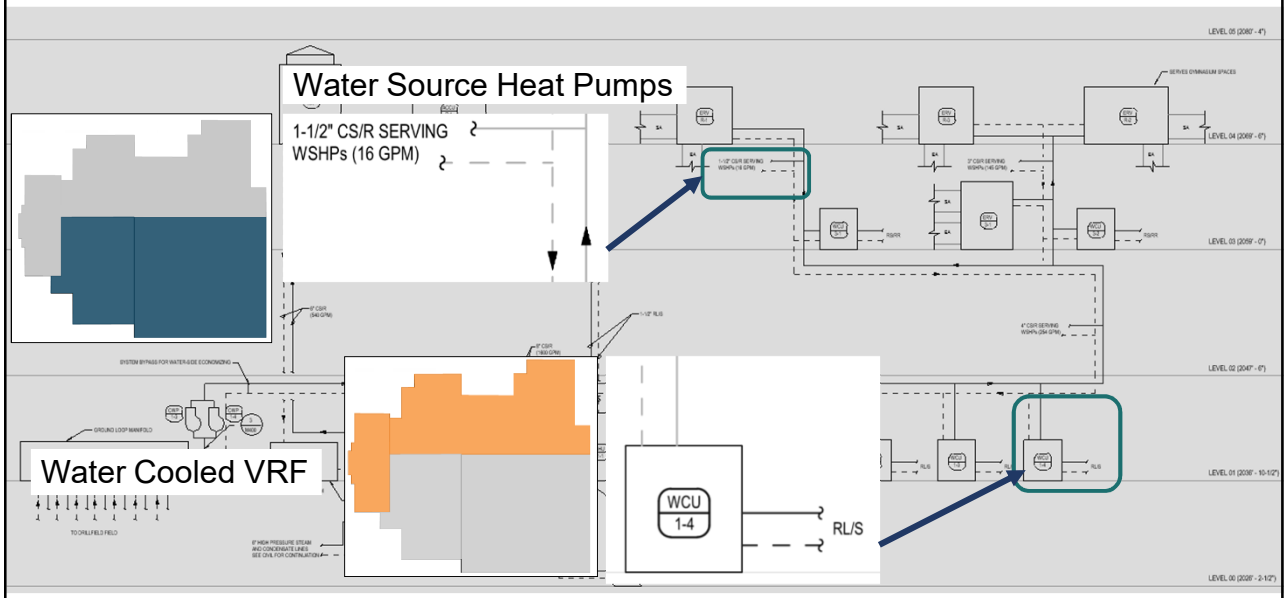



INTRO | SITE | ENVELOPE | INTEGRATION | DISCIPLINE | SUMMARY

## Secondary Systems

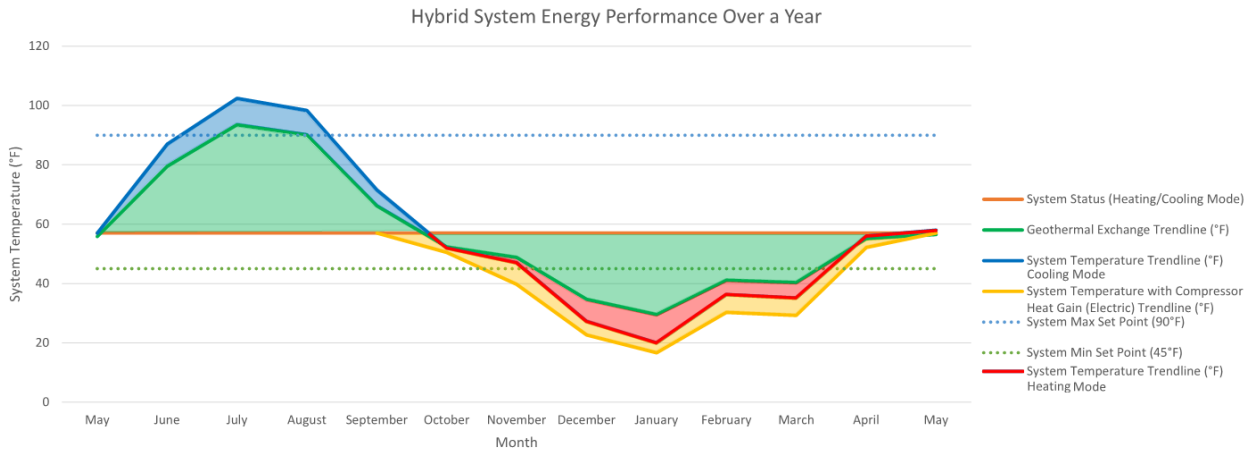
86




INTRO | SITE | ENVELOPE | INTEGRATION | DISCIPLINE | SUMMARY

## Energy Performance of the System

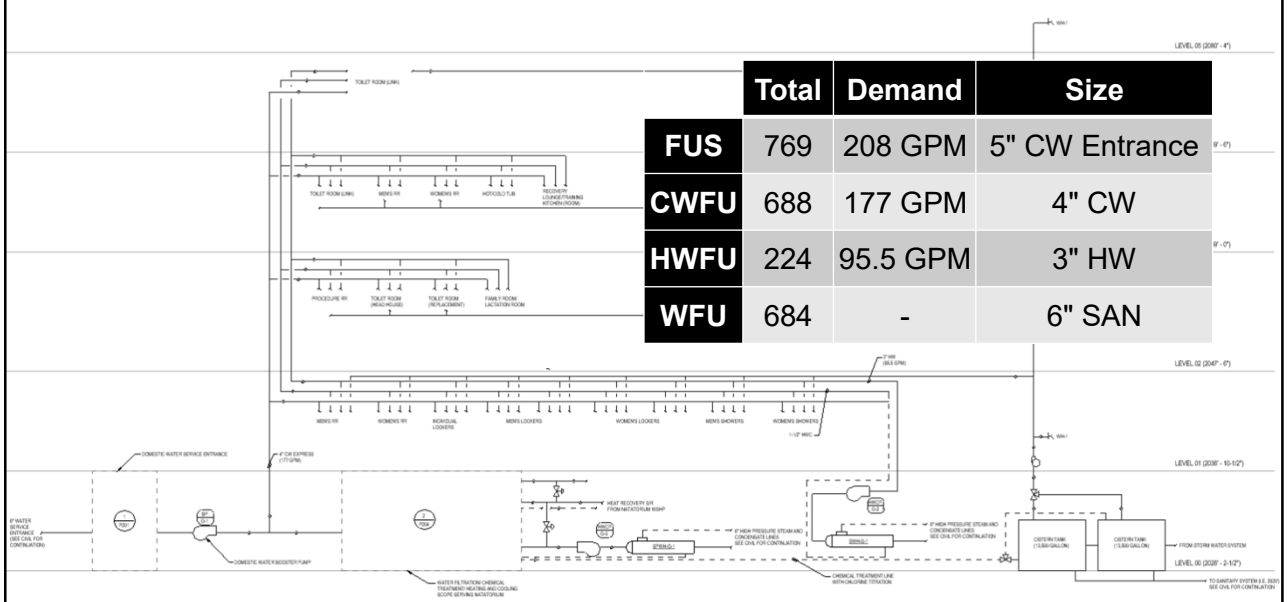
87




- 33% “free energy”
- 64% energy savings per year

## Domestic Water Riser

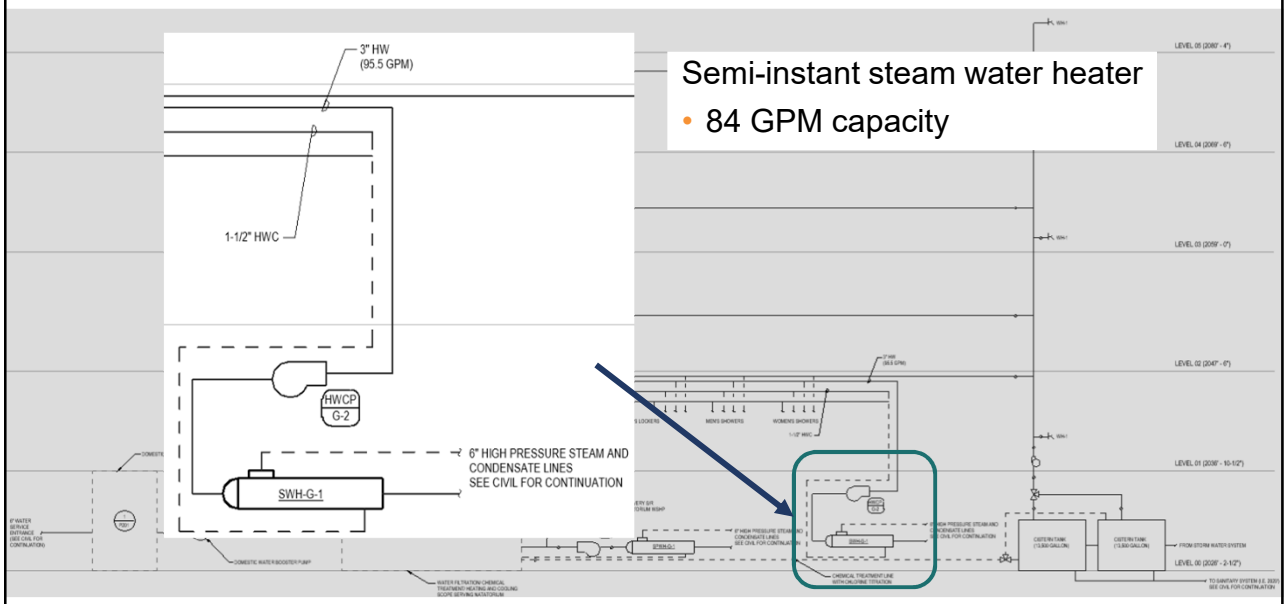
88



| | Total | Demand | Size |
|---|---|---|---|
| FUS | 769 | 208 GPM | 5" CW Entrance |
| CWFU | 688 | 177 GPM | 4" CW |
| HWFU | 224 | 95.5 GPM | 3" HW |
| WFU | 684 | - | 6" SAN |

## Domestic Hot Water

89

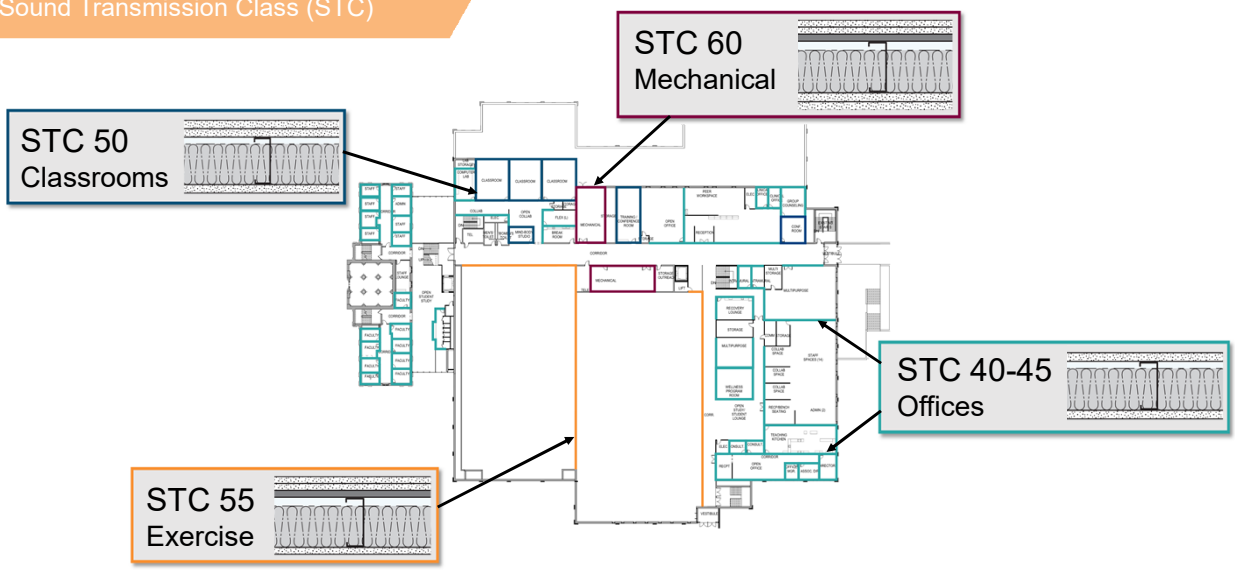





## Acoustics

90

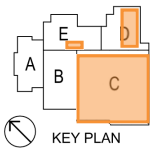
Sound Transmission Class (STC)



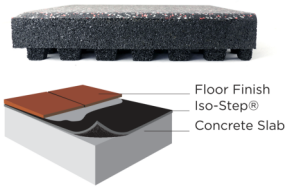
# Acoustics

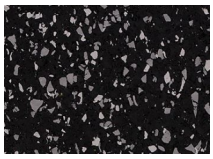
91

## Impact Insulation Class (IIC)




| Gyms and exercise classrooms | Teaching weight room | Open exercise |
|---|---|---|
| • Floating wood floor<br>• IIC 64 | • Rubber athletic flooring and underlayment<br>• IIC 75 | • Rubber athletic flooring<br>• IIC 58 |



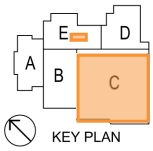





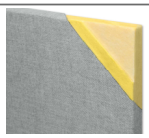
# Acoustics

92

## Reverberation Time




### Gym



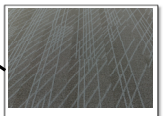
Impact-resistant wall panels

Acoustical spray finish

### Classrooms

Acoustical ceiling tile


Wall panels



Carpet

| Room | Max Recommended RT (sec) | Calculated RT (sec) |
|---|---|---|
| Level 1 Gym | 1.5 | 1.07 |
| Level 2 Gym | 1.5 | 1.10 |
| Classrooms | 0.6 | 0.26 |

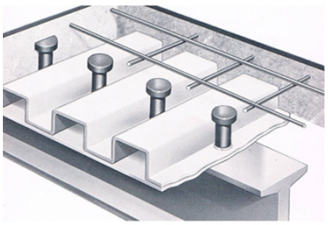
# DESIGN SUMMARY

## Selected Systems

94

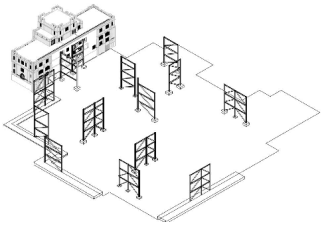
Structural

### Gravity System



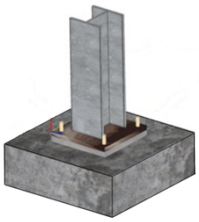
Non composite roof and composite floor systems supported by steel framing and steel columns.

### Lateral System



Lateral loads are supported using steel braced frames and a single moment frame.

### Foundation System



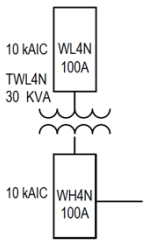
The design includes shallow foundations, helical piles, and composite foundations.

# Selected Systems

95

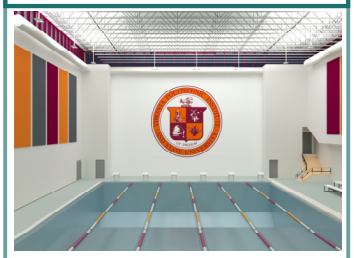
## Electrical

### Power




- 2500 A, 480/277V, 3ϕ, 4 w main
- 200 kW generator

### Lighting



- LED Fixtures were selected for life, efficiency and occupants' comfort
- 48% sDA was achieved

### Systems

- Lightning Protection System
- Speaker/Strobe Fire Alarm System

INTRO | SITE | ENVELOPE | INTEGRATION | DISCIPLINE | SUMMARY

# Selected Systems

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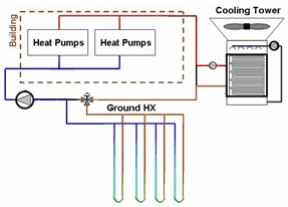
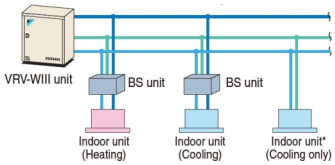
## Mechanical

### Primary Systems




Geothermal field + cooling tower + steam heat exchanger = Hybrid System

### Secondary Systems




- Water Source Heat Pumps
- Water Cooled VRF

### Rain Harvesting

- Cistern

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# LEED Certification

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**LEED v4 for BD+C: New Construction and Major Renovation**
Project Checklist

| Y | ? | N | | | |
|---|---|---|---|---|---|
| 1 | | | Credit | Integrative Process | 1 |
| **7** | **8** | **17** | | **Location and Transportation** | **16** |
| 0 | 0 | 16 | Credit | LEED for Neighborhood Development Location | 16 |
| 1 | 0 | 0 | Credit | Sensitive Land Protection | 1 |
| 0 | 2 | 0 | Credit | High Priority Site | 2 |
| 0 | 5 | 0 | Credit | Surrounding Density and Diverse Uses | 5 |
| 5 | 0 | 0 | Credit | Access to Quality Transit | 5 |
| 0 | 1 | 0 | Credit | Bicycle Facilities | 1 |
| 1 | 0 | 0 | Credit | Reduced Parking Footprint | 1 |
| 0 | 0 | 1 | Credit | Green Vehicles | 1 |
| **3** | **6** | **3** | | **Sustainable Sites** | **10** |
| Y | | | Prereq | Construction Activity Pollution Prevention | Required |
| 0 | 1 | 0 | Credit | Site Assessment | 1 |
| 0 | 0 | 2 | Credit | Site Development - Protect or Restore Habitat | 2 |
| 0 | 0 | 1 | Credit | Open Space | 1 |
| 2 | 1 | 0 | Credit | Rainwater Management | 3 |
| 0 | 4 | 0 | Credit | Heat Island Reduction | 2 |
| 1 | 0 | 0 | Credit | Light Pollution Reduction | 1 |
| **9** | **2** | **0** | | **Water Efficiency** | **11** |
| Y | | | Prereq | Outdoor Water Use Reduction | Required |
| Y | | | Prereq | Indoor Water Use Reduction | Required |
| Y | | | Prereq | Building-Level Water Metering | Required |
| 2 | 0 | 0 | Credit | Outdoor Water Use Reduction | 2 |
| 4 | 2 | 0 | Credit | Indoor Water Use Reduction | 6 |
| 2 | 0 | 0 | Credit | Cooling Tower Water Use | 2 |
| 1 | 0 | 0 | Credit | Water Metering | 1 |
| **20** | **15** | **0** | | **Energy and Atmosphere** | **33** |
| Y | | | Prereq | Fundamental Commissioning and Verification | Required |
| Y | | | Prereq | Minimum Energy Performance | Required |
| Y | | | Prereq | Building-Level Energy Metering | Required |
| Y | | | Prereq | Fundamental Refrigerant Management | Required |
| 6 | 6 | 0 | Credit | Enhanced Commissioning | 6 |
| 8 | 6 | 0 | Credit | Optimize Energy Performance | 18 |
| 1 | 0 | 0 | Credit | Advanced Energy Metering | 1 |
| 2 | 0 | 0 | Credit | Demand Response | 2 |
| 3 | 0 | 0 | Credit | Renewable Energy Production | 3 |
| 0 | 1 | 0 | Credit | Enhanced Refrigerant Management | 1 |
| 0 | 2 | 0 | Credit | Green Power and Carbon Offsets | 2 |
| **7** | **12** | **0** | | **Materials and Resources** | **13** |
| Y | | | Prereq | Storage and Collection of Recyclables | Required |
| Y | | | Prereq | Construction and Demolition Waste Management Planning | Required |
| 0 | 5 | 0 | Credit | Building Life-Cycle Impact Reduction | 5 |
| 1 | 1 | 0 | Credit | Building Product Disclosure and Optimization - Environmental Product Declarations | 2 |
| 2 | 2 | 0 | Credit | Building Product Disclosure and Optimization - Sourcing of Raw Materials | 2 |
| 2 | 2 | 0 | Credit | Building Product Disclosure and Optimization - Material Ingredients | 2 |
| 2 | 2 | 0 | Credit | Construction and Demolition Waste Management | 2 |
| **8** | **9** | **0** | | **Indoor Environmental Quality** | **16** |
| Y | | | Prereq | Minimum Indoor Air Quality Performance | Required |
| Y | | | Prereq | Environmental Tobacco Smoke Control | Required |
| 1 | 1 | 0 | Credit | Enhanced Indoor Air Quality Strategies | 2 |
| 0 | 3 | 0 | Credit | Low-Emitting Materials | 3 |
| 1 | 1 | 0 | Credit | Construction Indoor Air Quality Management Plan | 1 |
| 2 | 0 | 0 | Credit | Indoor Air Quality Assessment | 2 |
| 1 | 0 | 0 | Credit | Thermal Comfort | 1 |
| 1 | 1 | 0 | Credit | Interior Lighting | 2 |
| 0 | 3 | 0 | Credit | Daylight | 3 |
| 1 | 0 | 0 | Credit | Quality Views | 1 |
| 1 | 0 | 0 | Credit | Acoustic Performance | 1 |
| **0** | **5** | **1** | | **Innovation** | **6** |
| 0 | 5 | 0 | Credit | Innovation | 5 |
| 0 | 0 | 1 | Credit | LEED Accredited Professional | 1 |
| **0** | **0** | **4** | | **Regional Priority** | **4** |
| 0 | 0 | 1 | Credit | Regional Priority: Specific Credit | 1 |
| 0 | 0 | 1 | Credit | Regional Priority: Specific Credit | 1 |
| 0 | 0 | 1 | Credit | Regional Priority: Specific Credit | 1 |
| 0 | 0 | 1 | Credit | Regional Priority: Specific Credit | 1 |
| **55** | **57** | **25** | | **TOTALS** Possible Points: | **110** |

**Certified:** 40 to 49 points, **Silver:** 50 to 59 points, **Gold:** 60 to 79 points, **Platinum:** 80 to 110

**55**
**Points**

INTRO | SITE | ENVELOPE | INTEGRATION | DISCIPLINE | SUMMARY

# Cost Considerations

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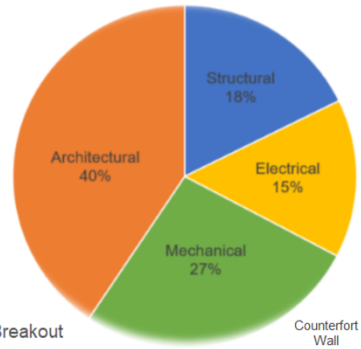
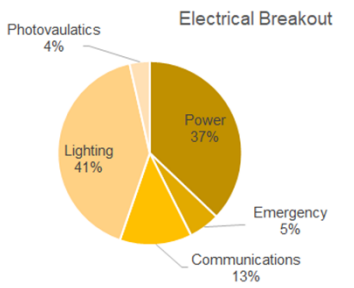
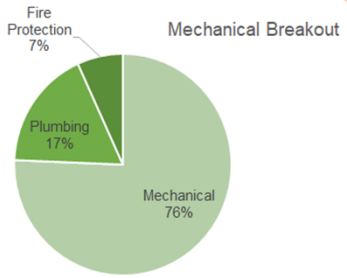
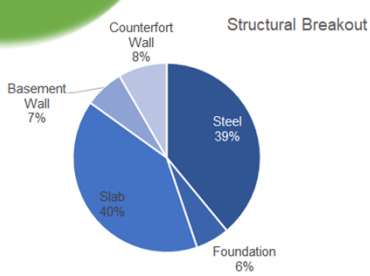
| | Cost | Percentage of Total Cost |
|---|---|---|
| Structural | $7.95 million | 18% |
| Electrical | $6.73 million | 15% |
| Mechanical | $12.02 million | 27% |
| Architectural | $18.00 million | 40% |
| Total | $44.70 million | |




INTRO | SITE | ENVELOPE | INTEGRATION | DISCIPLINE | SUMMARY

## Design Summary

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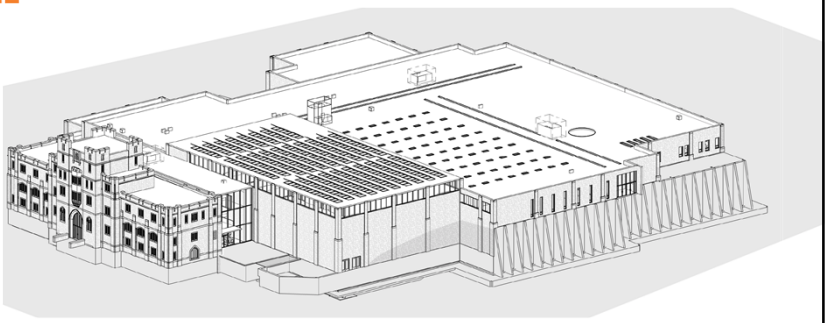
**UPDATE THE USER EXPERIENCE**

**PROMOTE ALL FORMS OF WELLNESS**

**CREATE A HEART OF CAMPUS**



INTRO | SITE | ENVELOPE | INTEGRATION | DISCIPLINE | SUMMARY

GOLIATH engineering