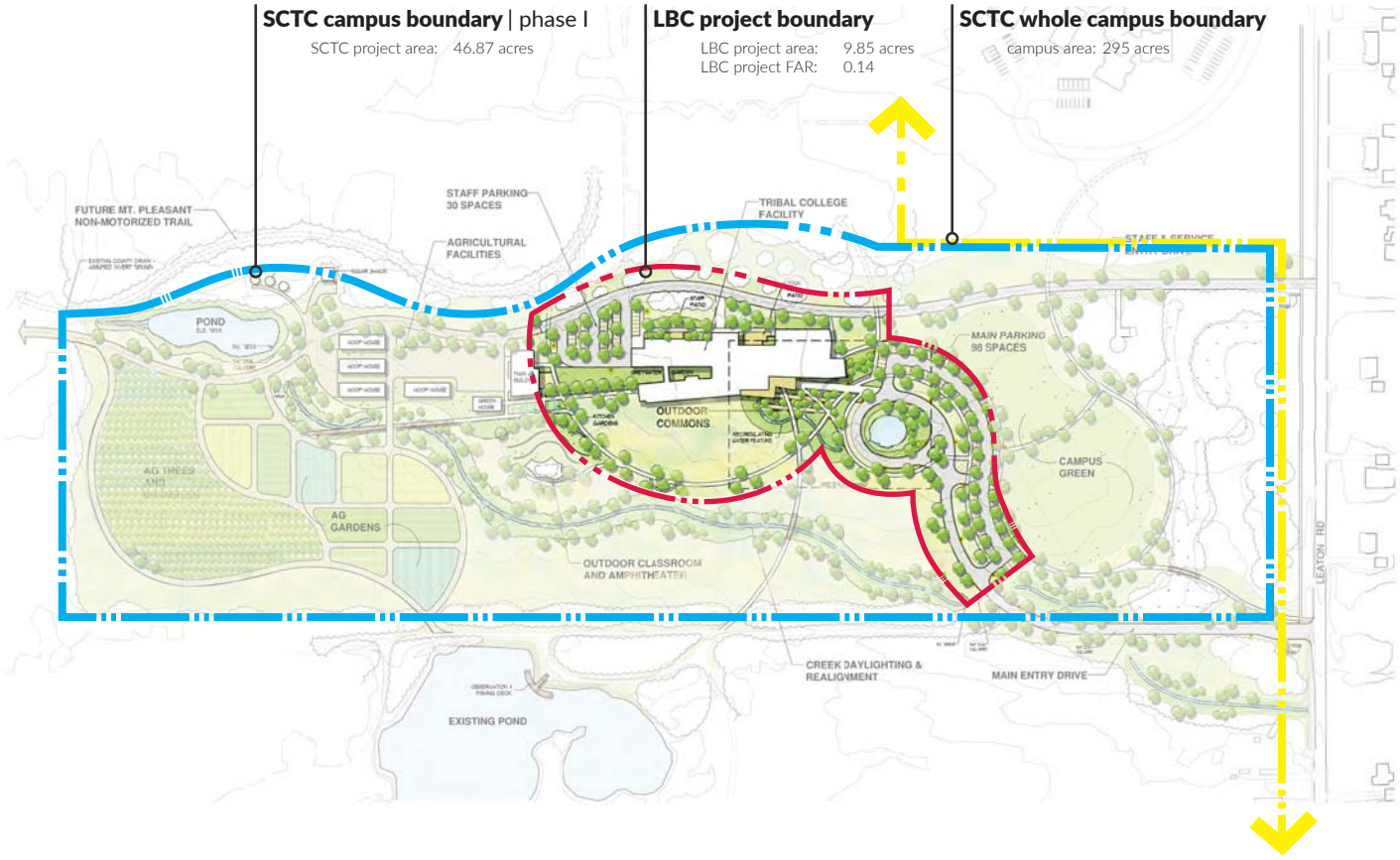
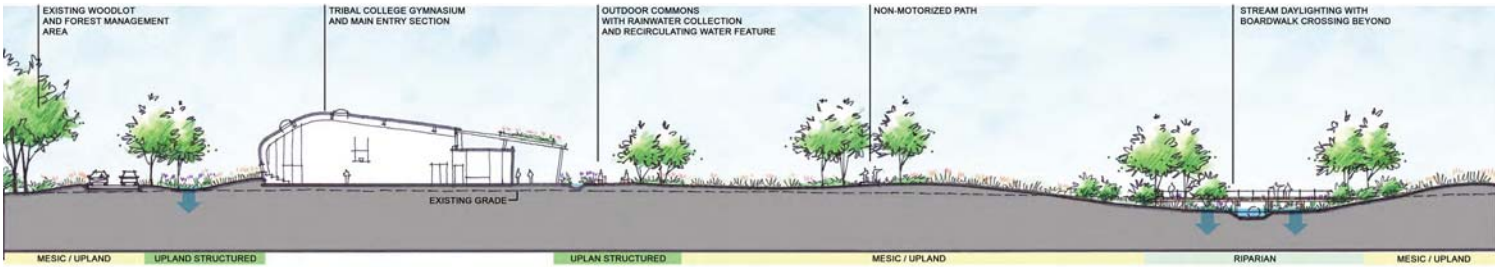


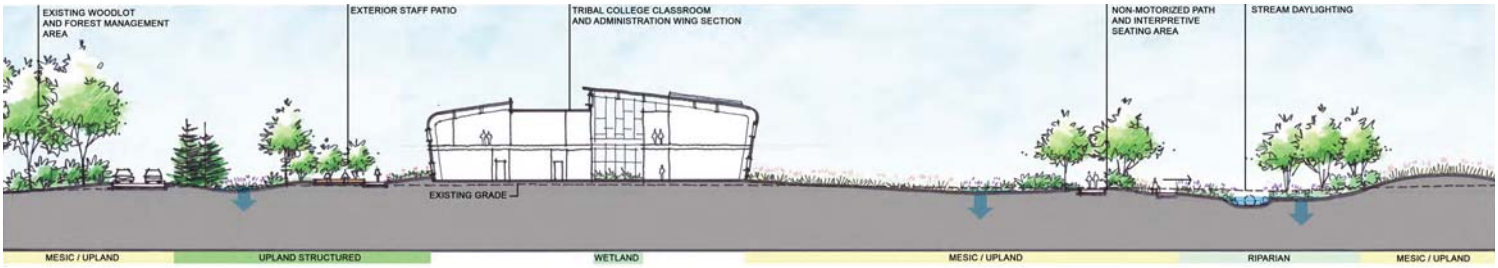
Integrated Architecture VIRIDIS Design Group

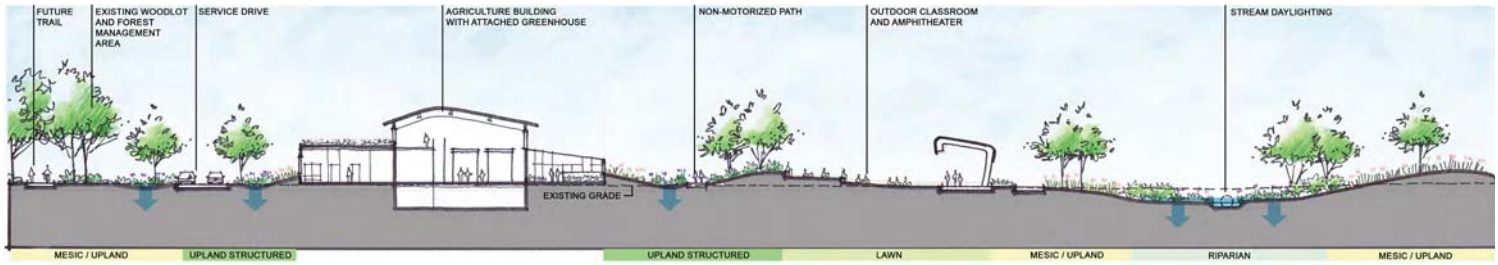
living building project boundary

Integrated Architecture VIRIDIS Design Group

site plan





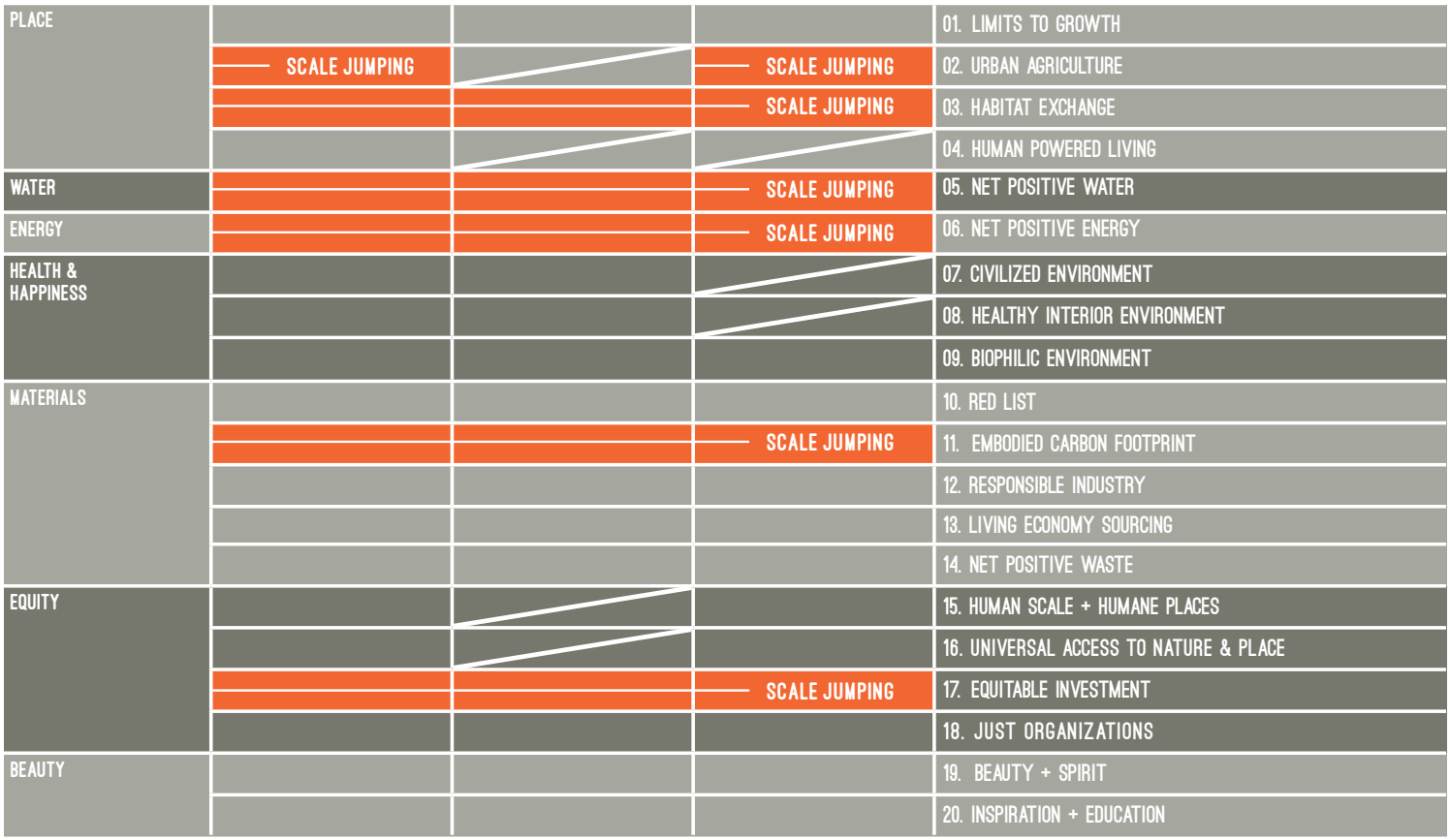


Integrated Architecture VIRIDIS Design Group

site cross sections

AGENDA :

- ✓ introductions
- ✓ process
- ✓ net positive water
- ○ net positive energy
  - petal intent
  - ideal conditions
  - i06 requirements
  - i06 process
  - i06 solutions
- ○ wrap up


PLACE
SCALE JUMPING
SCALE JUMPING
SCALE JUMPING
WATER
SCALE JUMPING
ENERGY
SCALE JUMPING
HEALTH & HAPPINESS
MATERIALS
SCALE JUMPING
EQUITY
SCALE JUMPING
BEAUTY
01. LIMITS TO GROWTH
02. URBAN AGRICULTURE
03. HABITAT EXCHANGE
04. HUMAN POWERED LIVING
05. NET POSITIVE WATER
06. NET POSITIVE ENERGY
07. CIVILIZED ENVIRONMENT
08. HEALTHY INTERIOR ENVIRONMENT
09. BIOPHILIC ENVIRONMENT
10. RED LIST
11. EMBODIED CARBON FOOTPRINT
12. RESPONSIBLE INDUSTRY
13. LIVING ECONOMY SOURCING
14. NET POSITIVE WASTE
15. HUMAN SCALE + HUMANE PLACES
16. UNIVERSAL ACCESS TO NATURE & PLACE
17. EQUITABLE INVESTMENT
18. JUST ORGANIZATIONS
19. BEAUTY + SPIRIT
20. INSPIRATION + EDUCATION

PLACE				01. LIMITS TO GROWTH
	SCALE JUMPING		SCALE JUMPING	02. URBAN AGRICULTURE
			SCALE JUMPING	03. HABITAT EXCHANGE
				04. HUMAN POWERED LIVING
WATER			SCALE JUMPING	05. NET POSITIVE WATER
ENERGY			SCALE JUMPING	06. NET POSITIVE ENERGY
HEALTH & HAPPINESS				07. CIVILIZED ENVIRONMENT
				08. HEALTHY INTERIOR ENVIRONMENT
				09. BIOPHILIC ENVIRONMENT
MATERIALS				10. RED LIST
			SCALE JUMPING	11. EMBODIED CARBON FOOTPRINT
				12. RESPONSIBLE INDUSTRY

PETAL INTENT:

"The intent of the Energy Petal is to signal a new age of design, wherein the built environment relies solely on renewable forms of energy and operates year round in a safe, pollution-free manner."

1

PETAL INTENT:

1

"The intent of the Energy Petal is to signal a new age of design, wherein the built environment relies solely on renewable forms of energy and operates year round in a safe, pollution-free manner."

2

"To prioritize reductions and optimization before technological solutions are applied to eliminate wasteful spending — of energy, resources, and dollars."

IDEAL CONDITIONS:

ENERGY | SCALE JUMPING | 06. NET POSITIVE ENERGY

"The Living Building Challenge envisions a safe, reliable, and decentralized power grid, powered entirely by renewable energy, supplied to incredibly efficient buildings and infrastructure without the negative externalities associated with combustion or fission."

i06 REQUIREMENTS

ENERGY | SCALE JUMPING | 06. NET POSITIVE ENERGY

"One hundred and five percent of the project's energy needs must be supplied by on-site renewable energy on a net annual basis, without the use of on-site combustion."

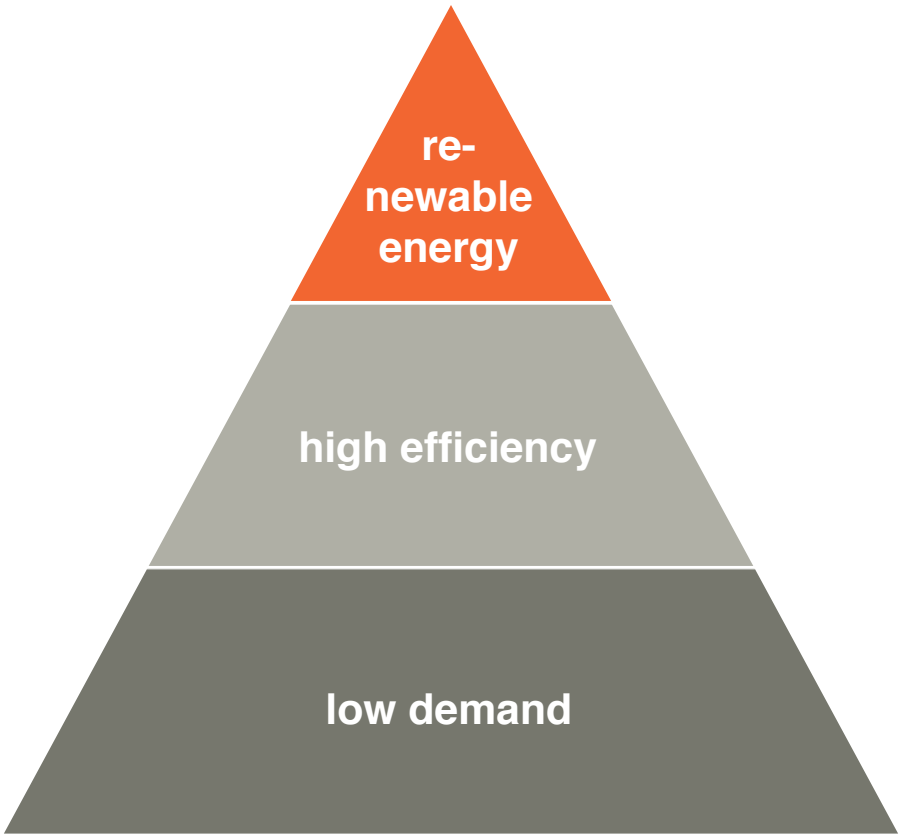
1

i06 REQUIREMENTS

ENERGY | SCALE JUMPING | 06. NET POSITIVE ENERGY

1 "One hundred and five percent of the project's energy needs must be supplied by on-site renewable energy on a net annual basis, without the use of on-site combustion."

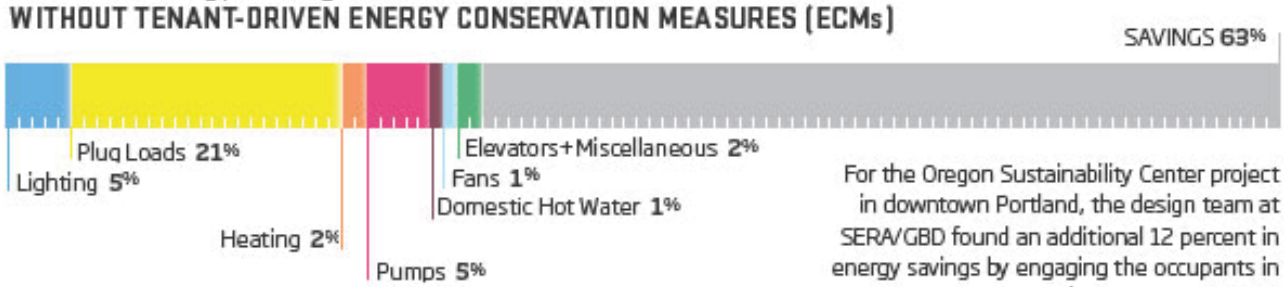
2 "Projects must provide on-site energy storage for resiliency."


re-
newable
energy
high efficiency
low demand

Energy efficient workspace....requires new occupant behavior
Workstation load – 70W; 300W continuous power draw per person (entire building)
LED task lights
6 Watts
Fluorescent task lights 35 Watts
24" LCD Energy Efficient Monitors
18 Watts
Typical 19"-24" Monitors
30-50 Watts
iGo Power Smart Towers
Reduces "vampire" energy use
VOIP phones 2 Watts
Removing personal space heater saves 1500 Watts
Laptop
30 Watts
Desktop Computer (Energy Star)
300 Watts
Multi-function Devices
100 Watts (continuous)
Removing desktop printers saves ~460 Watts/Printer

Potential Energy Savings

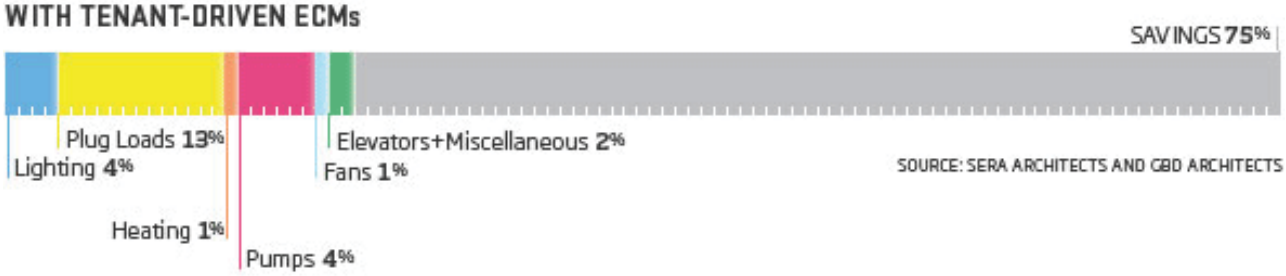
WITHOUT TENANT-DRIVEN ENERGY CONSERVATION MEASURES (ECMs)



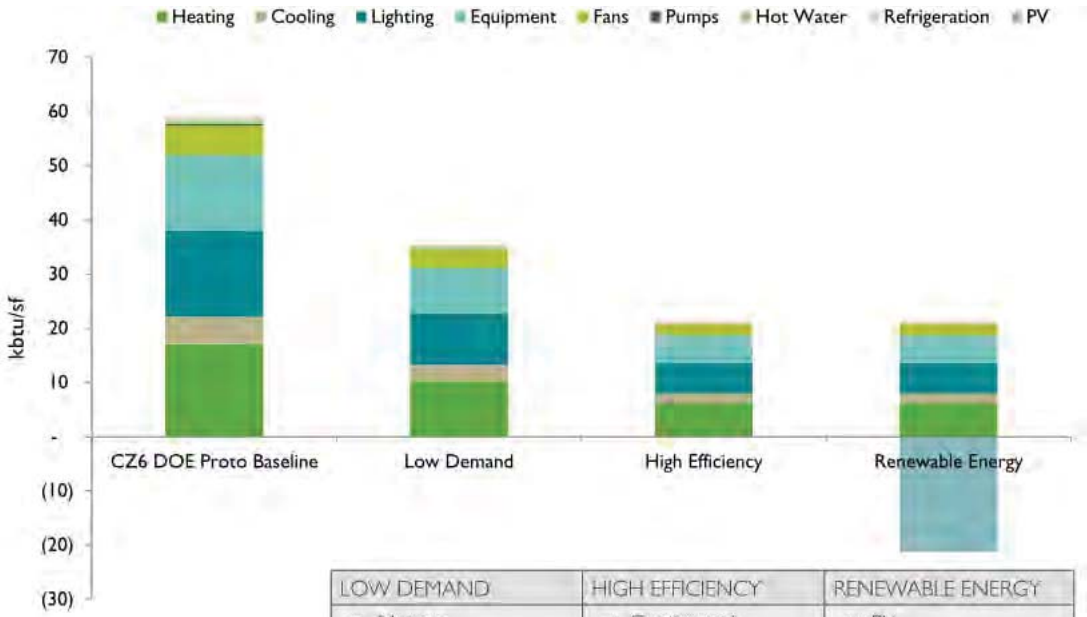
For the Oregon Sustainability Center project in downtown Portland, the design team at SERA/GBD found an additional 12 percent in energy savings by engaging the occupants in energy conservation measures (ECMs).

Energy Saving Goals

WITH TENANT-DRIVEN ECMs

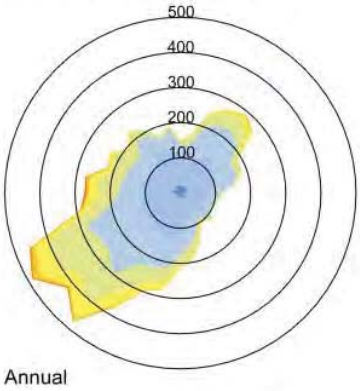


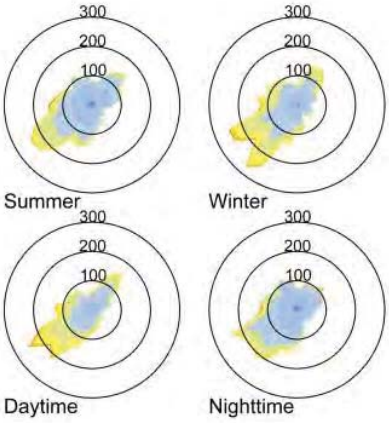
SOURCE: SERA ARCHITECTS AND GBD ARCHITECTS

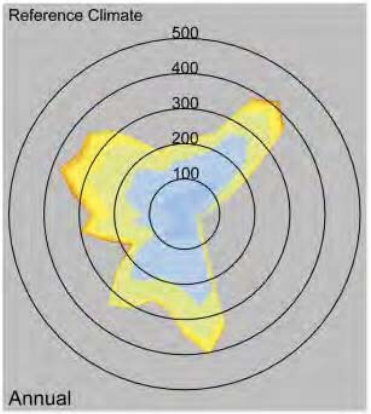


LOW DEMAND	HIGH EFFICIENCY	RENEWABLE ENERGY
Massing Orientation Insulation WWR Daylighting Thermal Mass Passive Vent Plug Loads Comfort Bands	Geothermal Heat Recovery Power Management Lighting Control System Efficiencies	PV Solar Hot Water Wind

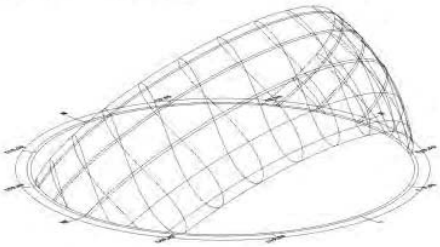
WIND SPEED AND FREQUENCY

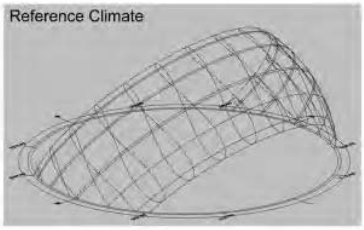




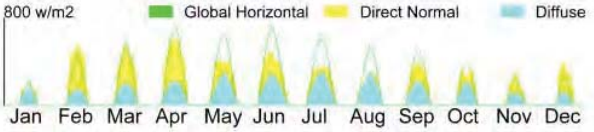


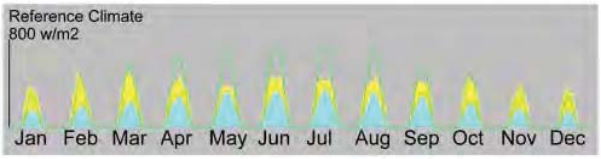
ANNUAL SUN PATH

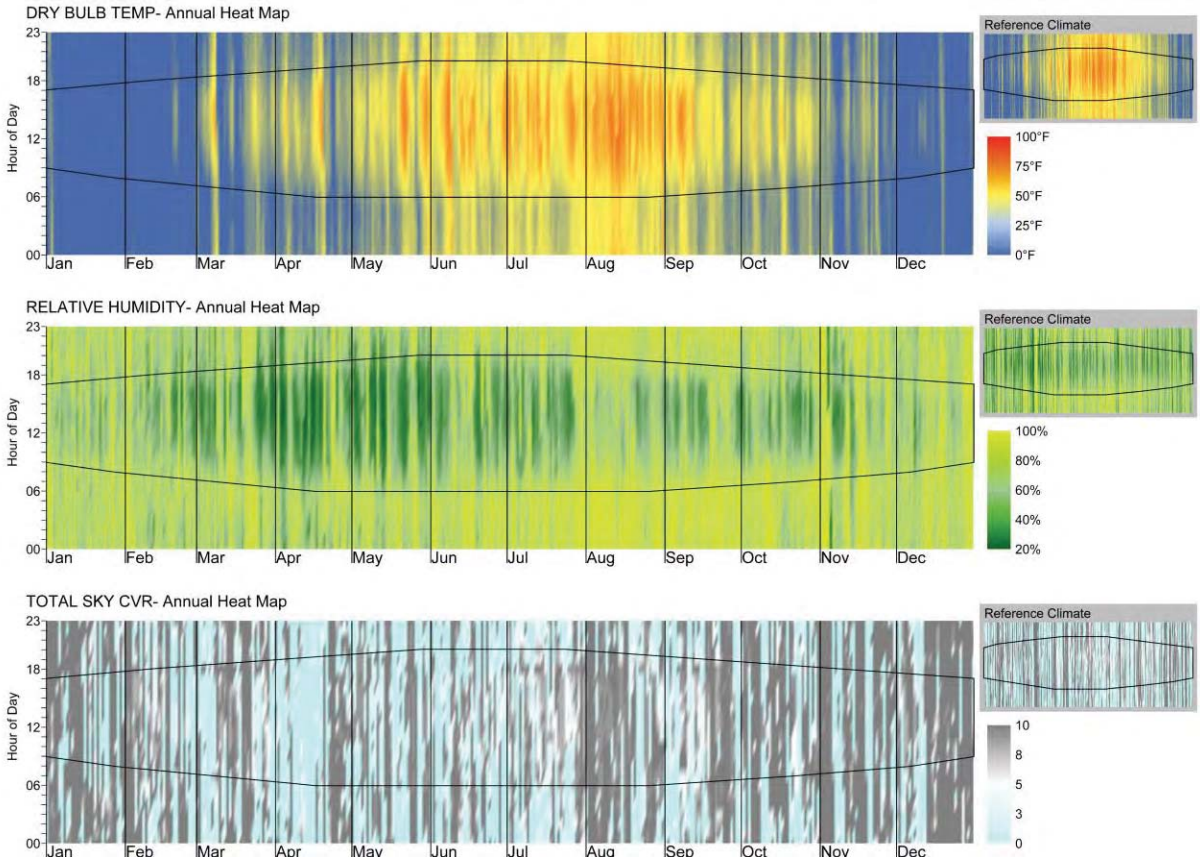


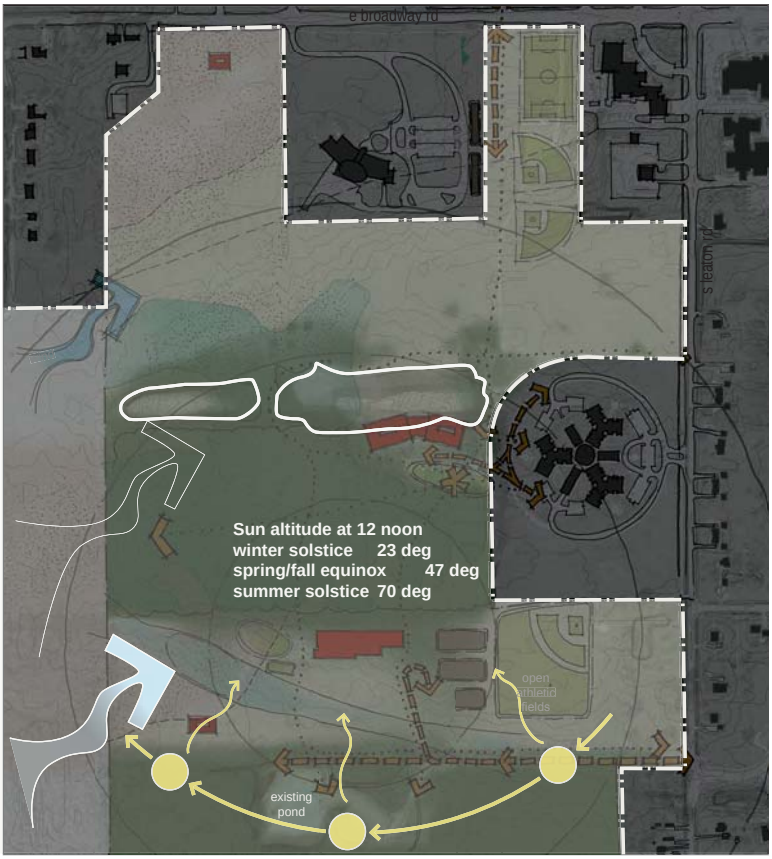


MONTHLY SOLAR RADIATION





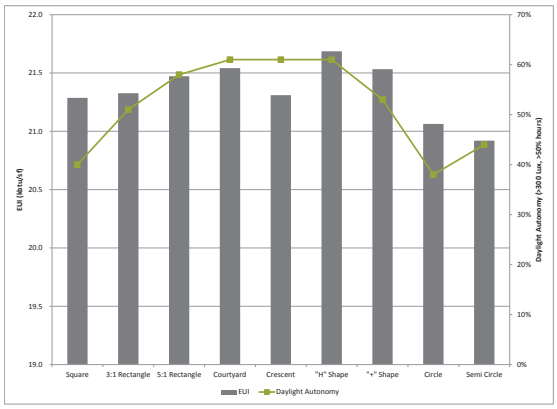

DRY BULB TEMP- Annual Heat Map
Reference Climate
Hour of Day
23
18
12
06
00
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
100°F
75°F
50°F
25°F
0°F
RELATIVE HUMIDITY- Annual Heat Map
Reference Climate
100%
80%
60%
40%
20%
TOTAL SKY CVR- Annual Heat Map
Reference Climate
10
8
5
3
0

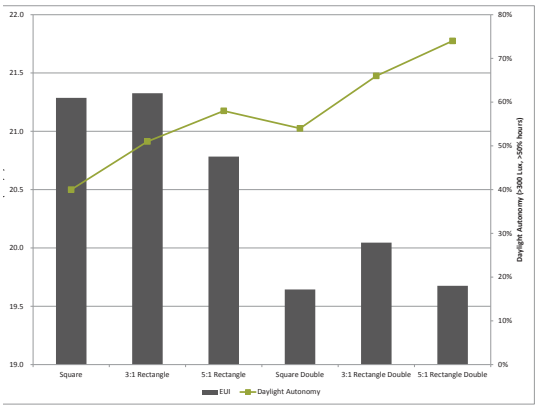


Integrated Architecture

existing climatic conditions

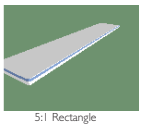
Increase in Perimeter Zone Area for Daylight Potential
Increase in Annual Solar Radiation Load
Increase
25%
20%
15%
10%
5%
0%
Baseline
N
8 Story Rectangular Forms
8 Story Courtyard Forms
8 Story Additional Building Forms
16 Story Tall Form
Total Annual Energy Savings:
1.7%
2.5%
5.8%
7.0%
6.3%
2.1%
2.6%
1.2%
4.6%
Savings
0%
-5%
-10%
-15%
-20%
-25%
Baseline
Cooling Annual Energy Savings
Lighting Annual Energy Savings
Total Annual Energy Savings





Square

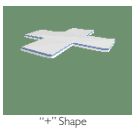
3:1 Rectangle

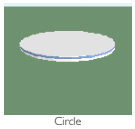

5:1 Rectangle

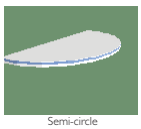
Courtyard

Crescent

"H" Shape

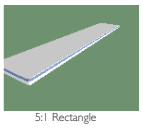

"+" Shape

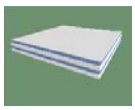

Circle

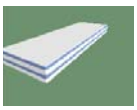

Semi-circle

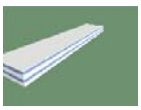
Square

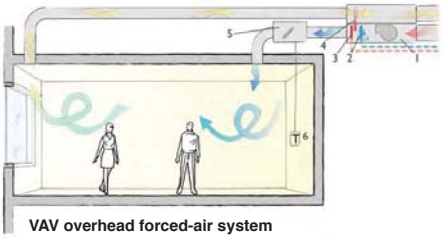
3:1 Rectangle


5:1 Rectangle

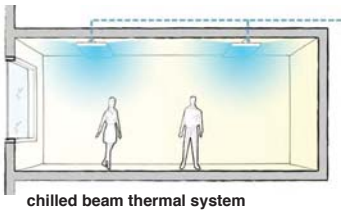

2 Story Square

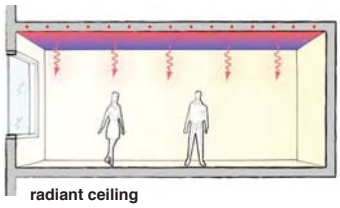

2 Story 3:1 Rectangle

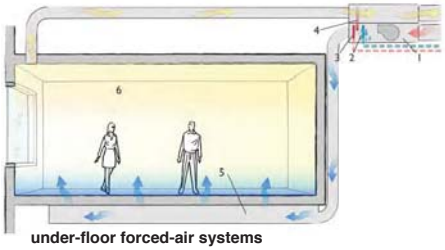

2 Story 5:1 Rectangle



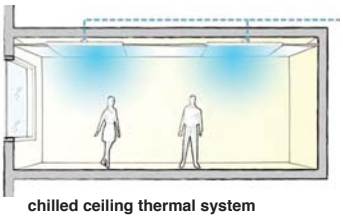
VAV overhead forced-air system

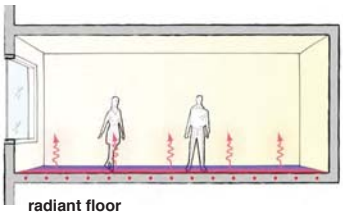

chilled beam thermal system

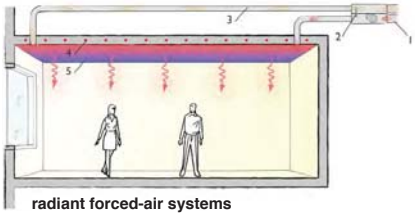

radiant ceiling



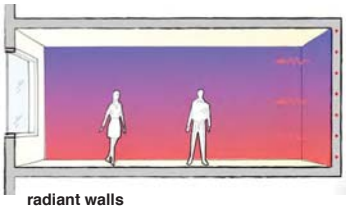
under-floor forced-air systems

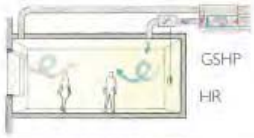

chilled ceiling thermal system

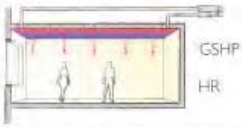

radiant floor



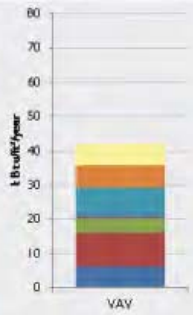
radiant forced-air systems

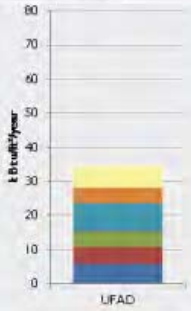

radiant walls

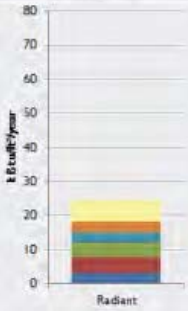


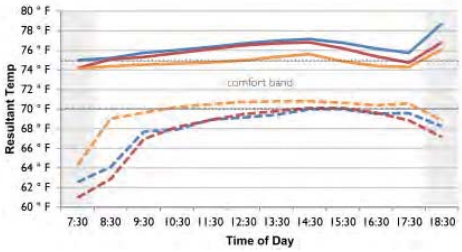


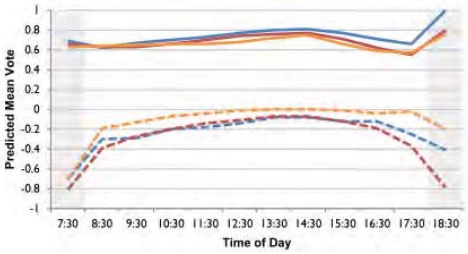
BASE CASE: VAV	Option 1: UFAD	Option 2: Radiant with Overhead Vent Supply
System 6: Packaged VAV + PFP Box	Under Floor Air Distribution (UFAD)	DOAS + Radiant System
Ground Source Heat Pump	Ground Source Heat Pump	Ground Source Heat Pump
4.14 Cooling 4.26 Heating	4.14 Cooling 4.26 Heating	4.14 Cooling 4.26 Heating
60% Efficiency	60% Efficiency	60% Efficiency
Variable Speed Drive Fans	Variable Speed Drive Fans	Variable Speed Drive Fans
2,267,900 kBtu	1,864,300 kBtu	1,336,700 kBtu
42.0 kBtu/ft²	34.5 kBtu/ft²	24.7 kBtu/ft²

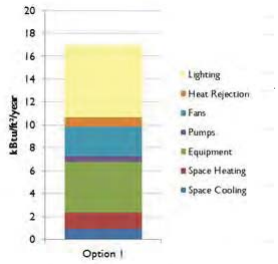










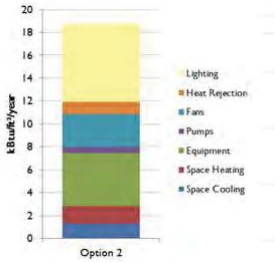


EUI - 17.0 kBtu/SF

gymnasium NE buffering

town hall on interior court

south entry



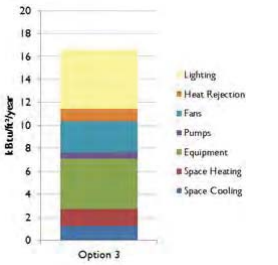
program layout 2

EUI - 18.4 kBtus/sf

gymnasium detached

town hall direct connection to the north and south

southeast entry



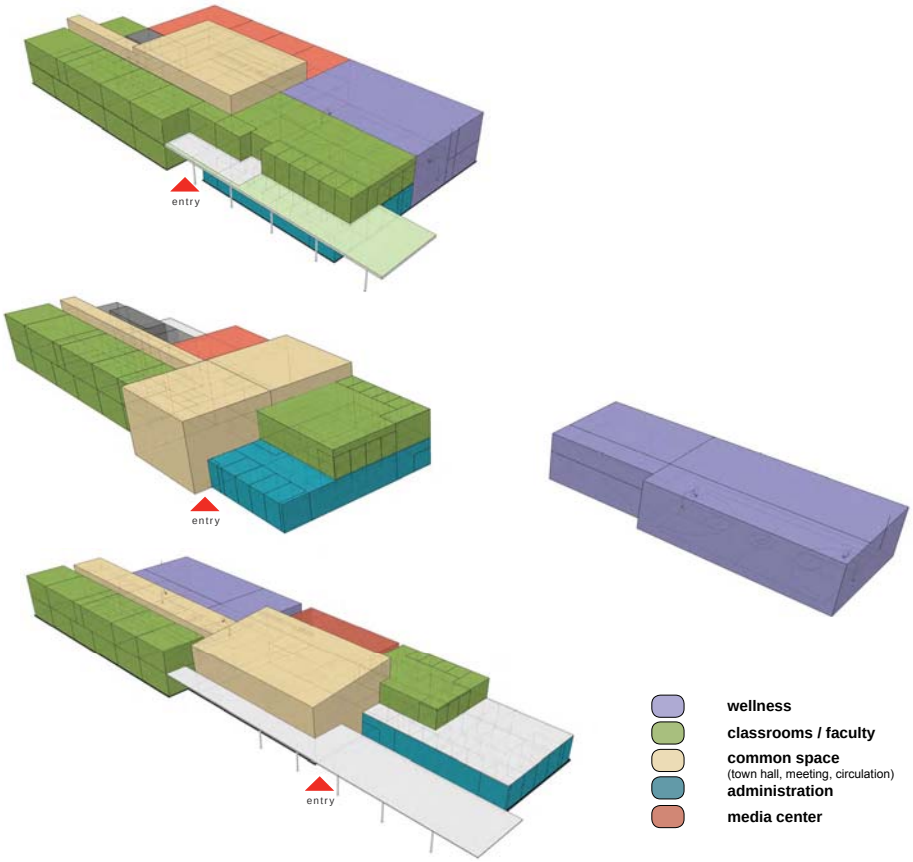
program layout 3

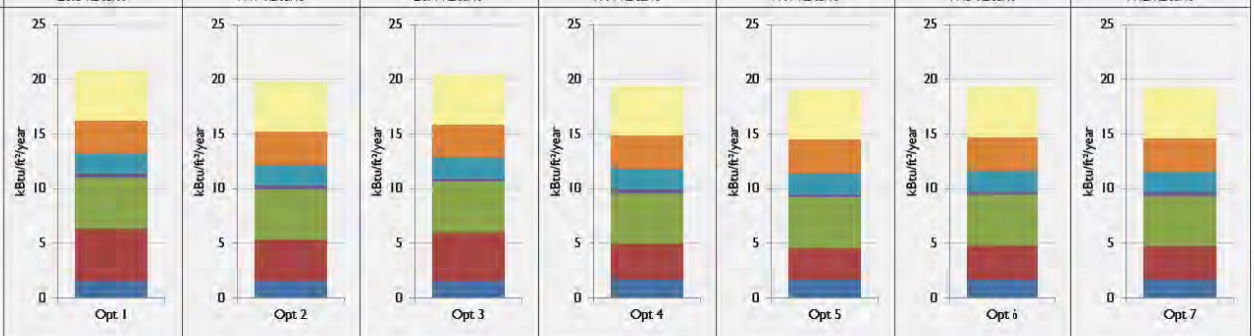
EUI - 16.6 kBtu/sf

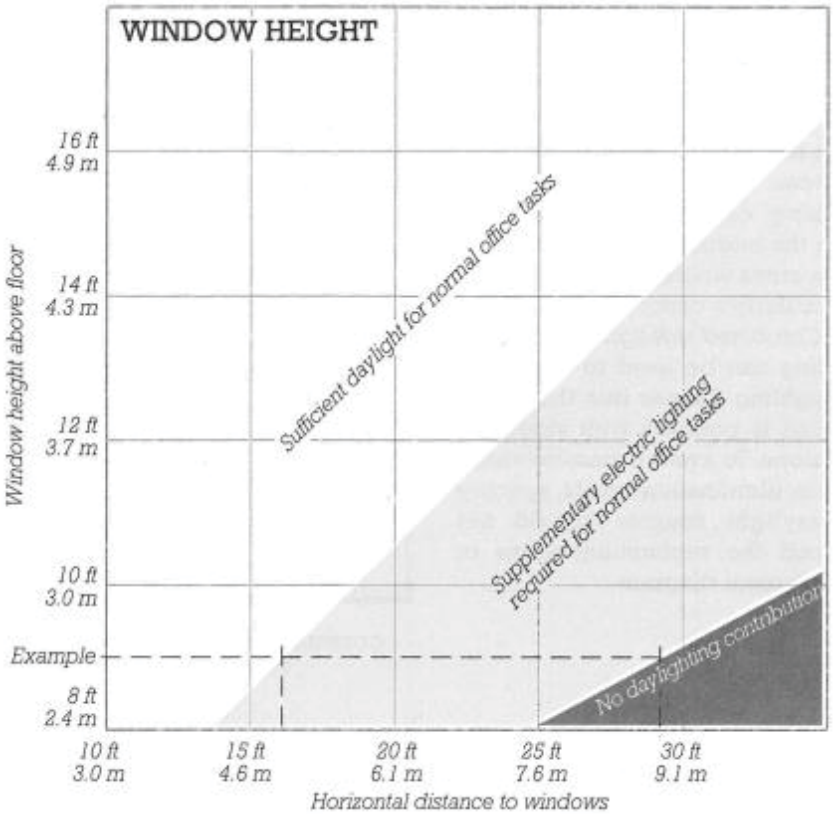
gymnasium NW buffering

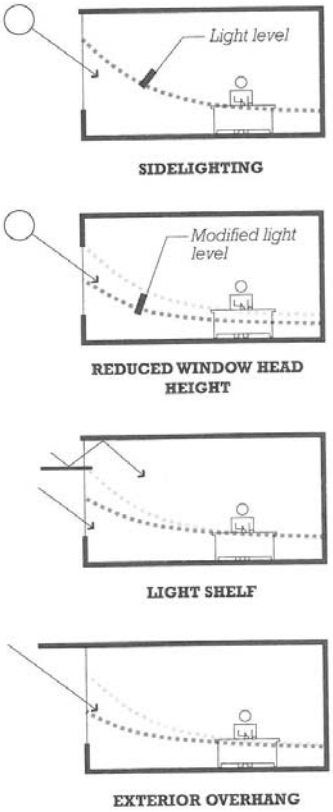
town hall direct connection to south and east

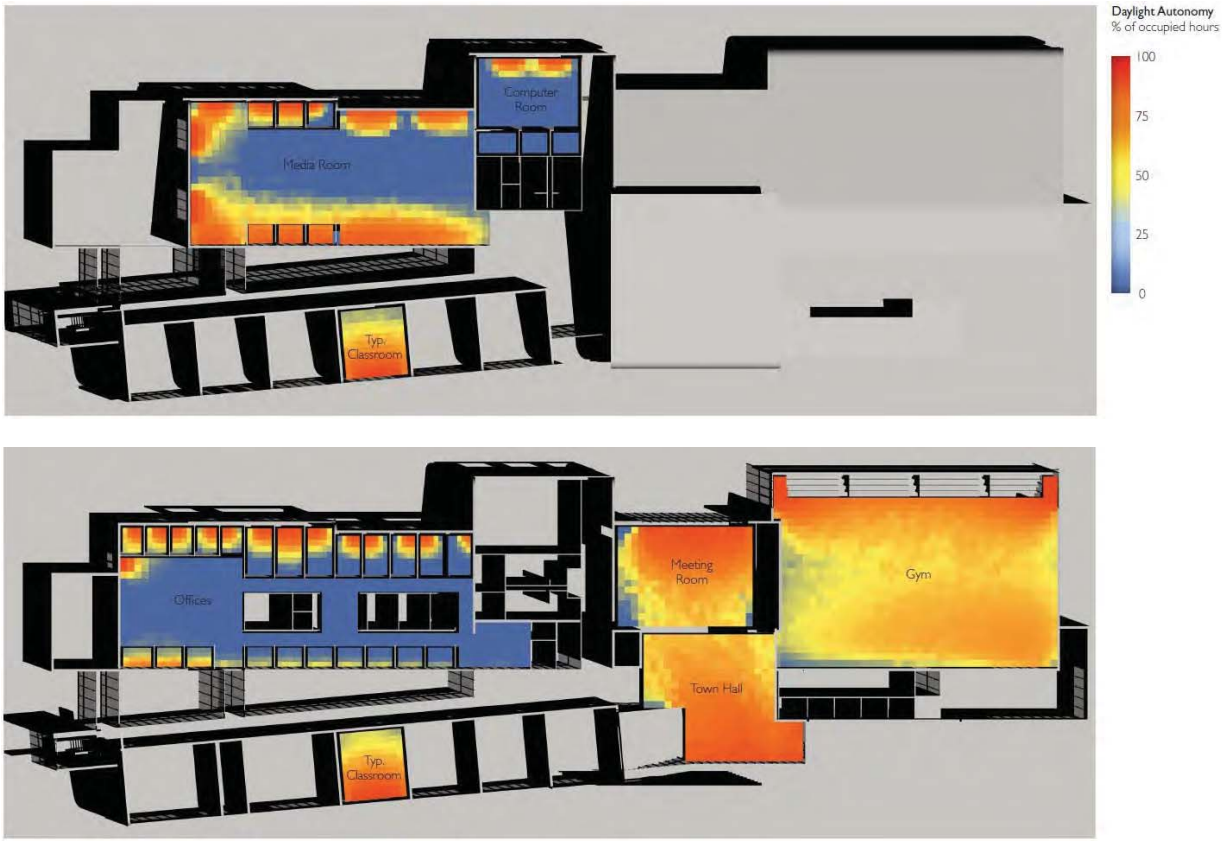
east entry



OPTION	OPTION 1	OPTION 2	OPTION 3	OPTION 4	OPTION 5	OPTION 6	OPTION 7
Description	Standard Insulation with High Insulating Double Glazing	Standard Insulation with Triple Glazing and Insulating Coating	Passivhaus Insulation Levels with High Insulating Double Glazing	Passivhaus Insulation Levels with Triple Glazing and Insulating Coating	Maximum Passivhaus Insulation Levels with Triple Glazing and Insulating Coating	24" Rammed Earth Walls with Triple Glazing and Insulating Coating	Passivhaus Insulation Levels with Improved Roof Insulation and Triple Glazing and Insulating Coating
Envelope Standard	ASHRAE 2013	ASHRAE 2013	Passivhaus (Typical)	Passivhaus (Typical)	Passivhaus (Extreme)	N/A	N/A
Wall R-Value	R-20	R-20	R-38	R-38	R-71	R-36	R-36
Roof R-Value	R-31.25	R- 31.25	R-38	R-38	R-71	R-38	R-71
Ground Floor Slab R-Value	R-25	R-25	R-25	R-25	R-25	R-25	R-25
Interior Floor/Ceiling	8" Concrete Slab	8" Concrete Slab	8" Concrete Slab	8" Concrete Slab	8" Concrete Slab	8" Concrete Slab	8" Concrete Slab
Glazing	SNX51/23 (Air)	SNX 62/27 + IS 20 (Air)	SNX51/23 (Air)	SNX 62/27 + IS 20 (Air)	SNX 62/27 + IS 20 (Air)	SNX 62/27 + IS 20 (Air)	SNX 62/27 + IS 20 (Air)
Glazing U-Value	0.29	0.18	0.29	0.18	0.18	0.18	0.18
Glazing SHGC	0.22	0.23	0.22	0.23	0.23	0.23	0.23
Visual Transmittance	51%	54%	51%	54%	54%	54%	54%
Curtain Wall System	Kawneer's 7500 Wall	CTW's wood/aluminum system	Kawneer's 7500 Wall	CTW's wood/aluminum system	CTW's wood/aluminum system	CTW's wood/aluminum system	CTW's wood/aluminum system
% Frame	12%	12%	12%	12%	12%	12%	12%
Overall Assembly U-Value	0.37	0.24	0.37	0.24	0.24	0.24	0.24
Annual Energy Use	1,242,563 kBtu	1,180,369 kBtu	1,256,948 kBtu	1,159,567 kBtu	1,140,047 kBtu	1,151,903 kBtu	1,147,2560
EUI	20.8 kBtu/ft²	19.7 kBtu/ft²	20.4 kBtu/ft²	19.4 kBtu/ft²	19.1 kBtu/ft²	19.3 kBtu/ft²	19.2 kBtu/ft²
EUI By End Use							
Savings Vs. Option 1	N/A	5%	1.8%	6.7%	8.3%	7.3%	7.7%

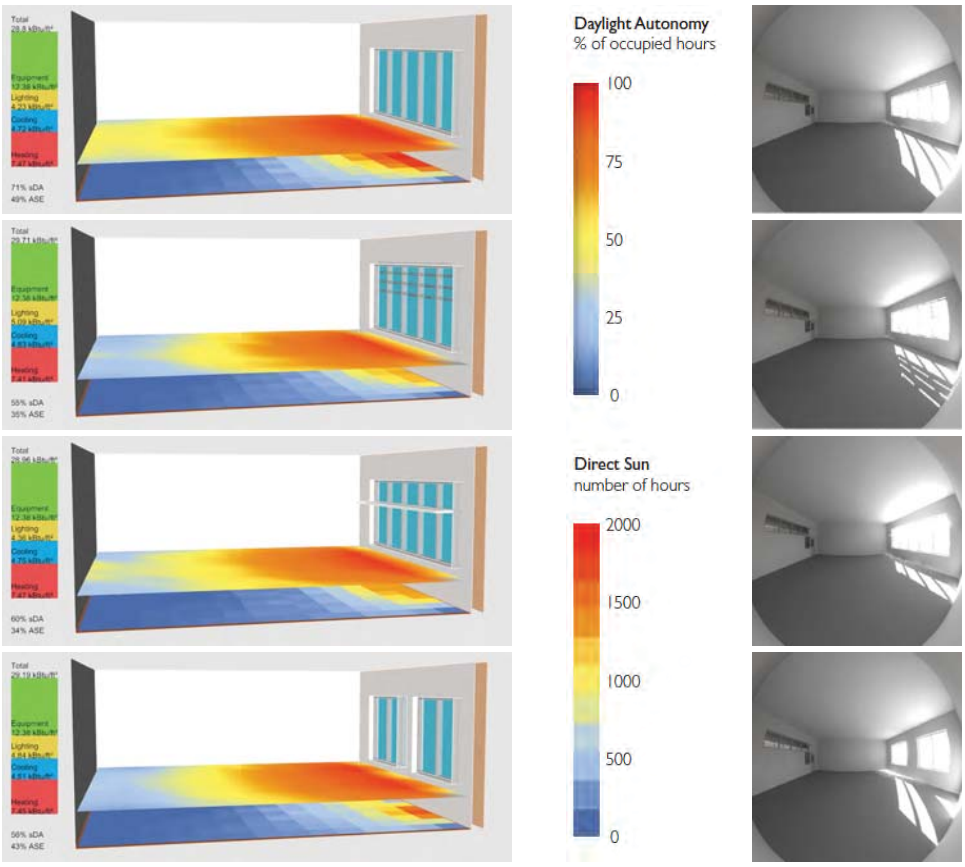

WINDOW HEIGHT
Window height above floor
16 ft
4.9 m
14 ft
4.3 m
12 ft
3.7 m
10 ft
3.0 m
Example
8 ft
2.4 m
Sufficient daylight for normal office tasks
Supplementary electric lighting required for normal office tasks
No daylighting contribution
10 ft
3.0 m
15 ft
4.6 m
20 ft
6.1 m
25 ft
7.6 m
30 ft
9.1 m
Horizontal distance to windows

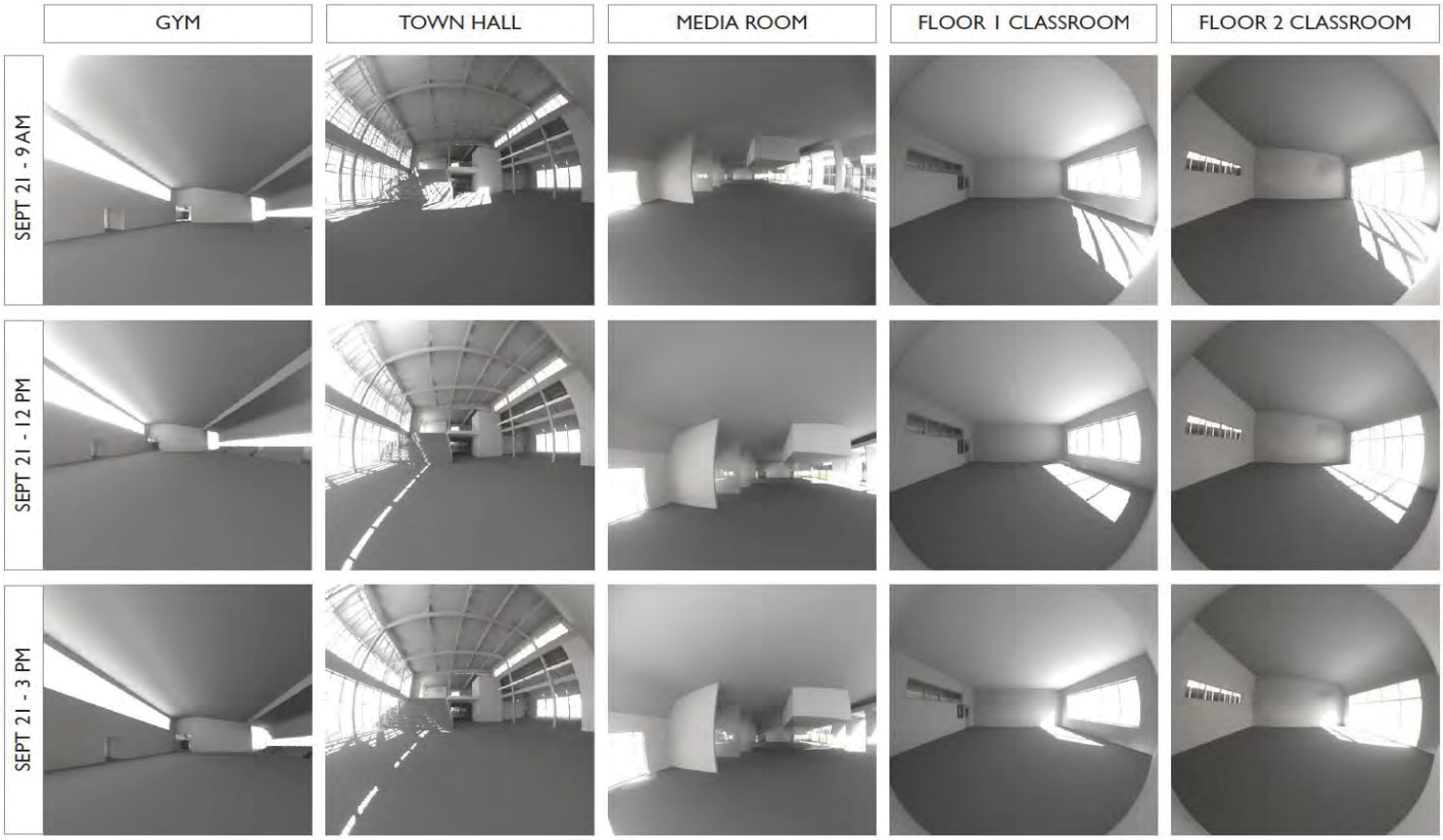

Light level
SIDELIGHTING
Modified light level
REDUCED WINDOW HEAD HEIGHT
LIGHT SHELF
EXTERIOR OVERHANG



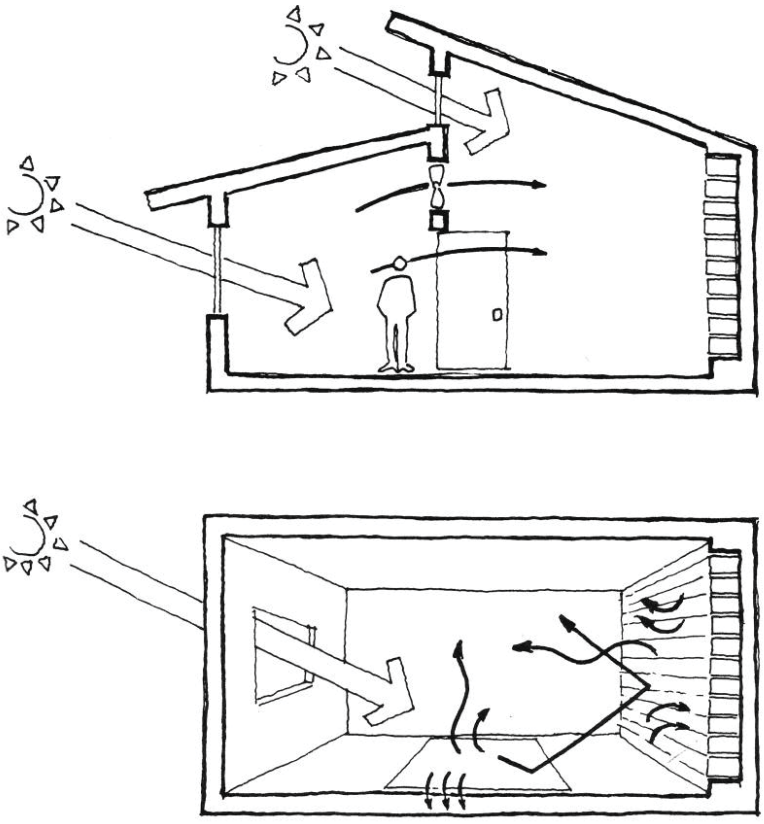
Integrated Architecture

daylight autonomy analysis

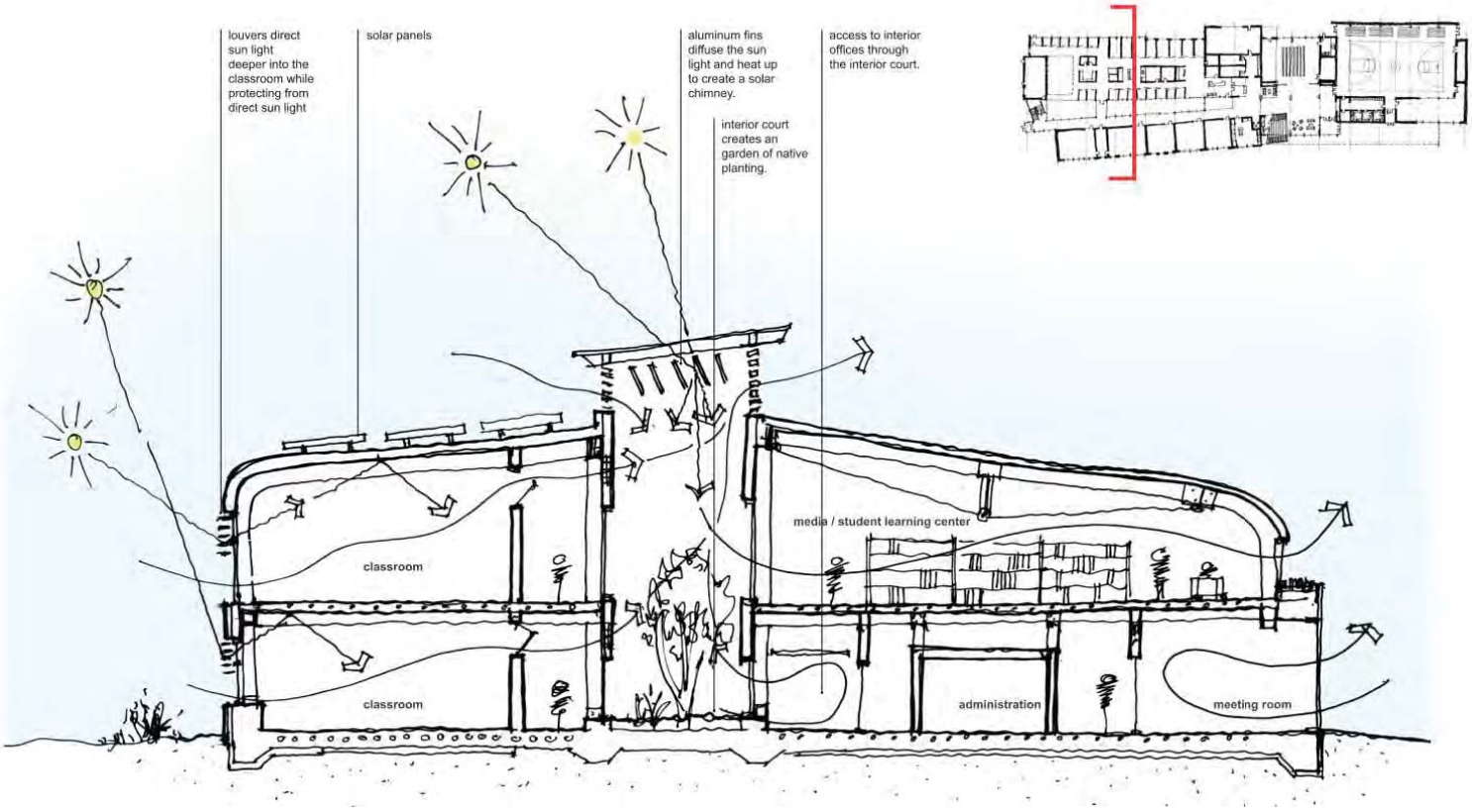

Daylight Autonomy
% of occupied hours
100
75
50
25
0
Direct Sun
number of hours
2000
1500
1000
500
0



daylight spacial study



passive solar and thermal storage study



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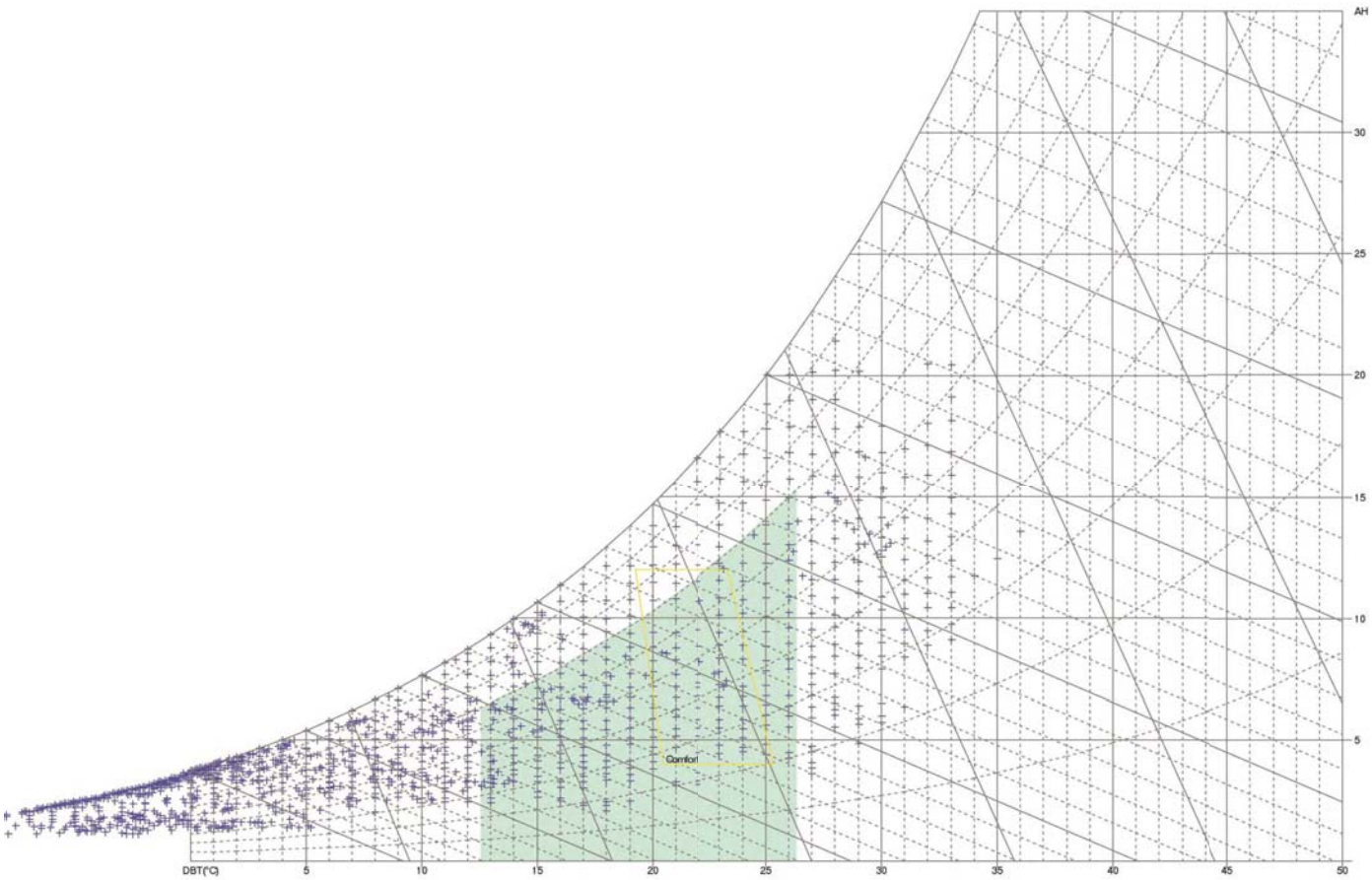
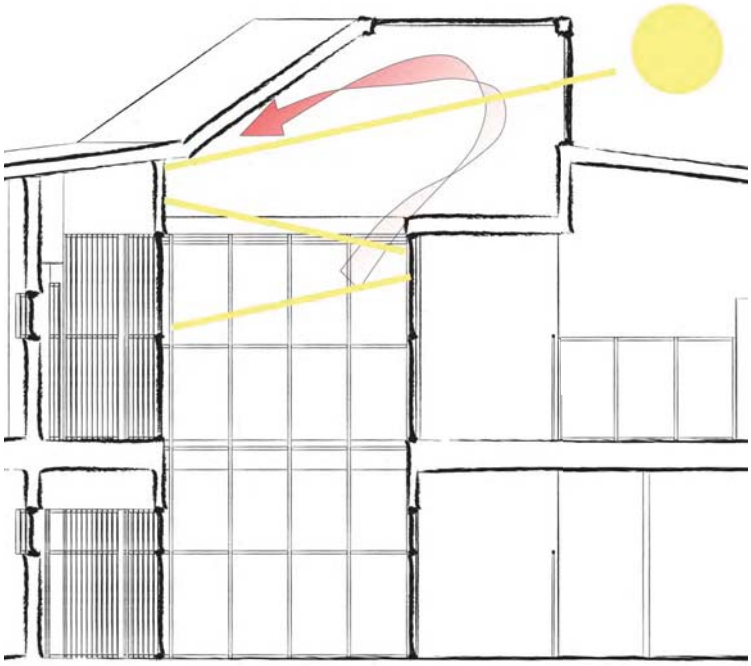
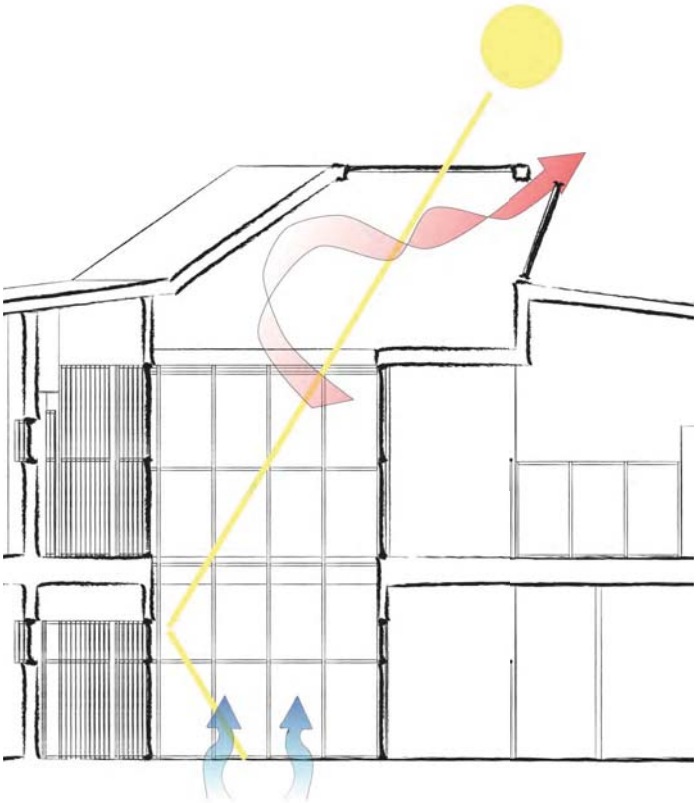
natural ventilation study

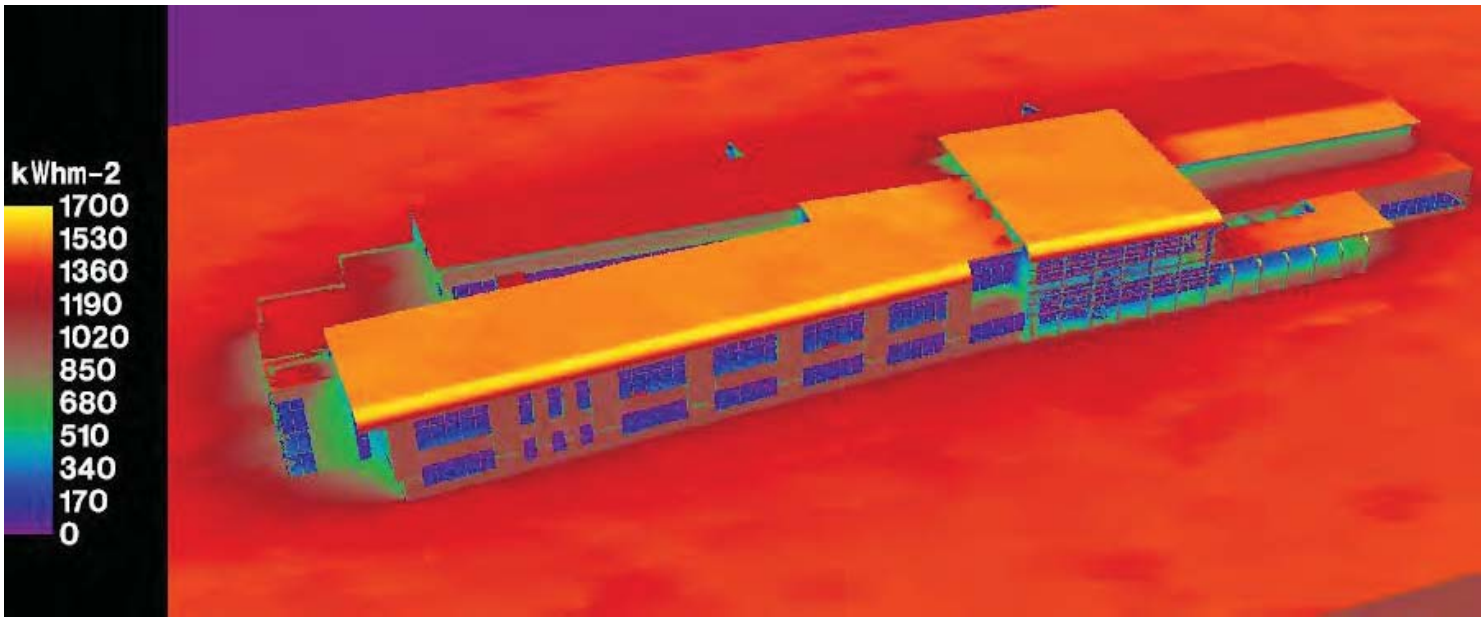


Integrated Architecture

natural ventilation feasibility

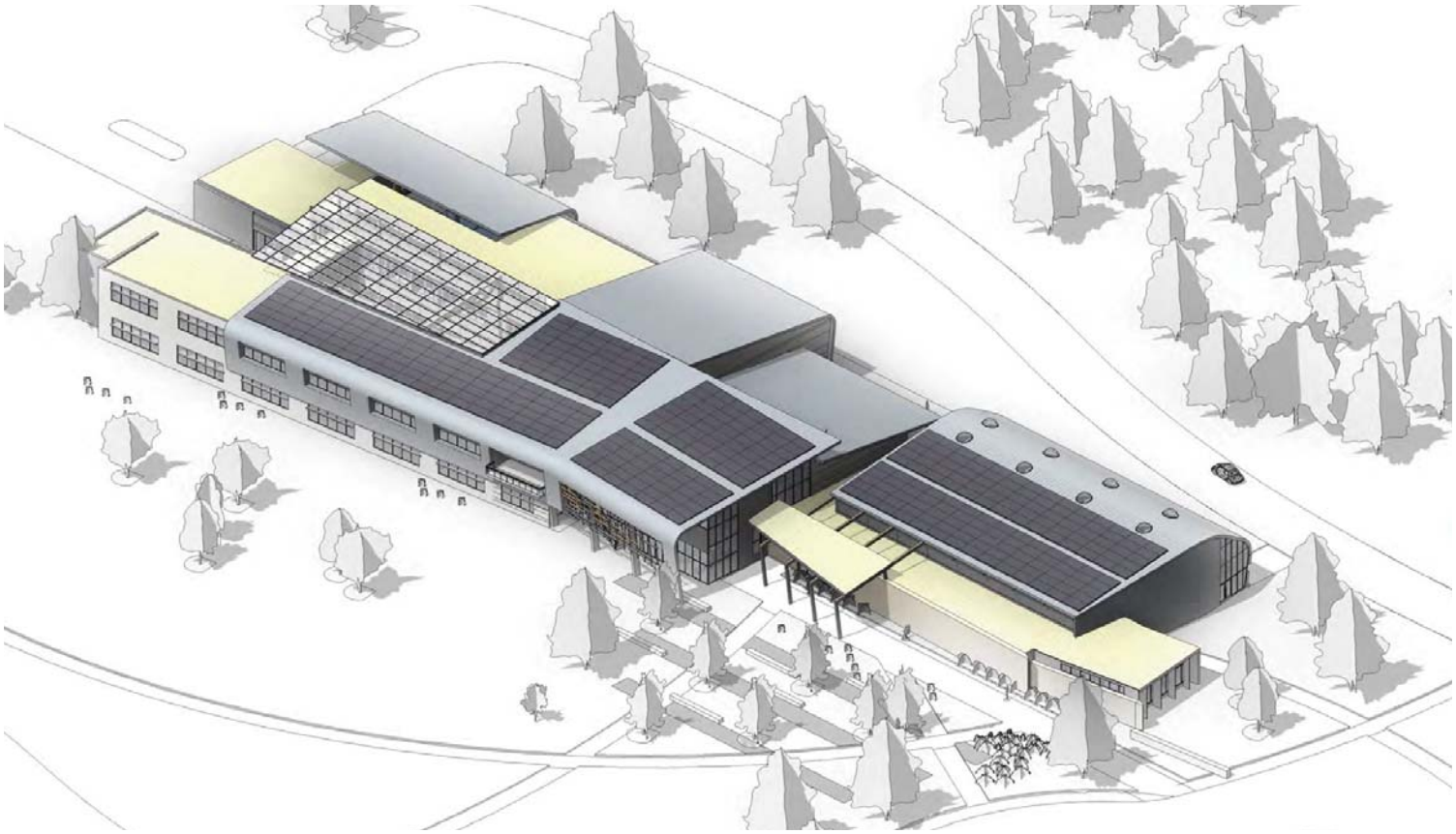


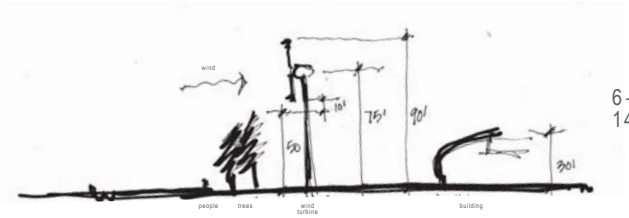




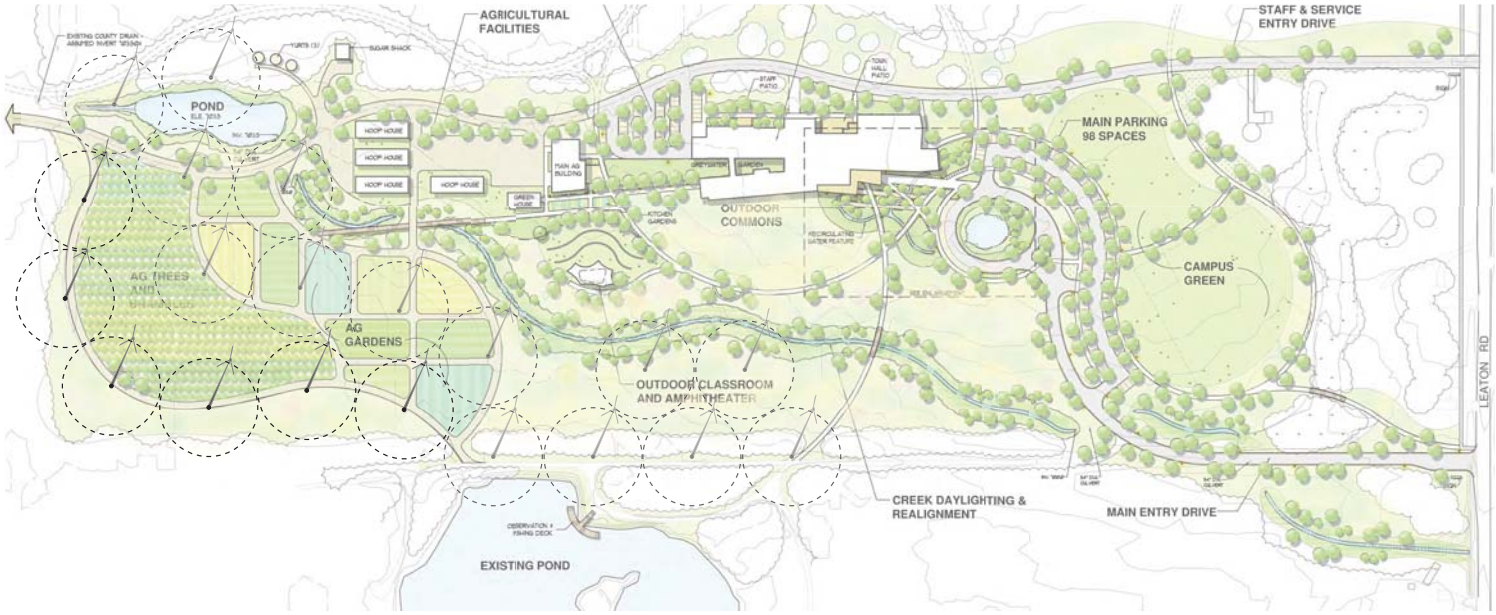
Integrated Architecture

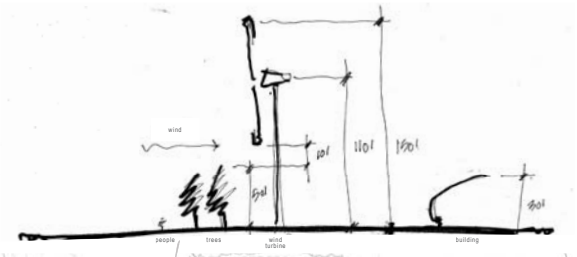
annual solar radiation study



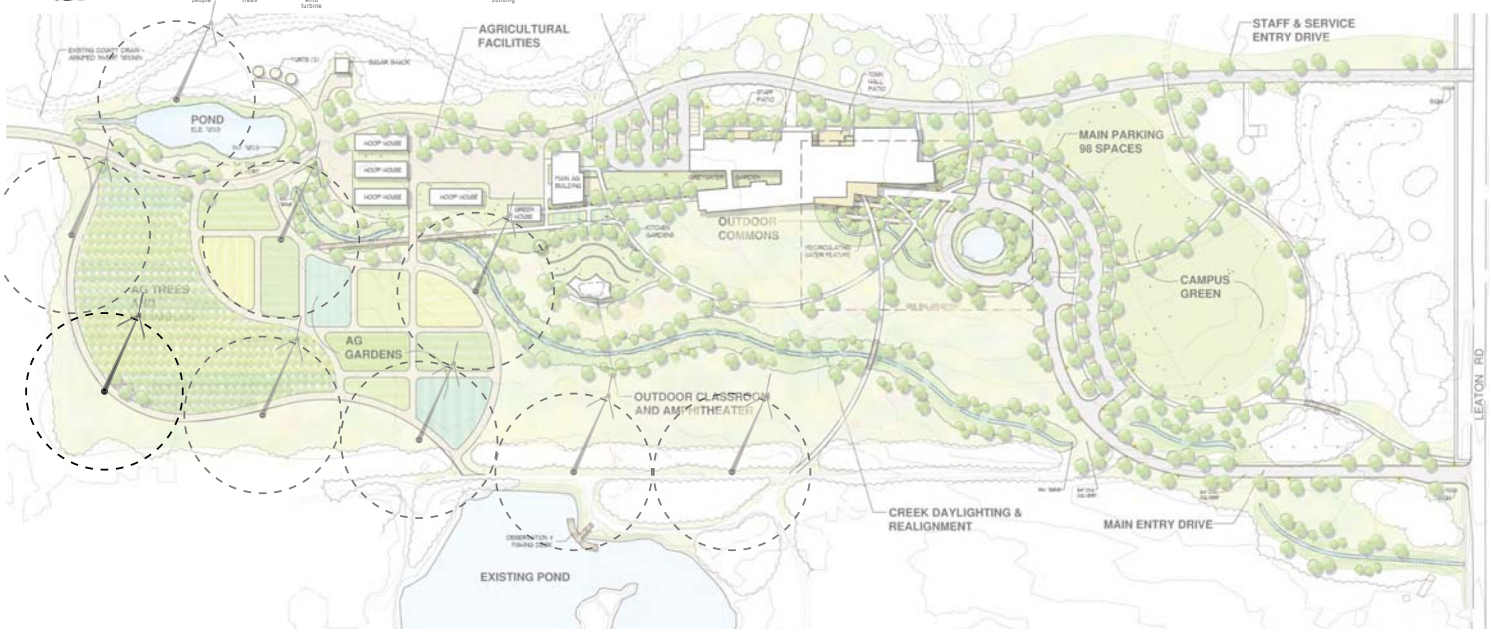


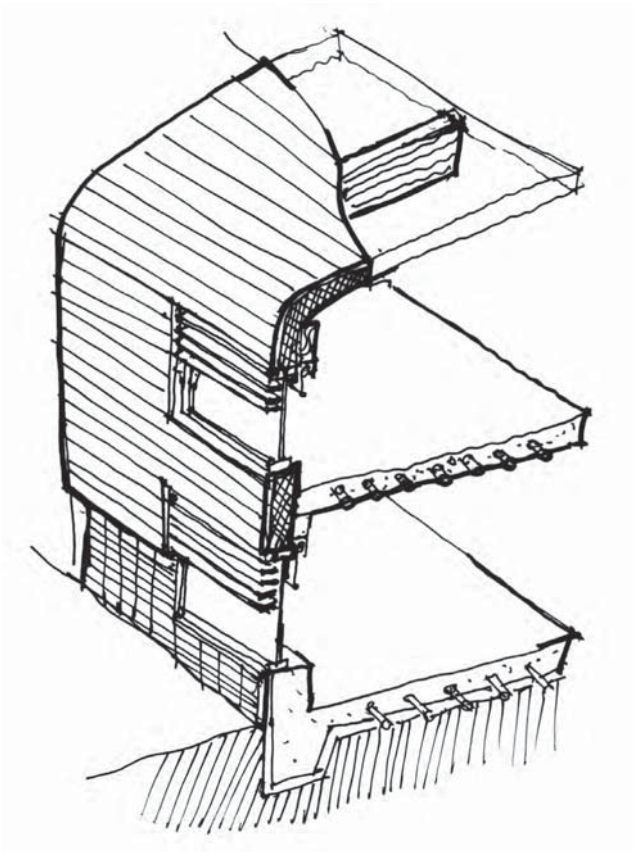
6—10kw unit x $48,000 = $288,000 = 74,750 kWh / year
14—future units x $48,000 = $672,000 = 174,416 kWh / year = **$3.85 / kWh**

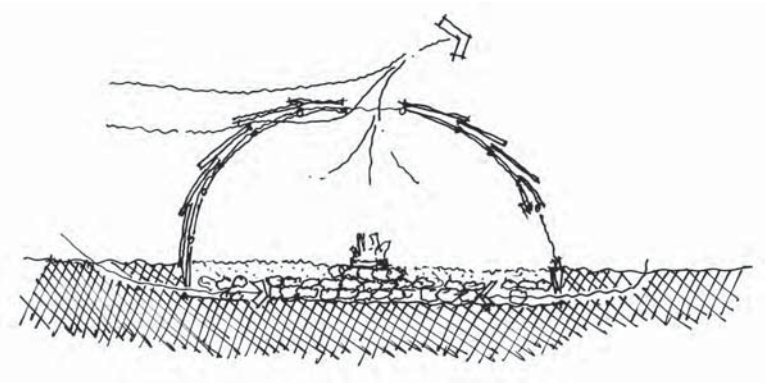


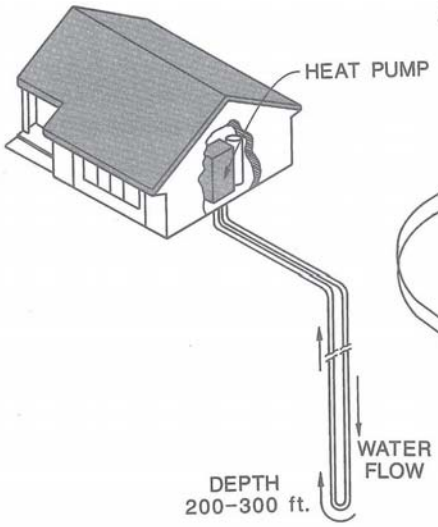


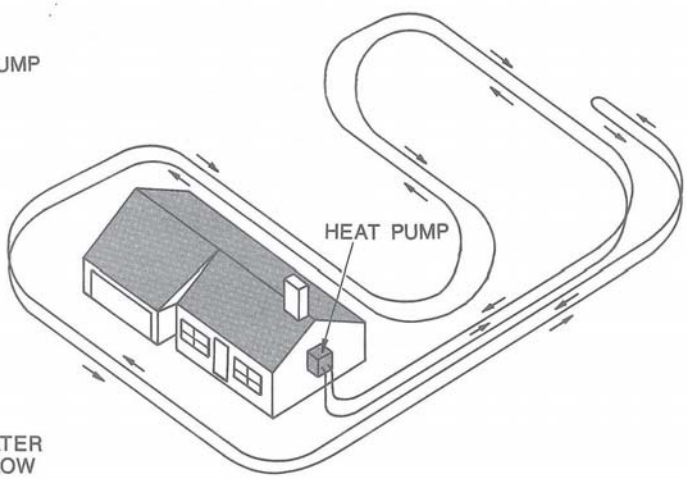
1—240kw unit x $470,000 = $470,000 = 443,907 kWh / year
8—future units x $470,000 = $3,760,000 = 3,551,256 kWh / year = **$1.05 / kWh**

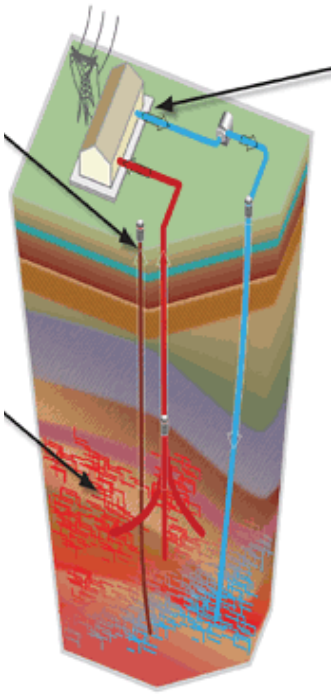






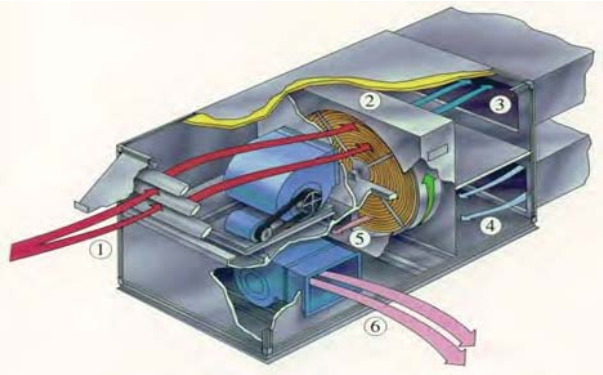






Integrated Architecture

geothermal heat pump diagram

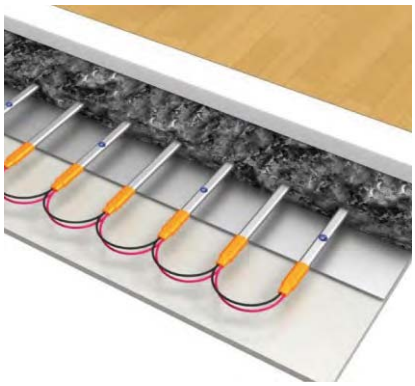


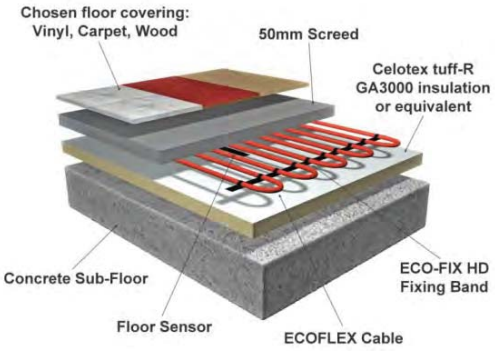
dedicated outdoor air handling unit

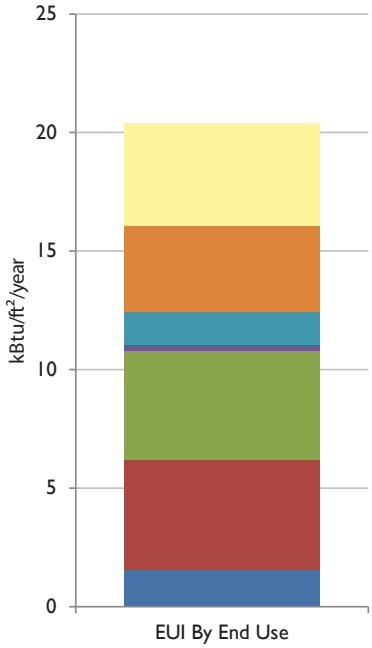
enthalpy wheel

UFAD air distribution w/ buried ducts

viega

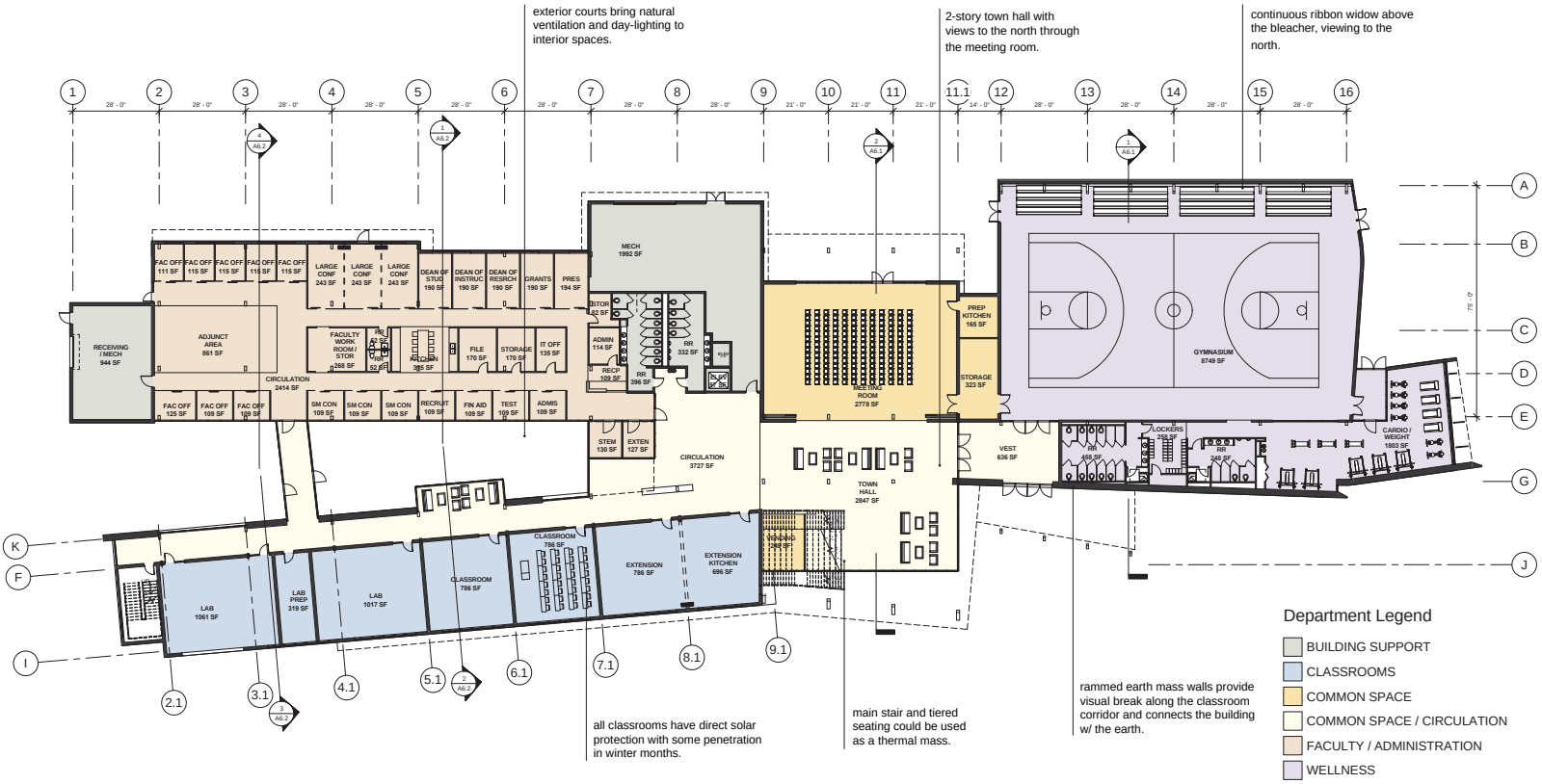



Chosen floor covering:
Vinyl, Carpet, Wood
50mm Screed
Celotex tuff-R
GA3000 insulation
or equivalent
Concrete Sub-Floor
ECO-FIX HD
Fixing Band
Floor Sensor
ECOFLEX Cable

Annual Energy Use	1,294,315
EUI	20.4 kBtu/ft^2
EUI By End Use Lighting Heat Rejection Fans Pumps Equipment Space Heating Space Cooling	

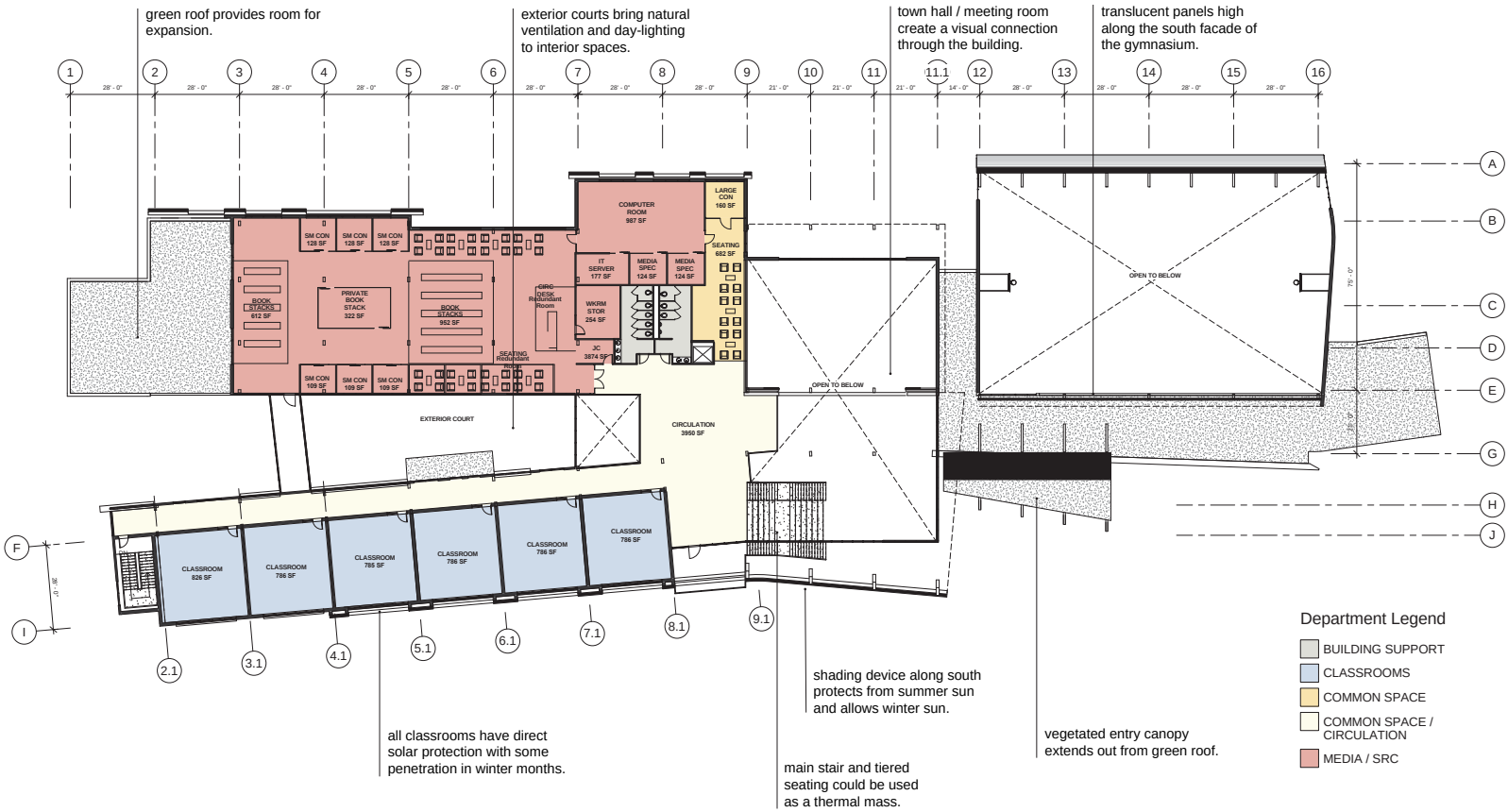
AGENDA :

- ✓ introductions
- ✓ process
- ✓ net positive water
- ✓ net positive energy
- ○ wrap up



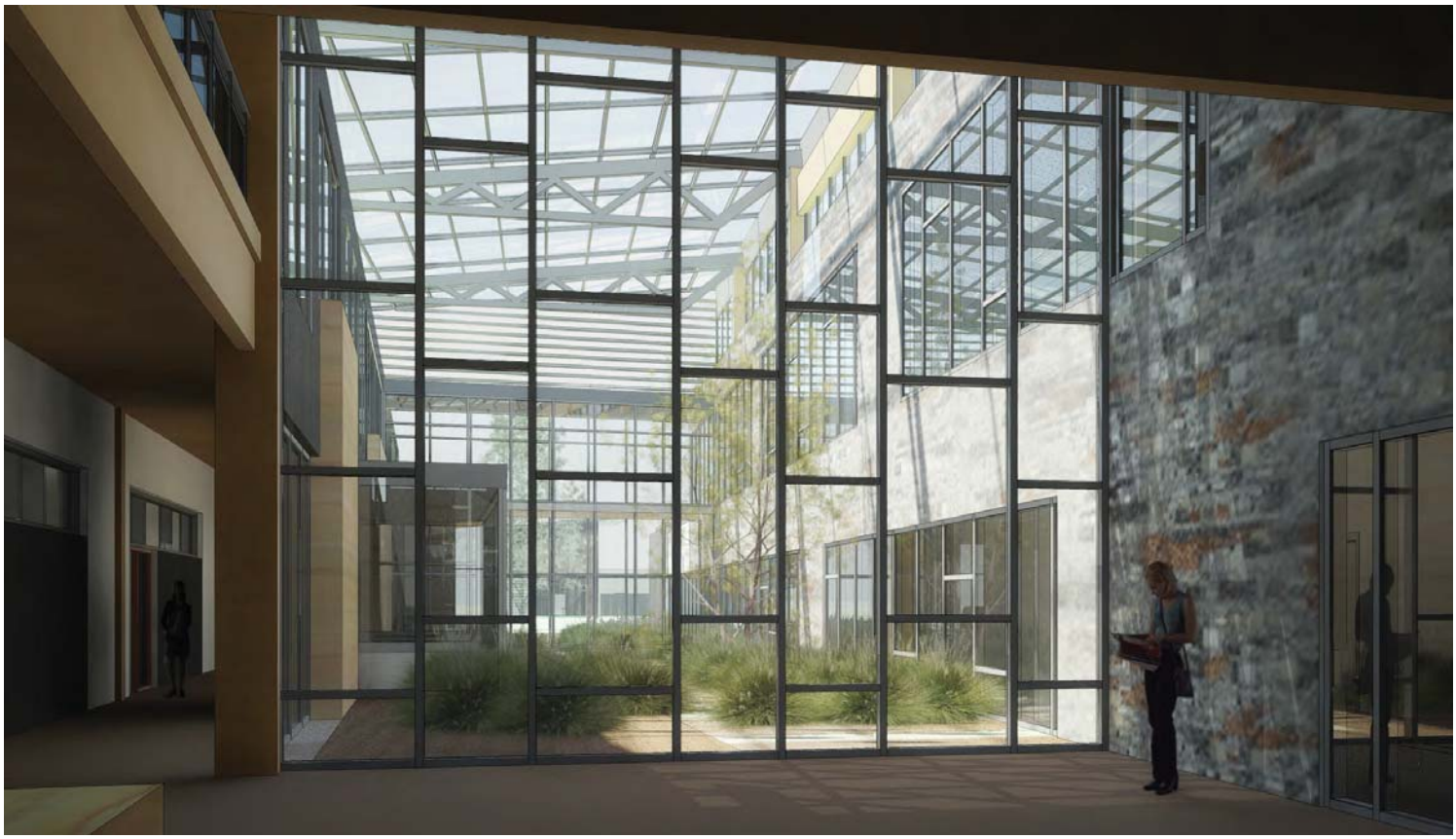
Integrated Architecture

wrap-up | solution



Integrated Architecture

wrap-up | solution



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