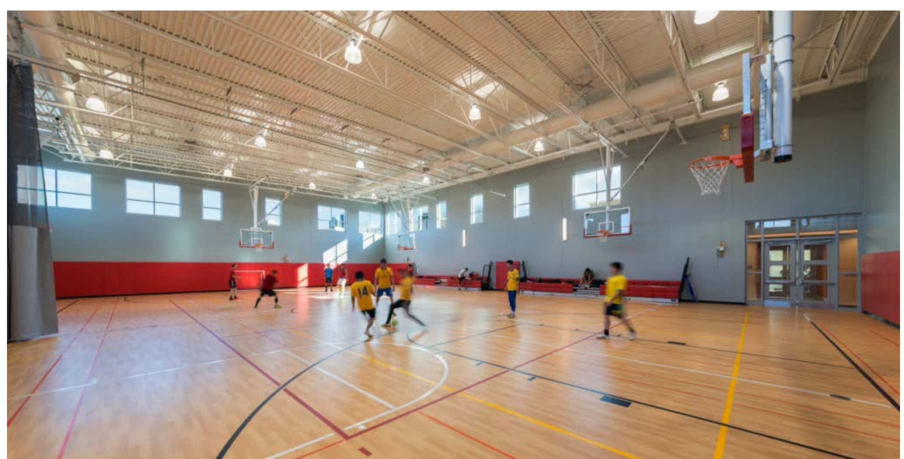

Public Building Commission of Chicago

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Creating Extraordinary Results Through Integrative Design

PUBLIC BUILDING COMMISSION

Acknowledgements/Credits

Chicago Public Schools

Principal Marti

Public Building Commission of Chicago

Additional members of the team:

- Jacobs/Ryan – landscape architect
- Terra Engineering – civil engineer
- F.H.Paschen/S.N.Nielsen - contractor

Introduction

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October 1, 2014

- **Sachin Anand,**
  PE, LEED AP BD+C, Principal, dbHMS

Deeta Bernstein,
LEED AP BD+C, Sustainability Manager, Public Building Commission of Chicago

- **Jennifer Costanzo,**
  AIA, LEED AP, Principal, STR Partners, LLC

- **Helen J. Kessler,**
  FAIA, LEED Fellow, President, HJKessler Associates

Course Objectives

- Encourage collaborative thinking beyond expectations. Develop new mindset.
- Leverage integrated design to reduce first cost while improving ongoing efficiency.
- Implement an integrative design process in context of a prototype based design process
- Show how synergies between architectural, mechanical, lighting and site design can improve environmental performance

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Course Agenda

1. Integrative Design Process
2. Public Building Commission Program
3. Audience mini-charrette
4. Sarah E. Goode STEM Academy
5. Comparison with similar building
6. Conclusions
7. Audience discussion

Preliminary Questions

- *How many of you are Architects? Engineers? Landscape Architects? Owners?*
- *How many of you have experience with integrative design process? Yes/No*
- *How many have felt that integrative design process led to better outcomes?*
- *How many felt it was easy? Hard?*
- *Paired share on experiences, or what you hope to learn in this session*

Characteristics of an Integrative Design Process

Everybody Engaging Every Issue Early

- Intentional process
- Discover interrelationships and synergies
- More and earlier analysis than typical practice
- Question conventional assumptions
- Iterative analysis
- Everyone working together

Stepping Stones to Integrative Design

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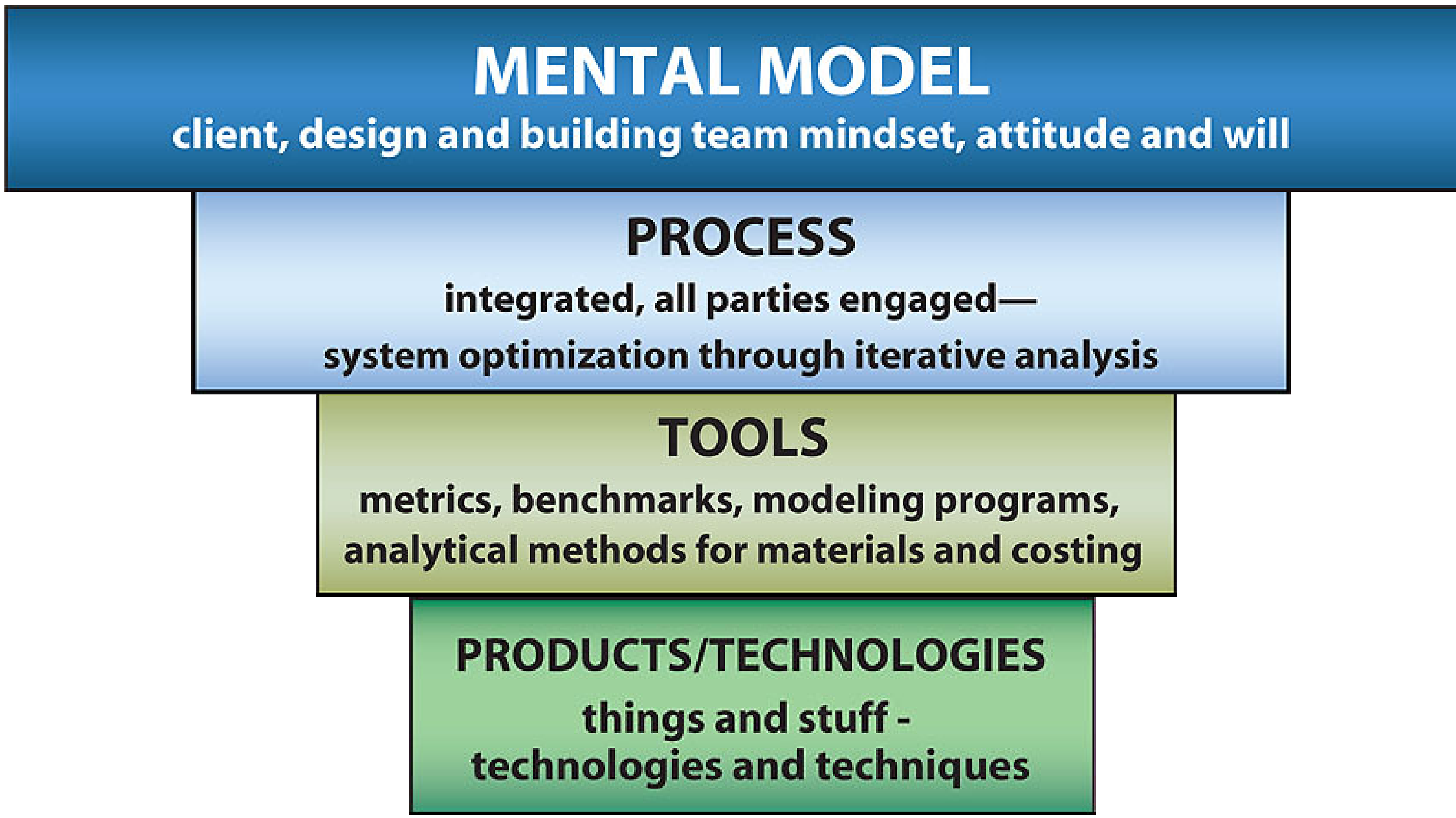


Concept by Bill Reed and Barbra Batshalom

Shifting the Way We Think

From a linear process to

an interactive process to

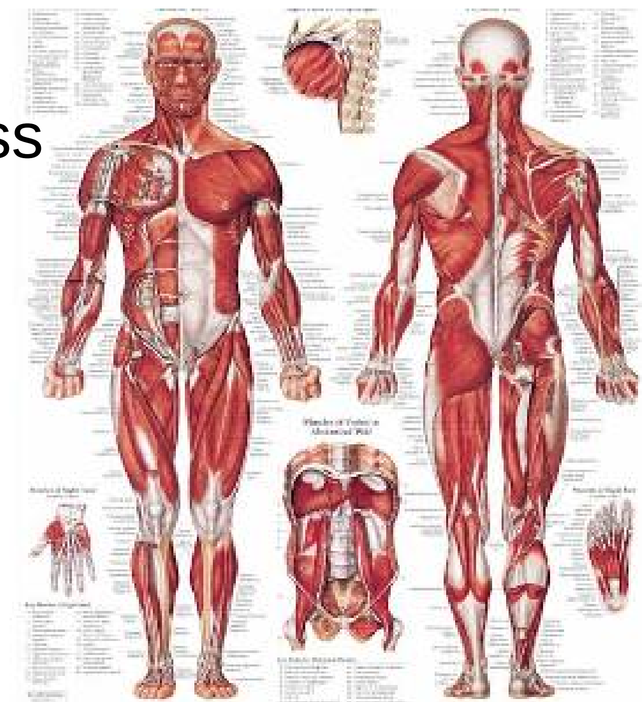
an interdisciplinary process to

a whole systems process

Building as an Organism

Systems Integration:

- Understand relationships among systems
- Not a set of component parts (Optimization in isolation)
- Holistic, non-linear process
- Downsize or eliminate systems



A Whole Systems Integrative Process

Tunneling through the cost barriers - Optimize the system, not the parts

How?

- Take advantage of systems interactions
- Eliminate silos
- Use modeling/analysis tools

Goal –

Improve performance at lower first cost

Diminishing Returns

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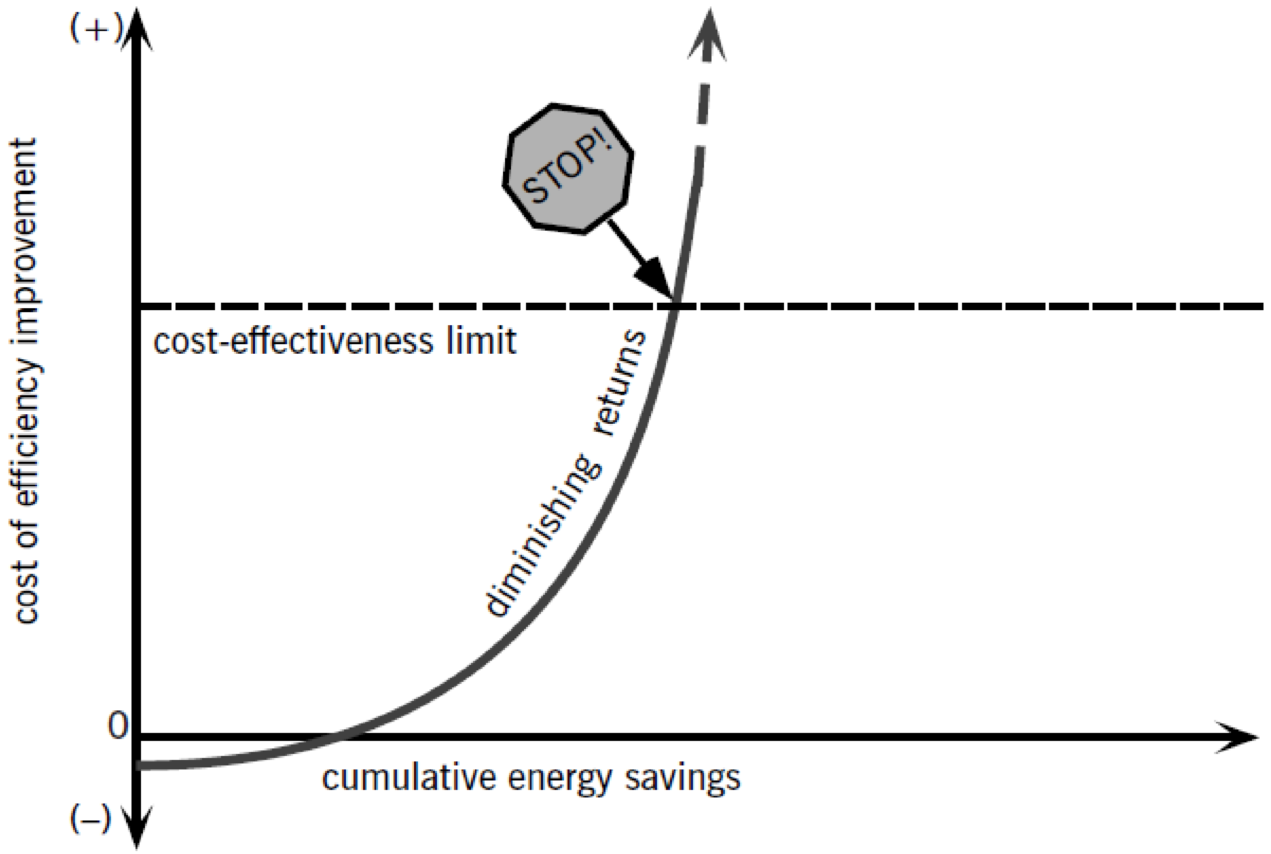

From Natural Capitalism by Lovins, Lovins and Hawken, 1999, Chapter 6

Tunneling Through the Cost Barrier

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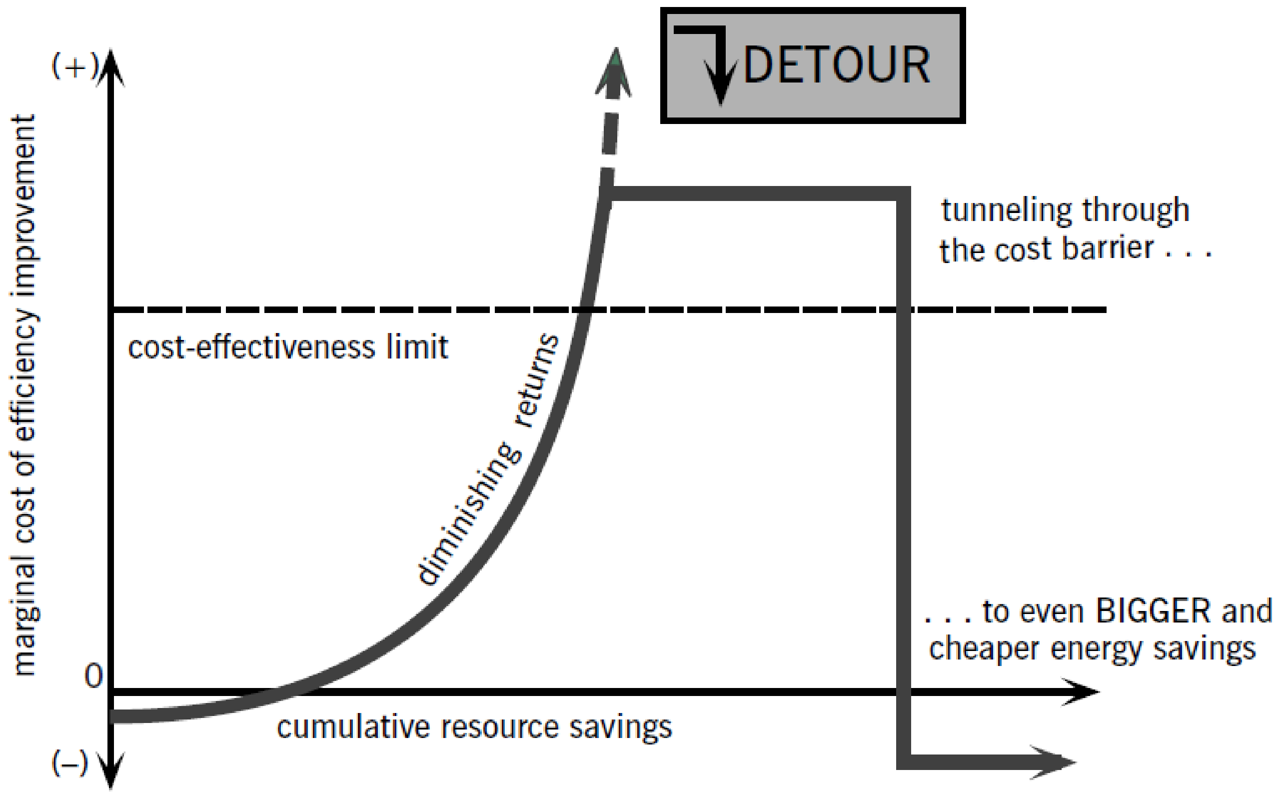

From Natural Capitalism by Lovins, Lovins and Hawken, 1999, Chapter 6

Integrative Design Process

- Start with an Initial Charrette, but don't stop there
- Ongoing Team Meetings, Discussions, Research throughout design process
  - Iterative, makes use of tools, such as energy and lighting models
  - Interdisciplinary
  - Considers Whole systems – the project and systems within larger context

The Program

The Public Building Commission of Chicago

Mission

The Public Building Commission of Chicago (PBC) is committed to client service and strong stewardship of public resources. The PBC plans, designs and builds facilities that reflect the highest standards of environmental and economic sustainability.

Vision

A built environment in which function, beauty and sustainability are inherent to every community; where physical surroundings inspire and support achievement of the individual goals of those who live, work and visit Chicago and Cook County; and, where people gather to share the common values that truly build our communities.

Daley Center, PBC Offices

The Program

- PBC manages a multi-year capital program - Over $2.6B in development authority
- >4 Million SF of development
- Over100+ total projects
- 84 LEED-eligible (66 Certified to date):
  - Public Schools
  - Municipal – Firehouses/Police Stations/ Libraries
  - Parks/Field Houses/Harbors
  - Other Projects

Context

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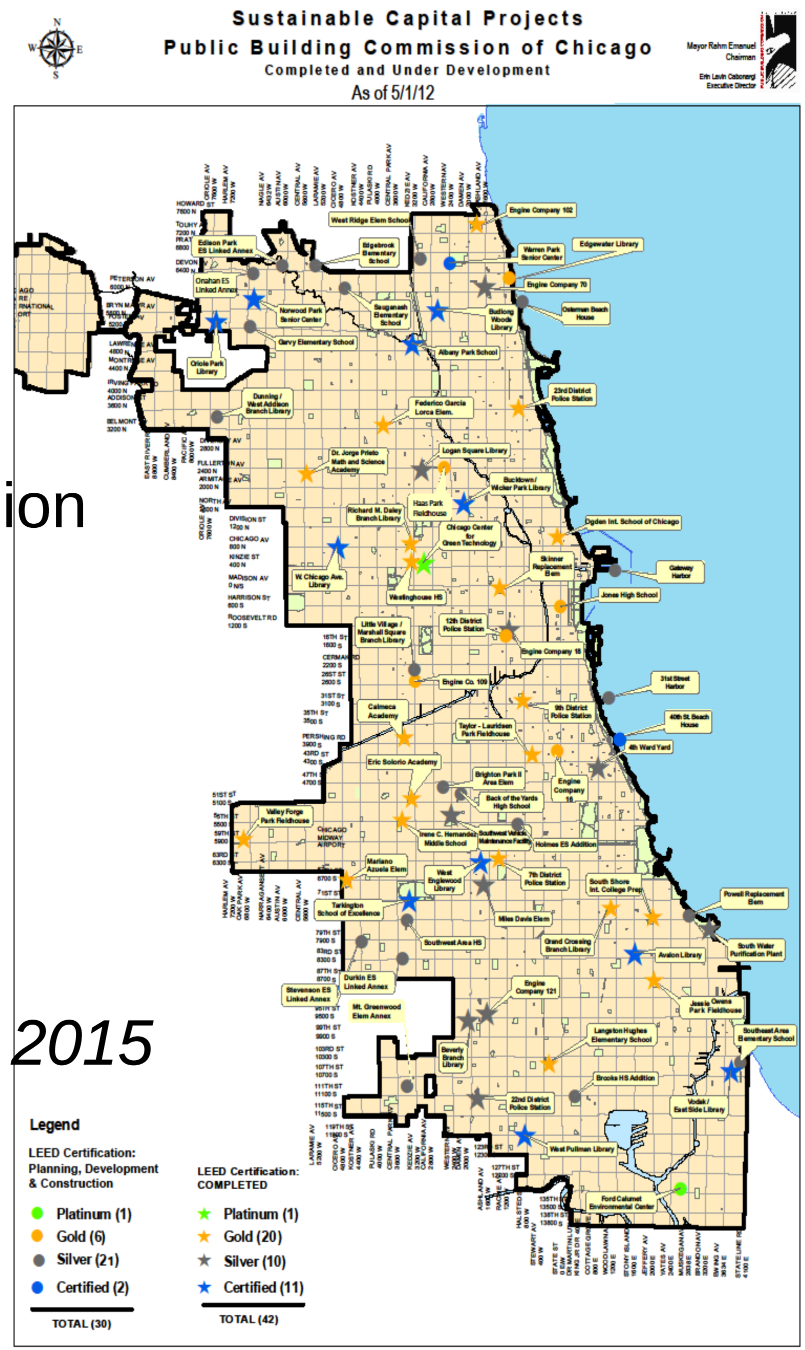
Public Building Commission of Chicago

Chicago Public Schools

City of Chicago

- ✓ Aligned Goals
- ✓ Shared Commitment
- ✓ *Sustainable Chicago 2015*



Aligned Goals

From Green Medians to Sustainable Chicago 2015

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Aligned Goals

Program-wide: Make “green” routine

Excellent student experience / learning environment

Use LEED to help meet goals

The Evolving Prototype

- Chicago Public Schools Urban Model High School program – prototype design
- Minimum LEED Silver certification (LEED for Schools)
- Constraints – Design Standards

The Evolving Prototype

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Concept Transfer Package

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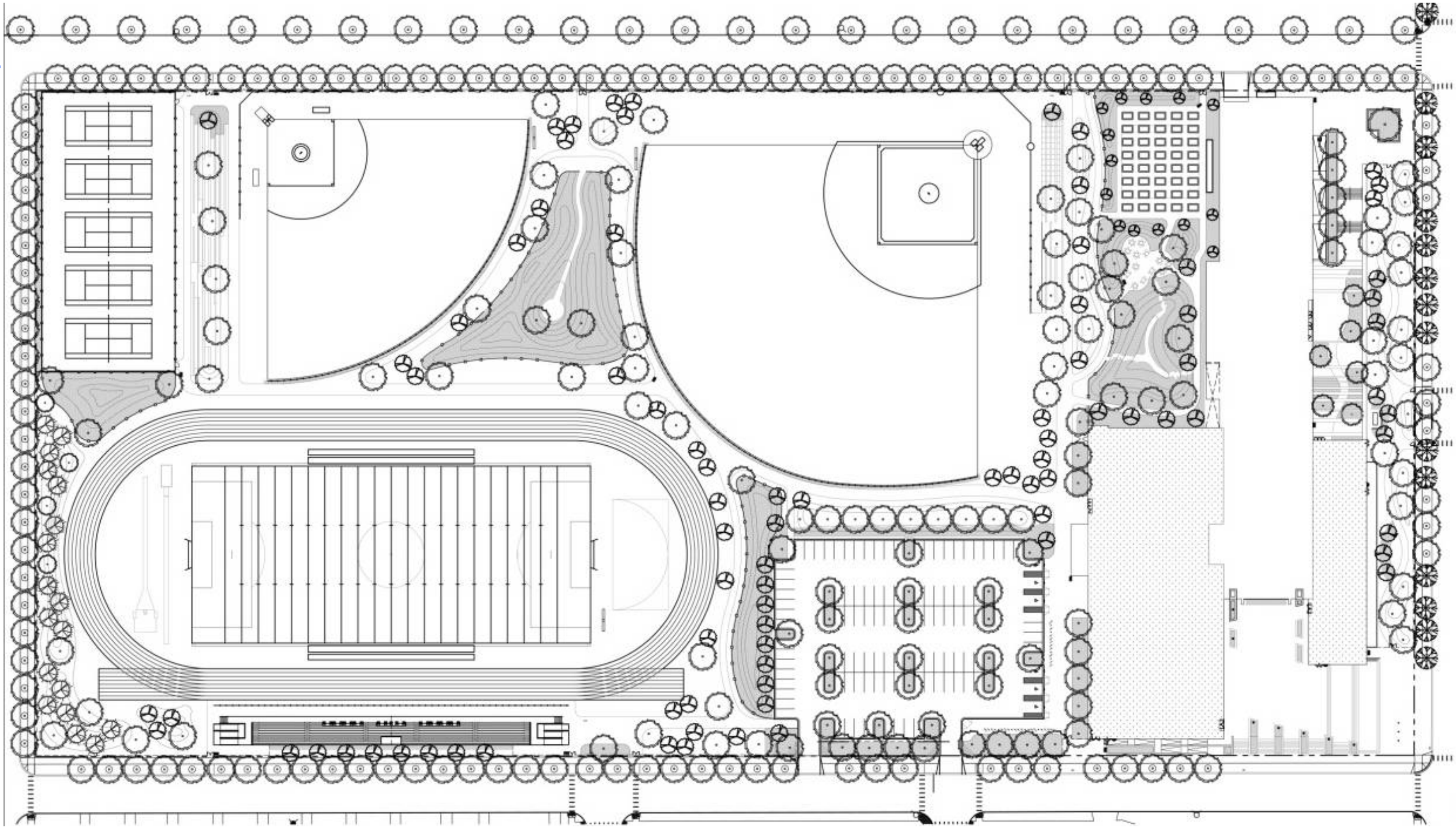

Concept Transfer Package

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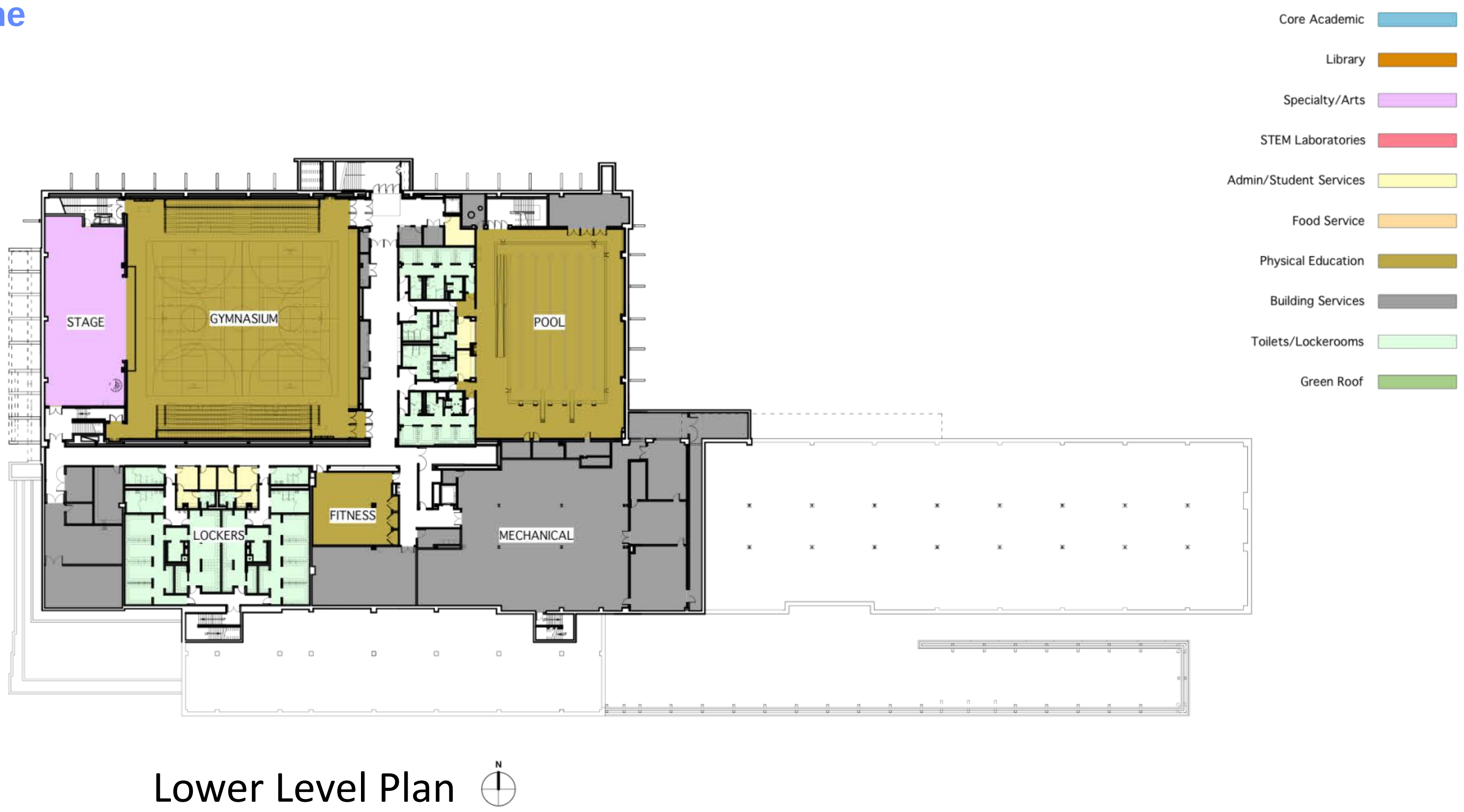

Lower Level Plan

Concept Transfer Package

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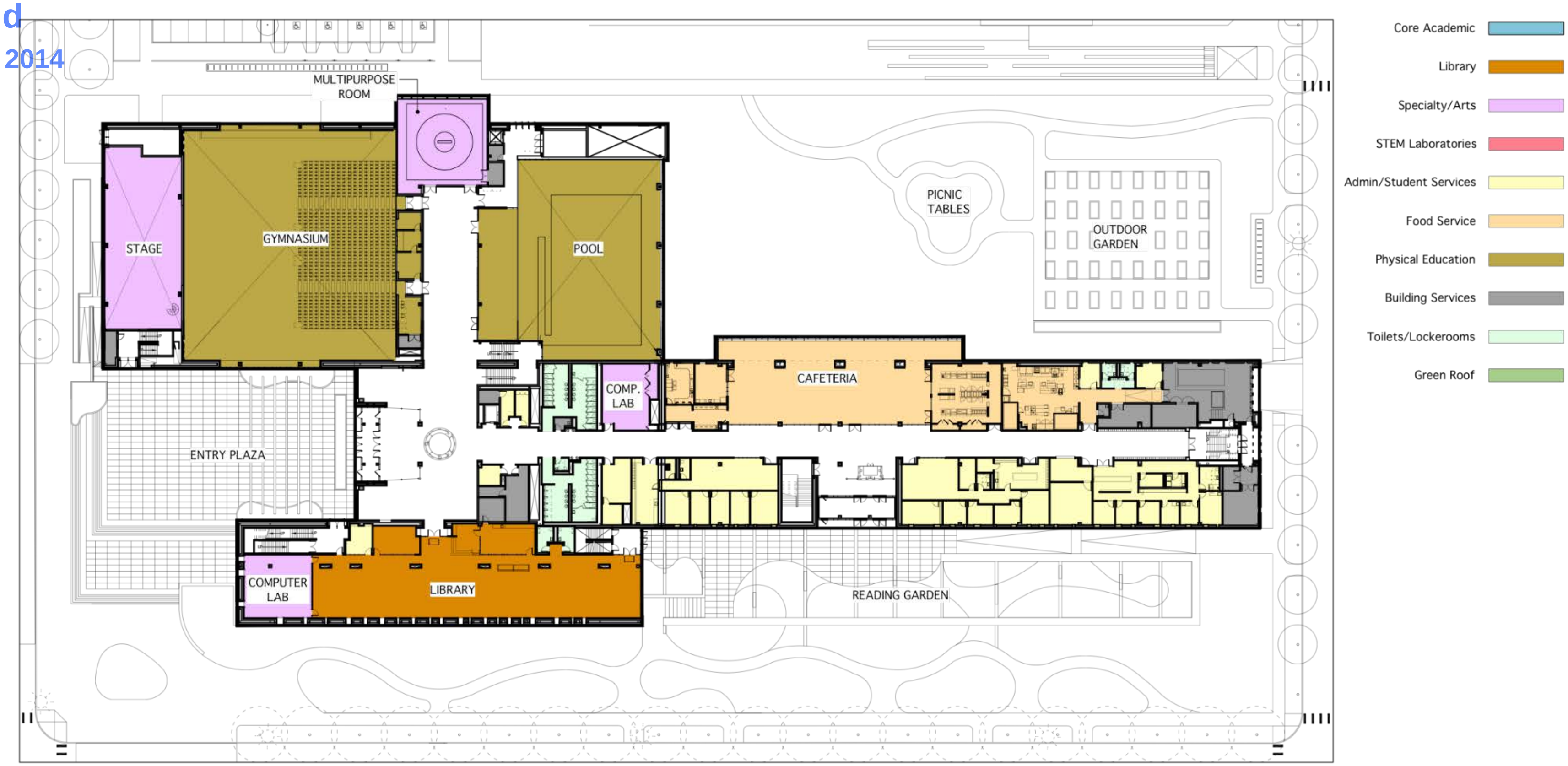

Main Level Plan

Concept Transfer Package

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Second Floor Plan

Concept Transfer Package

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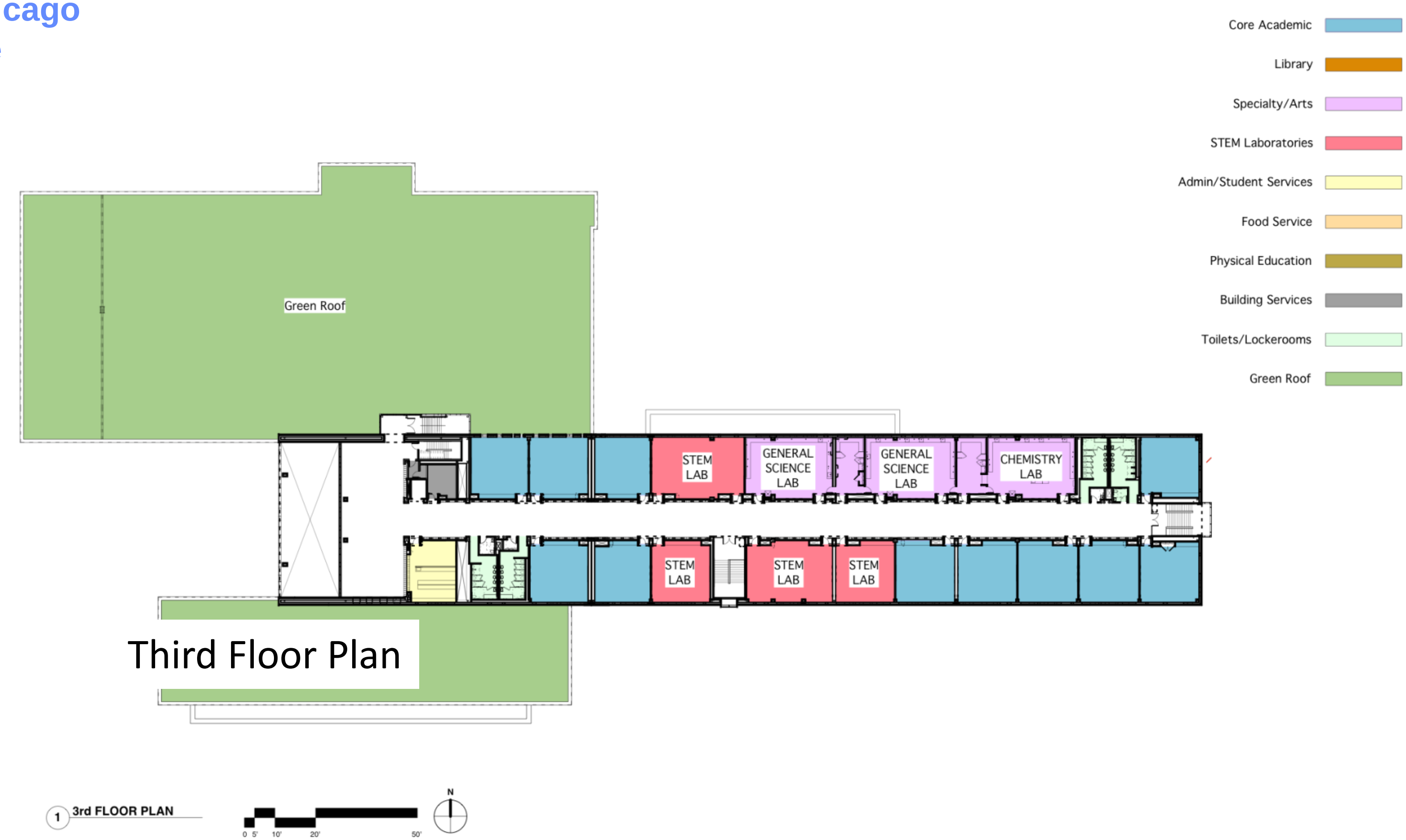

Concept Transfer Package

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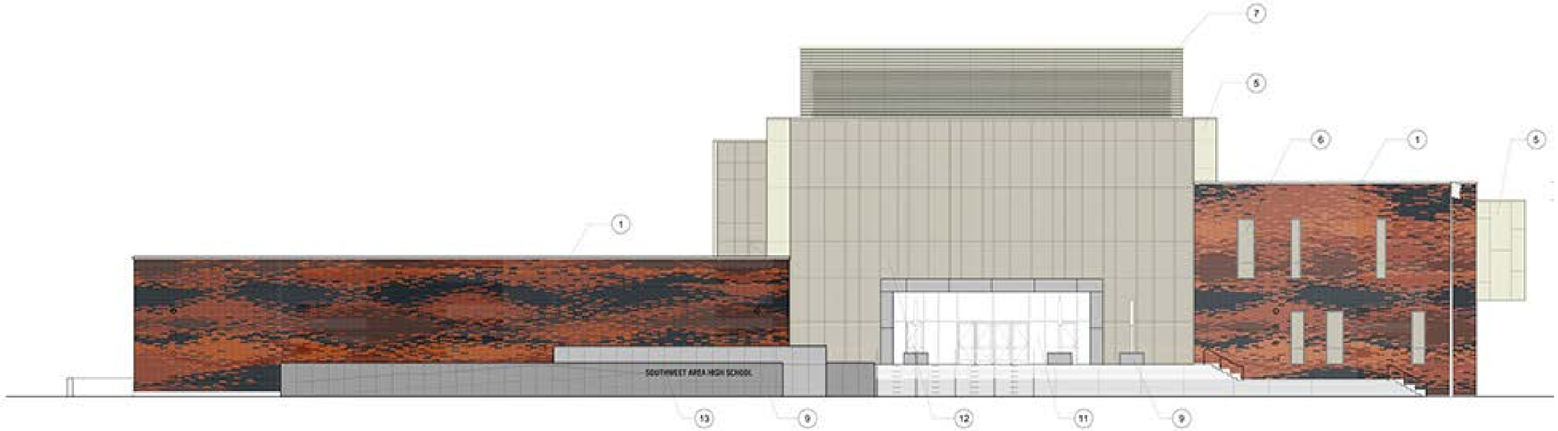

West Elevation

East Elevation

Concept Transfer Package

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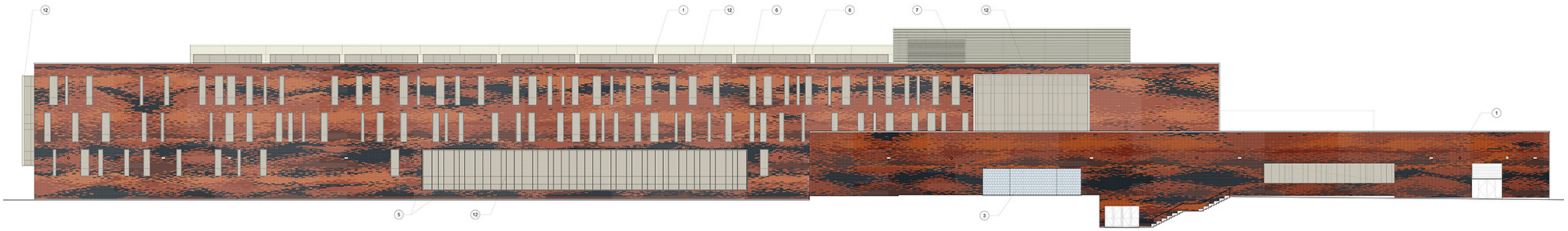
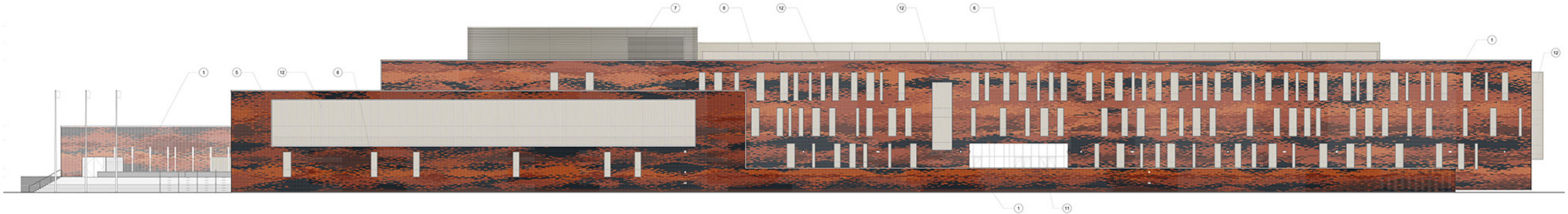
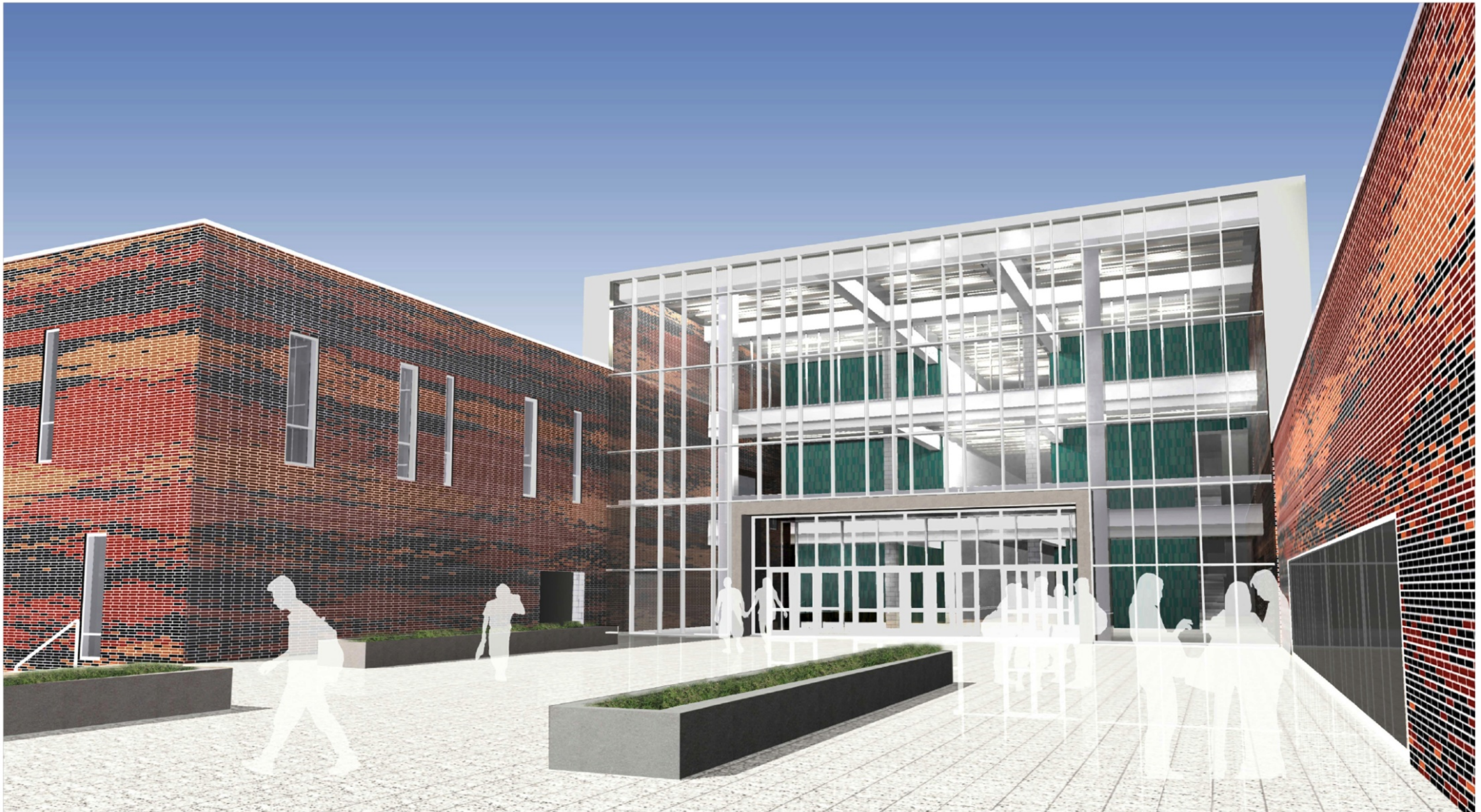


North Elevation



South Elevation

Concept Transfer Package



Sustainable Design / LEED Charrette

Purpose of Initial Sustainable Design/LEED Charrette

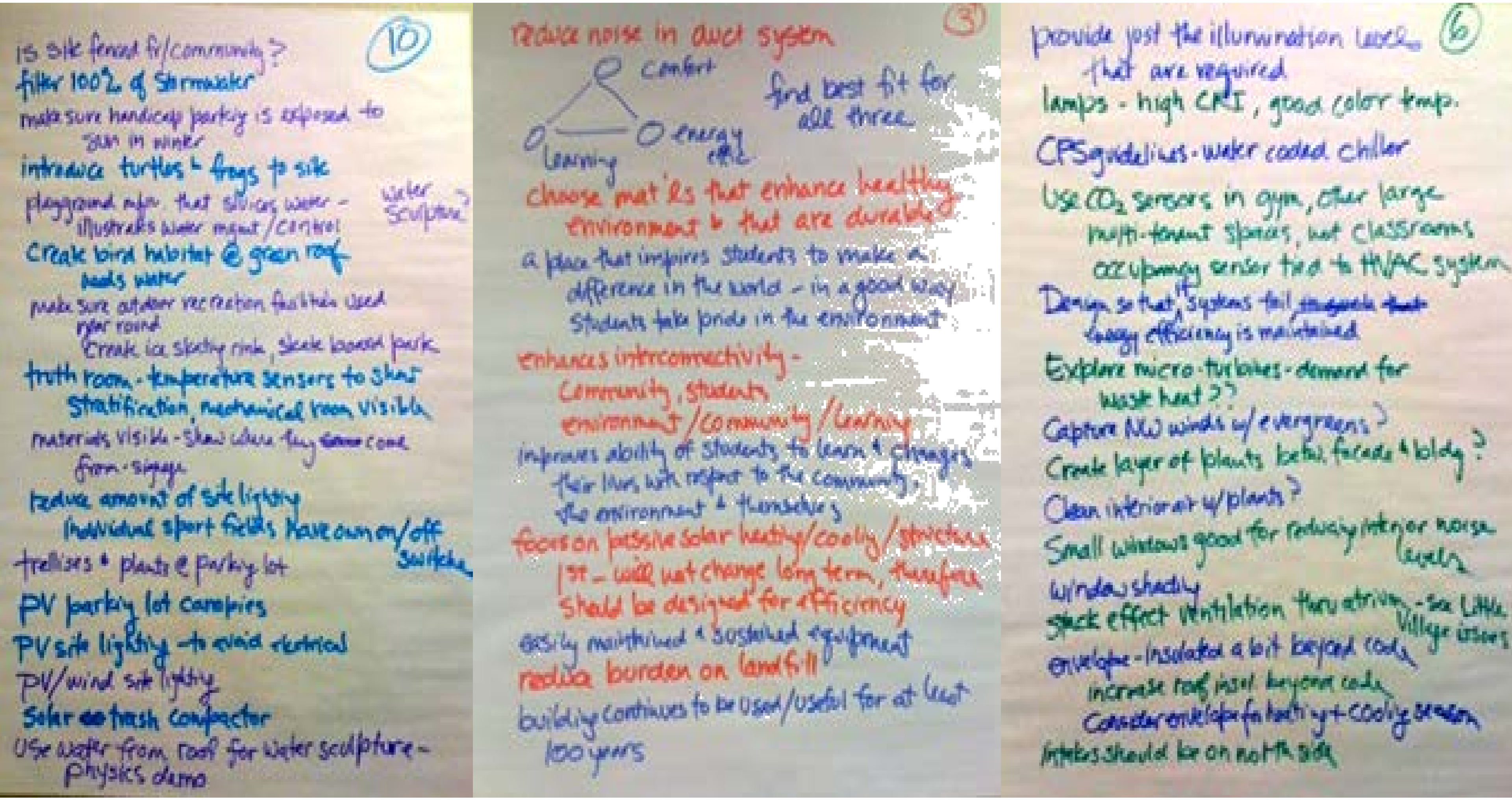
- Understand what Sustainability means to stakeholders.
- Explore sustainable design goals, opportunities, interacting relationships.
- Identify further research.
- Develop LEED Checklist – Target points (Don’t start here!!)

Charrette – Initial Discussion Points

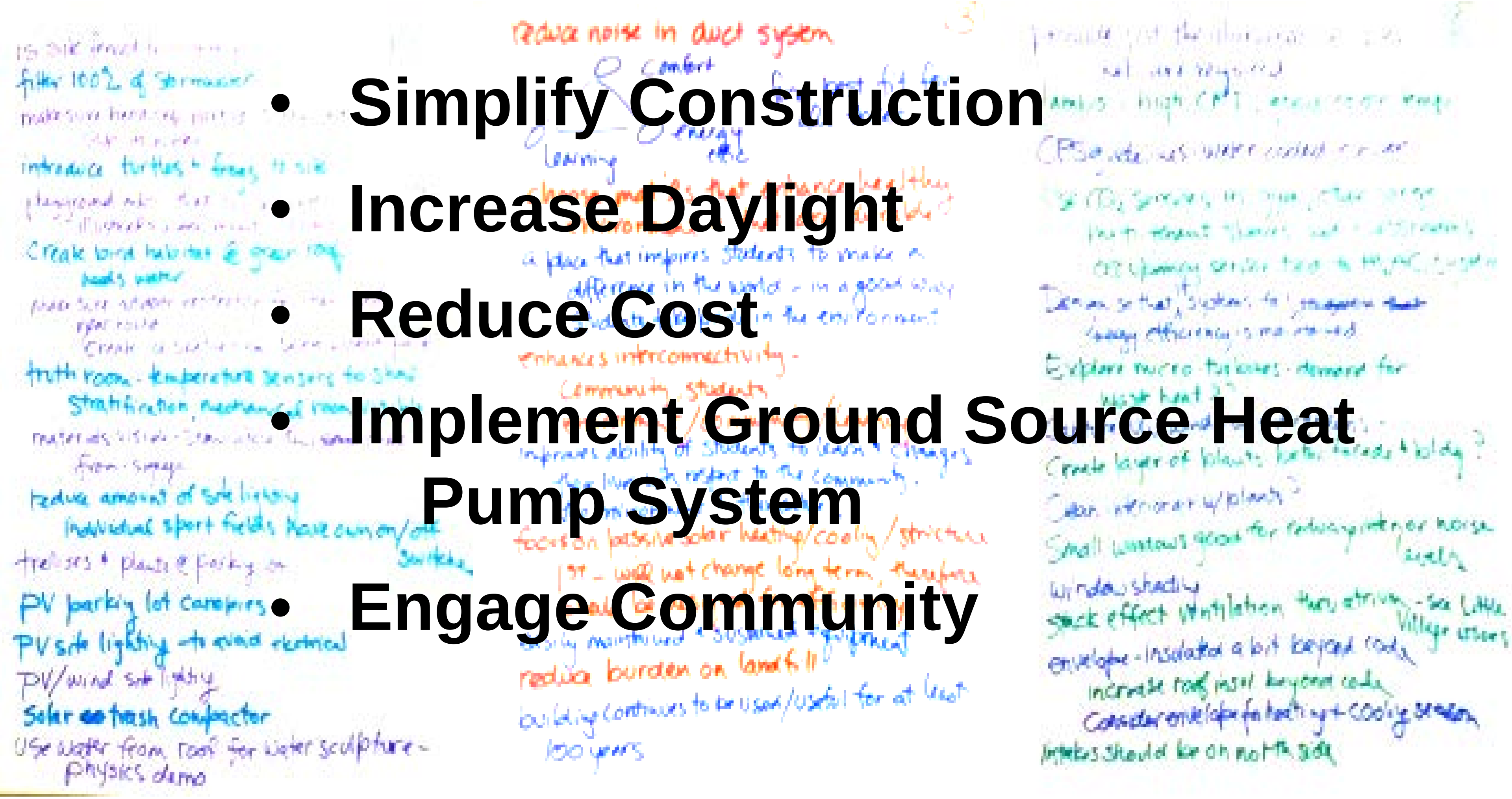
What would have you be able to say the project is sustainable?

What would make the project a success?

Charrette Notes

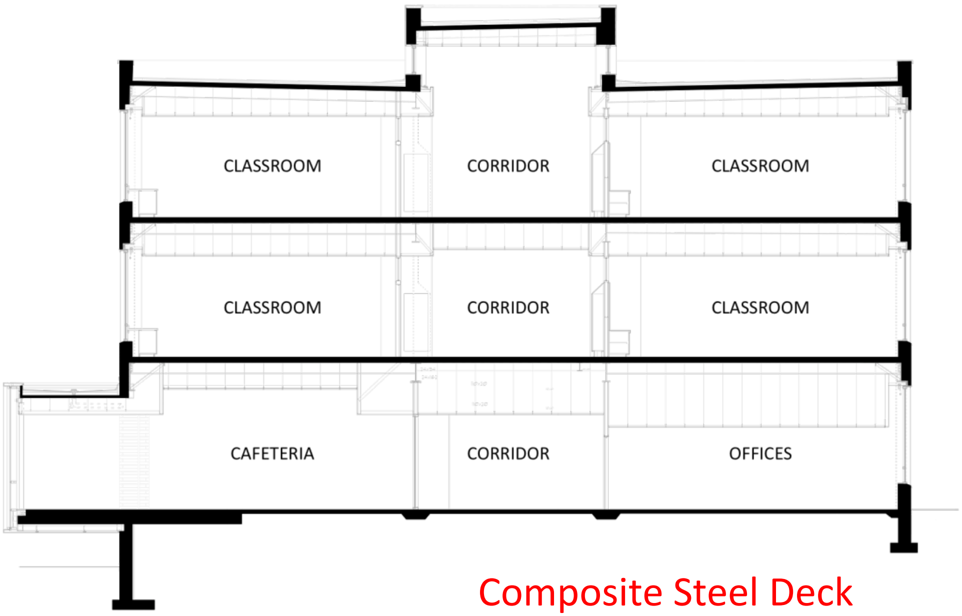


Good(e) Charrette Goals:



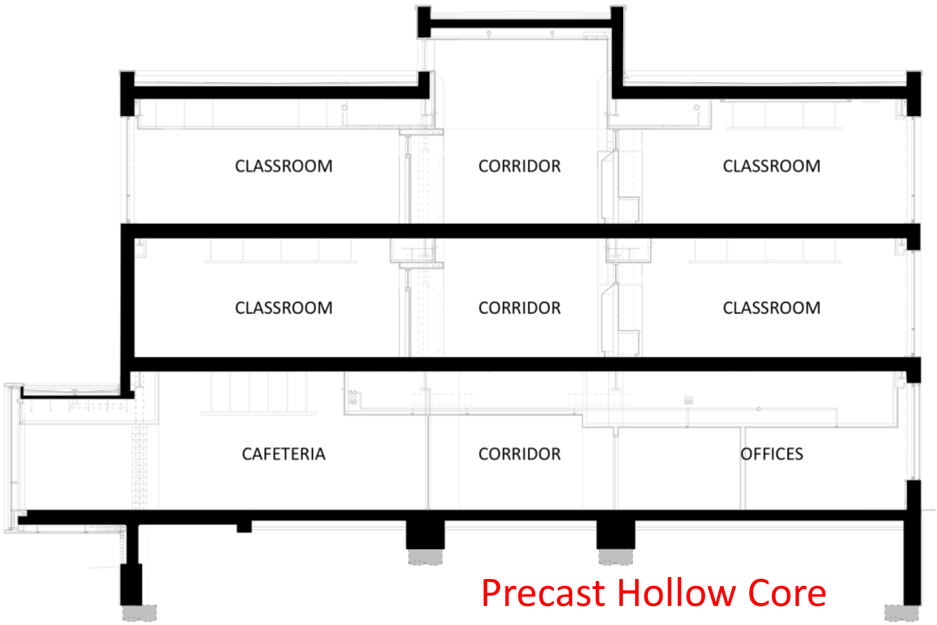
- Simplify Construction
- Increase Daylight
- Reduce Cost
- Implement Ground Source Heat Pump System
- Engage Community

Structural System



Composite Steel Deck
w/ Concrete Topping

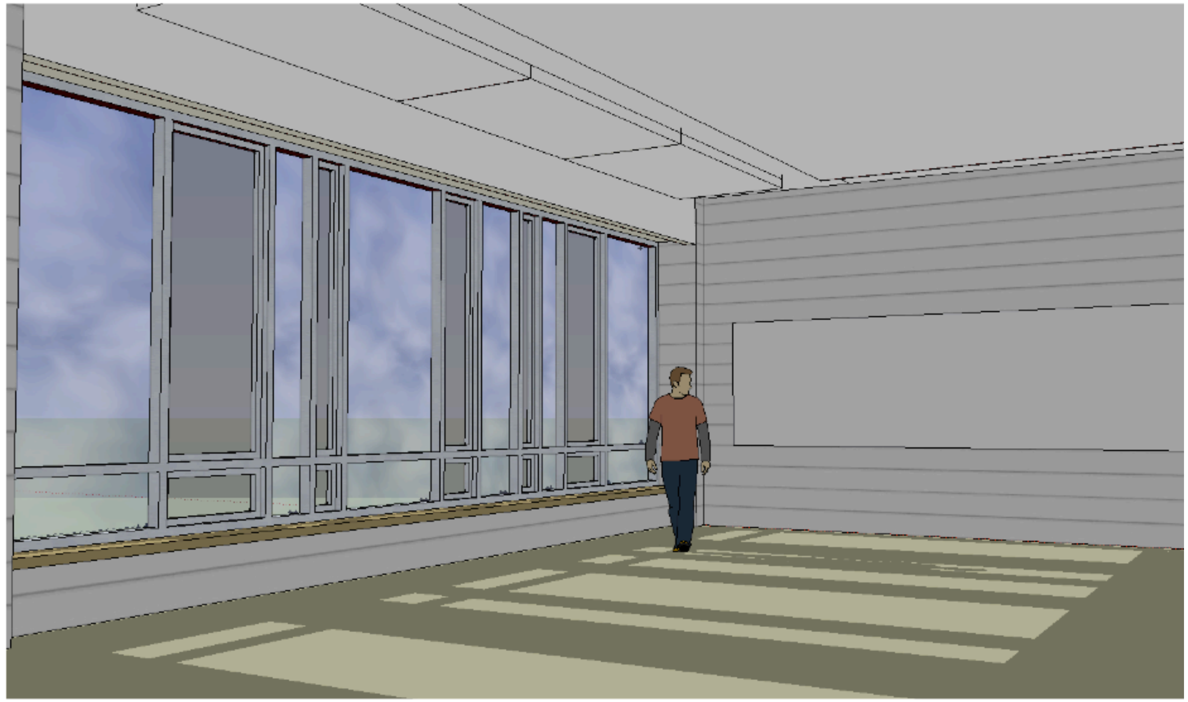
Sarah E. Goode Building Section



Precast Hollow Core
Concrete Planks

Prototype Building Section

Increase Daylight



OPTION 2:
INTERIOR VIEW IN TYPICAL CLASSROOM

41% Glazing Area

BASE CONCEPT DESIGN:
INTERIOR VIEW IN TYPICAL CLASSROOM

28% Glazing Area

OPTION 1:
INTERIOR VIEW IN TYPICAL CLASSROOM

35% Glazing Area

Study: Glazing Properties

Table 1: Cost and Energy Comparison

Simulation Option	Glazing Area (% of Total Wall Area)	Electrical Energy		Gas Energy		Total Energy	
		Usage (kWh)	Cost ($)	Usage (Therms)	Cost ($)	Usage (10^6 Btu)	Cost ($)
Option 1[a]	28%	941,500	30,214	62.04	1,220	3,833	31,434
Option 2[a]	41%	918,377	29,471	72.86	1,433	3,862	30,904
Option 2[b] - Scenario 1	41%	946,073	30,360	68.71	1,352	3,915	31,711
Option 2[b] - Scenario 2	41%	944,431	30,307	69.06	1,358	3,913	31,666
Option 2[b] - Scenario 3	41%	934,379	29,985	67.10	1,320	3,859	31,305

Prototype

Sarah E. Goode

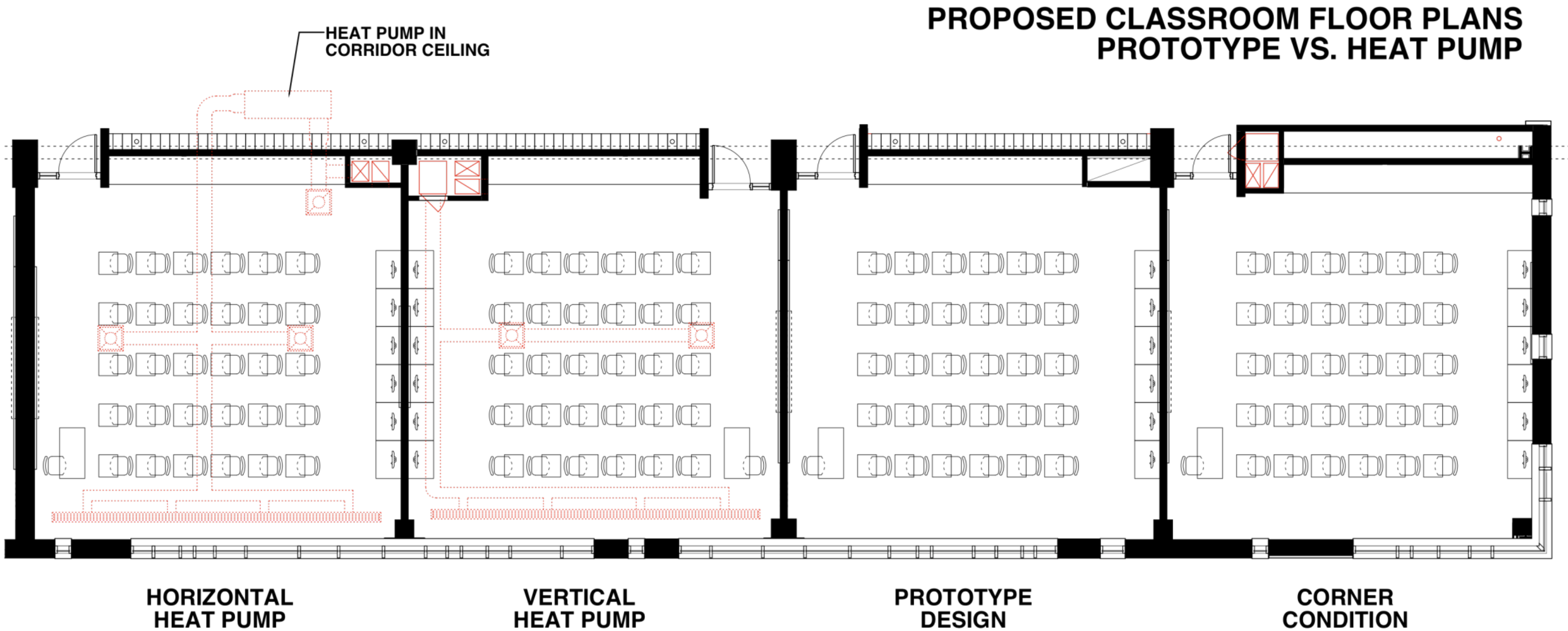
HVAC System: Life-Cycle Cost Analysis

HVAC SYSTEM COMPARISON FOR SOUTH WEST AREA HIGH SCHOOL

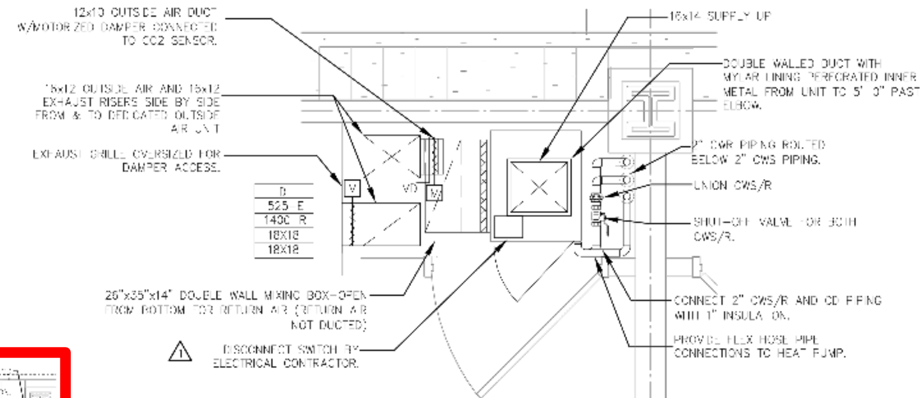
		Ashrae 90.1 Baseline Water Cooled VAV	Alternate 1 Air Cooled VAV	Alternate 2 Water Cooled VAV	Alternate 3 GSHP VAV	Alternate 4 GSHP
53	VAV Boxes (80 boxes)		$240,000	$240,000	$240,000	NA
54	Controls		$150,000	$150,000	$150,000	$150,000
55	Water Treatment					
56	COST SUMMARY					
57	Total Equipment Cost		$2,598,000	$2,553,000	$2,180,000	$1,980,000
58	Total Installed Cost		$7,794,000	$7,659,000	$6,540,000	$5,940,000
59	Geo-Exchange Wells		N/A	N/A	$2,000,000	$1,700,000
60	Capital Cost (Note 2)		$7,794,000	$7,659,000	$8,540,000	$7,640,000
61	Federal Tax Credit (10% for Geothermal)		$0	$0	-$854,000	-$764,000
62	Total Cost of System to Owner		$7,794,000	$7,659,000	$7,686,000	$6,876,000
63	$/sq ft		$46.20	$45.40	$45.56	$40.76
64	ENERGY SUMMARY					
65	Electric Consumption (kWh) - (Note 3)	1,007,516	1,000,746	971,117	885,189	735,811
66	Gas Consumption (THERMS) - (Note 3)	34,506	7,313	7,313	3,272	3,807
67	Annual Energy Cost	$93,261	$70,580	$68,582	$59,488	$50,247
68	Performance Improvement	0.0%	24.3%	26.5%	36.2%	46.1%
69	LEED For Schools Points		4	5	8	10
70	METRICS					
71	$/Sq.ft Energy Cost	$0.55	$0.42	$0.41	$0.35	$0.30
72	Cooling (sf/ton)	375	482	482	475	359

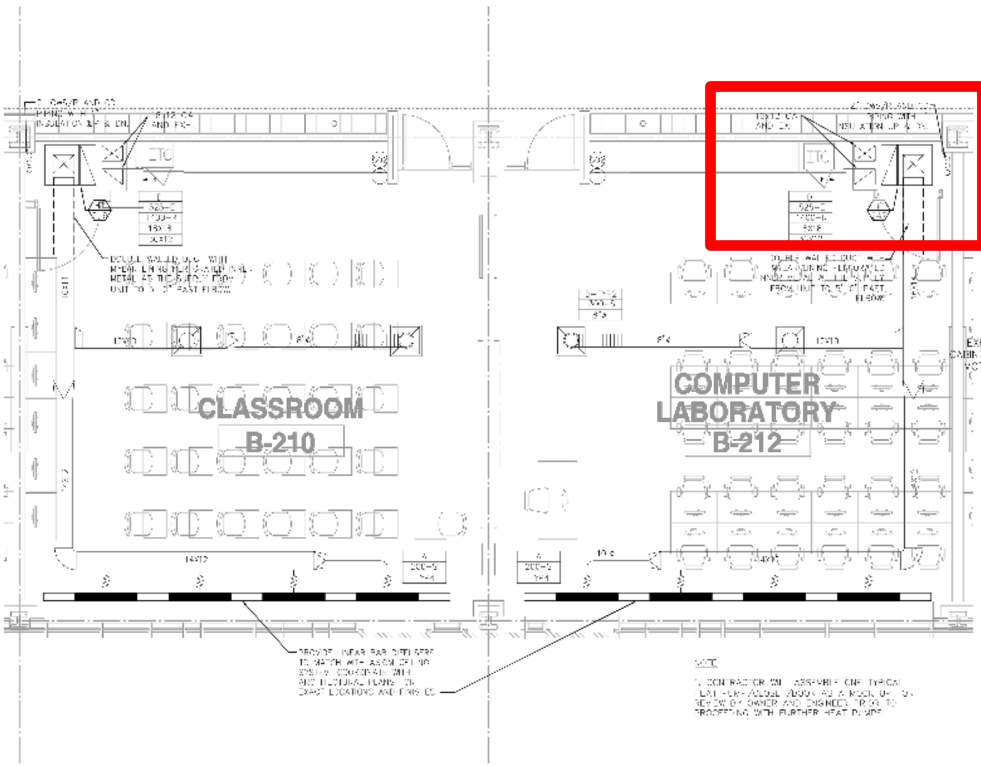
Ground Source Heatpump System

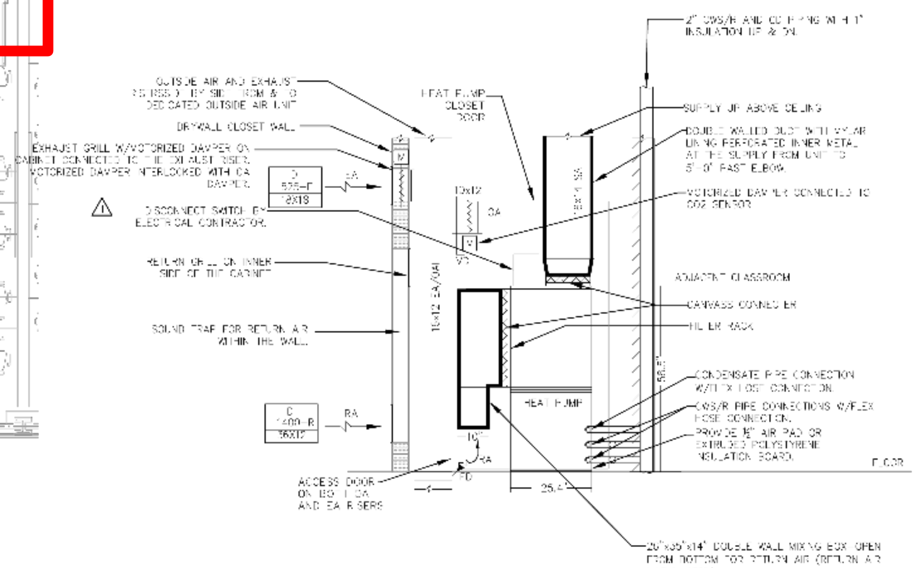
Ground Source Heatpump System



Ground Source Heatpump System







Ground Source Heatpump System

Drilling wells for geo-exchange system

Heatpump Closet located in classroom

Ground Source Heatpump System

Areas of Intense Mechanical Coordination

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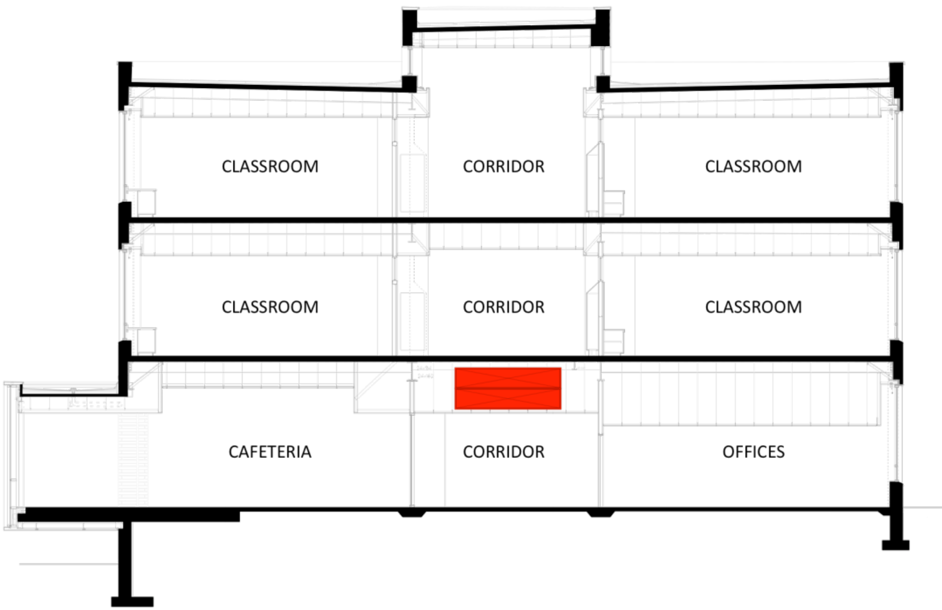
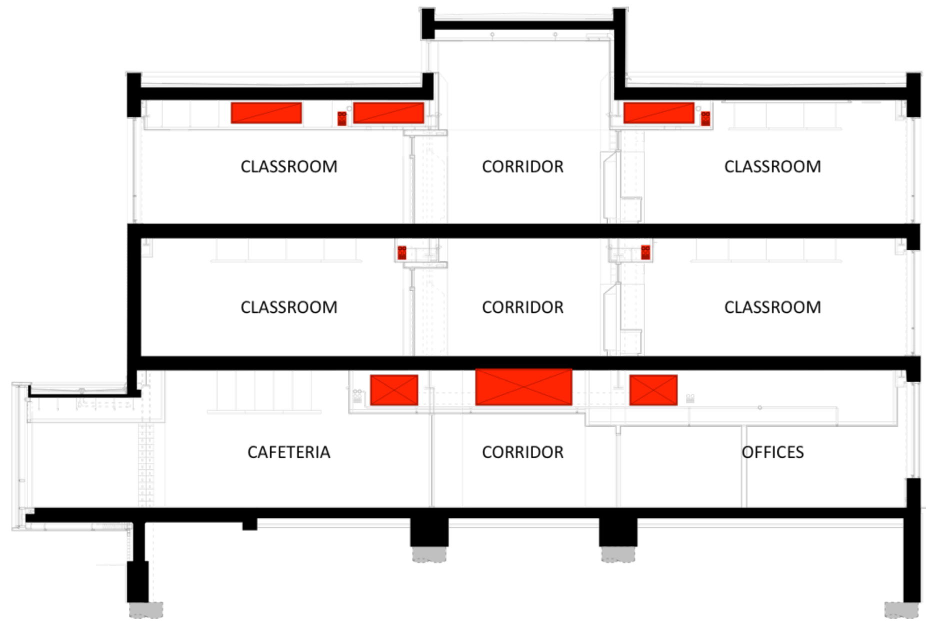


Sarah E. Goode Building Section



Prototype Building Section

Ground Source Heatpump System

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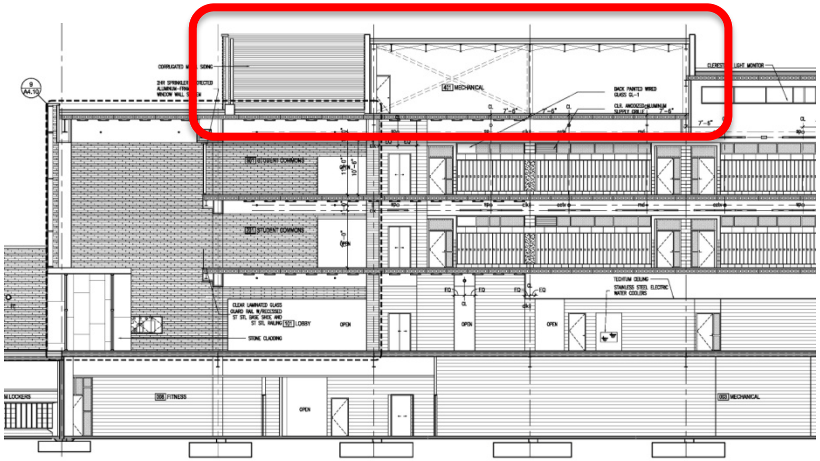
Penthouse Eliminated At Sarah E Goode



Prototype Building Section

Sarah E Goode Solar Panels

Engage Community




Solar Water Heating

Natatorium

Energy Baseline

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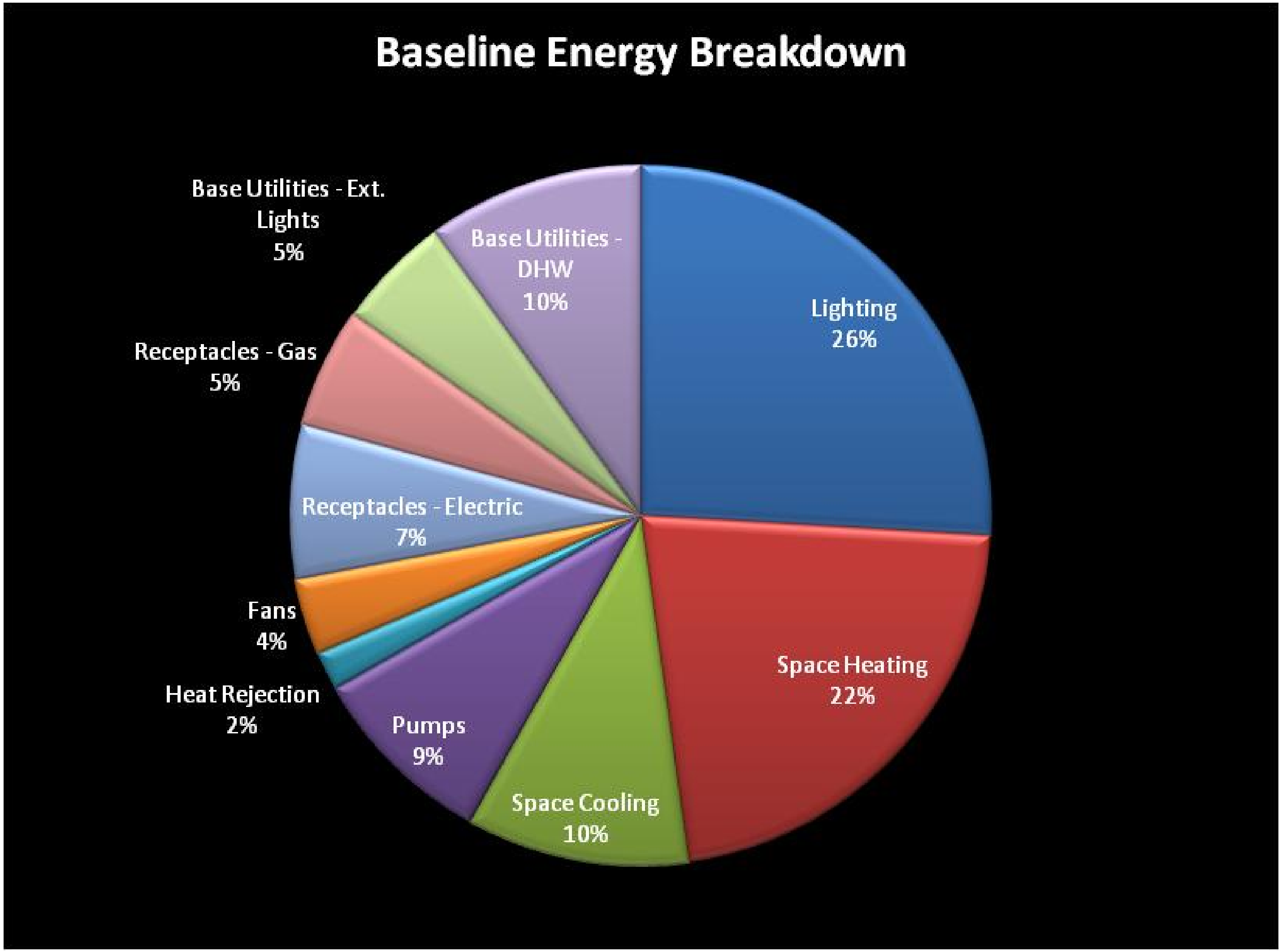

Energy Proposed

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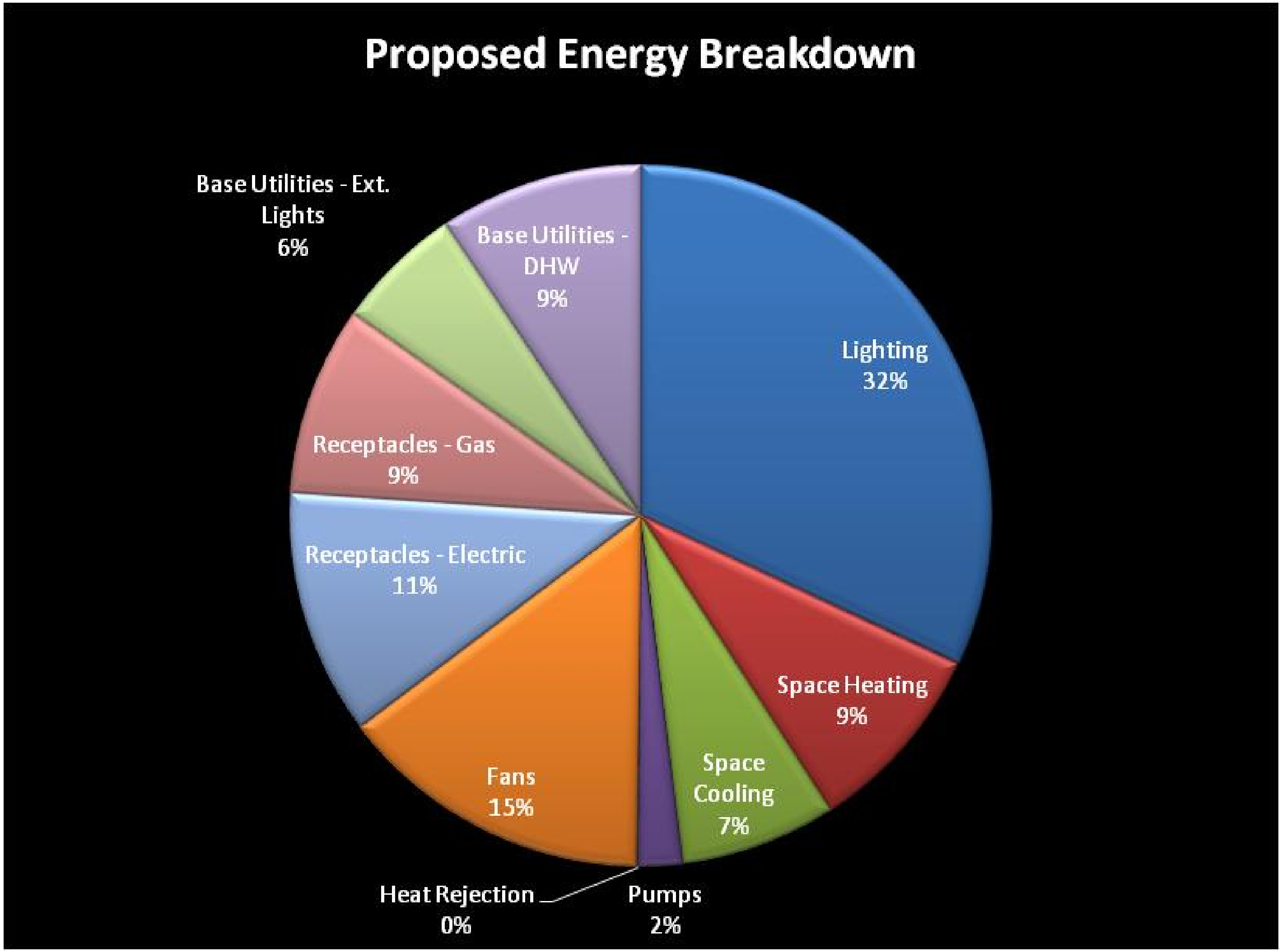

Energy Comparison

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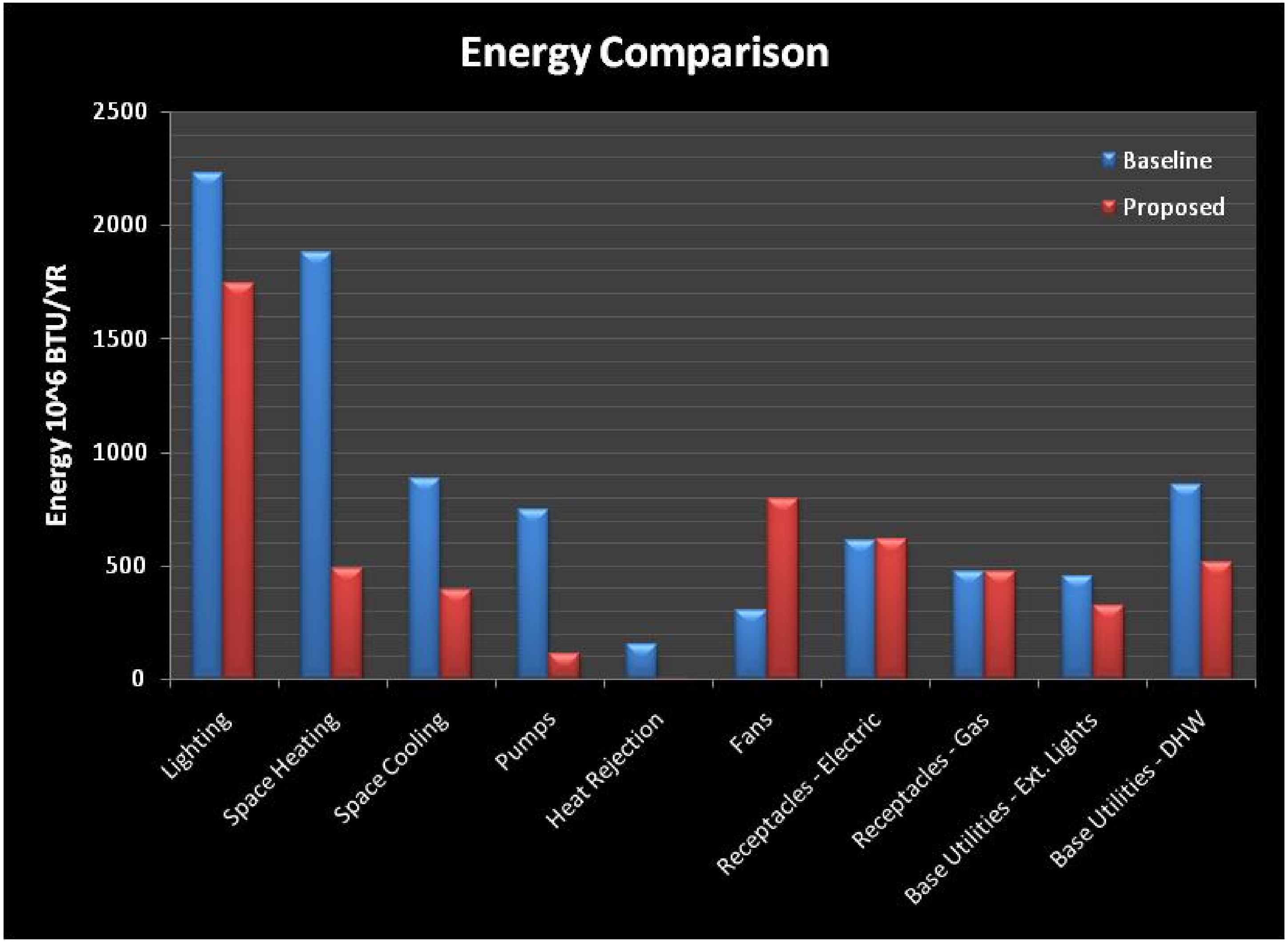

Sarah E. Goode vs. Evolving Prototype

A Side-By-Side Comparison: Cost

Goode	$ 62,452,000	
BOTY	$ 63,822,440	
	$ (1,370,440)	@ $7/SF difference
Significant Scope Differences:		
Masonry	Brick pattern regularized; Less quantity than prototype due to increase in windows and shorter building due to HVAC changes.	
Steel / Miscellaneous Metals	Goode changed from concrete deck to steel deck with concrete top. Shorter building due to smaller HVAC ductwork. Eliminated Penthouse. BOTY stayed with precast plank. Penthouse required with standard HVAC	
Spray Fireproofing and Insulation	Less Steel; less fireproofing.	
HVAC	Smaller ductwork – VAV versus distributed heat pumps with dedicated outside air; Added acoustic insulation at classroom heat pump closets; Boilers reduced from (3) 3,000 mbh to (2) 1,500 mbh; (1) 450 ton Chiller versus distributed heat pumps and geothermal pool dehumidification unit.	
Geothermal wells	Added geothermal wells – 170 wells at 450 feet deep each.	

Sarah E. Goode vs. Evolving Prototype

A Side-By-Side Comparison: LEED

LEED Categories	GOODE	BOTYHS
Sustainable Sites	14	10
Water Efficiency	5	5
Energy and Atmosphere	12	8
Materials and Resources	7	7
Indoor Environmental Quality	16	10
Innovation	5	5
TOTAL	**59**	**45**
	Platinum	**Gold**


effort
green
research
holistic
focused
support
efficiency
high
leverage
believer
durable
optimize
creative
collaborative
broadminded
welcoming
cognitive
leadership
integrative
risk
challenging
value
receptive
extraordinary
persistence
cost
ongoing
synergies
thoughtful
unstoppable
design
performance
diversity
roi
comparable
interrelationships
communication
first
modeling
process
champion
out
committed
open
innovative
continuous
sustainable
taking
proved
mindset
engage
quality
team
belief

Questions

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October 1, 2014

Contact Information

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