




Creating Extraordinary Results through an Integrative Design Process



IL Healthy & High Performing Schools Symposium

US GBC IL / IL Green Governments Coordinating Council

Creating Extraordinary Results through an Integrative Design Process

*2 case studies – The Wolcott School
and the Sarah E. Goode STEM
Academy*

Integrative Design

18 April 2014



Introduction

Integrative Design

18 April 2014

- Deeta Bernstein, LEED AP BD+C, Sustainability Manager,
Public Building Commission of Chicago
- Jennifer Costanzo, AIA, LEED AP BD+C, Principal,
STR Partners, LLC
- Lawrence Kearns, AIA, Principal,
Wheeler Kearns Architects
- Dr. Miriam Pike, Head of School,
Wolcott School
- Sachin Anand, PE, LEED AP BD+C, Principal,
dbHMS



Introduction

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Goode and Wolcott –
Similarities and Differences

Introduction

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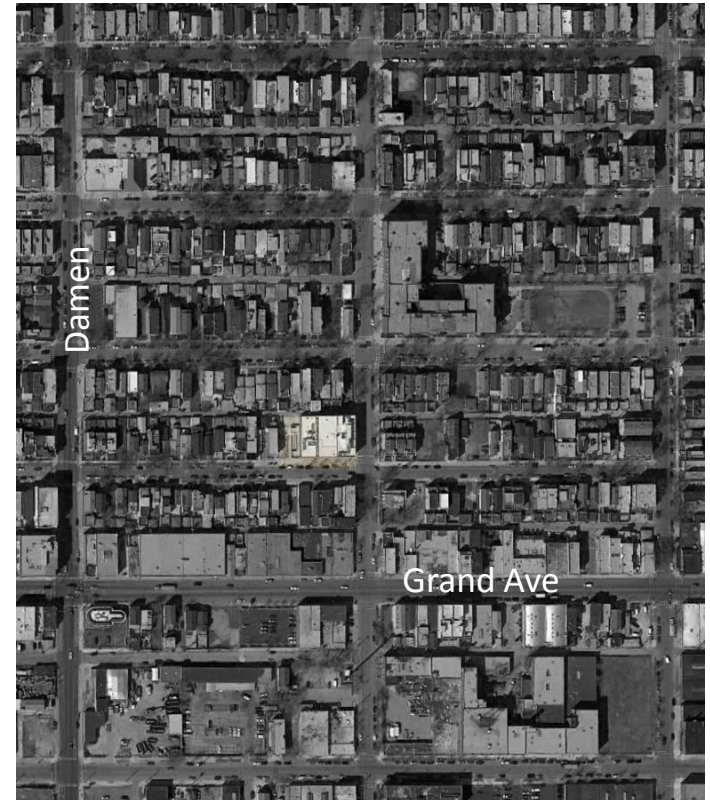
Sarah E Goode STEM Academy

207,000sf on 17.1 acres

1,200 students

New Construction

172sf



The Wolcott School

33,000sf on .35 acres

160 students

Adaptive Reuse

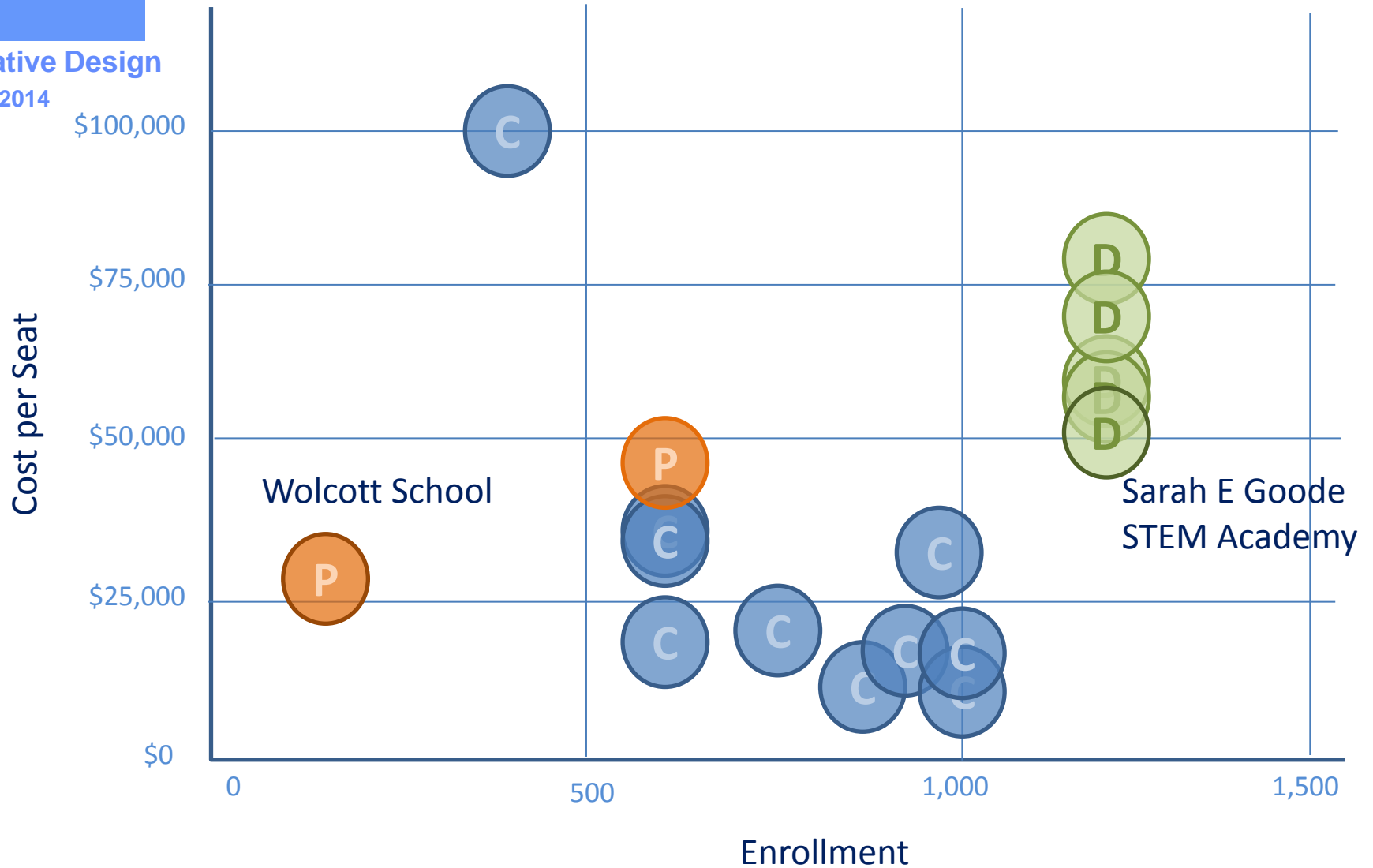
206sf



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Introduction

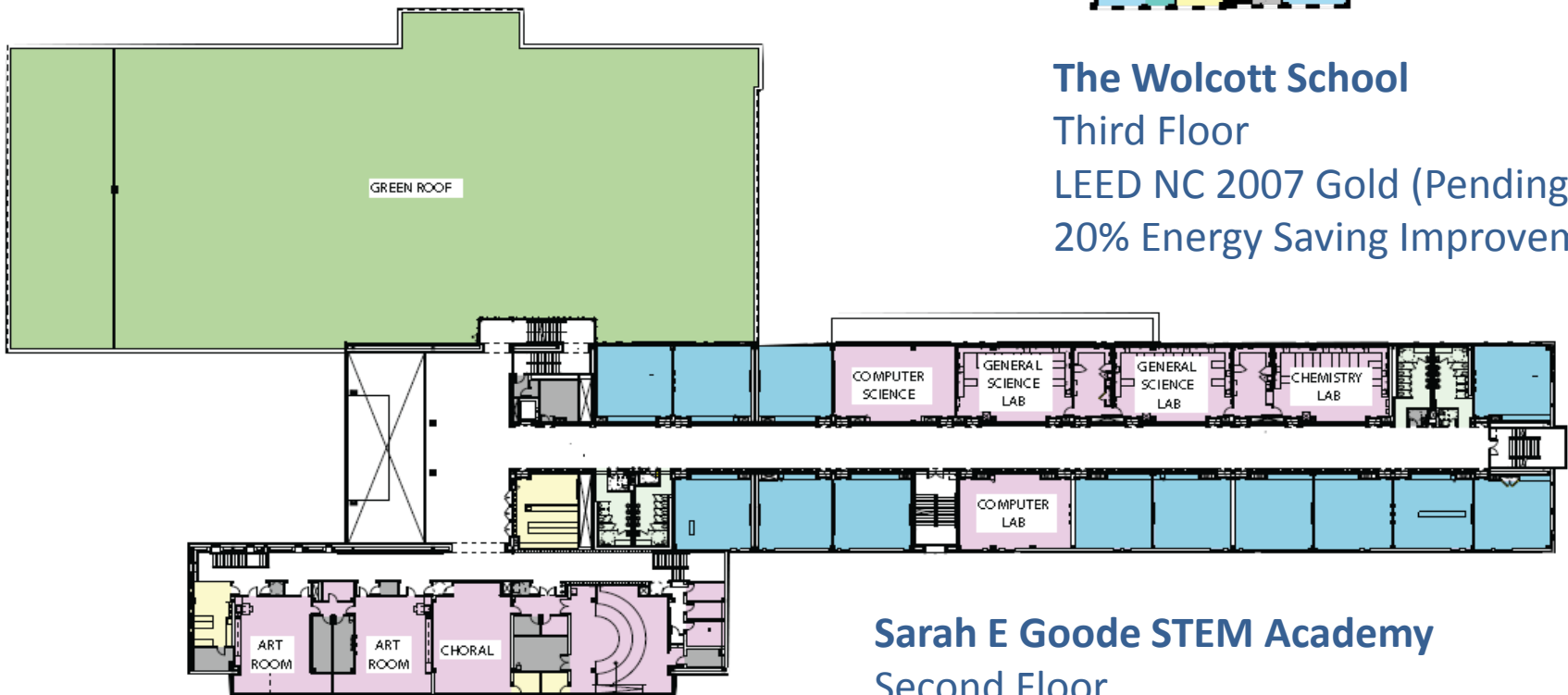


The Wolcott School

Third Floor

LEED NC 2007 Gold (Pending)

20% Energy Saving Improvement



Sarah E Goode STEM Academy

Second Floor

LEED for Schools 2007 Platinum

38.5% Energy Saving Improvement



Introduction

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Who Are You?



Objectives

- Understand how the integrative design process works.
- Learn how such collaboration can be leveraged to create extraordinary results – *whether to reduce first cost while improving ongoing efficiency or to create an “antithesis” school.*
- Learn how excellent learning environments can be created in and beyond the classroom through this process.
- See how practical off-the-shelf parts can be put together for a whole that is truly greater than the sum of its parts

A Word About Integrative Design...

Extraordinary projects can result from leveraging the cognitive diversity inherent in a project team. Each member can bring a different perspective and can possess different tools to solve difficult problems

Involve Team Members **EARLY** , working **INTENSIVELY** in pursuit of **JOINTLY** developed criteria, making decisions **COLLABORATIVELY**

- Partnerships - Will you be pursuing partnerships with organic growers or farms? If so, will they be recognized?
- Partnerships - Will the dining room host gallery space for local artists? Could the dining room host live music? Live dance? Is an impromptu dance floor desirable? Is there a story time for kids?

Posted at 10:52 AM in [Conceptual](#) | [Permalink](#) | [Comments \(2\)](#)

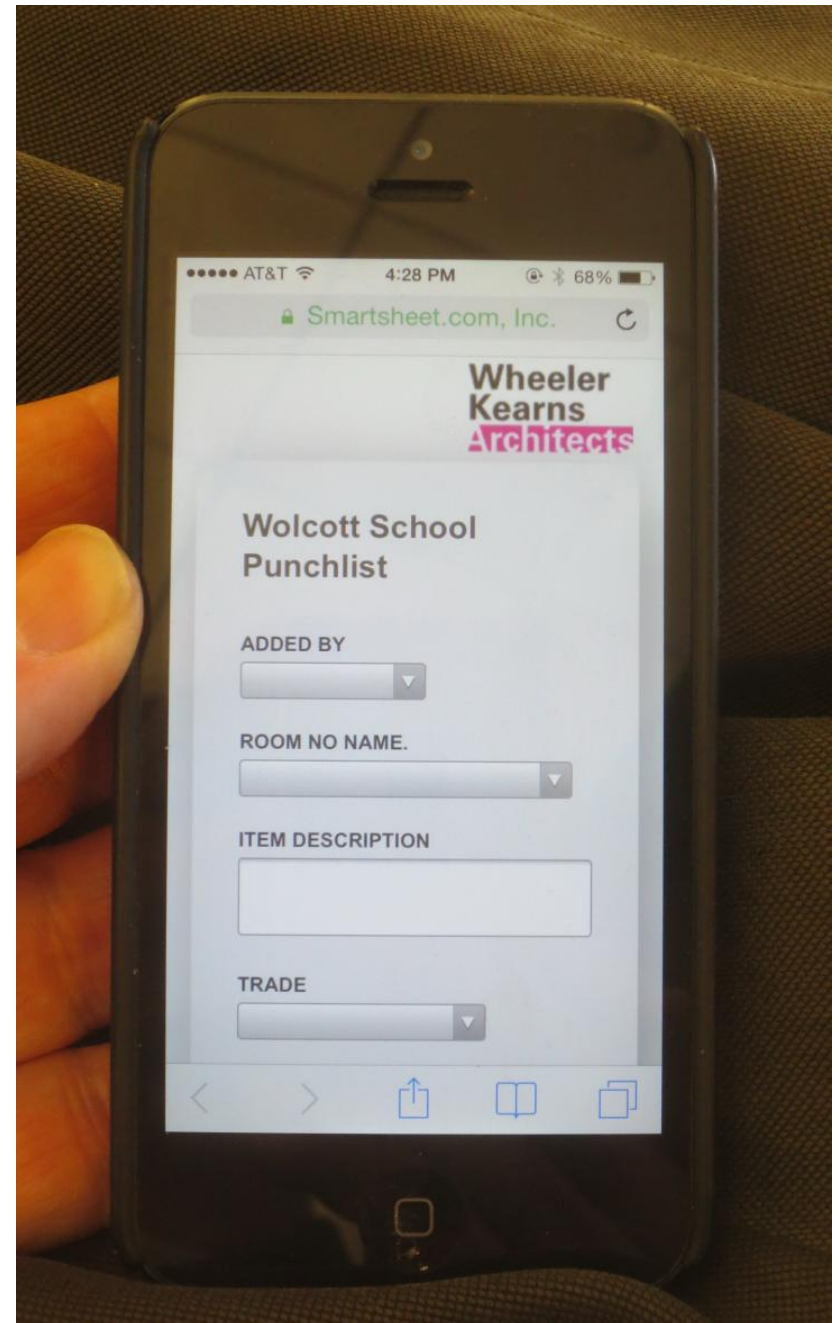
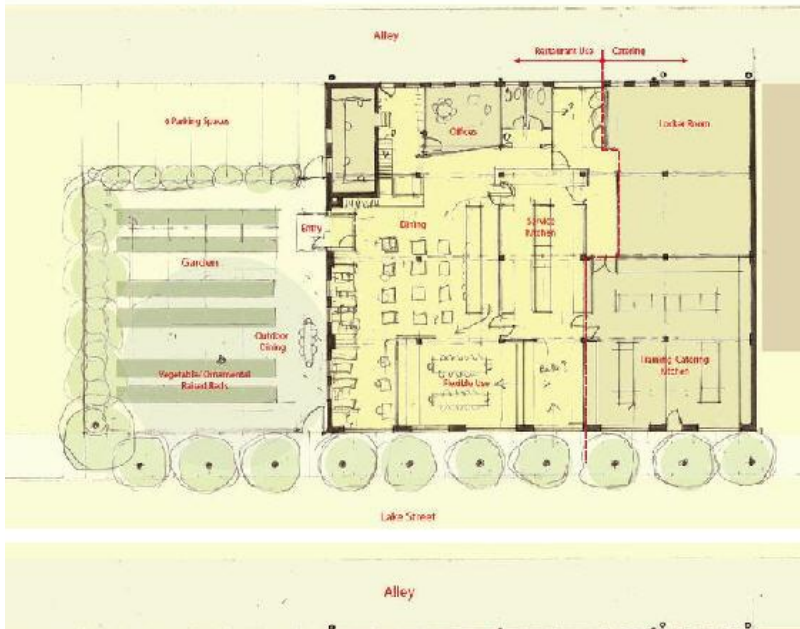
Materials

- Materials - Should the materials here be finished (polished metal, stone and wood) or more unfinished "raw" appearance seem better (exposed brick, concrete, timber)?

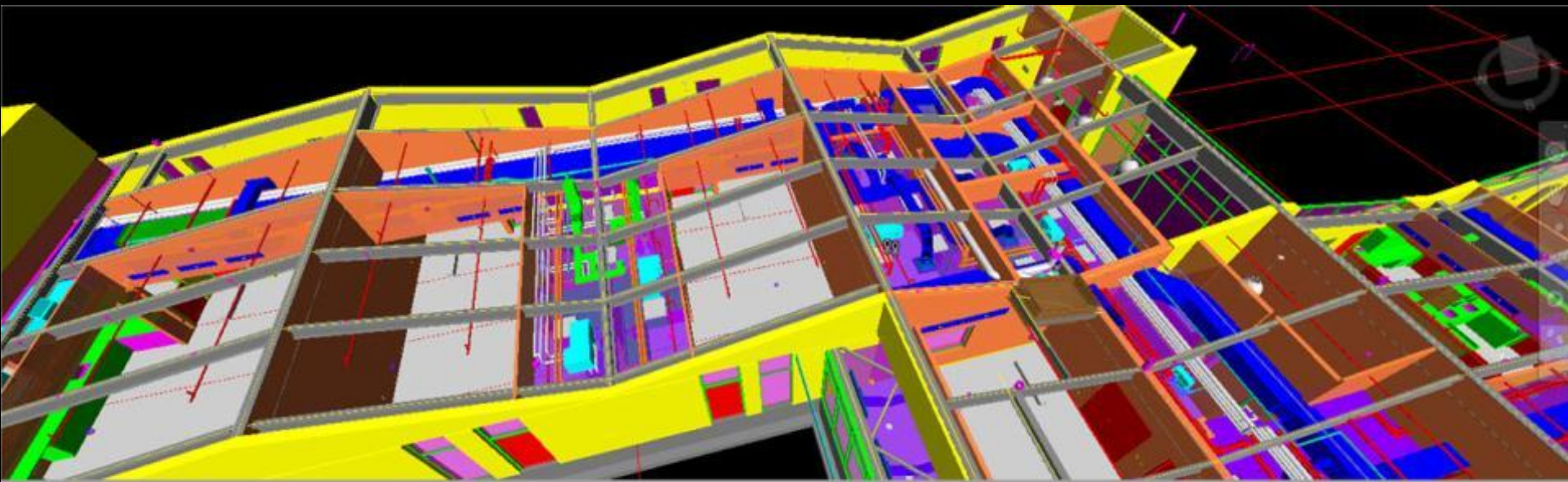
Posted at 10:52 AM in [Conceptual](#) | [Permalink](#) | [Comments \(2\)](#)

Schemes

- Schemes - Do you gravitate toward any of the three Predesign schemes? If so, why?

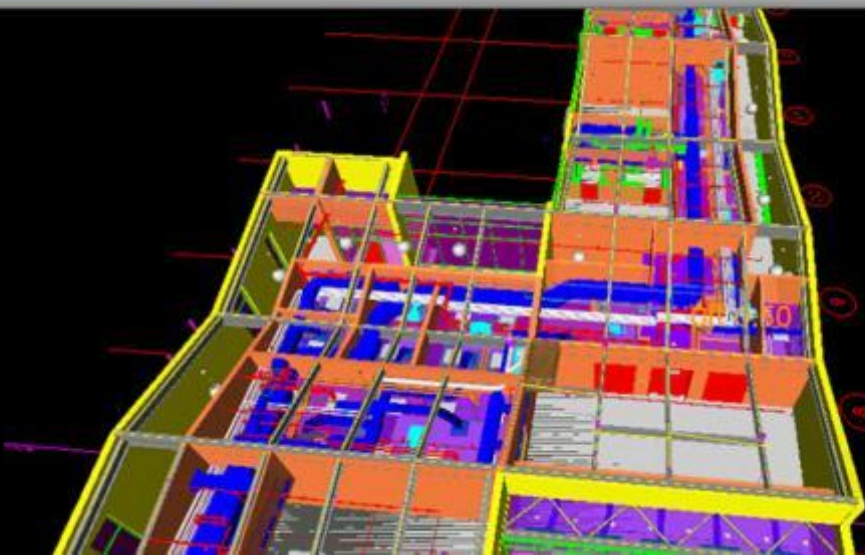


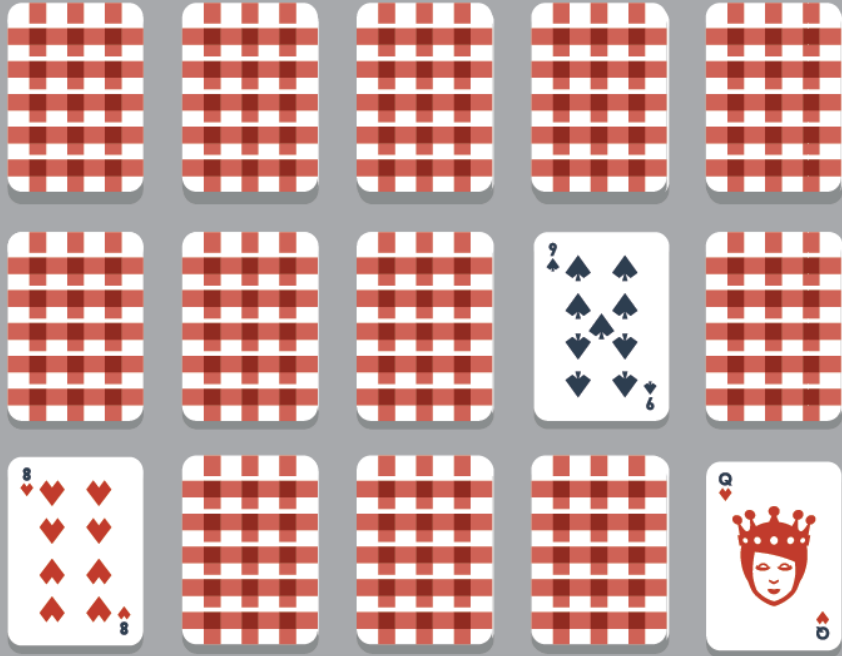
	Colu 2	Colu 3	Colu 4	Column 5	Credit Description	Column 7	Column 8	Credits	Comments
1				Certified 40 to 49 points Silver 50 to 59 points Gold 60 to 69 points Platinum 80+ points					
2	62	7	30	Points Achieved			Possible	110	Review Comments
3									Menu Item City Green Permit: 50% Green Roof or Achieve one higher level
4	20	0	6	Sustainable Sites			Possible	26	Review Comments
5	Y	?	N						
6	Y			Prereq 1	Construction Activity Pollution Prevention			0	Assumed that CM will develop and implement an erosion and sedimentation control plan for all activities associated with the project.
7	1			Credit 1	Site Selection			1	Site is not prime farmland or parkland, is developed, is not specifically identified as habitat for endangered species, and is not within 100 feet of any wetlands.
8	5			Credit 2	Development Density & Community Connectivity			5	Density is likely but needs to be verified
9			1	Credit 3	Brownfield Redevelopment			1	
10	6			Credit 4.1	Alternative Transportation - Public Transportation Access			6	2 bus lines likely within .25 miles. Can be University lines
11	1			Credit 4.2	Alternative Transportation - Bicycle Storage & Changing Rooms			1	Credit template for SSo4.2 is complete.
12			3	Credit 4.3	Alternative Transportation - Low Emitting & Fuel Efficient Vehicles			3	Credit template for SSo4.3 is complete.
13	2			Credit 4.4	Alternative Transportation - Parking Capacity			2	All 37 parking spaces provided on site plan are to upgrade parking for adjacent buildings that where not in compliance with Chicago Zoning Ordinance. Although 2 preferred parking spaces are provided, no parking spaces are designated for use by the building occupants (inner-city high school students).
14	1			Credit 5.1	Site Development - Protect or Restore Habitat			1	Likely with open space and green roof
15	1			Credit 5.2	Site Development - Maximize Open Space			1	Likely with open space and green roof
16			1	Credit 6.1	Stormwater Design - Quantity Control			1	
17			1	Credit 6.2	Stormwater Design - Quality Control			1	
18	1			Credit 7.1	Heat Island Effect - Non-Roof			1	All high albedo paving at alley or parking walking surfaces
19	1			Credit 7.2	Heat Island Effect - Roof			1	Non green roof will be highly reflective white TPO or PVC



View 1

v x

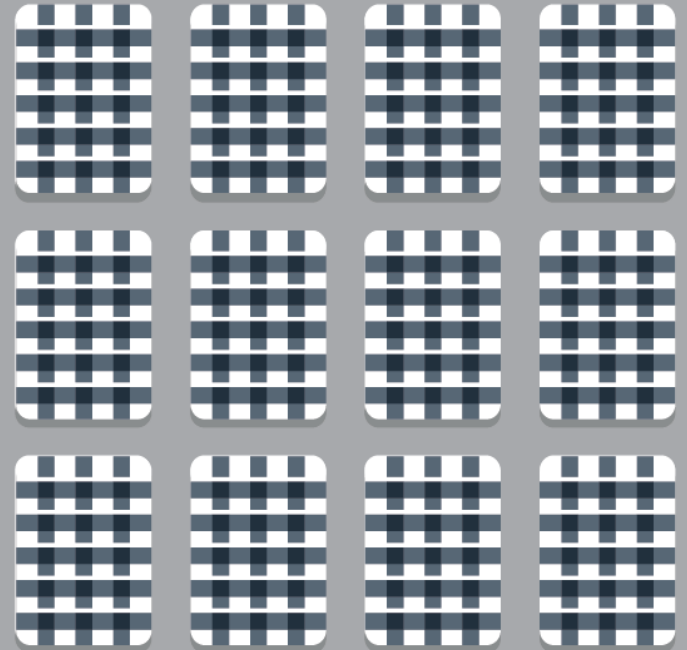




15 Cards (Tools) out of 52
14.5 Trillion Possible Combinations



12 Cards (Tools) out of 52

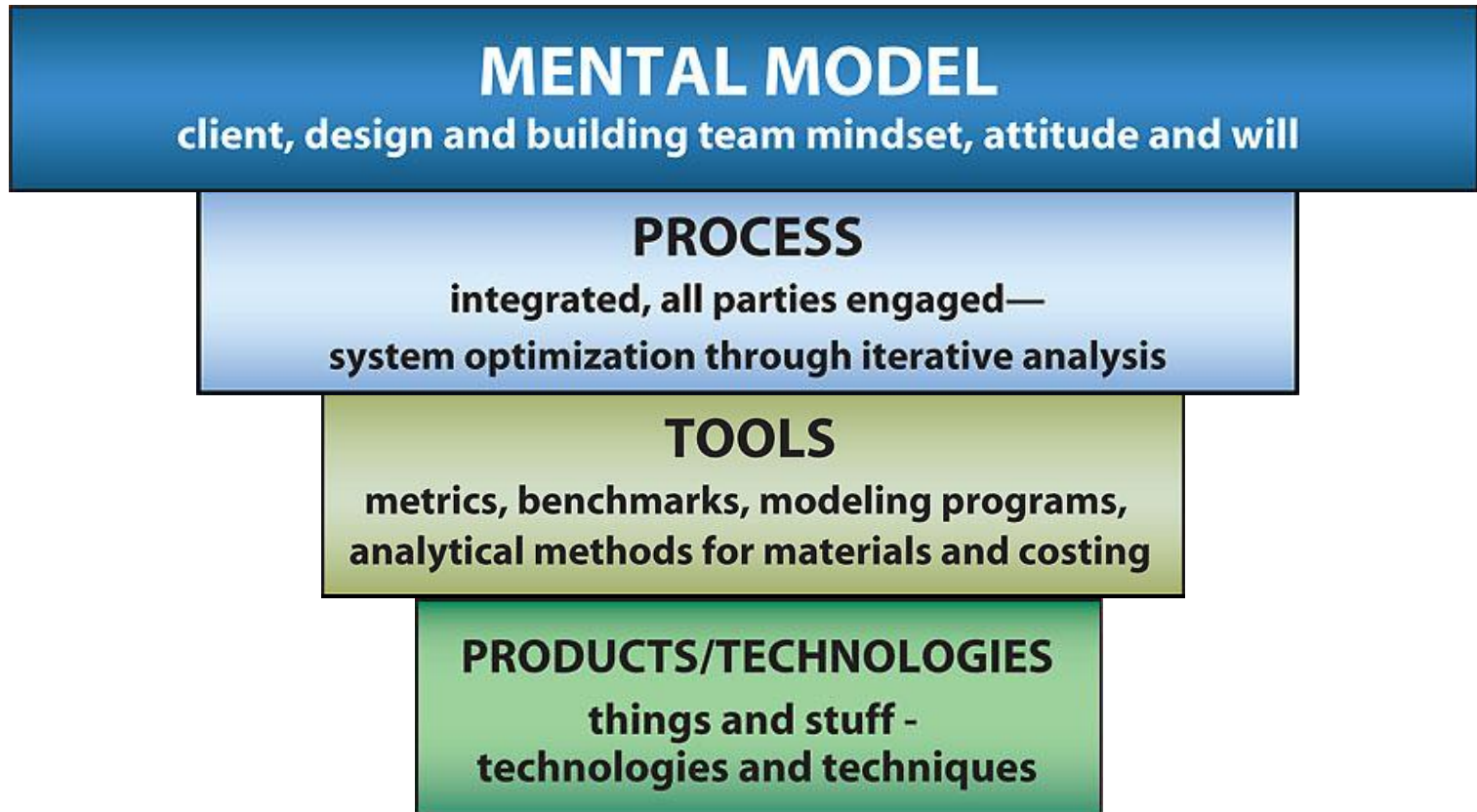


1:450,000,000 chance
that SHE has all HIS tools

Stepping Stones to Integrative Design – Shifting the Way We Think

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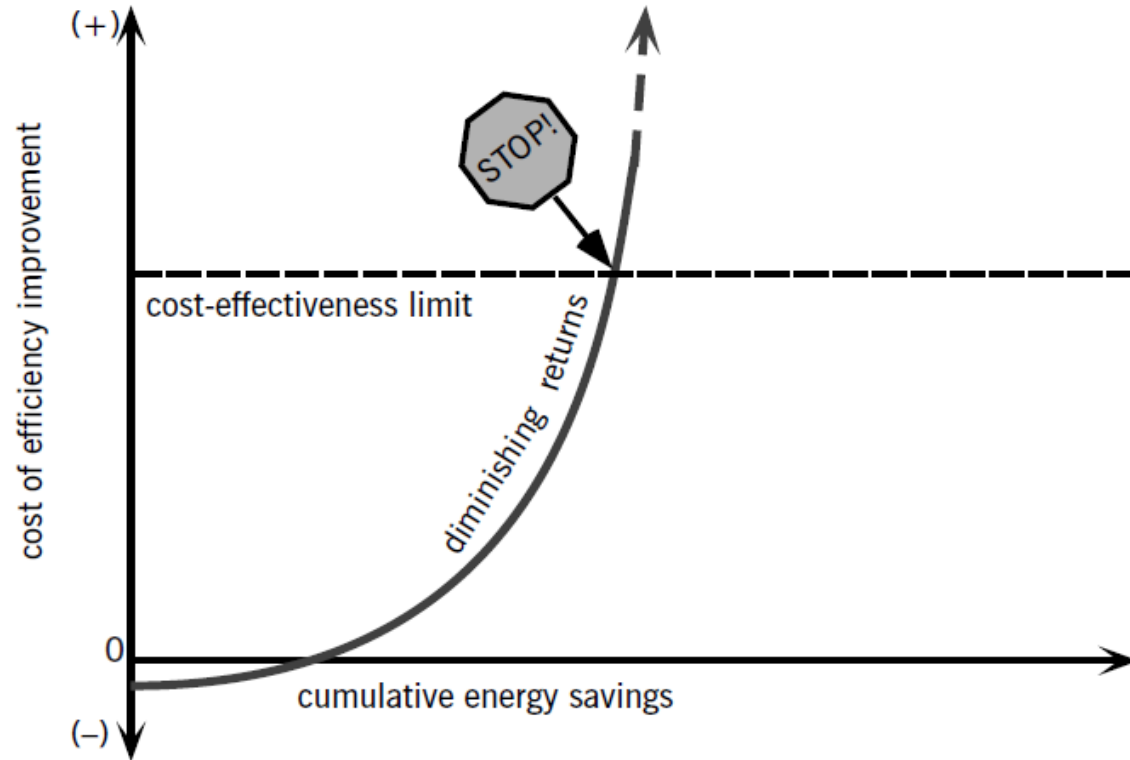
Concept by Bill Reed and Barbra Batshalom

Building as an Organism

- Systems are related, integrated
- Parts not independent
- Holistic, non-linear
- Analyze to streamline



Diminishing Returns

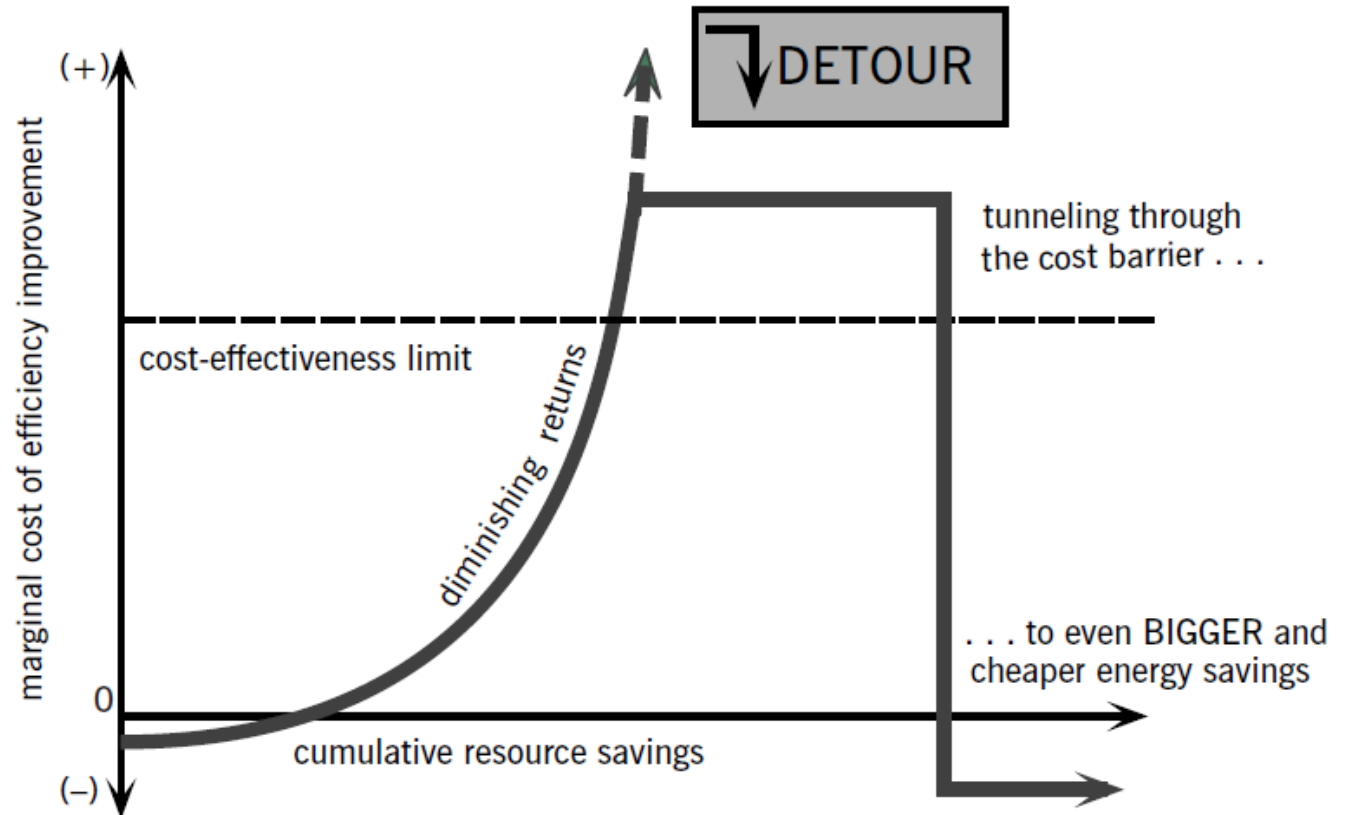


From Natural Capitalism by Lovins, Lovins and Hawken, 1999, Chapter 6

Tunneling Through the Cost Barrier

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

Sarah E. Goode STEM Academy

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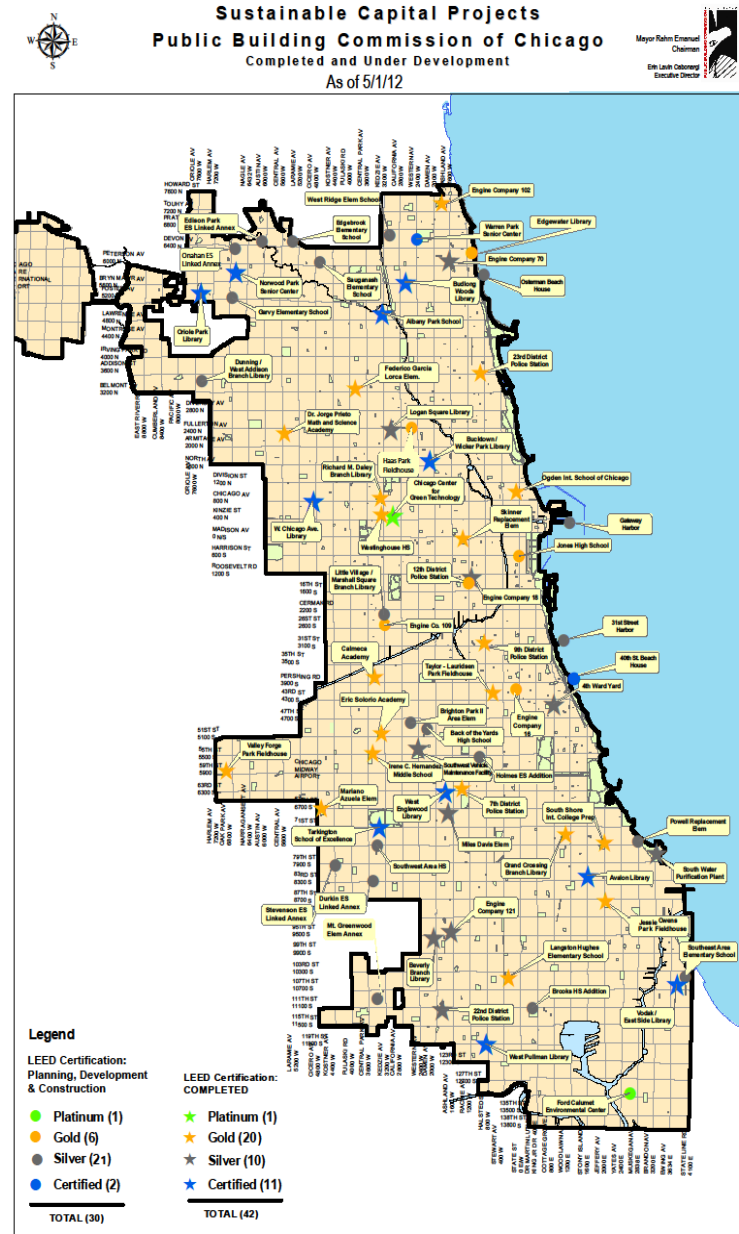
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Context

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- Public Building Commission of Chicago
 - Chicago Public Schools
 - City of Chicago
- ✓ Aligned Goals
 - ✓ Shared Commitment
 - ✓ *Sustainable Chicago 2015*



Mayor Rahm Emanuel
Chairman

Eric Lavin
Executive Director

Aligned Goals

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- Program-wide: Make “green” routine
- Excellent student experience / learning environment
- Use LEED to help meet goals



Context

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City of Chicago Sustainability Goals From Green Medians to Sustainable Chicago 2015



Context - The Evolving Prototype

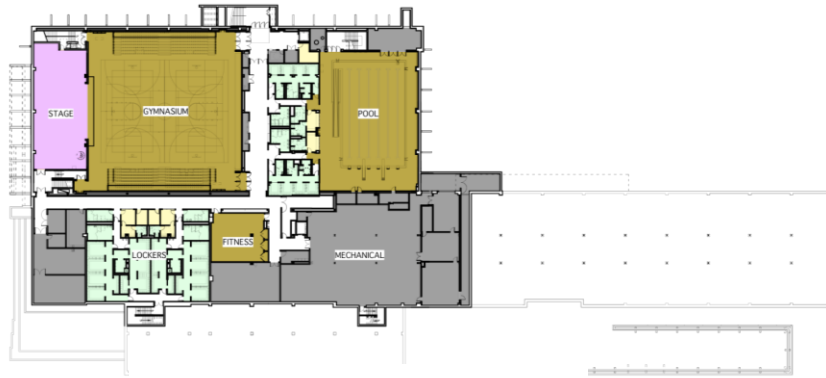
- Urban Model High School - Chicago Public Schools
- Minimum LEED Silver certification
- Design Standards Constraints



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Prototype Layout

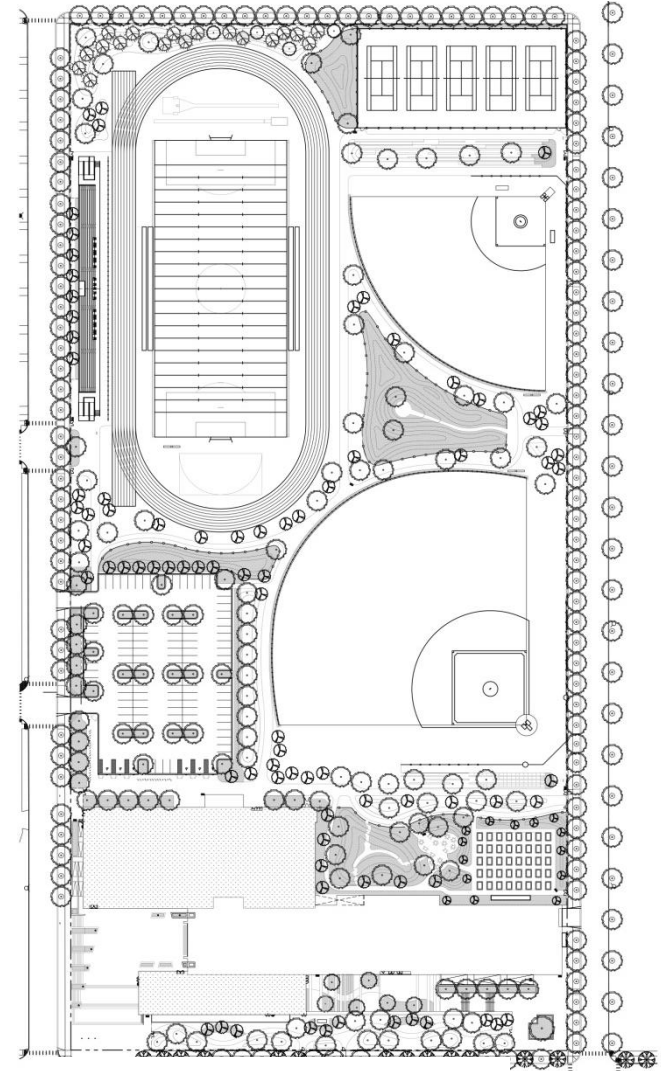


Lower Level Plan



Main Level Plan

- Core Academic
- Library
- Specialty/Arts
- STEM Laboratories
- Admin/Student Services
- Food Service
- Physical Education
- Building Services
- Toilets/Lockerrooms
- Green Roof

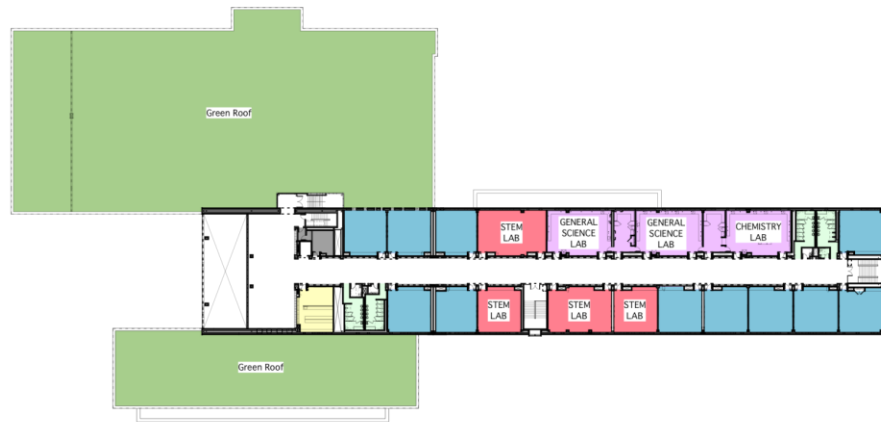


Site Plan

Prototype Layout



Second Floor Plan



Third Floor Plan

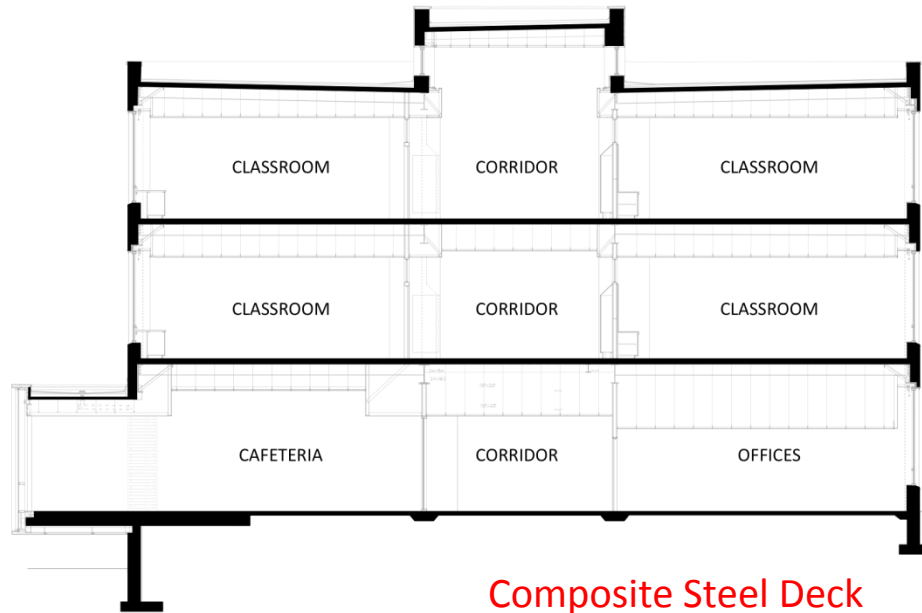
Good(e) Charrette Goals:

- Simplify Construction
- Increase Daylight
- Reduce Cost
- Implement Geothermal System
- Engage Community

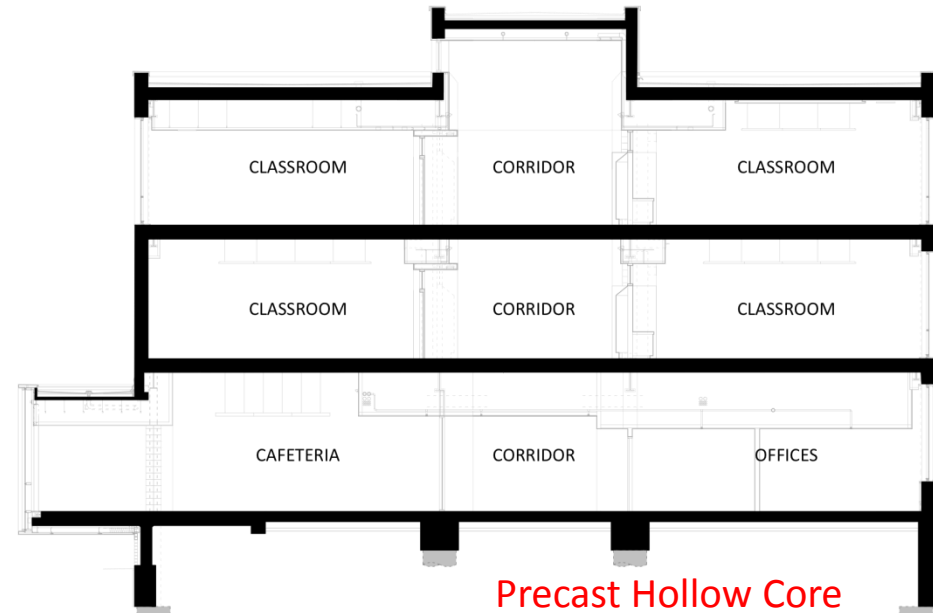
15 side front for...
filter 100% of stormwater
make sure hand of parking...
introduce turtles + frogs
playground with...
Create bird habitat @ green roof
halls water
fruth room - temperature sensor
Stratification, mechanical
materials used - take into account
from sewage
reduce amount of site lighting
individual sport fields have
trellises + plants @ parking on
PV parking lot canopies
PV site lighting - to avoid electric
PV/wind site lighting
Solar fresh compactor
Use water from roof for water sculpture -
Physics demo

Reduce noise in duct system
comfort
energy
find best fit for all three
Change materials that create
Environment + that are durable?
a place that inspires students to make a
Students take pride in the environment
enhances interconnectivity -
improves ability of students to learn + changes
their lives with respect to the community.
1st - will not change long term, therefore
should be designed for efficiency
reduce burden on landfill
building continues to be used/useful for at least
100 years

provide just the illumination...
that are required
lamps - high CPT, glow color temp
CPS... water cooled...
Use CO2 sensors in gym, other large
multi-tenant spaces, and classrooms
OR... system tied to HVAC system
Demand so that systems for...
energy efficiency is maintained
Explore micro-turbines - demand for
waste heat?
Capture NW winds w/...
Create layer of plants behind facade + building?
Small windows...
Window shading
stack effect ventilation thru atrium - see Little
envelope - insulate a bit beyond code
increase roof mass beyond code
Consider envelope for heating + cooling season
intakes should be on north side



Composite Steel Deck
w/ Concrete Topping



Precast Hollow Core
Concrete Planks

Sarah E. Goode Building Section

Prototype Building Section

Structural System



**OPTION 2:
INTERIOR VIEW IN TYPICAL CLASSROOM**

41% Glazing Area



**OPTION 1:
INTERIOR VIEW IN TYPICAL CLASSROOM**



**BASE CONCEPT DESIGN:
INTERIOR VIEW IN TYPICAL CLASSROOM** **28% Glazing Area**

Study: Glazing Properties

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







System Life-Cycle Cost Analysis

HVAC SYSTEM COMPARISON FOR SOUTH WEST AREA HIGH SCHOOL

Equipment	Alternate 1 Baseline Water Cooled VAV	Alternate 1 Air Cooled VAV	Alternate 2 Water Cooled VAV	Alternate 2 GSHP VAV	Alternate 3 GSHP VAV	Responsibility/Comments
1	BASELINE DATA					
2	Plant/Boiler	0.01				
3	Heat Exchanger	0.00				
4	Sub. or Single Pipe Foundation	0.13				
5	Valve	0.07				
6	Coating/Insulation	0.05				
7	Heating Plant	Gas Boiler				
8	Heating Plant	Water Cooled Chiller				
9	Heating Plant					
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99	Heating Plant					
100	Heating Plant					

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 (st/ton)	375	482	482	475	359	

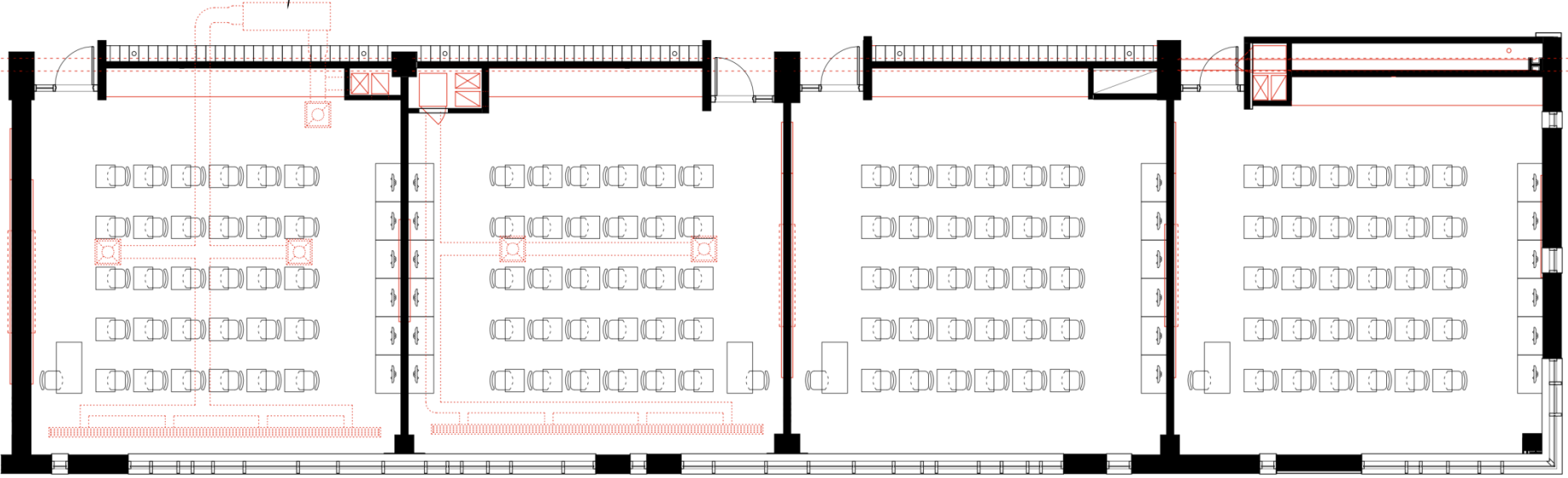
Alternate 1: The system is Alternate 1 as defined. A water cooled chiller plant. From: Low level and operating costs than Alternate 1, needs CPE Standards and Code. Capital expenditures from Alternate 1.

Alternate 2: The system is Alternate 2 as defined. A water cooled chiller plant. From: Low level and operating costs than Alternate 1, needs CPE Standards and Code. Capital expenditures from Alternate 1.

Alternate 3: The system is Alternate 3 as defined. A geothermal heat pump system. From: High energy savings, High LEED rating, lowest cost after tax credits, capital will require the least space. From: High energy savings, High LEED rating, lowest cost after tax credits, capital will require the least space. From: High energy savings, High LEED rating, lowest cost after tax credits, capital will require the least space.

PROPOSED CLASSROOM FLOOR PLANS PROTOTYPE VS. HEAT PUMP

HEAT PUMP IN
CORRIDOR CEILING

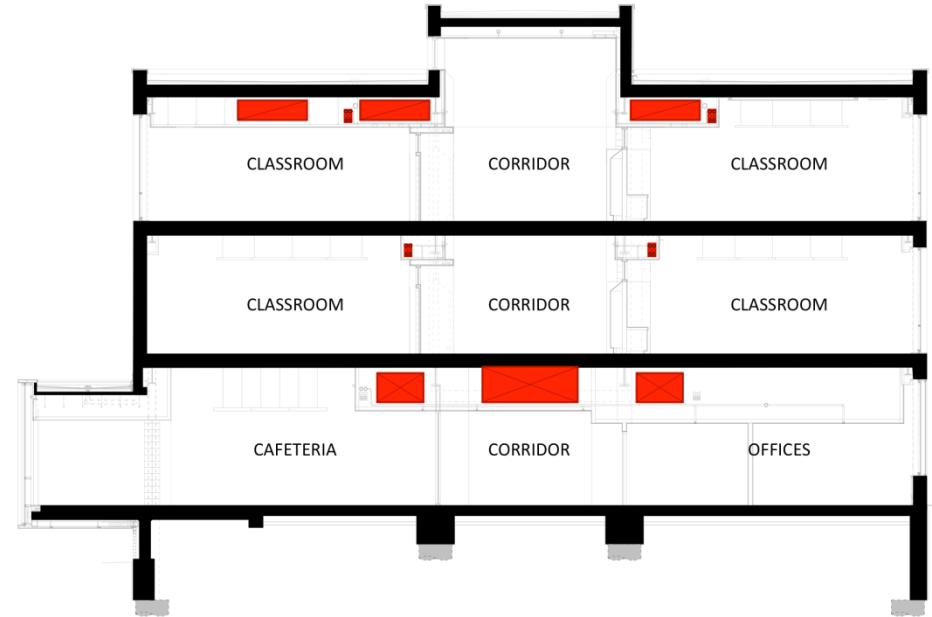
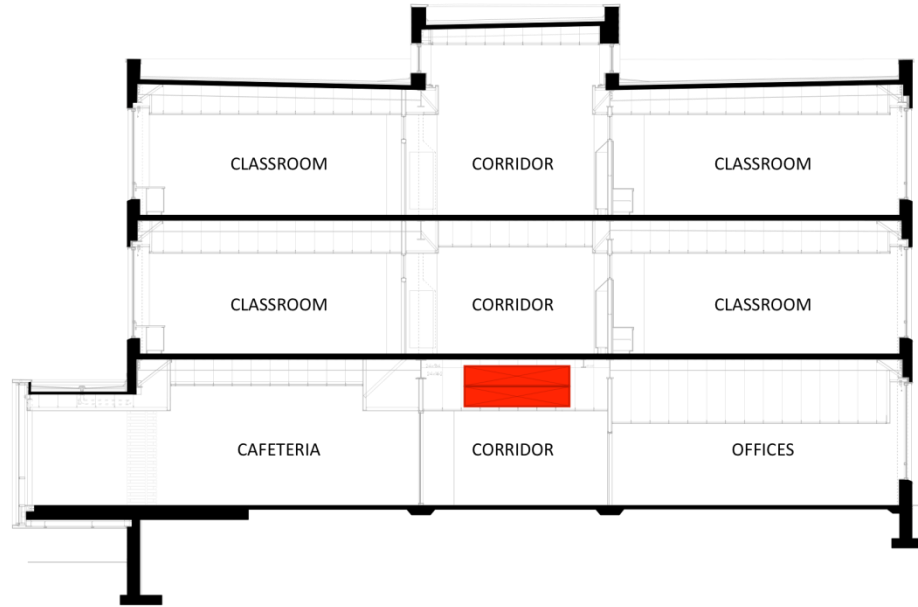


**HORIZONTAL
HEAT PUMP**

**VERTICAL
HEAT PUMP**

**PROTOTYPE
DESIGN**

**CORNER
CONDITION**



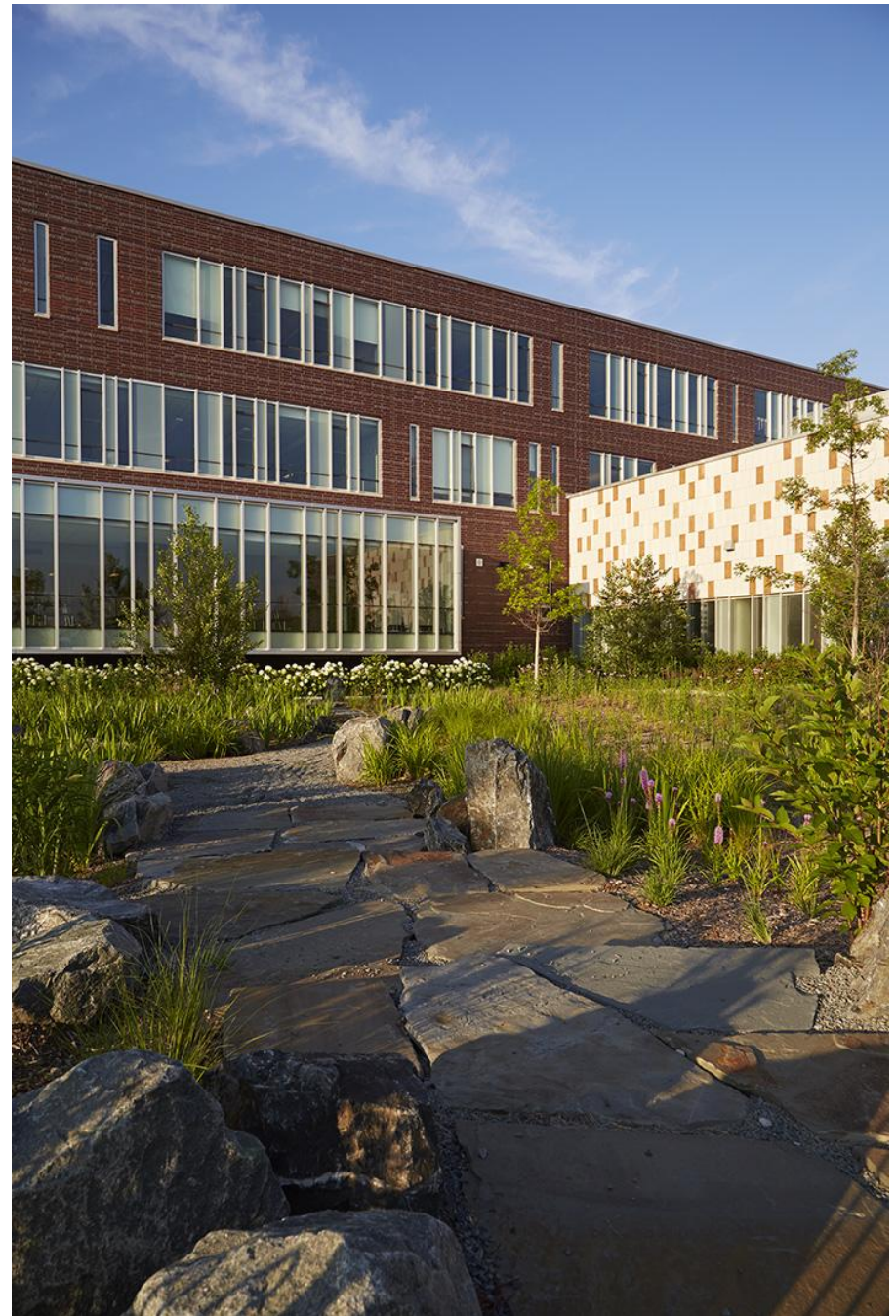
Sarah E. Goode Building Section

Prototype Building Section

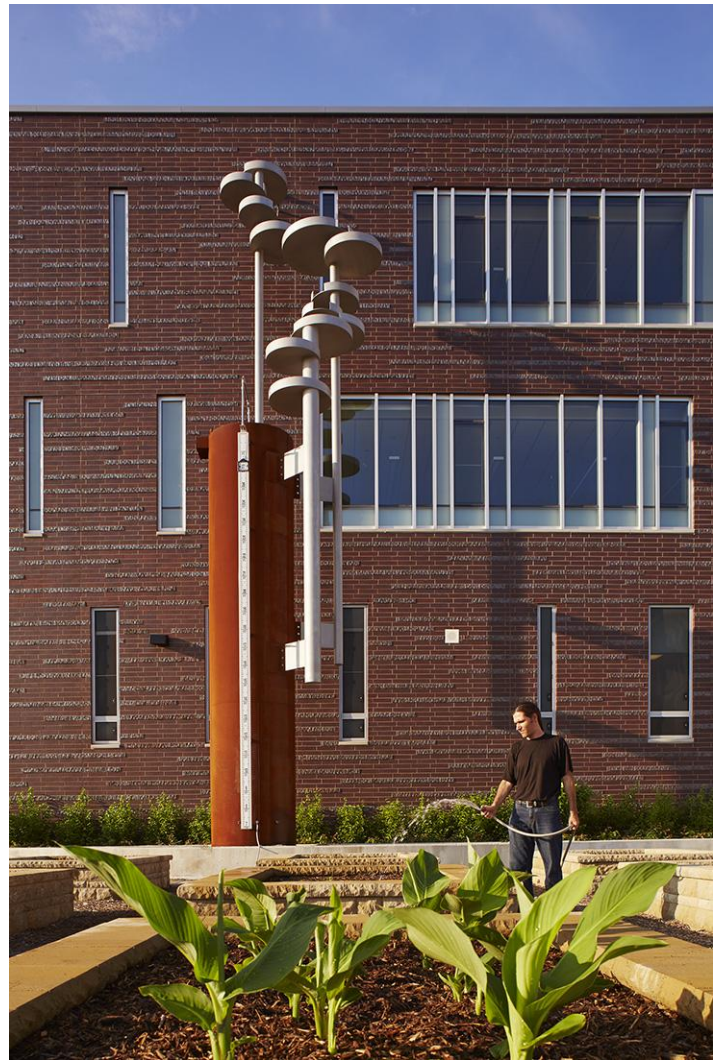
Areas of Intense Mechanical Coordination











LEED Results - Sarah E. Goode STEM Academy vs. BOTYHS

	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

Sarah E. Goode vs. Evolving Prototype

A Side-By-Side Comparison

	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;
Geothermal wells	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. Added geothermal wells – 170 wells at 450 feet deep each.



The Wolcott School

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**CHICAGO'S
VERY OWN**

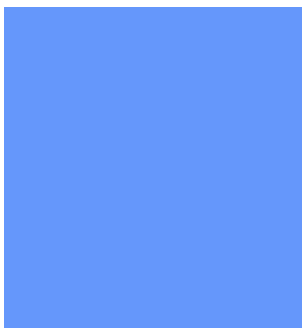


WOLCOTT SCHOOL IS BUILT AROUND THE STRENGTHS OF OUR STUDENTS



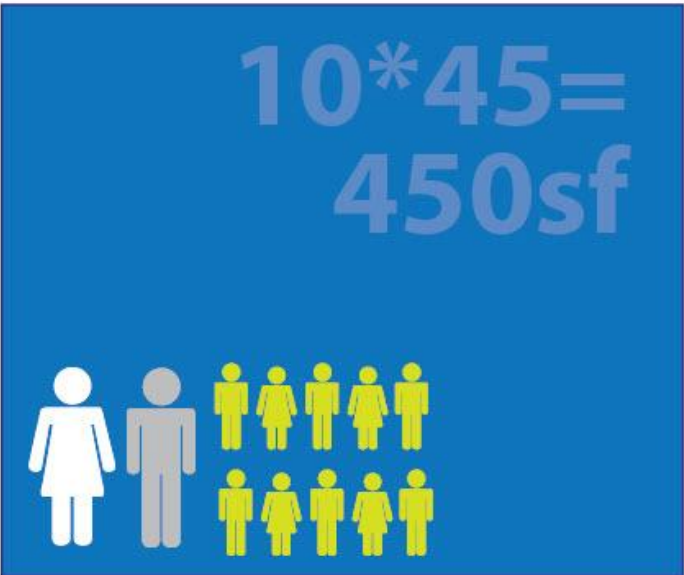


Gov. Peter Shumlin
(D) Vermont



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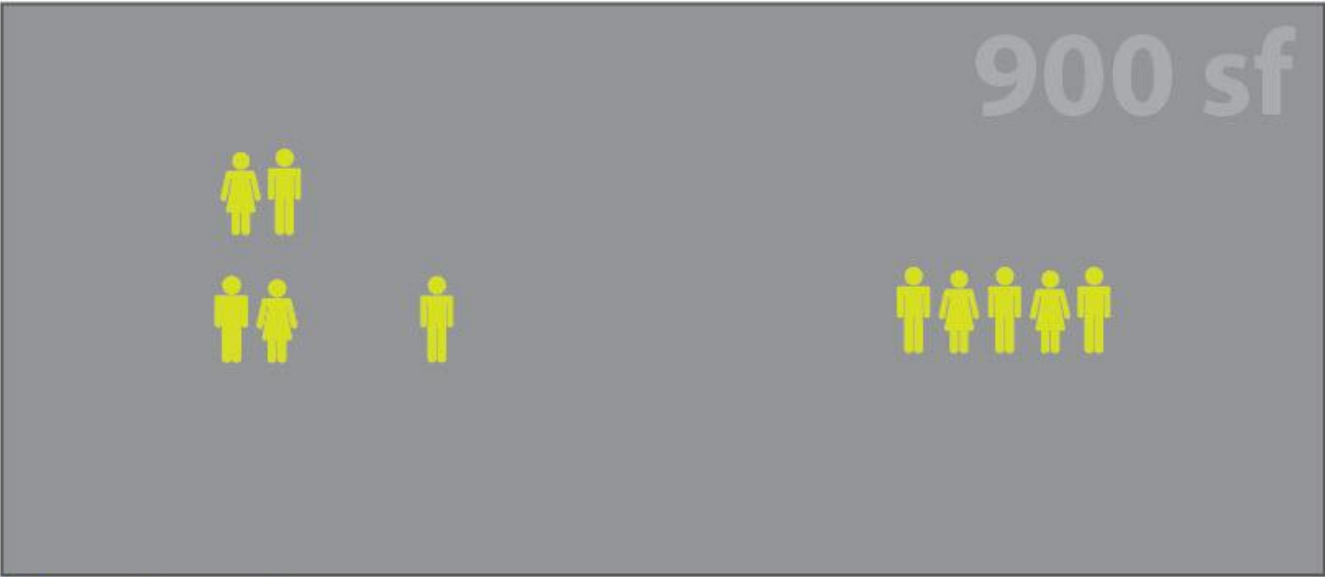
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Classroom



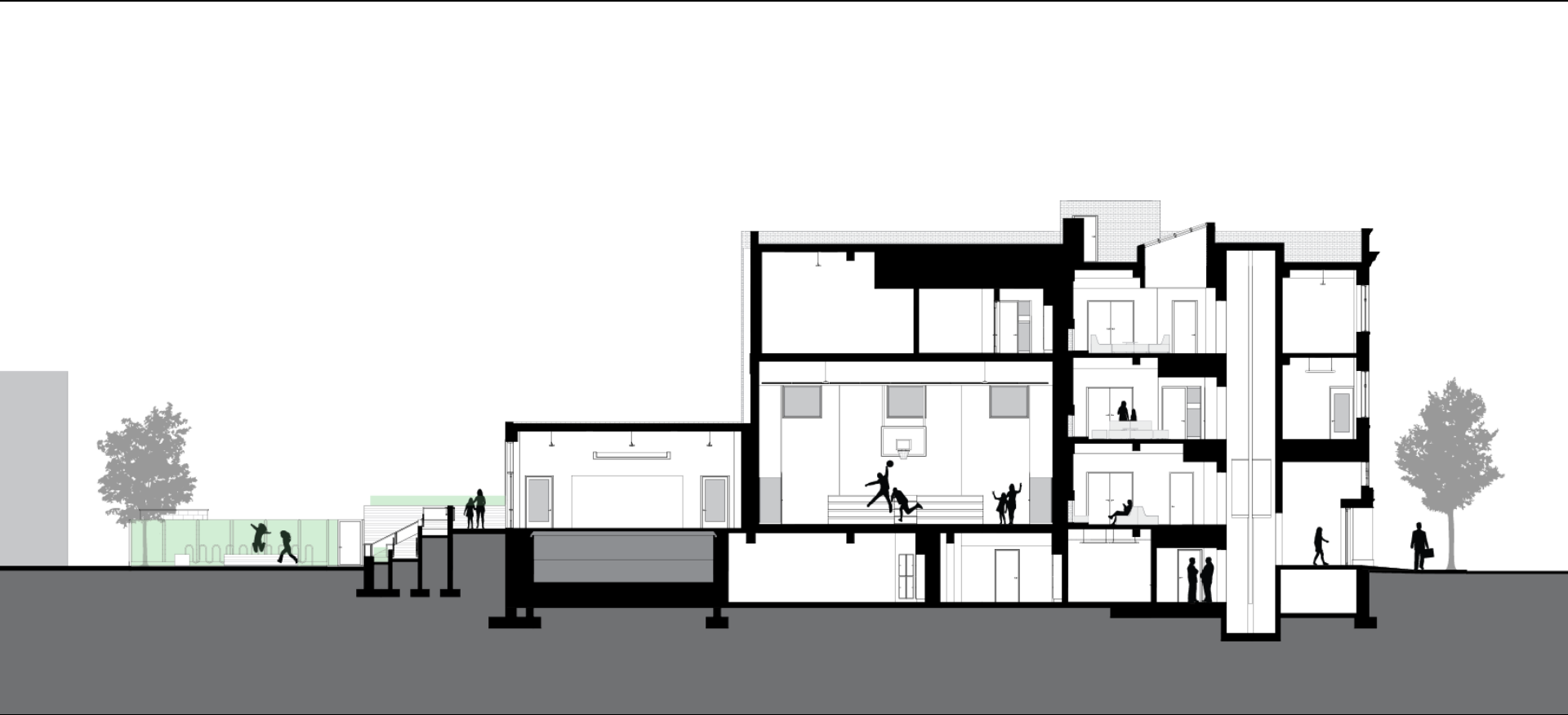
Huddle Room



Fireplace Core

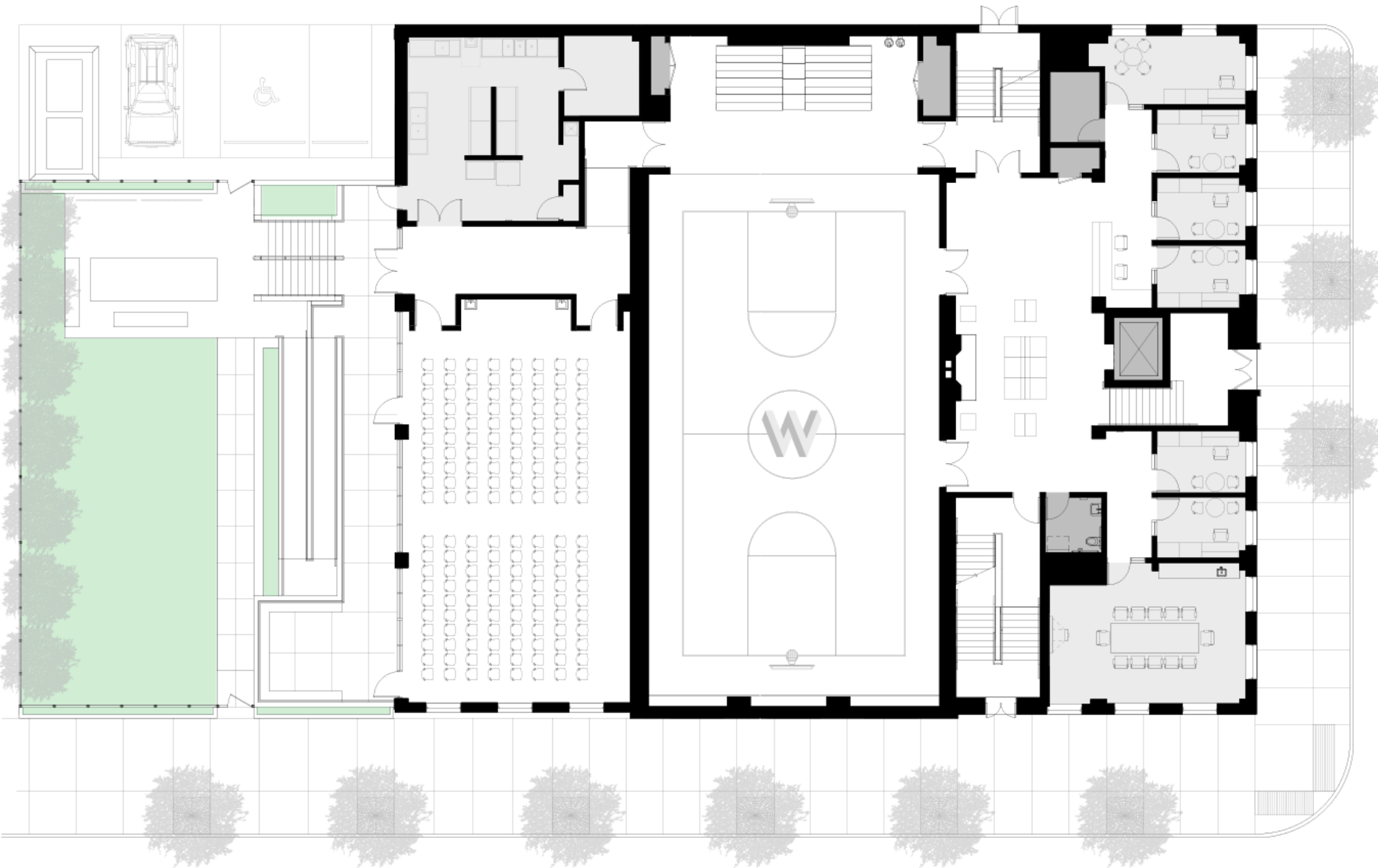












FIRST FLOOR

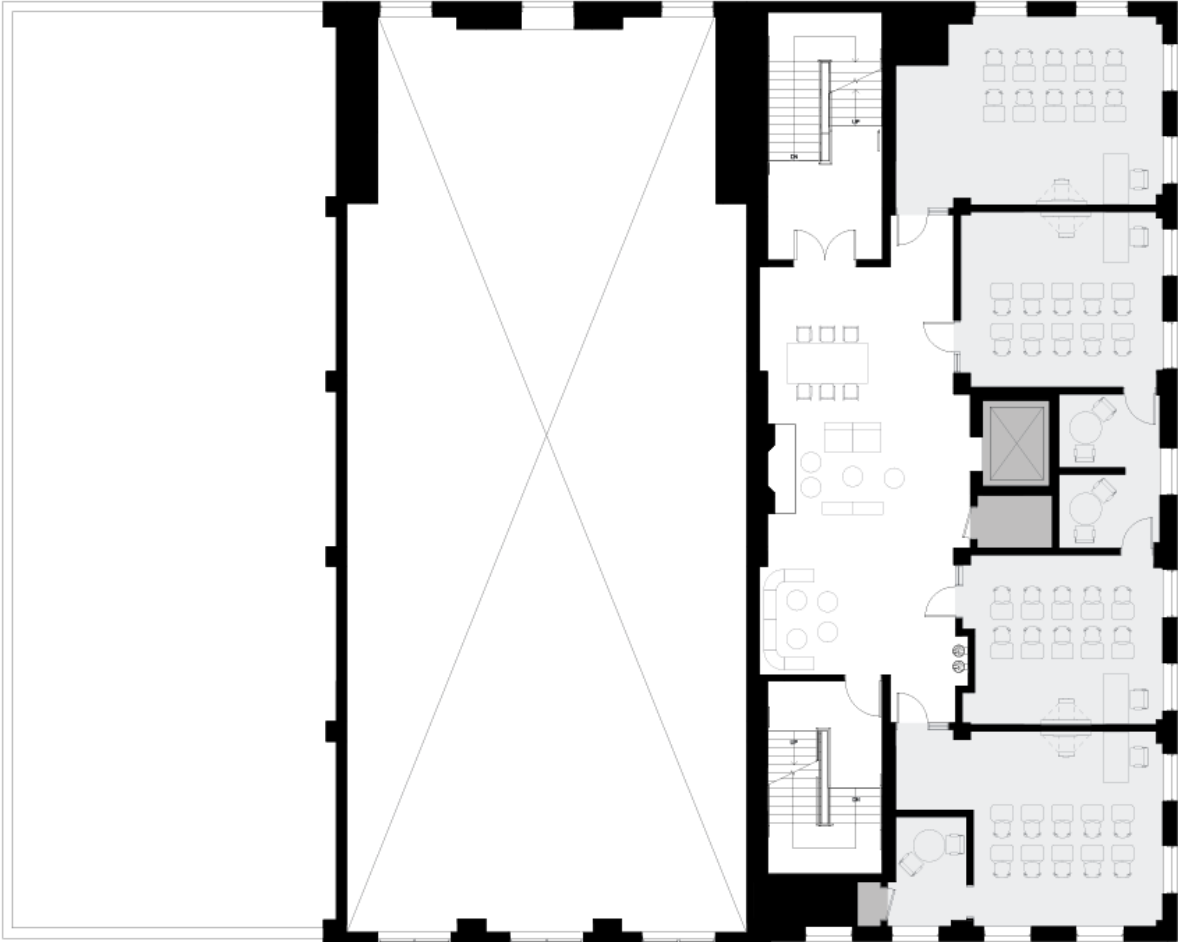






Welcome To Loyal Hearts.
We join our selves to no party which does not honor
the flag, and keep step to the music of the Union.



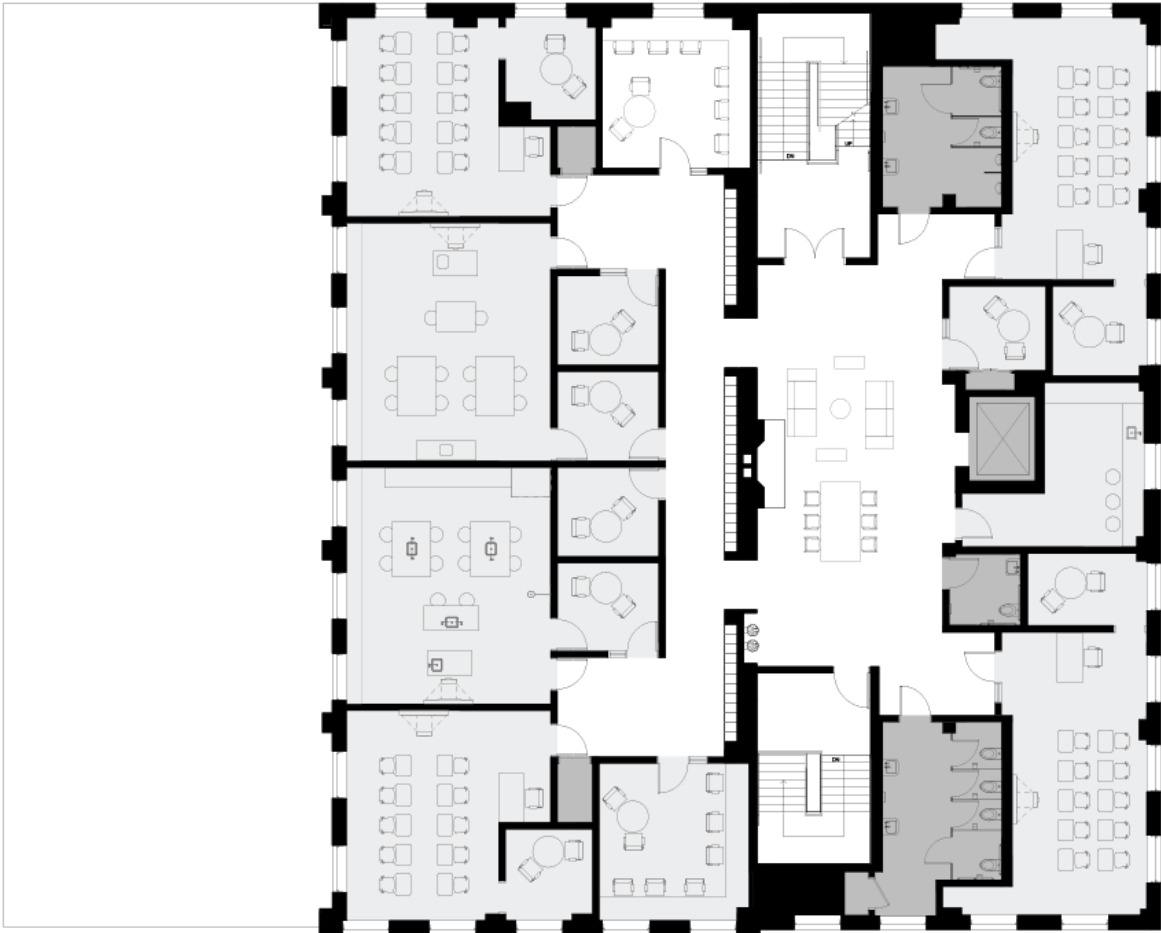


SECOND FLOOR









THIRD FLOOR

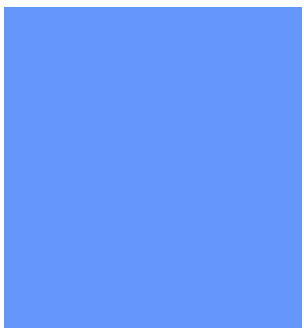






LOWER LEVEL





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18 April 2014

Questions?



Contact Info

Integrative Design

18 April 2014

- Deeta Bernstein, Public Building Commission of Chicago
deeta.bernstein@cityofchicago.org
- Jennifer Costanzo, STR Partners, LLC
jennifer@strpartners.com
- Lawrence Kearns, Wheeler Kearns Architects
larry@wkarch.com
- Dr. Miriam Pike, Wolcott School
mpike@wolcottschool.org
- Sachin Anand, dbHMS
sanand@dbhms.com