

# PLACES FOR THE MIND

## Learning Spaces for Brookline's 21st Century

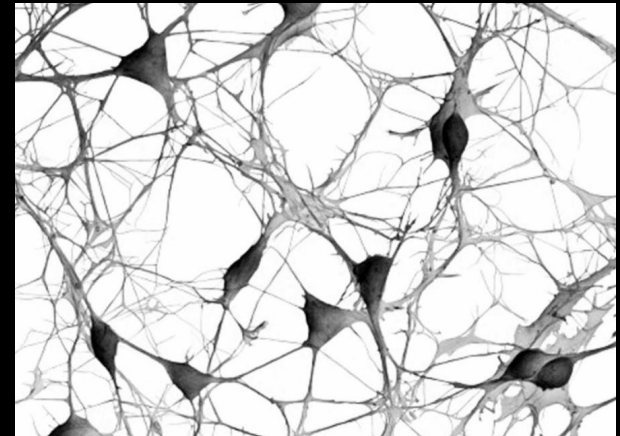
*Joint Session of the*

Town of Brookline School Committee

Baldwin School Building Committee

Driscoll School Building Committee

January 22, 2019



# Outline of Topics

1. Sustainability and Fossil Free Energy Systems
2. Introduction to Educational Places
3. How Young People Think
4. Virtual and Physical
5. Why Places Matter
6. Topics in Evidence-Based Design
7. A Look Into the Future at Baldwin and Driscoll

# Outline of Topics

## 1. Sustainability and Fossil Free Energy Systems

- All-electric heating and cooling
- Geothermal
- Photovoltaics

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# HVAC ZERO COMBUSTION ENERGY SYSTEM TYPES

Baldwin School and Driscoll School  
Brookline, MA



# HVAC ZERO COMBUSTION ENERGY CONSUMPTION SUMMARY

SYSTEM TYPES (Based upon previous school projects)		Annual	Annual	Annual	Annual	COEFFICIENT OF PERFORMANCE (COP)
		Elec. Cons. (kWh)	Electric Cost	Utility \$/s.f.	kBTU/s.f. (EUI)	
1*	Full air-conditioning displacement ventilation diffusers and perimeter electric radiant panel Air-source heat pump heating/cooling VAV ventilating units with energy recovery with terminal VAV boxes with CO2 controls	1,028,800	\$108,020	\$1.87	60.8	3.6 **
2	Variable refrigerant flow (VRF) terminal evaporator units or indoor air handling units with air-cooled condensing units and perimeter electric radiant panel Air-source VRF heating/cooling VAV ventilating units with energy recovery with terminal VAV boxes with CO2 controls	897,320	\$97,200	\$1.09	35.2	4.4
3	Geothermal central heat pump plant which provides chilled water and hot water to air handling units with energy recovery sized for ventilation only Perimeter chilled beam/radiant panel for trim heating and cooling VAV boxes with CO2 controls to displacement diffusers	1,711,928	\$267,060	\$1.15	25.1	7.0

\* Building is multiple use which includes classroom spaces, artist studios and auditorium.

\*\*COP<sub>heating</sub> of 3.5 provides 3.5 units of heat for each unit of energy consumed (i.e. 1 kWh consumed would provide 3.5 kWh of output heat).



# SYSTEM #1: ROOFTOP UNITS HIGH-EFFICIENCY HEAT PUMP

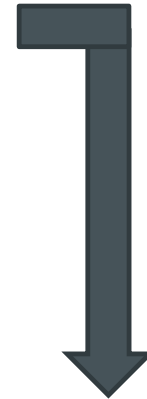


Heat Pump Rooftop Unit (12-30 Ton)



Variable Air Volume Box

Heating Performance			
Heat Type:	Heat Pump	COP:	3.6
Capacity:	212.1 MBh	Entering Air DB:	51.8 F
Ambient Air DB:	5 F	Leaving Air DB:	81.1 F



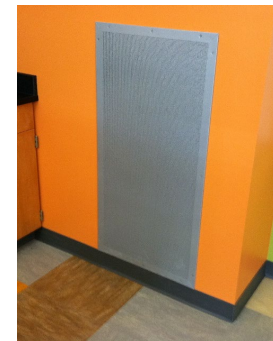
Electric Radiant Panel

## DESCRIPTION:

- Full air-conditioning displacement ventilation diffusers and perimeter electric radiant panel
- Air-source heat pump heating/cooling VAV ventilating units with energy recovery with terminal VAV boxes with CO2 controls

## PRO:

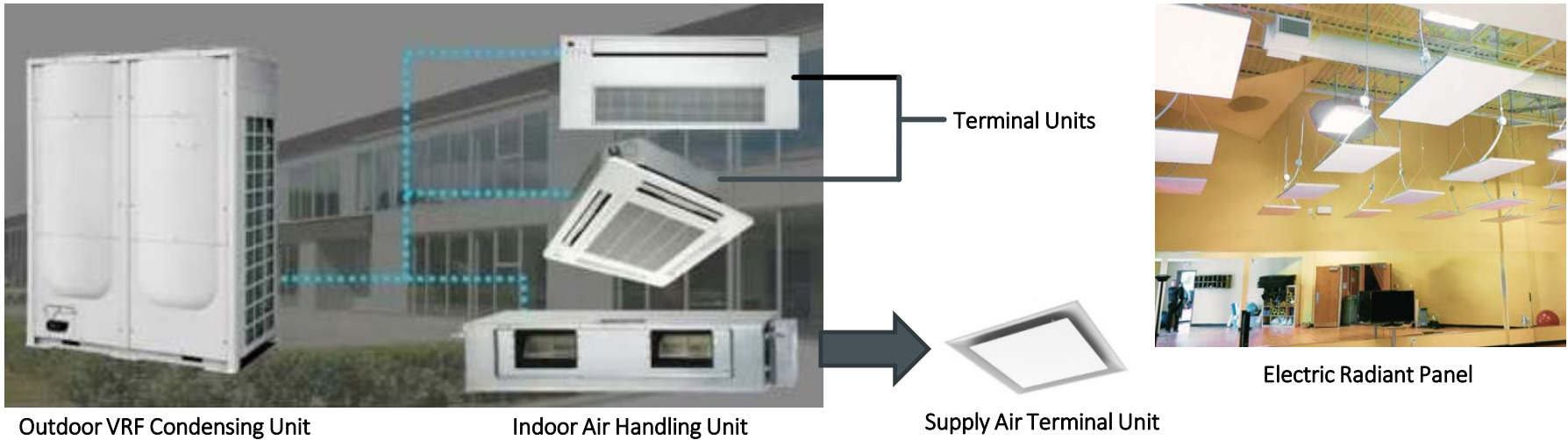
- Lowest Installation Costs, Does Not Use Fossil Fuels for Heating, Uses Conventional Distribution and Terminal Equipment, Projected EUI Range of 50-60



Displacement Diffuser



## SYSTEM #2: AIR-SOURCE ELECTRIC VRF (VARIABLE REFRIGERANT FLOW)



### DESCRIPTION:

- Variable refrigerant flow (VRF) terminal evaporator units or indoor air handling units with air-cooled condensing units and perimeter electric radiant panel
- Air-source VRF heating/cooling VAV ventilating units with energy recovery with terminal VAV boxes with CO2 controls

### Heating Performance

Outdoor units can operate up to 4.41 COP to reduce energy consumption.

### PRO:

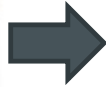
- Lower Energy Use, Moderate Installation Costs, Does Not Use Fossil Fuels for Heating, Terminal Units located in Ceiling, Projected EUI Range of 25-35



## SYSTEM #3: GEOTHERMAL HEAT PUMP



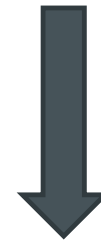
Geothermal Heat Pumps



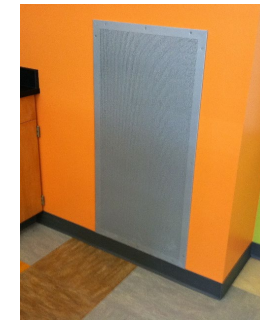
Indoor Air Handling Unit with Hot & Chilled Water Coils



Variable Air Volume Box



Chilled Beam/Radiant Panel



Displacement Diffuser

### DESCRIPTION:

- Geothermal central heat pump plant which provides chilled water and hot water to air handling units with energy recovery sized for ventilation only
- Perimeter chilled beam/radiant panel for trim heating and cooling
- VAV boxes with CO2 controls to displacement diffusers

### PRO:

- Lowest Energy Use, Highest Installation Costs, Does Not Use Fossil Fuels for Heating, Terminal Units located in Walls, Projected EUI Range of 20-25

**Heating Performance**  
COP can exceed 7.0 by leveraging combined chilled and hot water efficiency — more efficient than a gas-fired boiler at 0.95 COP





## HVAC ZERO COMBUSTION BUILDINGS

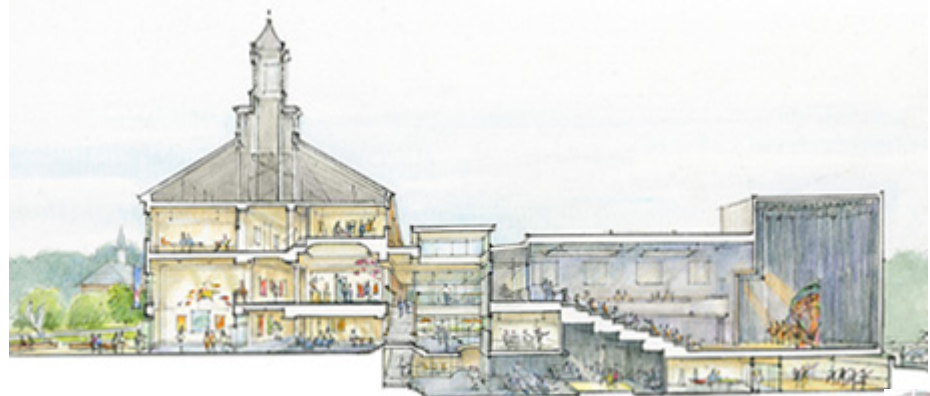


### **KING OPEN CAMBRIDGE UPPER SCHOOL, CAMBRIDGE, MA**

Plumbing, Fire Protection, HVAC, Electrical, Security and Technology design and construction services for the new construction of the new King Open Elementary School, Cambridge Street Upper School, a new Valente Branch Library, Gold Star Pool, Human Services space including preschool and afterschool programs, Cambridge Public Schools Administrative offices, and Parking. Estimated square footage for the purposes of preparing our fee is based on building area of 238,000 square feet and garage area of 20,000 square feet. This project is projected to become a Net Zero Energy Building achieve LEED Silver certification. This project has a geothermal well, solar water heater and photovoltaic system.

### **EMERSON UMBRELLA CENTER OF THE ARTS, CONCORD, MA**

Plumbing, Fire Protection, HVAC, Electrical and Technology schematic design through construction administration services for the renovation/addition to the existing approx. 48,000 s.f. Emerson Umbrella Center for the Arts and 27,000 s.f. addition. The previously renovated Gallery Space will remain and will only require HVAC modifications. The modifications include an all-electric HVAC system. The project is projected to meet LEED certification.



## HVAC ZERO COMBUSTION BUILDINGS



### **859 MASSACHUSETTS AVE FAMILY SHELTER CAMBRIDGE, MA**

Fire Protection, Plumbing, Mechanical and Electrical study, design and construction administration services for the design of 10 single room occupancy units located on the first, second and third floors and a common space at 859 Mass Ave. Our scope also included storage tank, photovoltaic array design and solar hot water collector. This project is anticipated to achieve LEED certification.

### **DCR WALDEN POND VISITOR'S CENTER, CONCORD, MA**

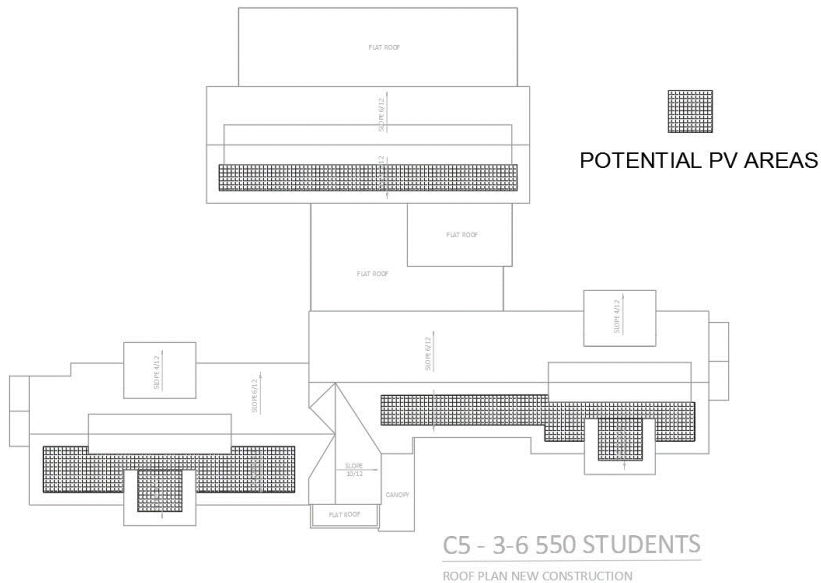
MEP/FP design for new high-efficiency (beyond Net Zero) 6,500 SF visitors center including exhibits, public & staff restrooms, administrative spaces, conference spaces, lunch room, kitchenette, gift shop/bookstore and storage areas. Sustainability features include solar parking canopy and electric vehicle charging stations. LEED Commissioning was part of this project. This project was the first DCR project if be awarded LEED certification.



# PHOTOVOLTAIC ARRAY SYSTEM FOR SCHOOLS

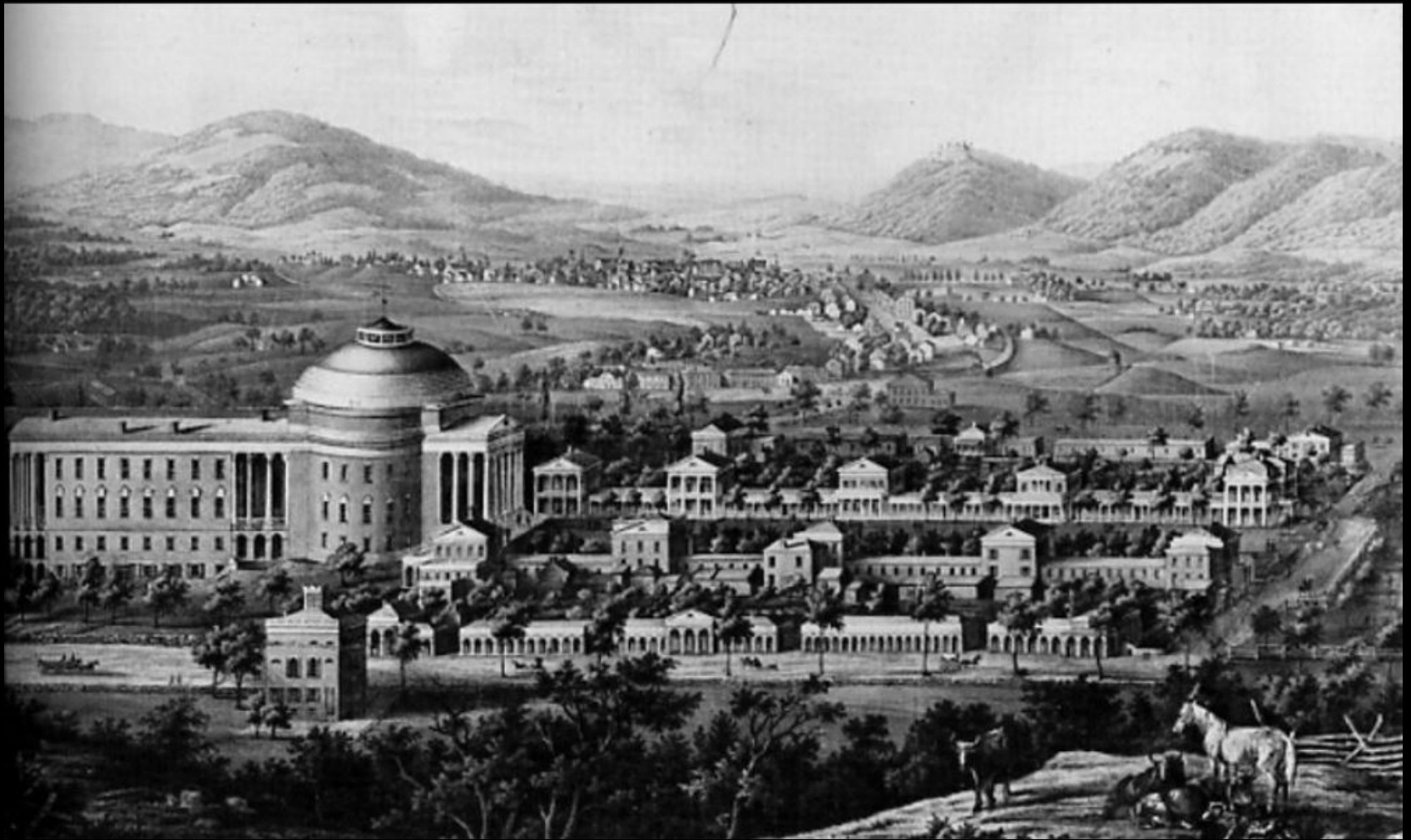
## ROOF MOUNTED SYSTEM

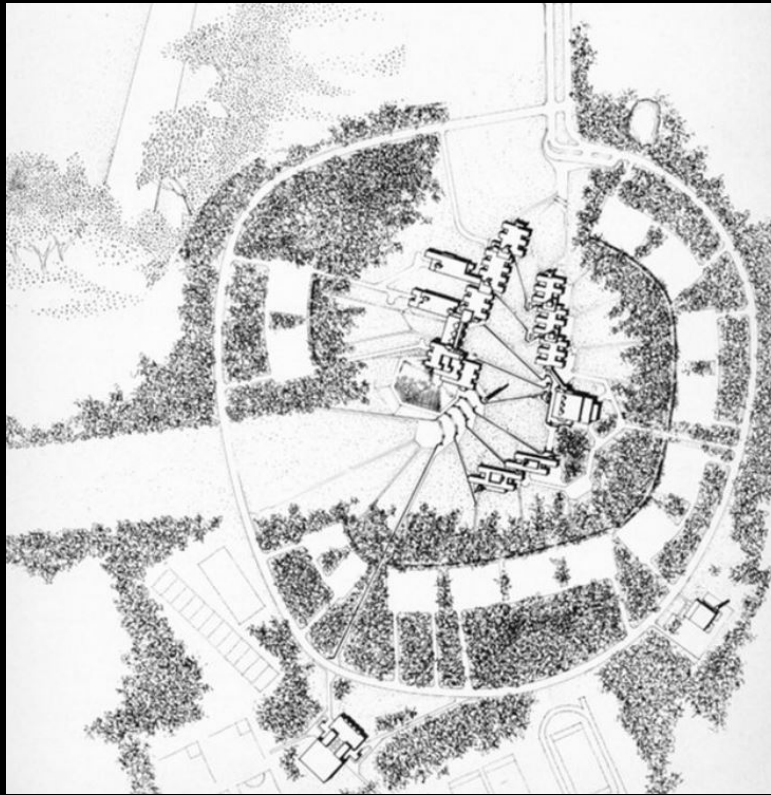
- Estimated Size: 95KW
- Estimated kWh generated: 123,461
- Estimated Construction Cost: \$285,000
- Estimated SMART Compensation: \$16,475/yr
- Estimated Discounted Payback: 9 years

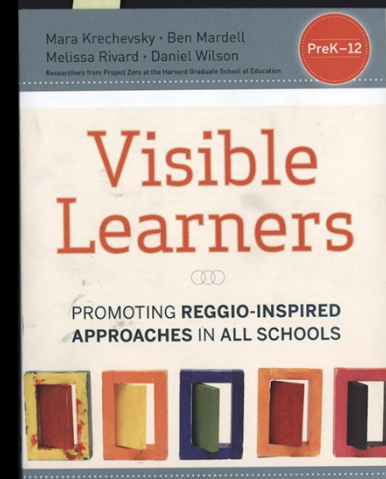
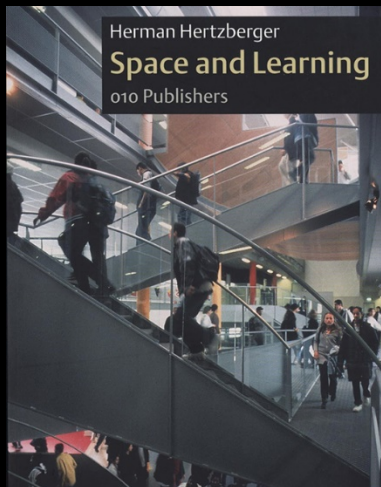
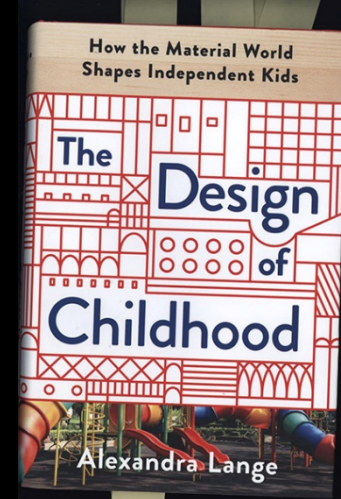
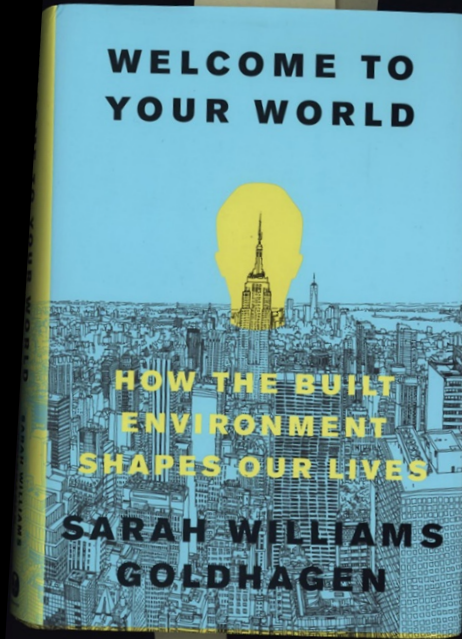
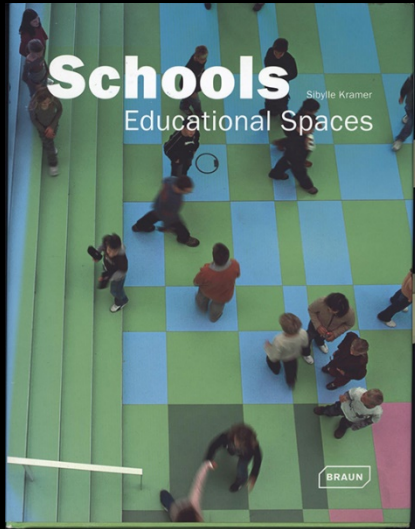


# Outline of Topics

1. Sustainability and Fossil Free Energy Systems
2. Introduction to Educational Places
  - The revolution in education
  - Multiple intelligences to individuated instruction
  - Technology and collaboration
  - Reference literature





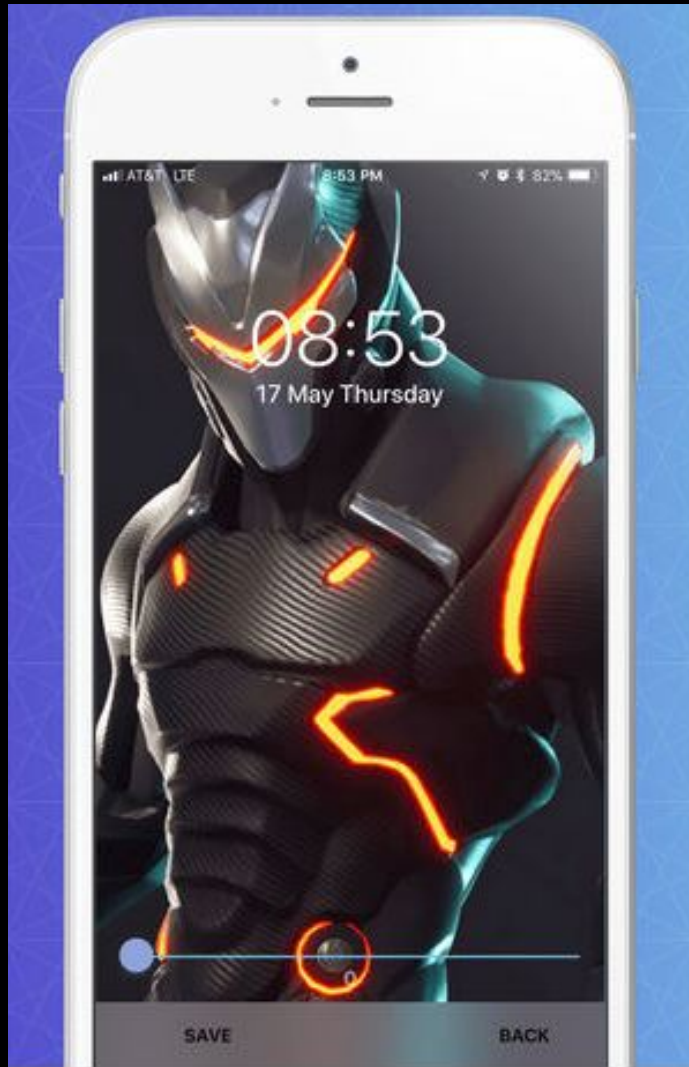


# Outline of Topics

1. Sustainability and Fossil Free Energy Systems
2. Introduction to Educational Places
3. How Young People Think
  - Simultaneous consciousness
  - The end of 'depth' and conclusiveness
  - Group think and openness
  - Graphical and spatial ideation







Jonathan Levi Architects



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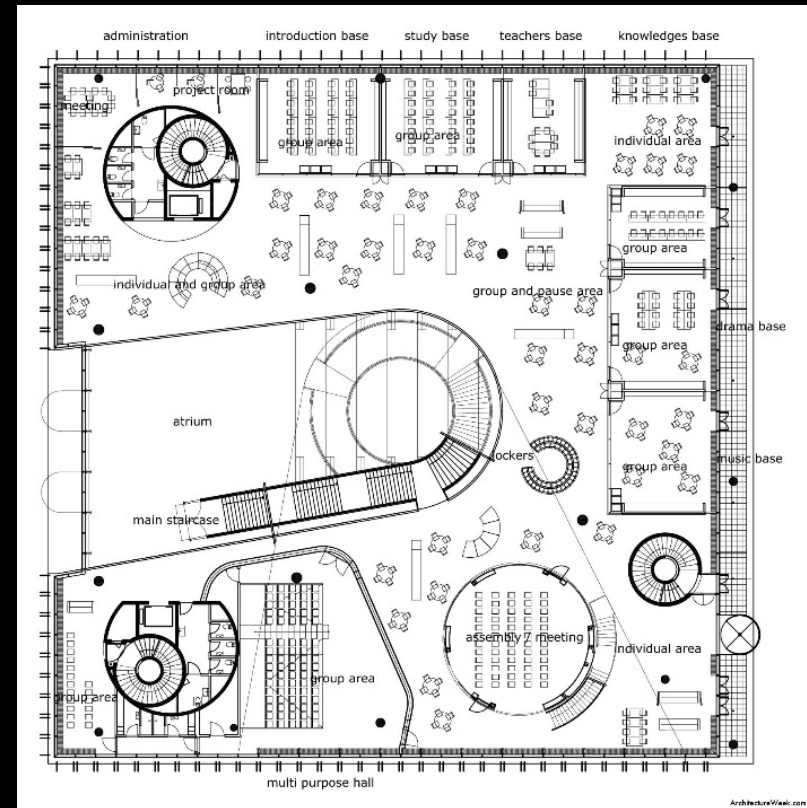
1. Sustainability and Fossil Free Energy Systems
2. Introduction to Educational Places
3. How Young People Think
4. Virtual and Physical
  - Bricks and mortar value-added
  - Complementing the virtual
  - Ordering knowledge in 3 dimensions
  - Browsing and Studying



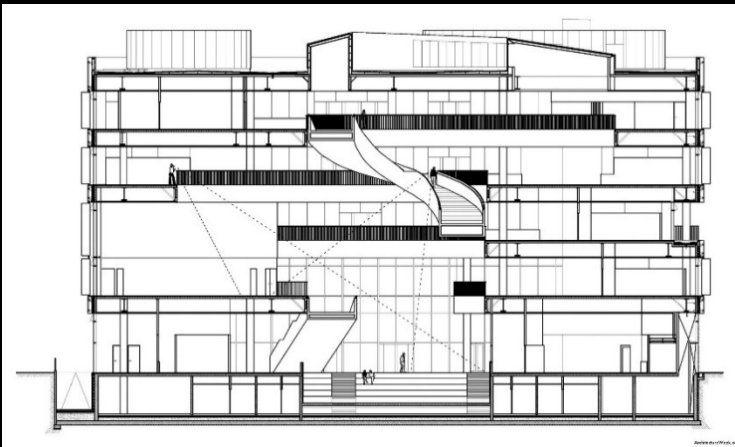
“No ideas but in things.”

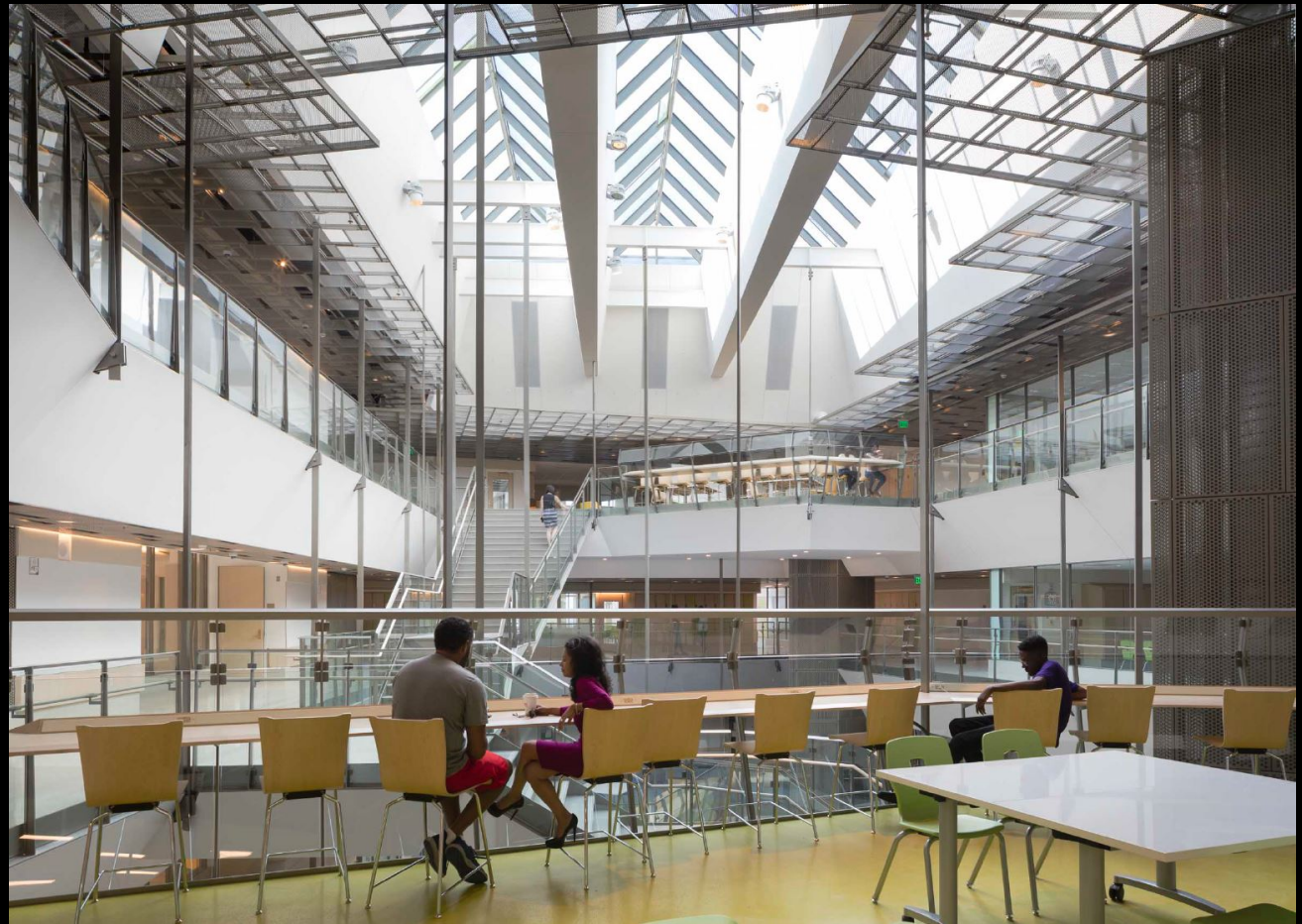
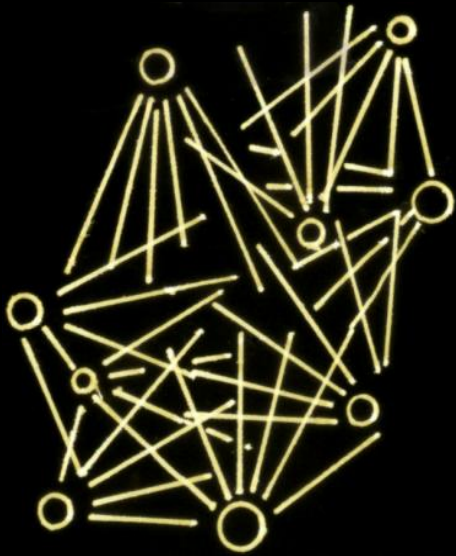
-William Carlos Williams





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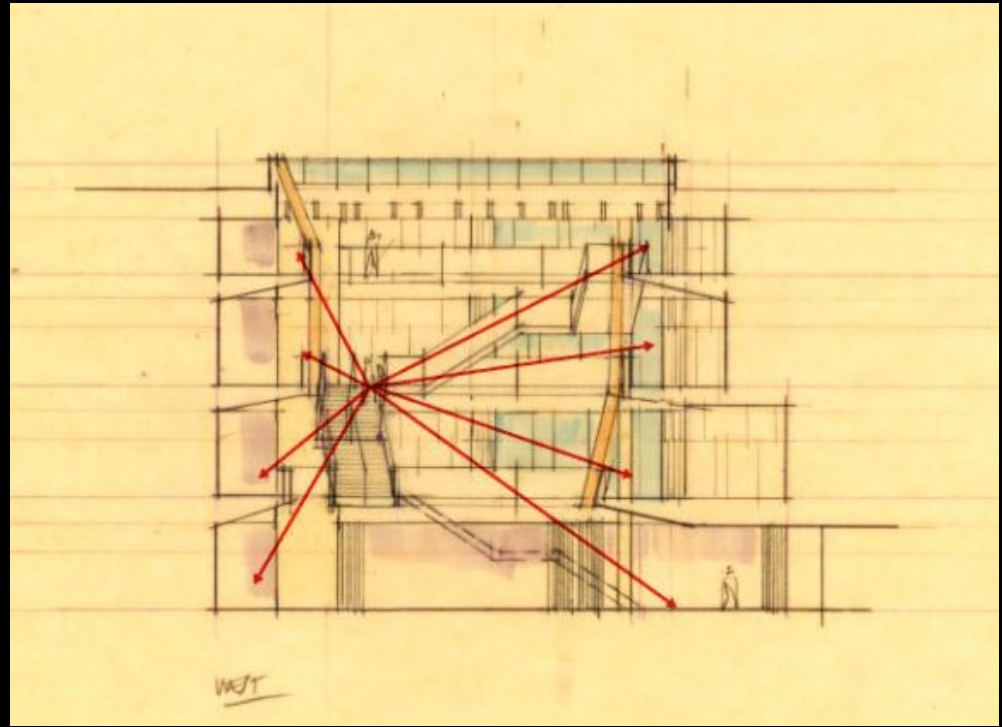


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1. Sustainability and Fossil Free Energy Systems
2. Introduction to Educational Places
3. How Young People Think
4. Virtual and Physical
5. Why Places Matter
  - Wonderstanding!
  - Visible learning
  - The ideational spectacle
  - Randomness and invention
  - Socialization







*“To marvel is the beginning of all  
knowledge”*

- ancient greek proverb



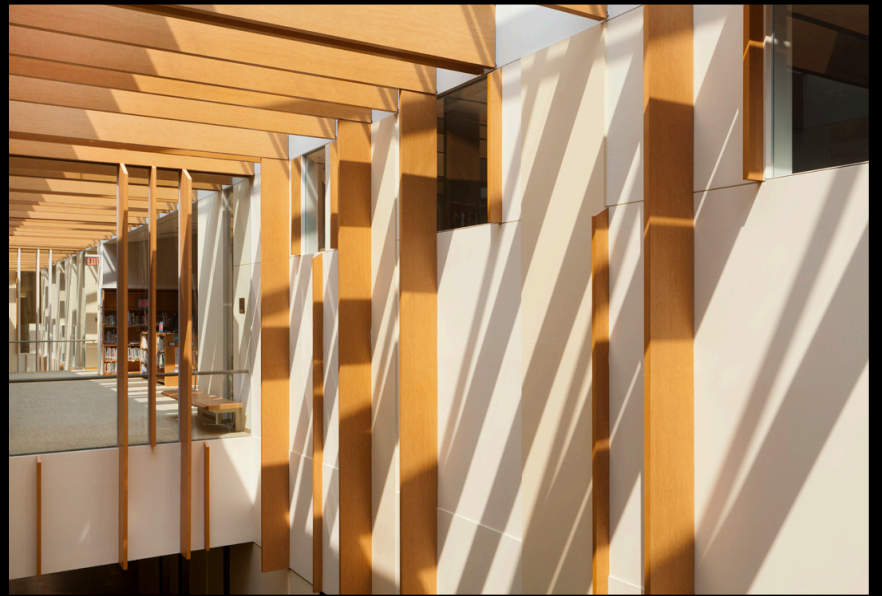


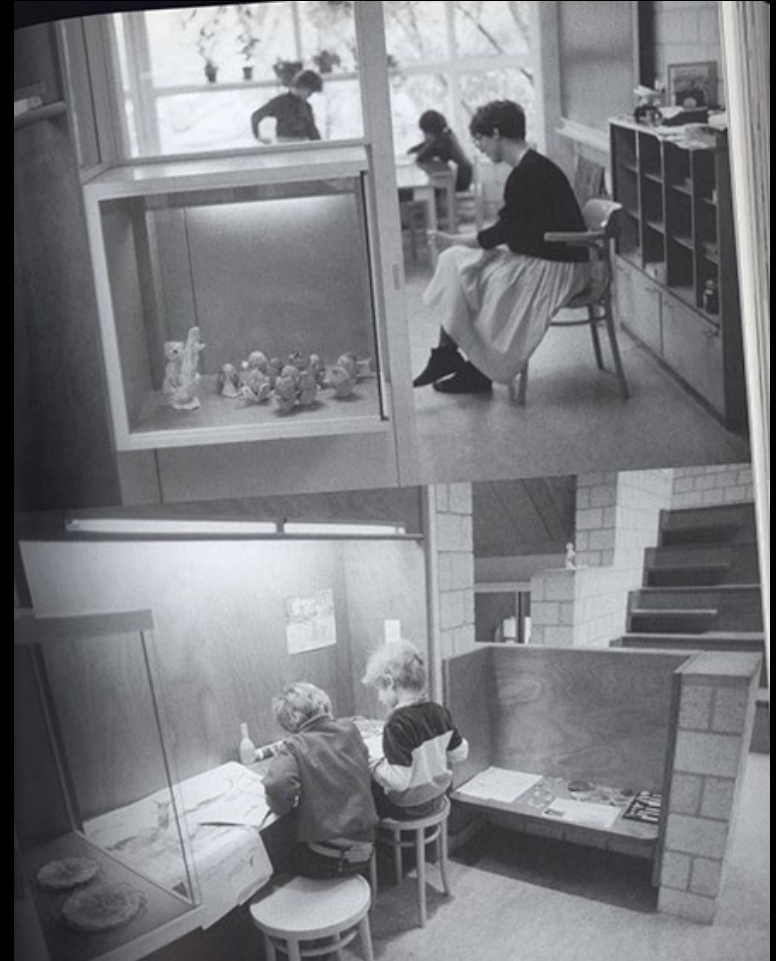
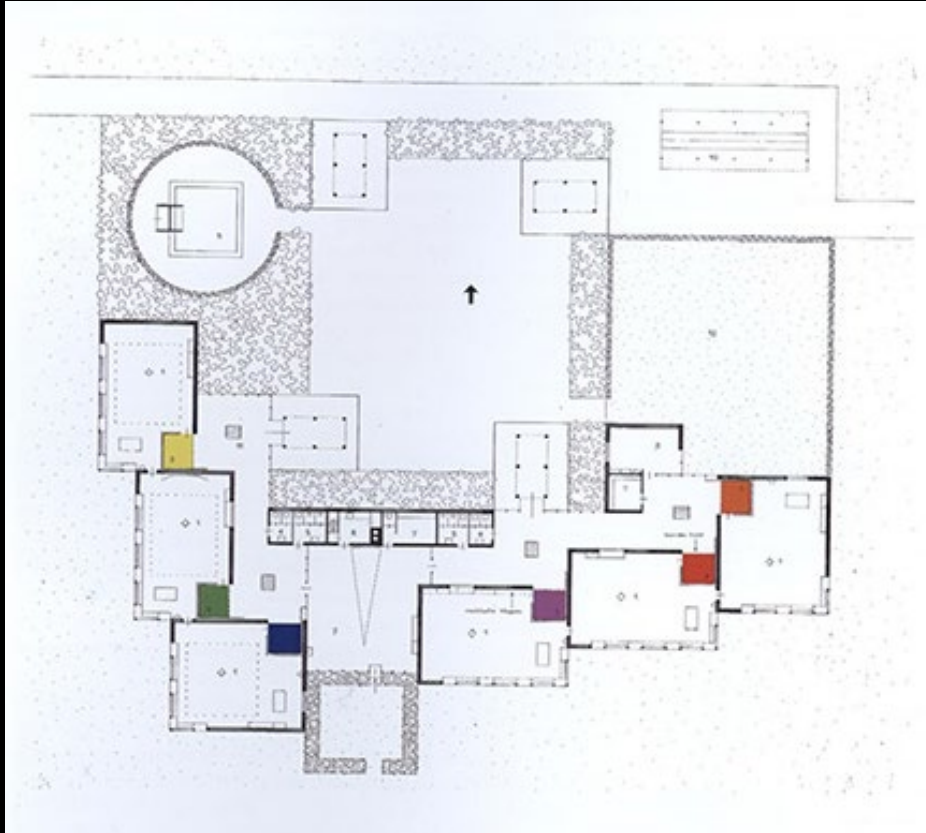


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3. How Young People Think
4. Virtual and Physical
5. Why Places Matter
6. Topics in Evidence-Based Design
  - Domesticity and institutions
  - Daylight
  - Small spaces and collaboration
  - Big spaces and big ideas
  - Curvature and material welcome







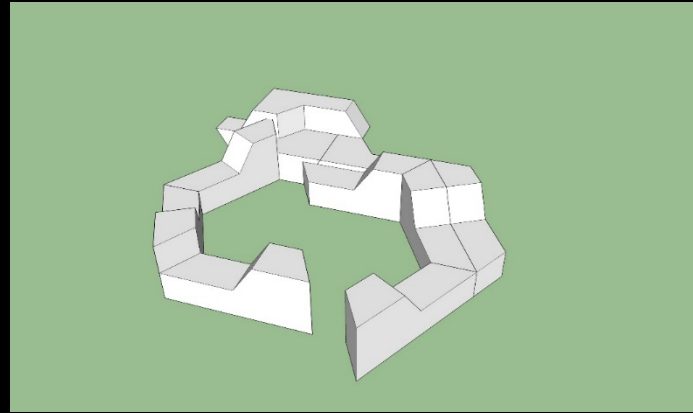
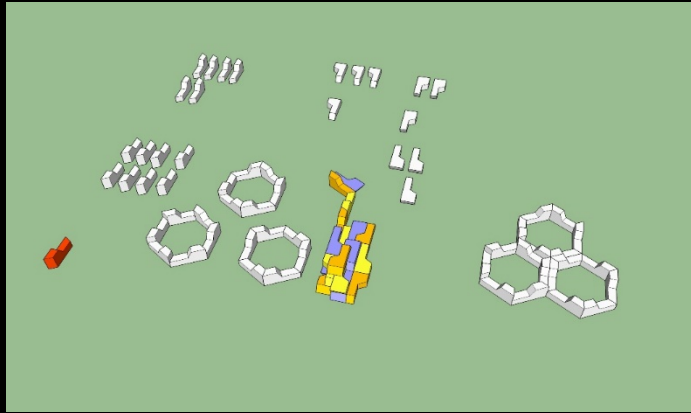














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7. A Look Into the Future at Baldwin and Driscoll
  - Baldwin and nature
  - Driscoll and the city

