



**TERMOBUILD™**

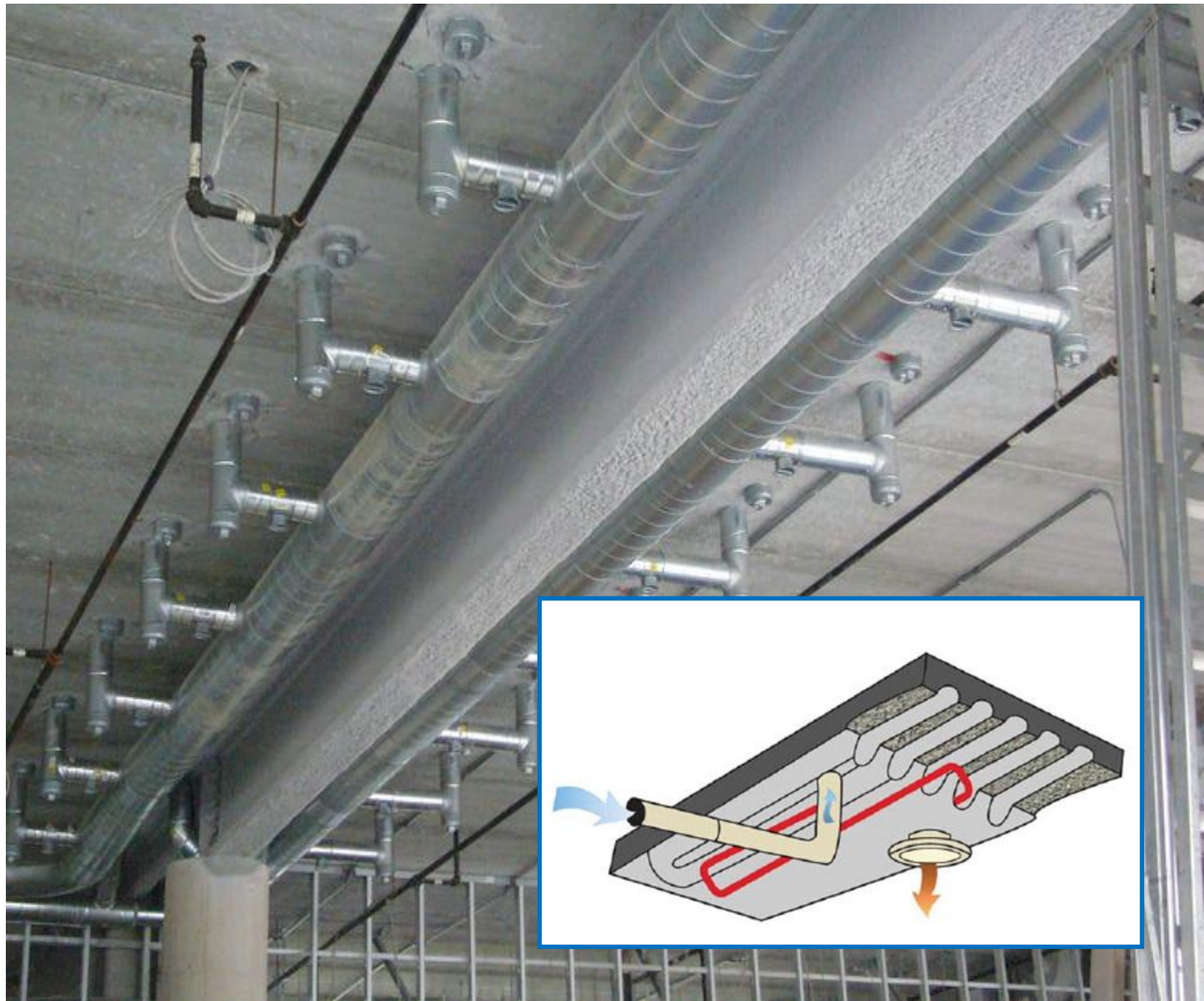
# Integrated Ventilation Design Solutions

Efficient, Sustainable & Safe Buildings for Less

# Introduction

Tom Machinchick  
Director Project Acquisition

Jack Laken  
President



# TermoBuild Introduction

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Engineering Design Assist Firm

Integrated Ventilation Design Solutions

Commercial, Residential, and Public Buildings

Work Alongside Project Architects, Engineers, and Designers

# Introduction

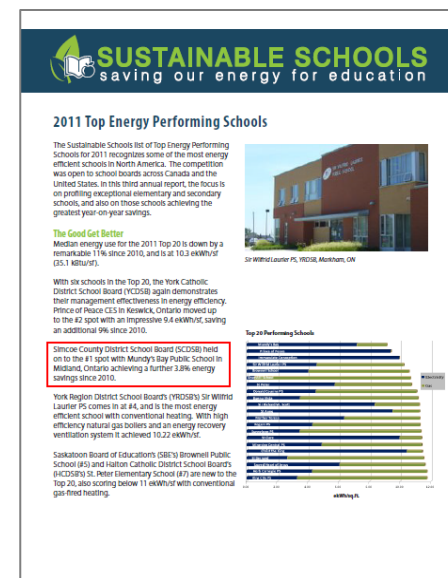
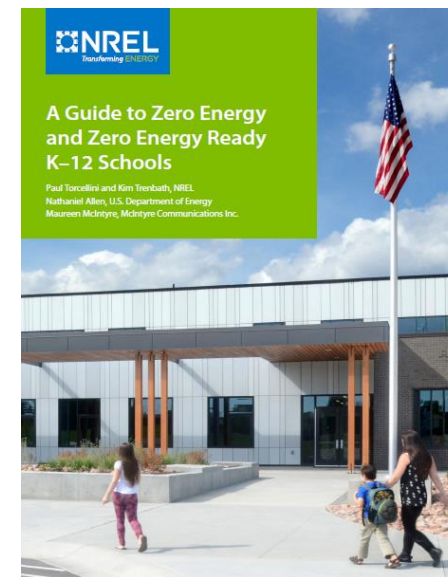
- Net Zero, Net Positive, & Smart City Sustainability Initiatives Are Enabled with Integrated Ventilation Design
- Enhanced Building Air Quality and Safety for Communicable Diseases

## This is NOT New Technology

15 Year Track Record  
 35 Completed Projects  
 2.1M square feet  
 4 LEED Certified Buildings

### Awards, Honors, and Accomplishments

- AIA Award of Excellence
- Living Building Challenge 3.0 Award
- **2 Best Performing School in Canada Awards** (2 different school buildings)
- **Best Performing School in Horry County SC** – (Net Positive campus with multiple buildings)
- Three TermoBuild schools featured in **NREL A Guide to Zero Energy and Zero Energy Ready K–12 Schools**
- EUI figures well below US DOE Building Type Averages for various ASHRAE zones



# What is Integrated Ventilation?

## Integrated Ventilation Design

The aim of Integrated Ventilation is to balance the building's indoor environment with the outdoor environment as naturally as possible.



Very Efficient (Energy and Carbon)

Enhanced Ventilation Safety

Superior Financial Performance  
Cost/Investment/Risk

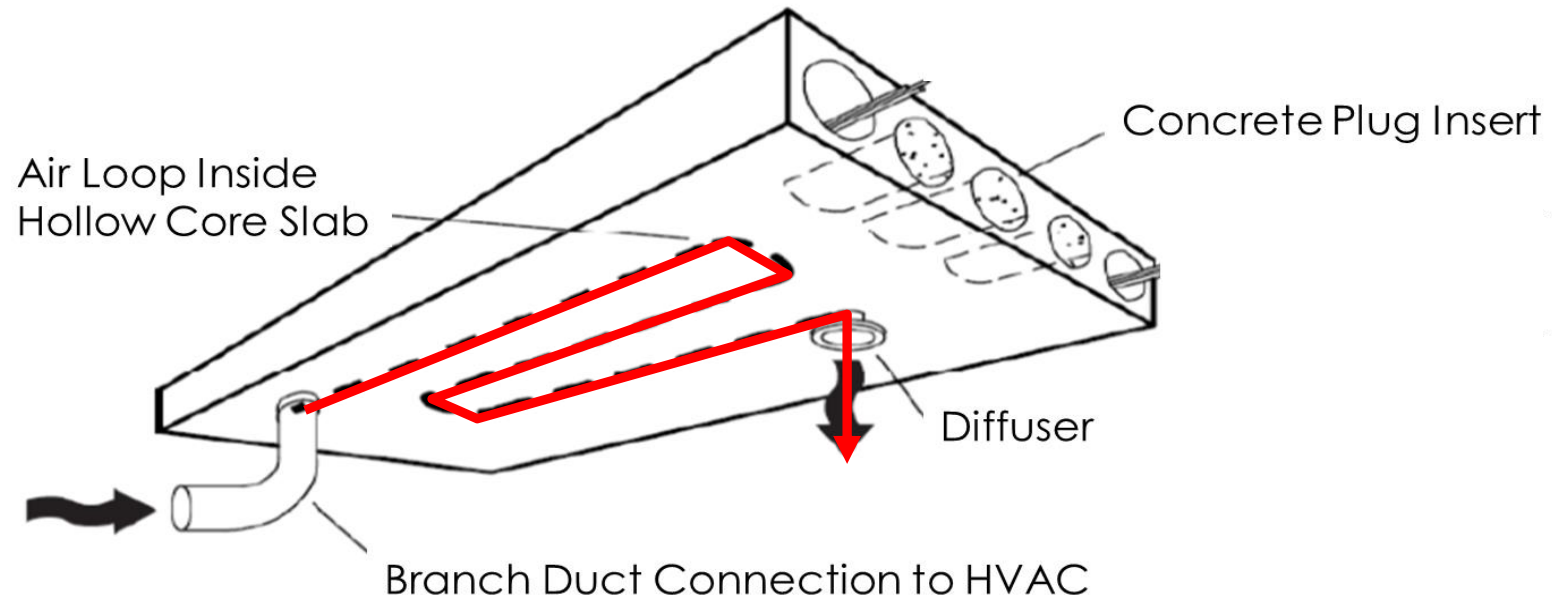
# Hollow Core Concrete Slabs

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Standard Hollow  
Core Concrete  
Flooring Slabs



# Hollow Core Concrete Slab Modification





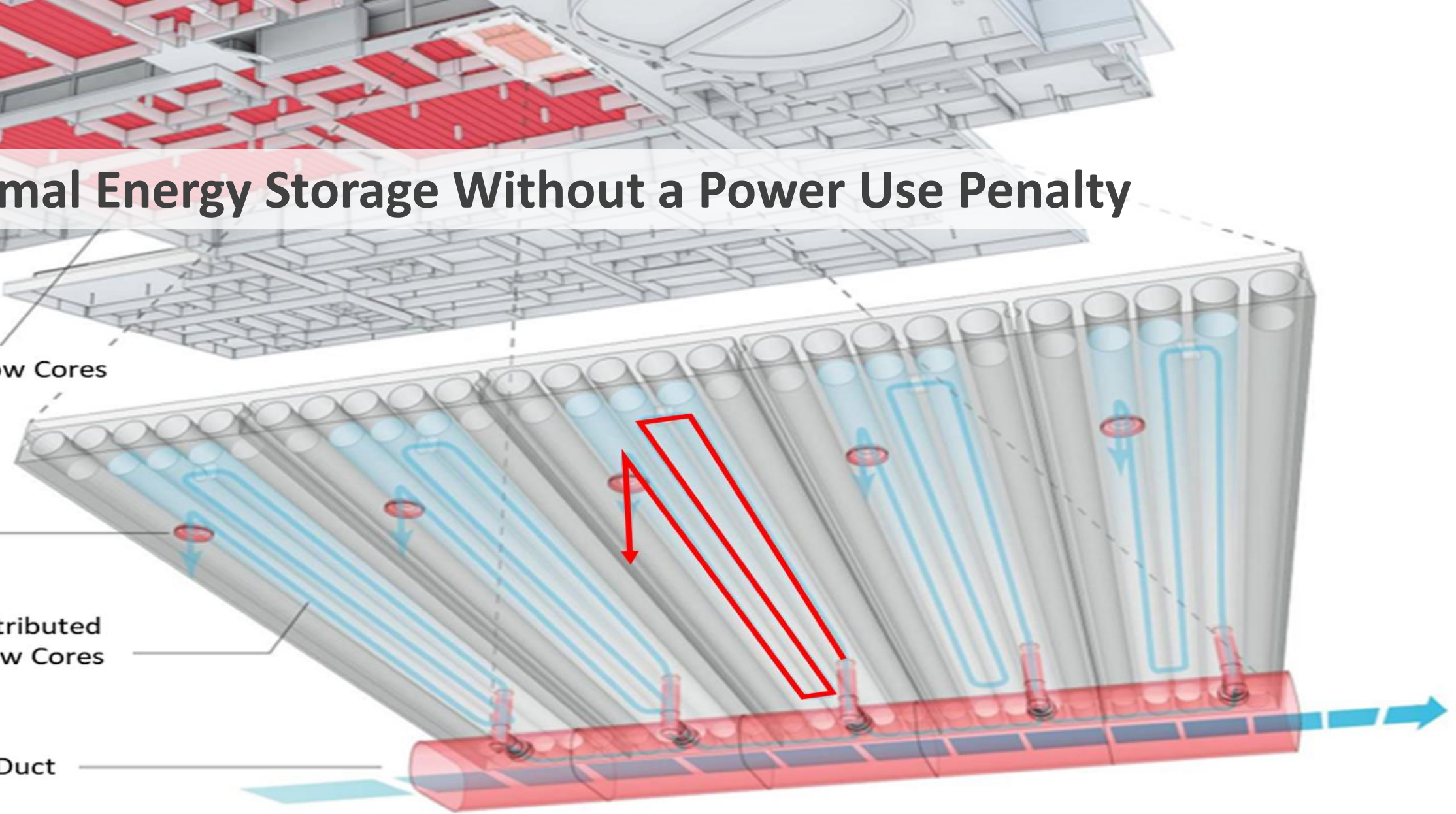
# Thermal Energy Storage Without a Power Use Penalty

Installed Hollow Cores

Air Diffuser

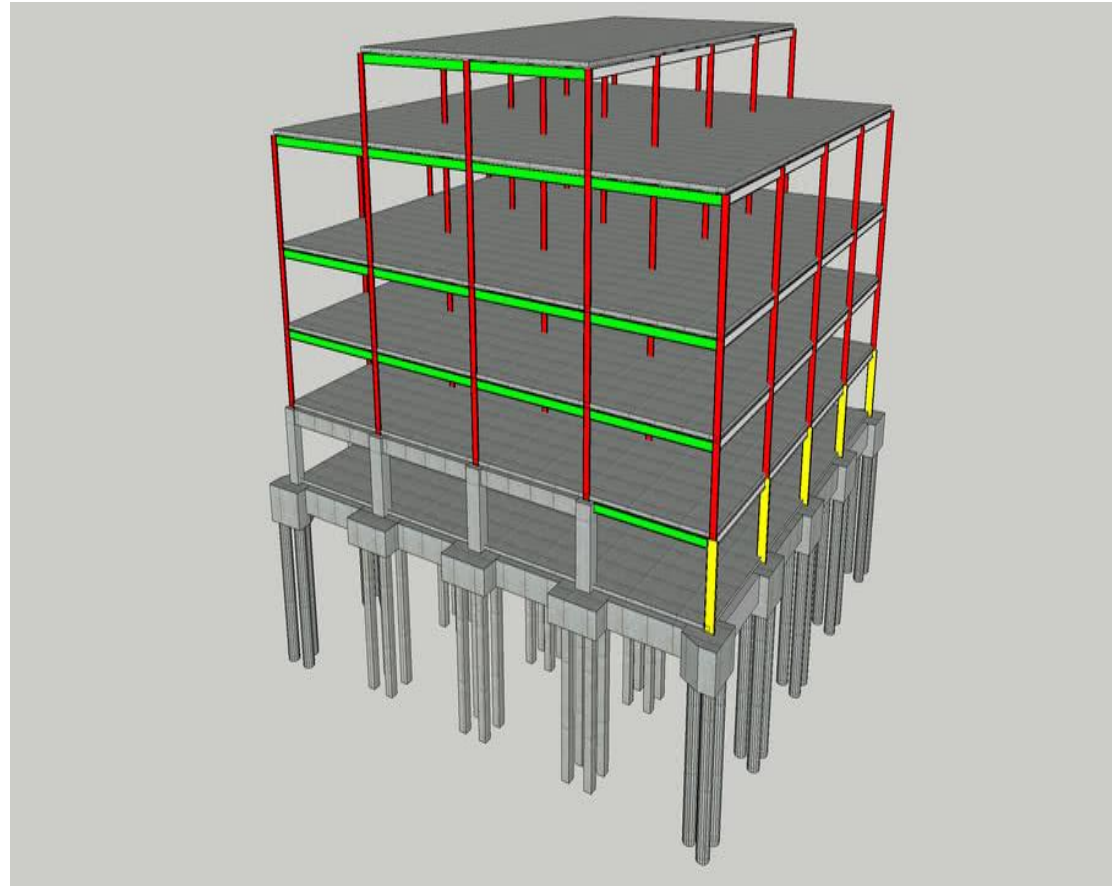
Supply Air Distributed Through Hollow Cores

Supply Trunk Duct

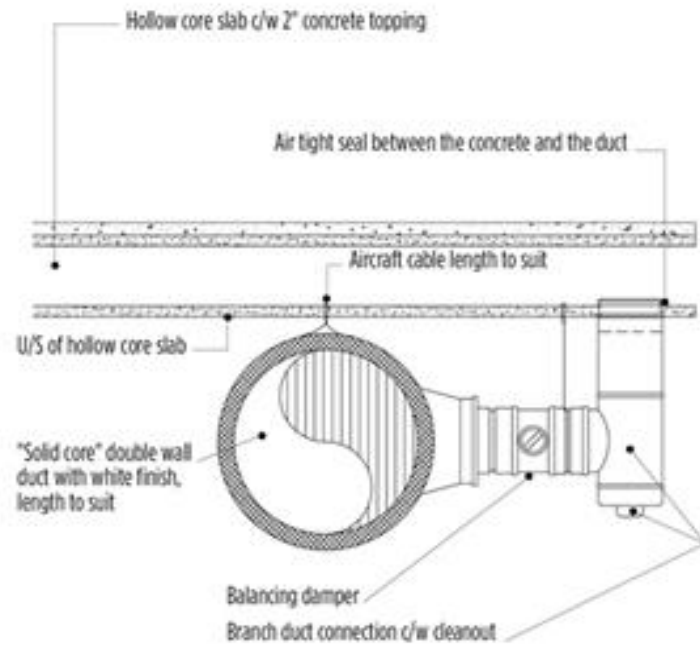


# Standard Building Structure

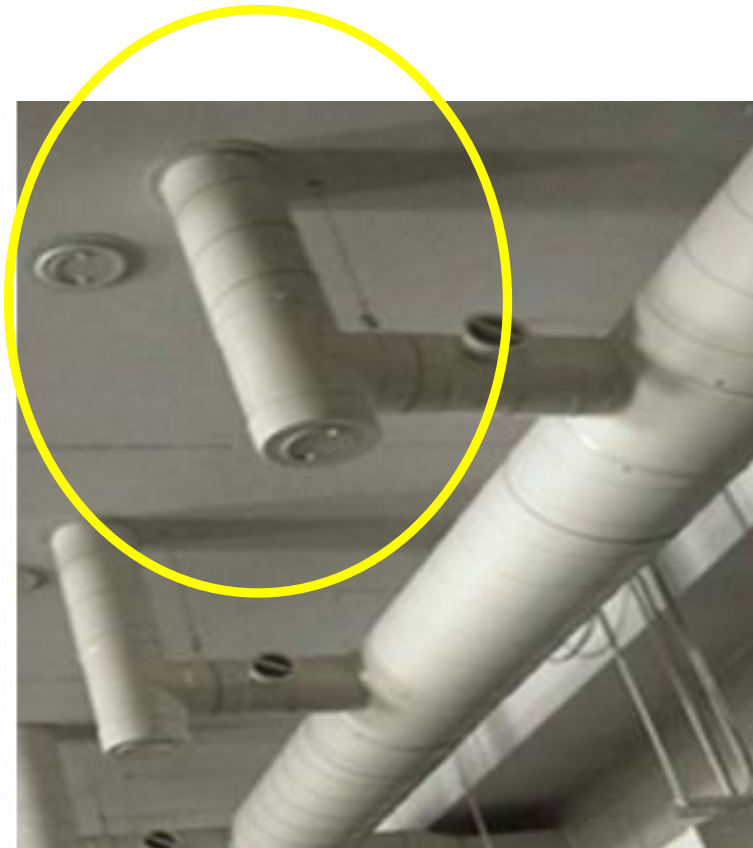
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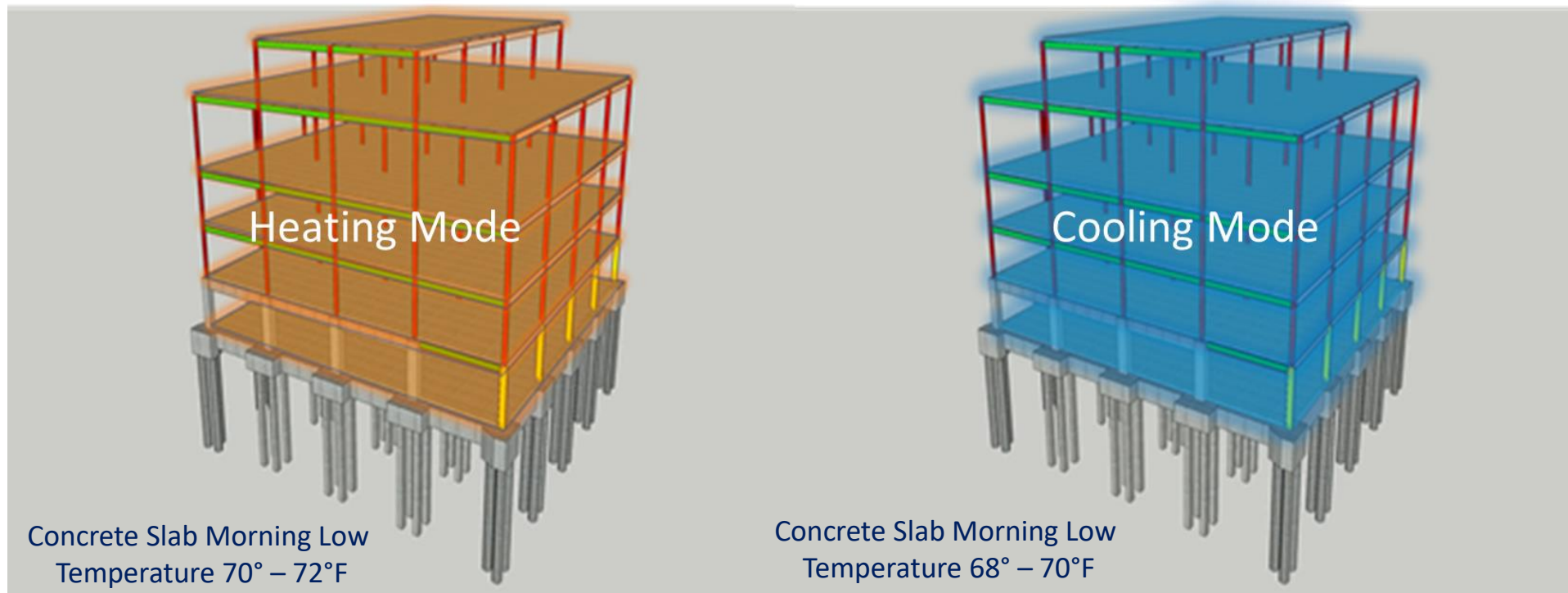
# Simple Connection Duct



Detail A: Typical branch duct connection to hollow core slab



# Thermally Charged Structure



## A Super Efficient Thermally Charged Structure

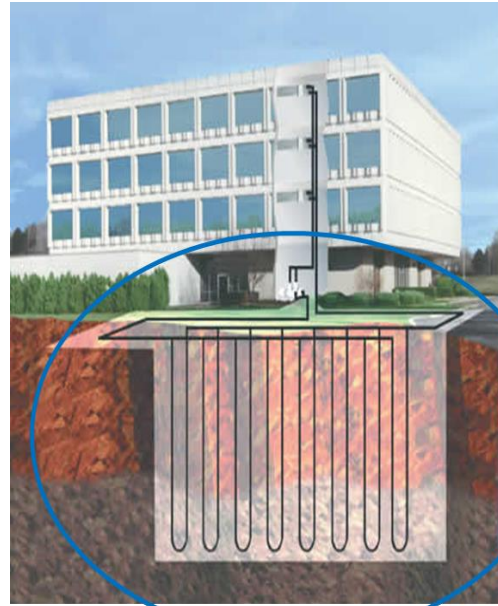
No moving parts

No new equipment

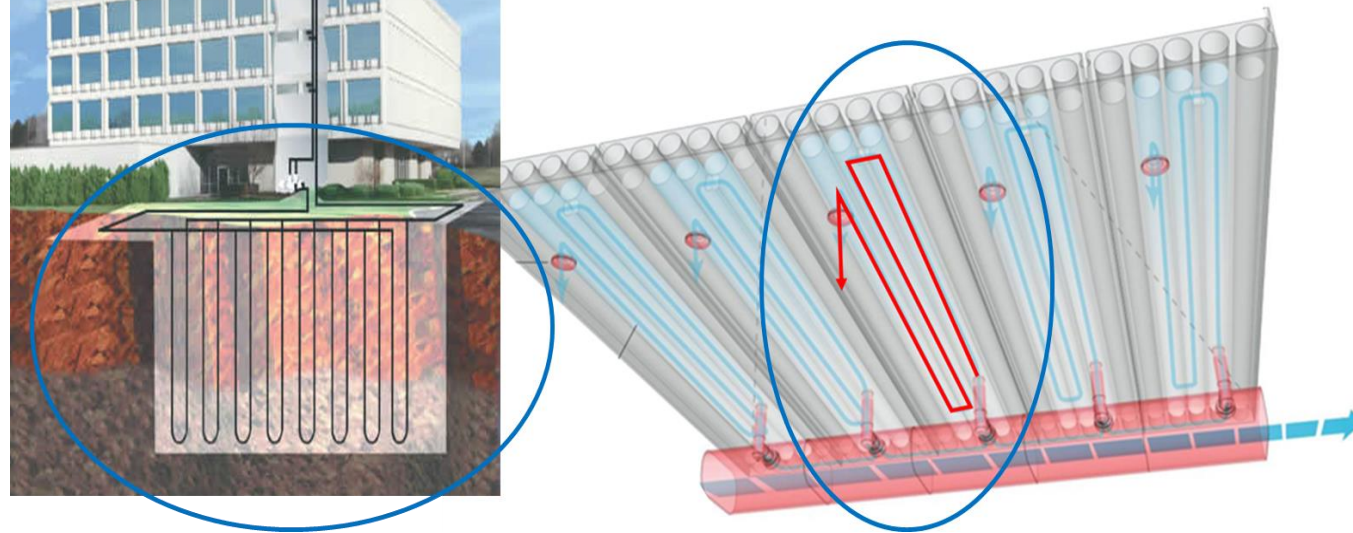
No complex software

# Integrated Ventilation vs. Geothermal

Integrated Ventilation total thermal duct lengths (non-hydronic) equal about **85% - 90%** of the loop lengths of a typical geothermal system for similar sized buildings.



In-building "Geothermal"



## Without Geothermal

- ✓ No need to drill
- ✓ No extra land or space needed
- ✓ No extra equipment, pumps, plumbing, etc.
- ✓ Greater flexibility
- ✓ Less maintenance

# Greater Efficiencies at a Lower Cost/sf<sup>2</sup>

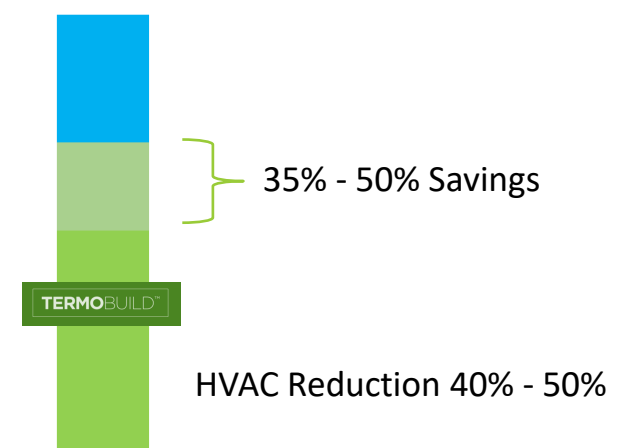
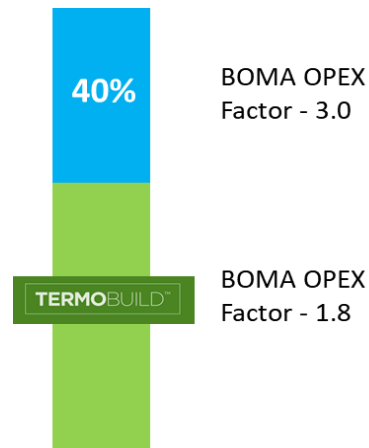
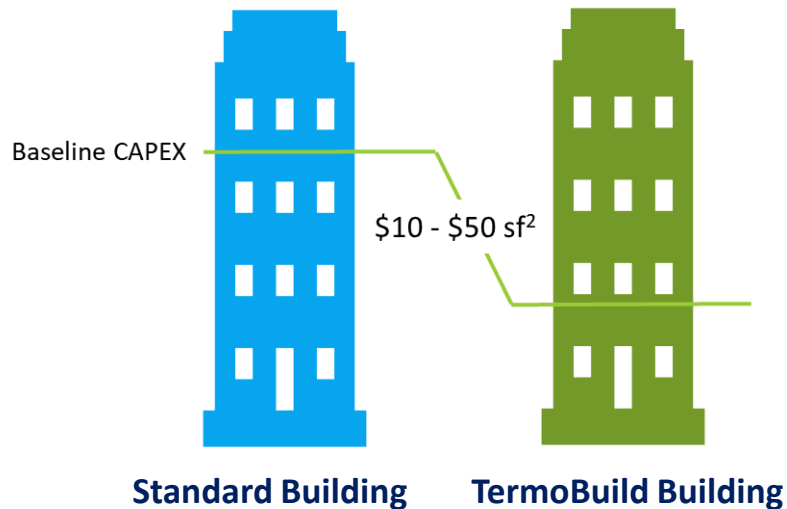
## Costs Less

## Performs Better

CAPEX

Lifecycle Cost

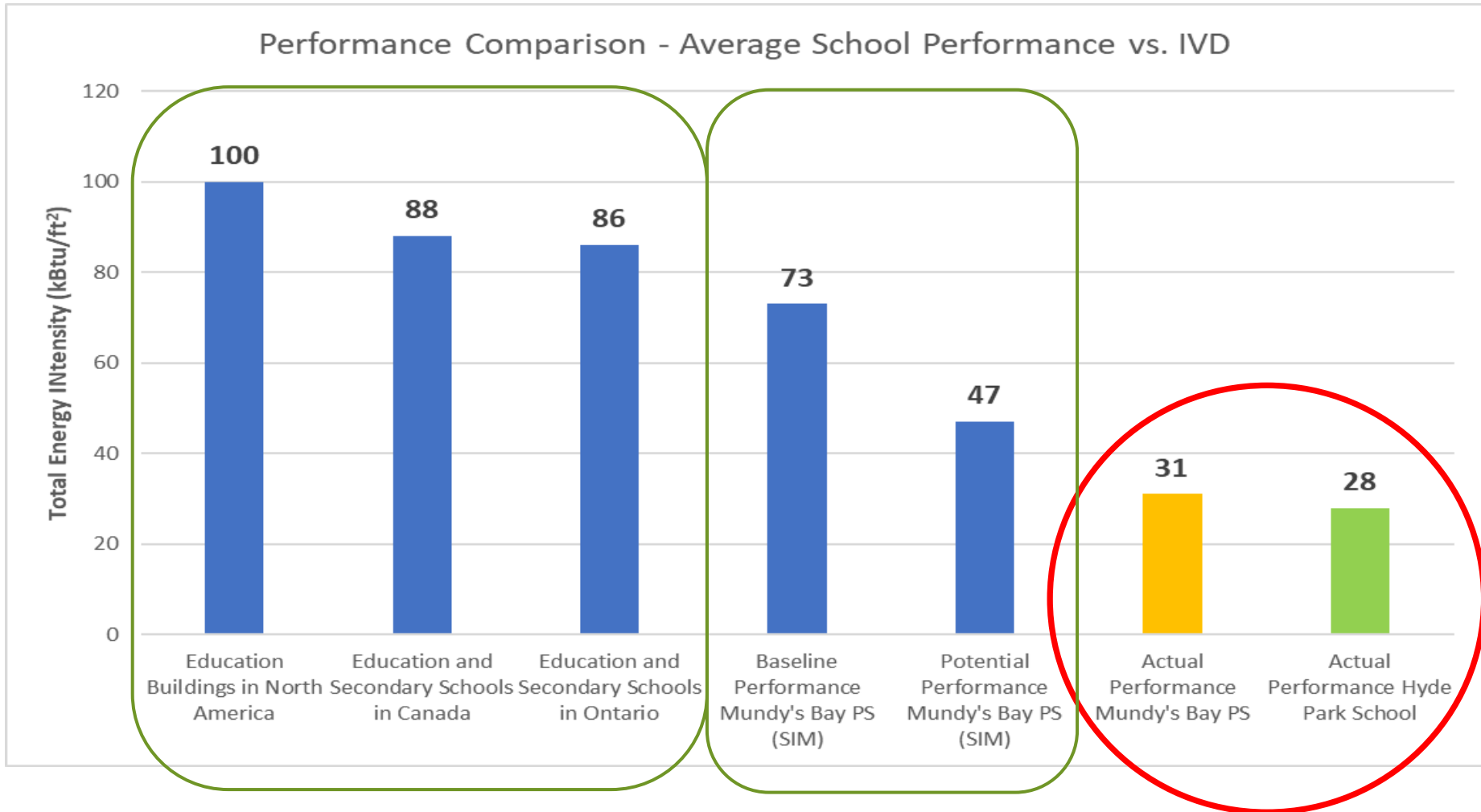
Energy Consumption



### Significant Areas of Cost Avoidance:

Eliminate Drop Ceilings, No Perimeter Ducting, No Advanced Energy Conservation Measures, No Software Fees/Subscriptions, Lower Maintenance/Parts Cost, Lower Maintenance Personnel Cost

# Achieves “Net Zero Ready” status as a baseline



# Why does Integrated Ventilation Cost Less?



# Typical Building Design Process w Integrated Ventilation

Standard Building Structure



+

Costly and More Complex Add-on Equipment



HVAC



DOAS



Chilled Beams



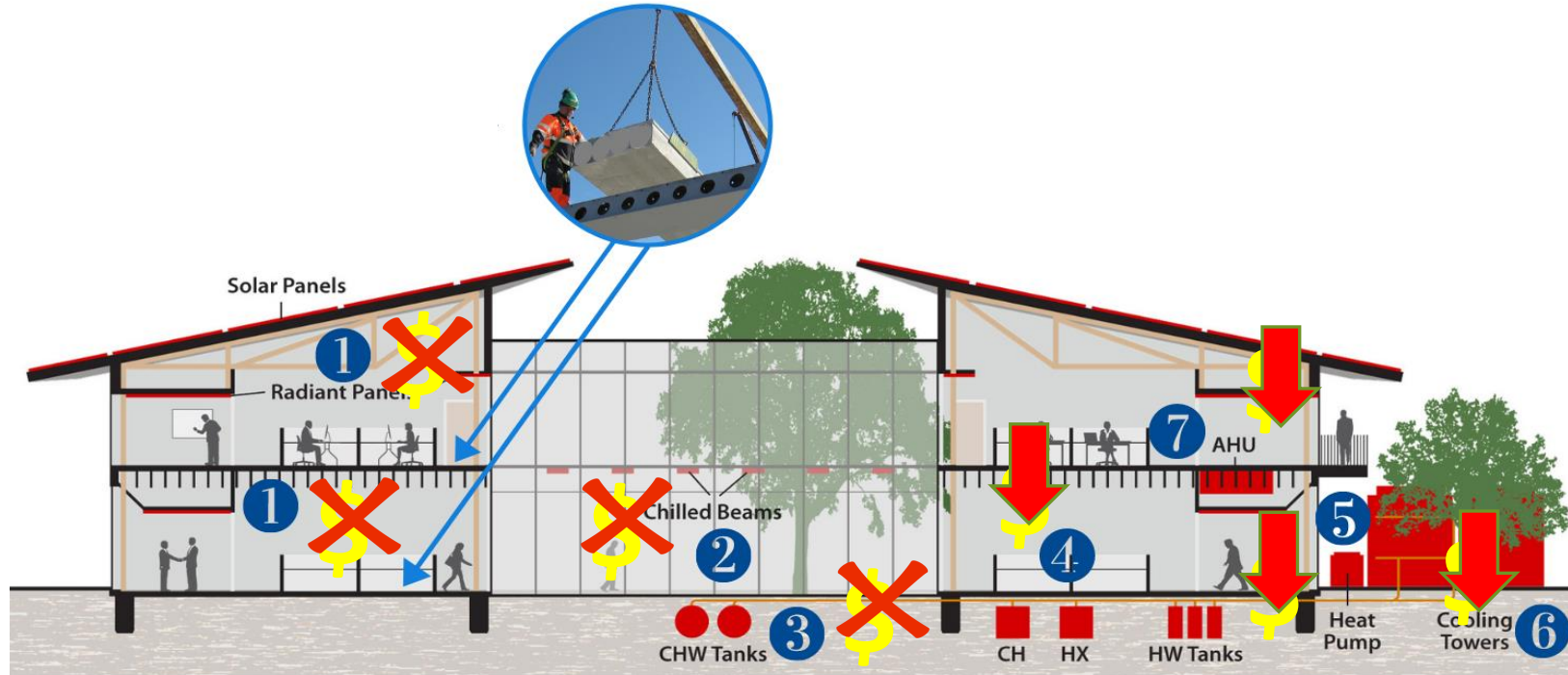
Ice Storage



Sensors



Radiant in Floor



As Designed

Integrated Ventilation

**ASHRAE ZONE 3C** 19.4 kBtu/sf-year  
**ASHRAE ZONE 4A** 35.5 kBtu/sf-year  
**Solar System** 285 kW (DC)

17.5 kBtu/sf-year  
 30 kBtu/sf-year  
 228kW

...better performance as a baseline

# HVAC Reductions and Savings

Construction Cost Savings with "Smart" Floors			
Based on 150,000 sq.ft educational buildings			
HVAC CONSTRUCTION TYPE	CONVENTIONAL	TERMOBUILD	SAVINGS
Conventional HVAC	\$32.30 / SQ.FT.	\$22.24 / SQ.FT.	\$10.08 / SQ.FT. <b>31.1%</b>
High Performance (Net ZERO) HVAC*	\$55.00 / SQ.FT.	\$32.54 / SQ.FT.	\$23.46 / SQ.FT. <b>40.8%</b>

# Integrated Ventilation Performs Better

# Seasonal Operation

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## Cooling Season

During occupied hours, heat from internal loads is absorbed by the precast concrete slabs.

During unoccupied hours, cool nighttime air is circulated through the slab to remove heat and pre-cool the space for the next day. The slabs maintain their cool temperatures to also allow cooling during the following day.



## Heating Season

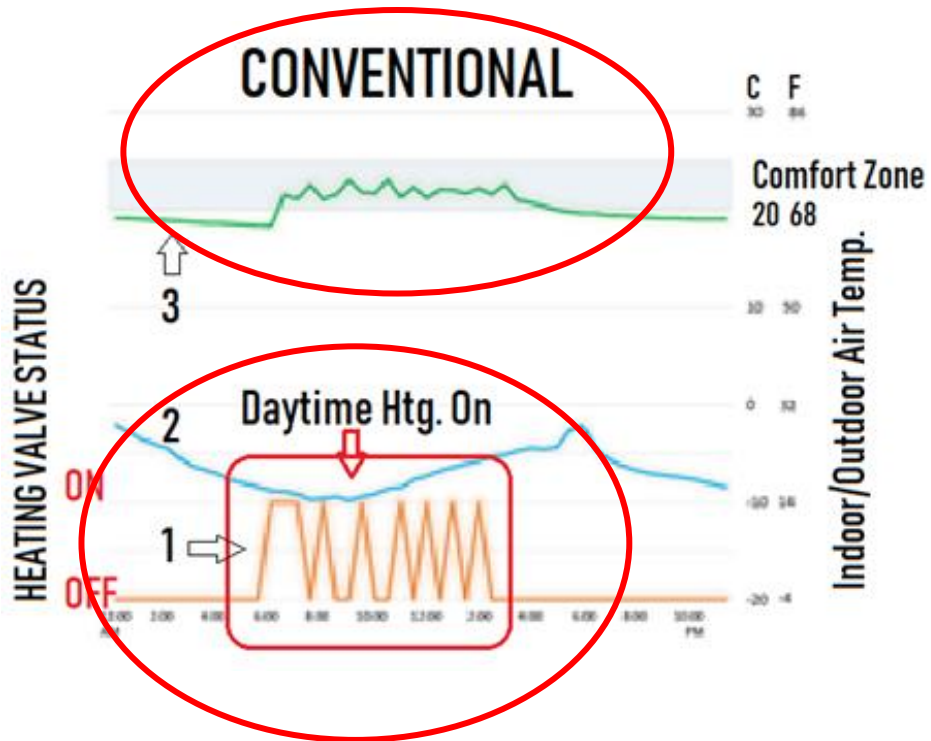
During occupied hours, heat from internal loads is transferred to the hollow core slabs through radiation.

During unoccupied hours, the air handling system utilizes the free heat captured in the hollow core slabs during the day to heat the building through the night and the next day.

Re-circulation of stale air is rarely necessary, preventing sick building syndrome and the potential spread of infectious diseases. Year-round, non-hydronic radiant comfort provides an enhanced occupant experience.

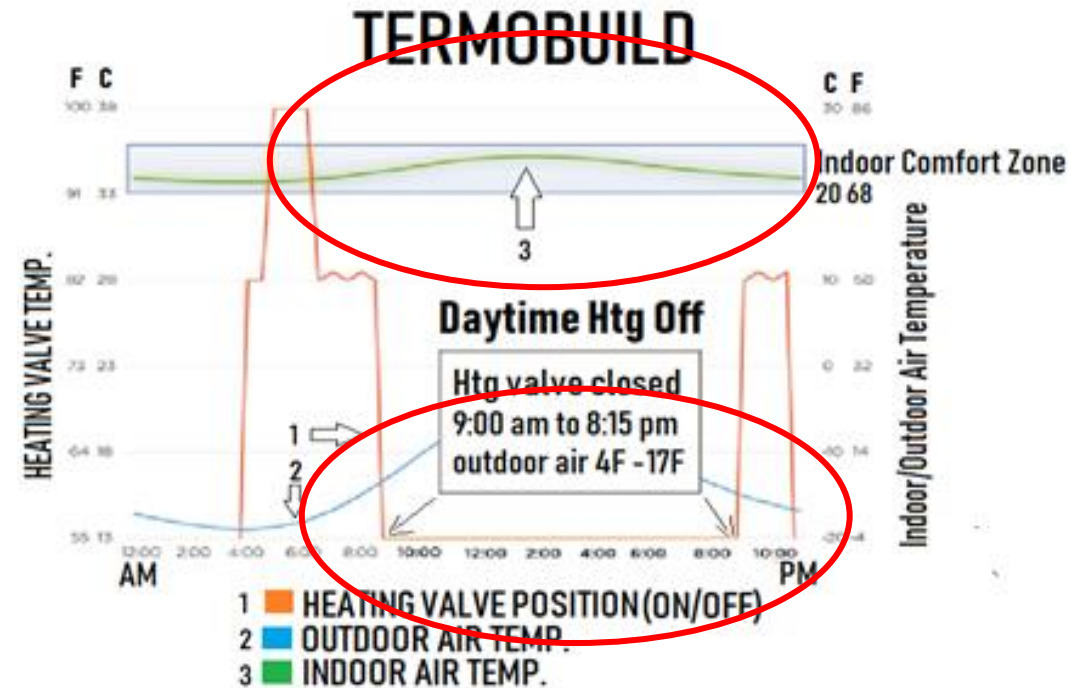
# Design/Engineering Considerations

Temperature Volatility



vs.

Temperature Stability



Canadian Climate Zone 7

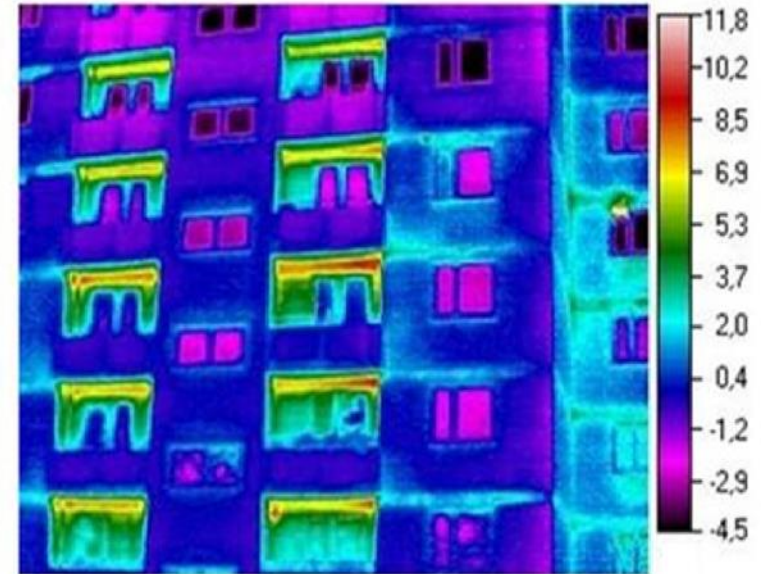
# Energy Loss Through Building Envelope

## Energy loss through exterior walls - Conventional vs. Integrated Ventilation Systems

Conventional envelope will look like the right-hand picture with an integrated ventilation design.



Conventional Ventilation System



Integrated Ventilation System

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# How Does Integrated Ventilation Increase Air Quality and Prevent the Spread of Disease?



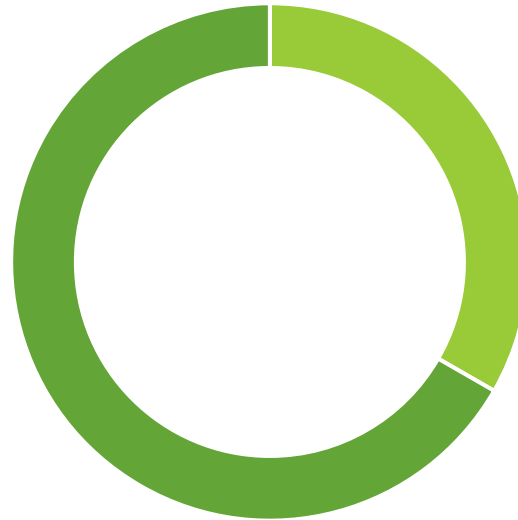
# Integrated Ventilation and Airborne Transmission

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30+% DOAS Year Round

30+ percent of buildings with TermoBuild's Integrated Ventilation Design act as a DOAS without an energy use penalty throughout most of the year.

Ventilation utilizes efficient fans and outside air with no heating/cooling elements required.



Re-circulation of stale air is rarely necessary, preventing sick building syndrome and the potential spread of infectious diseases.

Year-round, non-hydronic radiant comfort provides an enhanced occupant experience.

# Ventilation System Comparison

Warm air has buoyancy.  
Allow the air to transport itself.  
Put treated air where people  
are located – closer to the floor.  
Reduce drafts and noise.



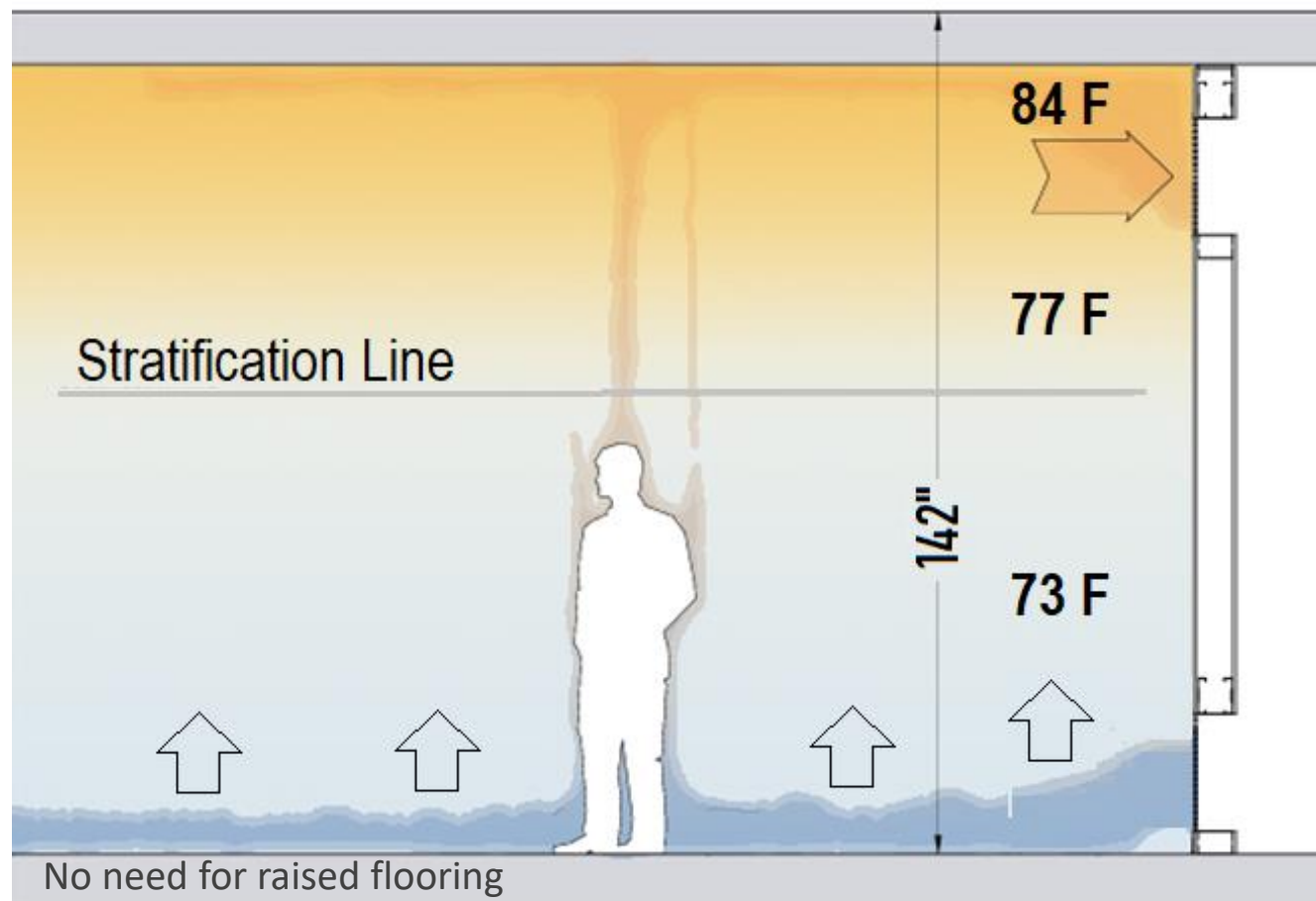
Forced air systems enhance conditions for  
the spread of disease

Integrated ventilation provides enhanced  
safety and comfort

# Occupant Comfort

With radiant systems, people are cooled by radiant heat transfer from their bodies to adjacent surfaces and ceilings whose temperatures are held a few degrees cooler than ambient.

With Integrated Ventilation, there is no need for raised flooring saving both space and cost.

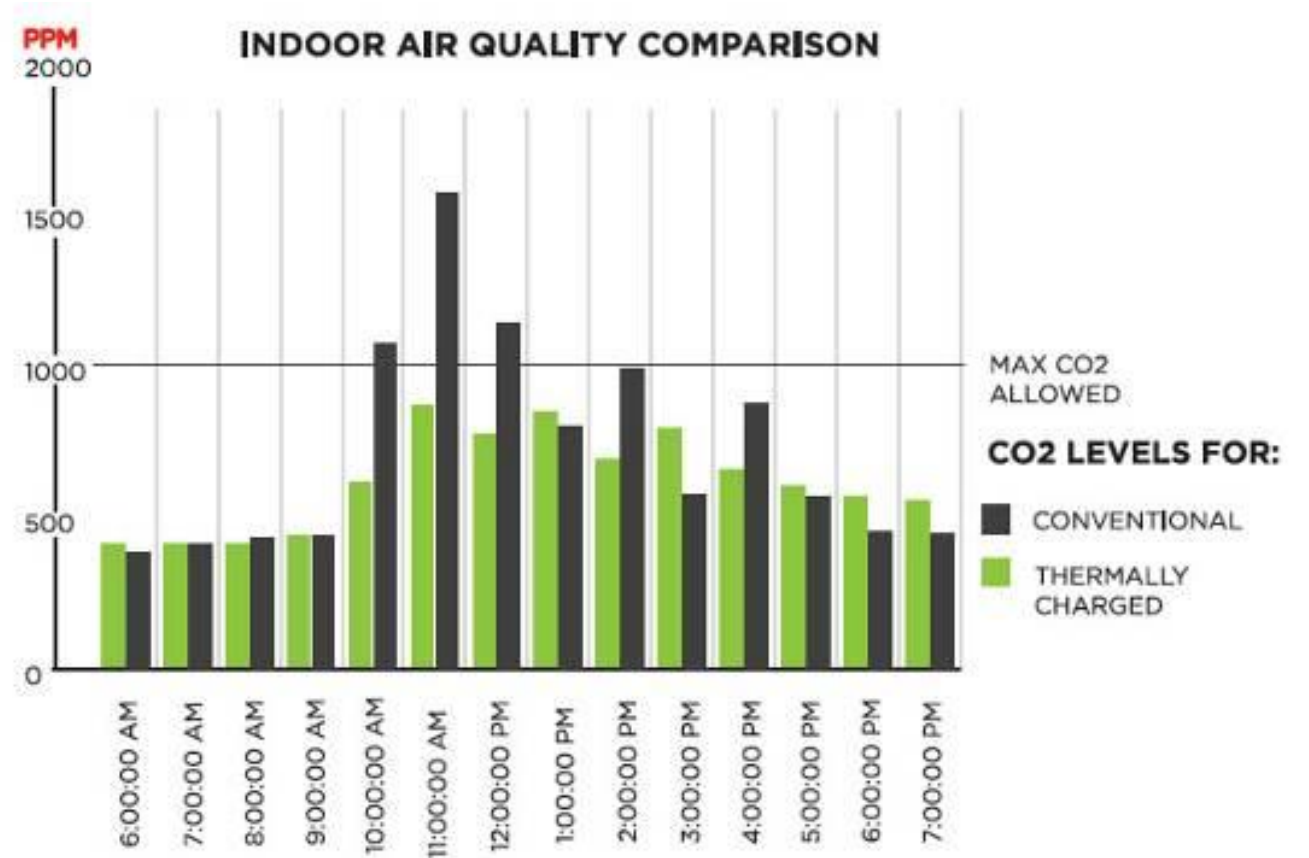


# Healthy Buildings

Generally, air re-circulation is only used overnight.

It is used in winter when heating is needed and in hot climates when night pre-cooling is required.

Note: Rooms with highly variable loads may require a booster system.



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# Integrated Ventilation Considerations for Public Projects

# Public Project Risk Mitigation

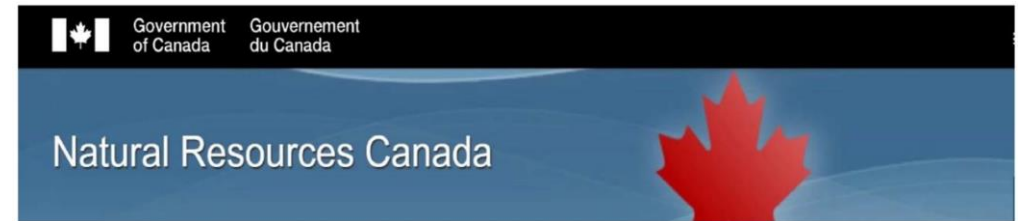
Design Simplicity  
Reduces Project Risk

- Costs Less
- Less OPEX
- Less Maintenance
- Efficient
- Comfortable
- Safe
- Resilient
- Responsive
- Net Zero Ready

Concrete Adds Resilience,  
Safety, Longevity



With Real World  
Performance, Efficiency,  
and Ventilation Safety



## RETScreen Best School consumption per sq.ft./sq.m.

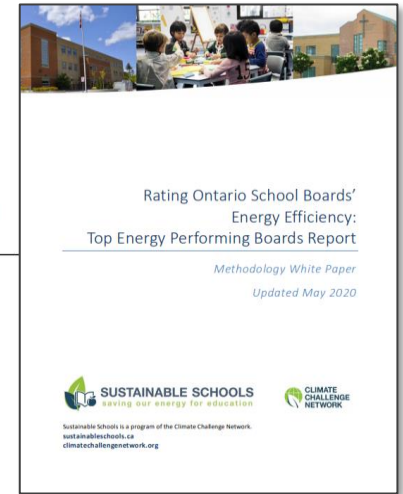
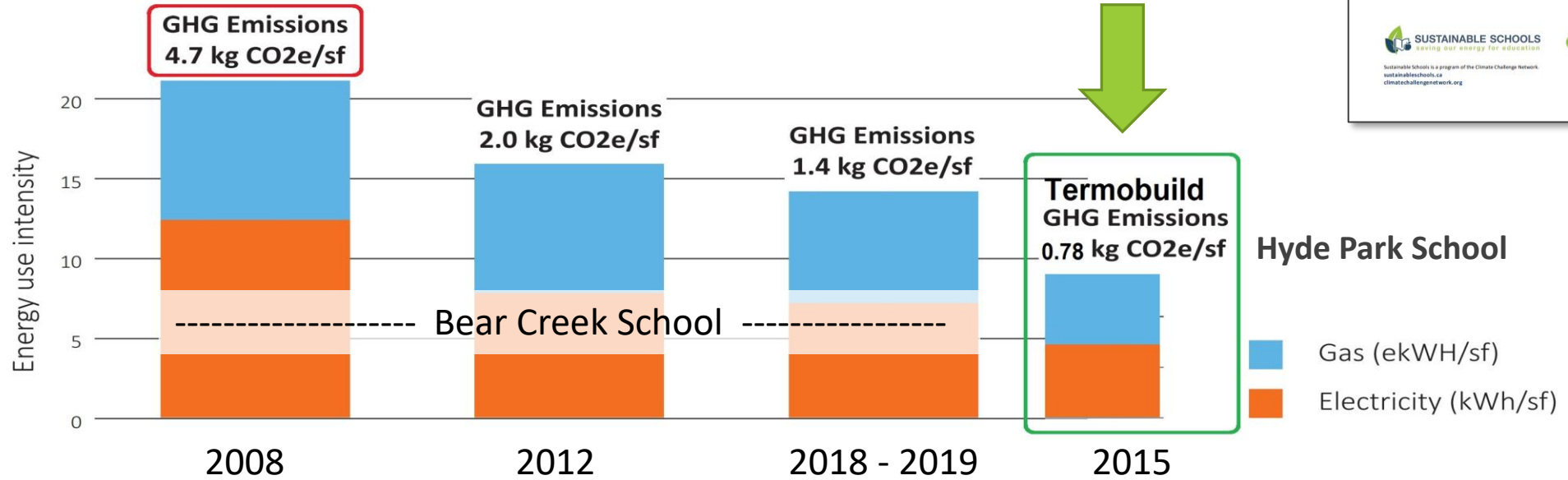
Name	Location	System	Year	Degree Days	Total per sq.ft.	Total per sq.m.
Hyde Park	Barrie	Termobuild	2014	Adjusted	<b>8.35 kWh/ft2/yr</b>	<b>89.9 kWh/m2</b>
Mundy Bay	Midland	Termobuild	2011	Adjusted	<b>9.13 kWh/ft2/yr</b>	116.7 kWh/m2
<b>Average school</b>		Conventional	2010	Adjusted	<b>16.25 kWh/ft2/yr</b>	<b>174.9 kWh/m2</b>

With Integrated ventilation you get safe structures that are  
Emergency Shelter and Smart City ready.

Insured Performance Guarantee

# YEAR 2008 BUILDING RETROFITS WITH H.C. SLABS.

## Bear Creek Secondary School: Energy Intensity and GHG Emissions



# Delivering Environmental and Economic Potential.

Reference: [www.sustainableschools.ca](http://www.sustainableschools.ca)

Sustainable Schools is a program of the Climate Challenge Network.



Technical direction by



# Standard Skills and Equipment

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This is a Design Assist. We do not manufacture or sell any components

No new skills are required to install or maintain an integrated ventilation design.

No unique equipment sets or components are required.

Integrated ventilation design uses standard, off-the-shelf equipment.

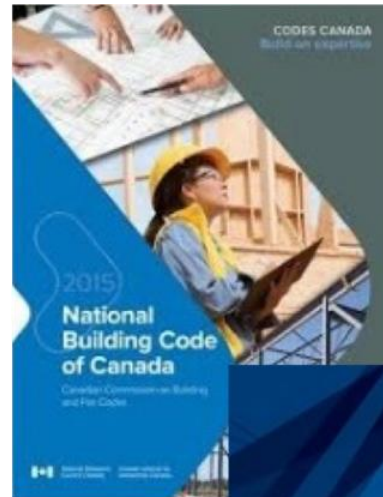




# Code Compliance

Integrated Ventilation Design complies with all national and local codes and standards where applicable. Unique local codes have never presented an issue

- Building Code
- Life Safety
- Fire Safety
- Ventilation
- Acoustics
- Structural



# Compatible with Unique Design Solutions

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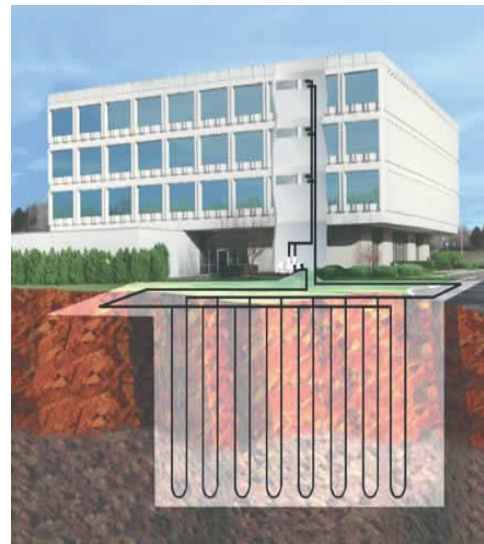
Bio-Filter Wall



Solar Thermal/  
Night Sky Cooling

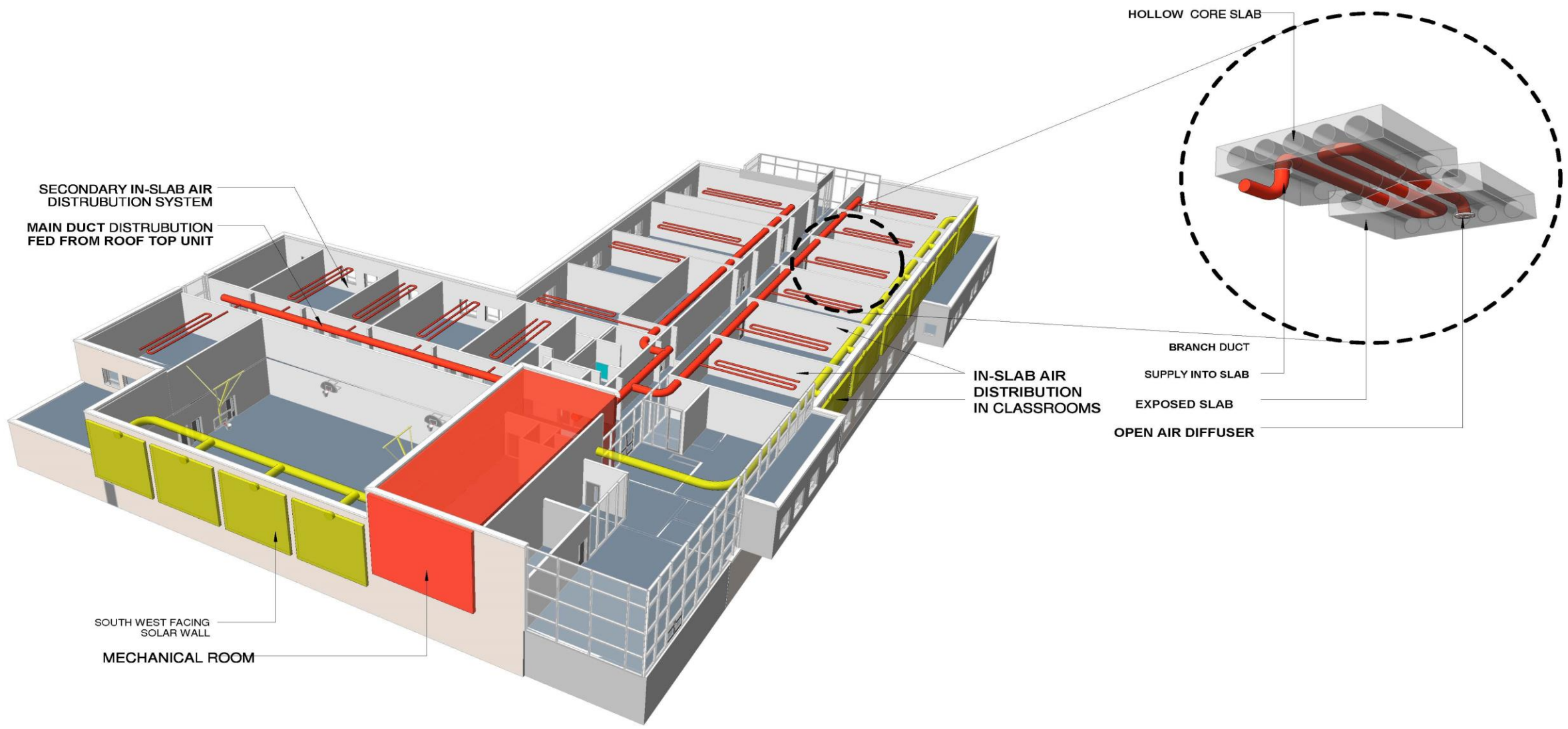


Reduced Geothermal



No New Substations





**Main Duct and In-slab Air Distribution**  
**TERMOBUILD HEATING/COOLING SYSTEM**

**TB**

# Design/Engineering Considerations

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# Design/Engineering Considerations



# Design/Engineering Considerations



# TermoBuild in Common Areas



# TermoBuild in Common Areas





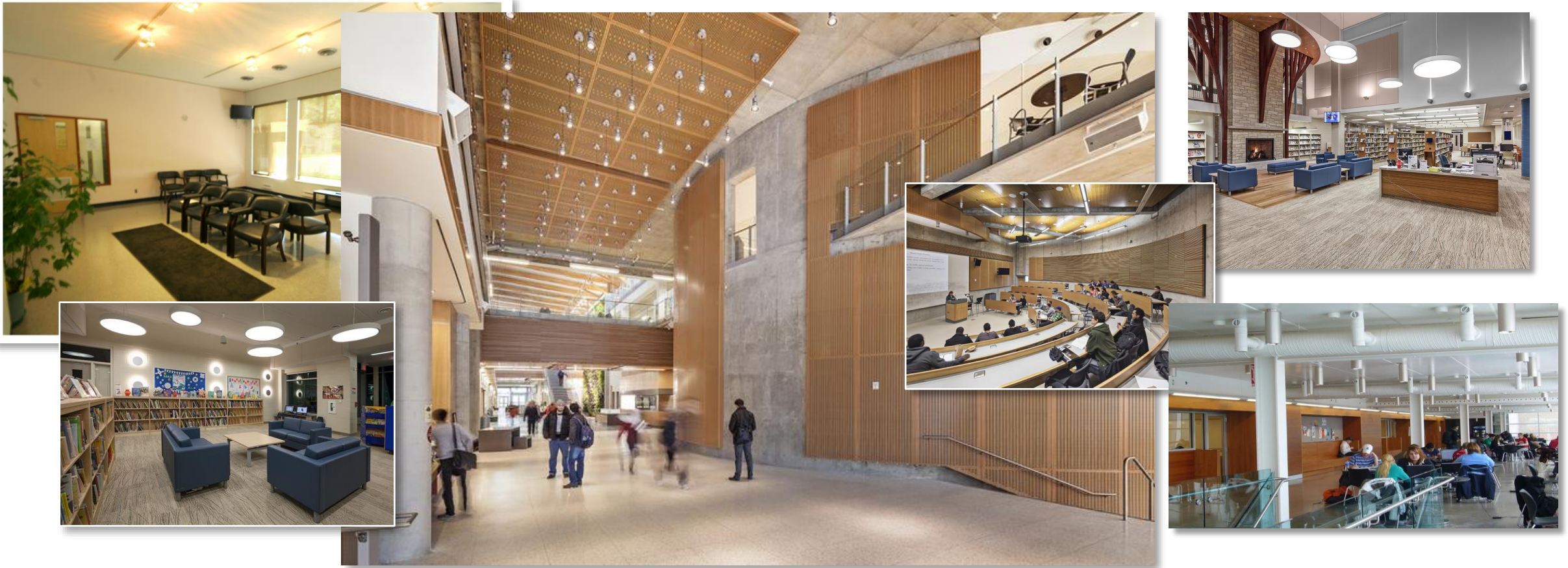
# TermoBuild in Common Areas



# TermoBuild in Common Areas



# TermoBuild in Common Areas



# Net Zero and Net Positive Ready as a Baseline

Buildings with Integrated ventilation design are:

- Net Zero/Net Positive ready as a baseline.
- “Smart City” and “Grid Interactive” ready as soon as local initiatives are implemented.

## Net Positive Campus in the USA



**TERMOBUILD™**

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Thank you!

# Summary of Additional Benefits:



## Tenant Comfort/ Air Quality

Radiant Comfort  
Air Quality (DOAS)  
Less Noise  
Warm/Cold Calls  
Pleasing Aesthetics



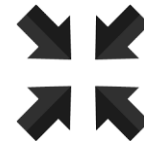
## Digital Complexity

Less Complex if Desired  
ECM Stacking  
Lower Personnel Cost  
Maintenance



## Resilience/Safety

Emergency Shelter  
Brown/Black Outs  
Work/Life Disruption  
Communicable Diseases



## Space Savings

7% - 13%  
More Floors  
Higher Ceilings  
Storage/Other Uses



## Aesthetics

Higher Ceilings  
Design Options  
Less Ducting



## Financial

Demand Response  
EE Credits  
Net Zero/Net Positive  
Time of Use Pricing

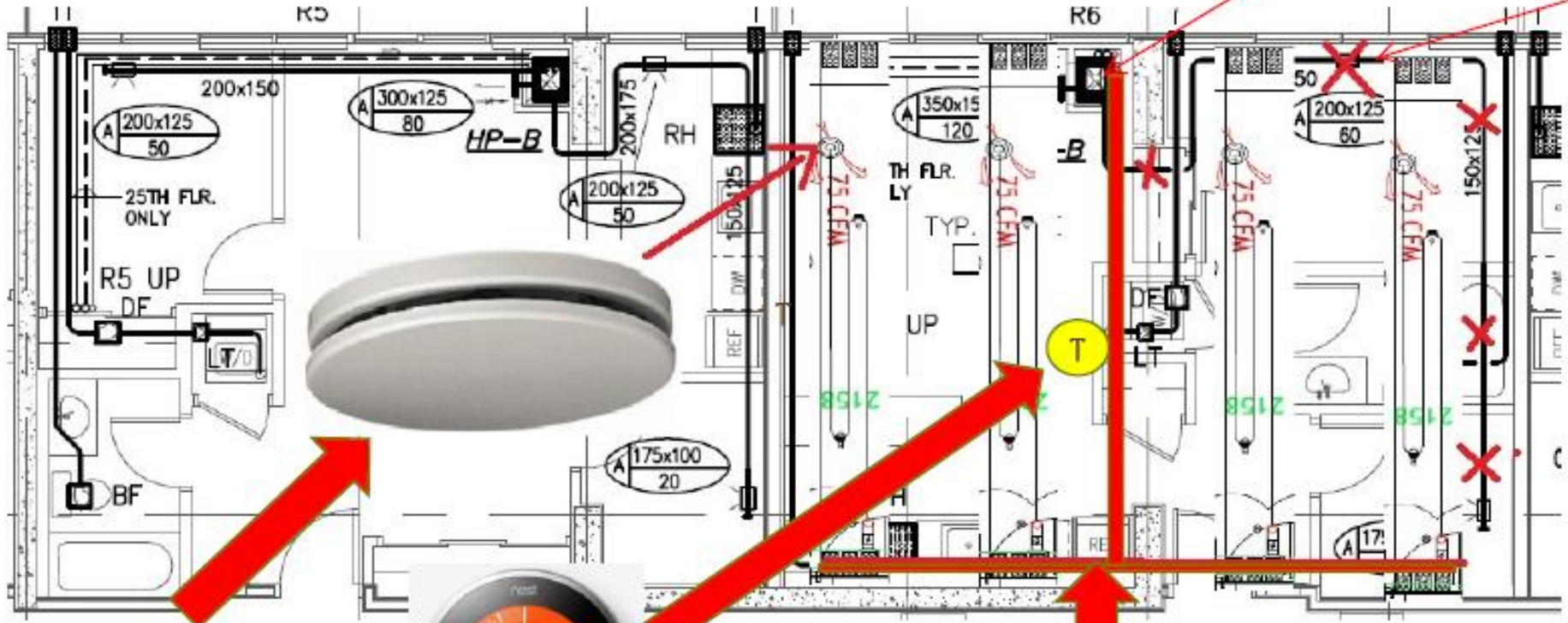


**Reduces the Spread of Infectious Disease Through  
Less Recirculation of Air Within the Building**

# Typical Termobuild Unit Layout

Smaller unit may fit into dropped ceiling

X - denotes deleted ductwork



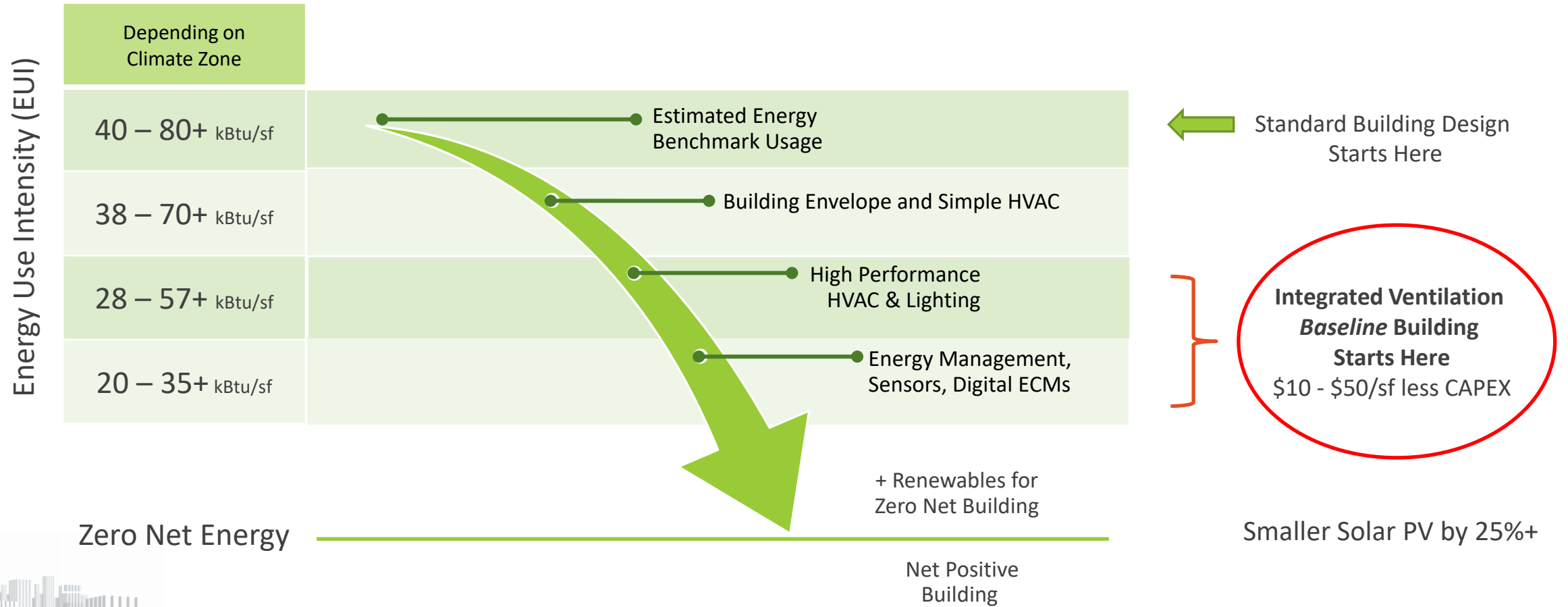
DIFFUSER  
THERMOSTAT



DUCTWORK



# Better Baseline Performance



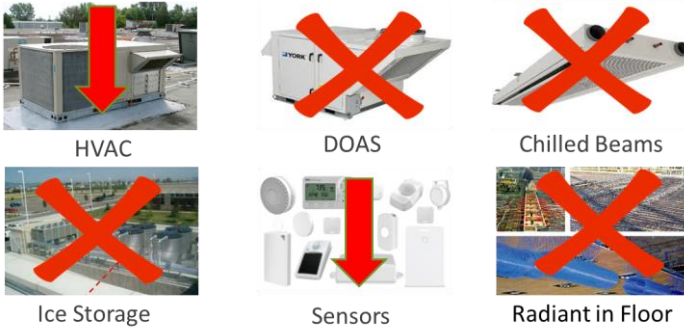


# Cost Avoidance vs. Cost Transfer

“The cost of Net Zero buildings can be done within normal budgets” - Architects

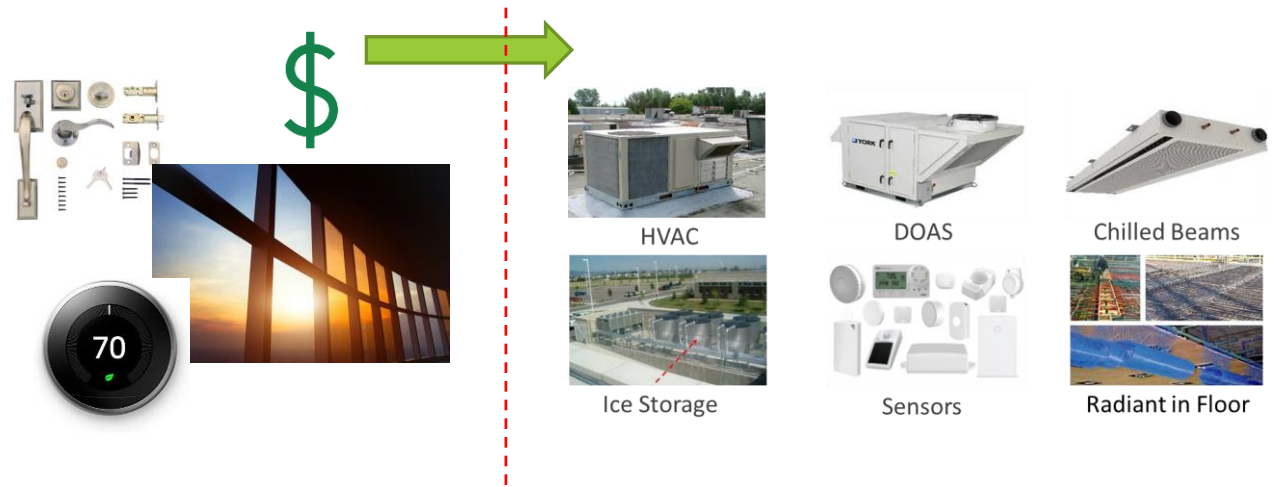
## Integrated Ventilation Cost Avoidance

Costly Add-on Equipment



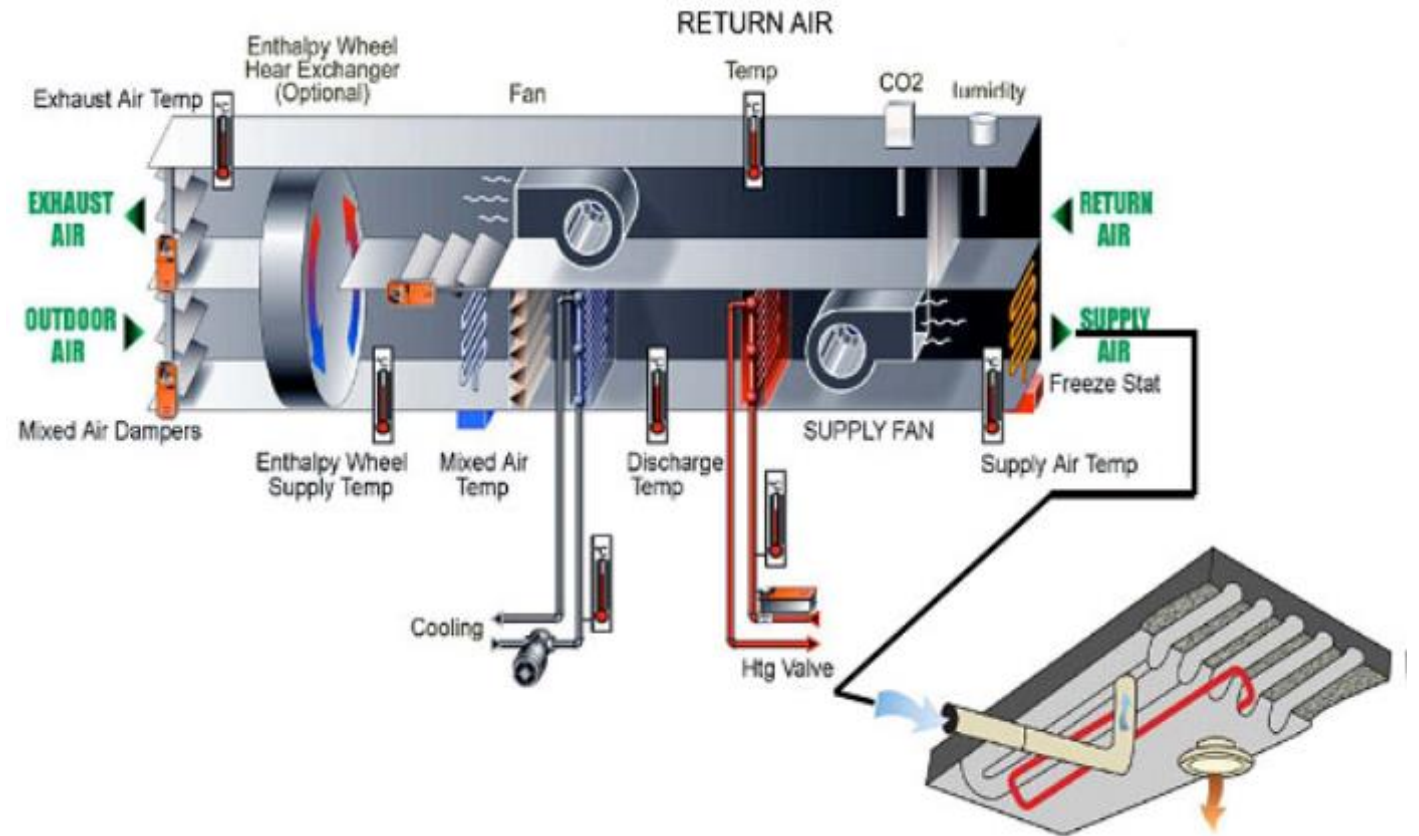
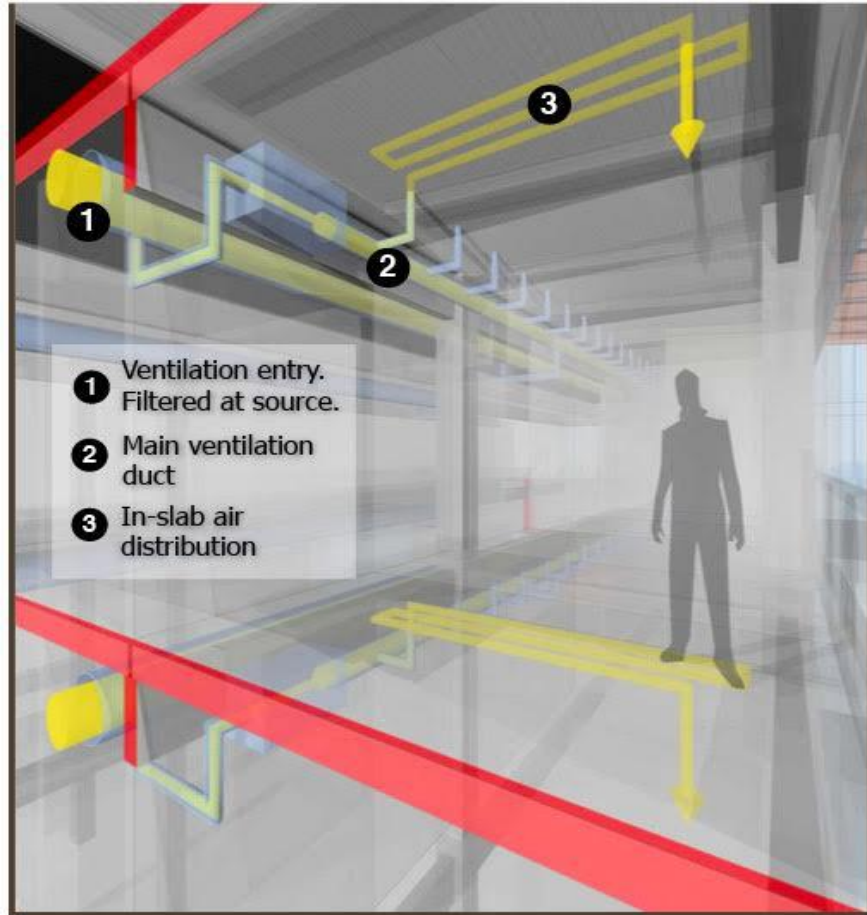
Free up budget for desired expenditures

## Construction Process Cost Transfer



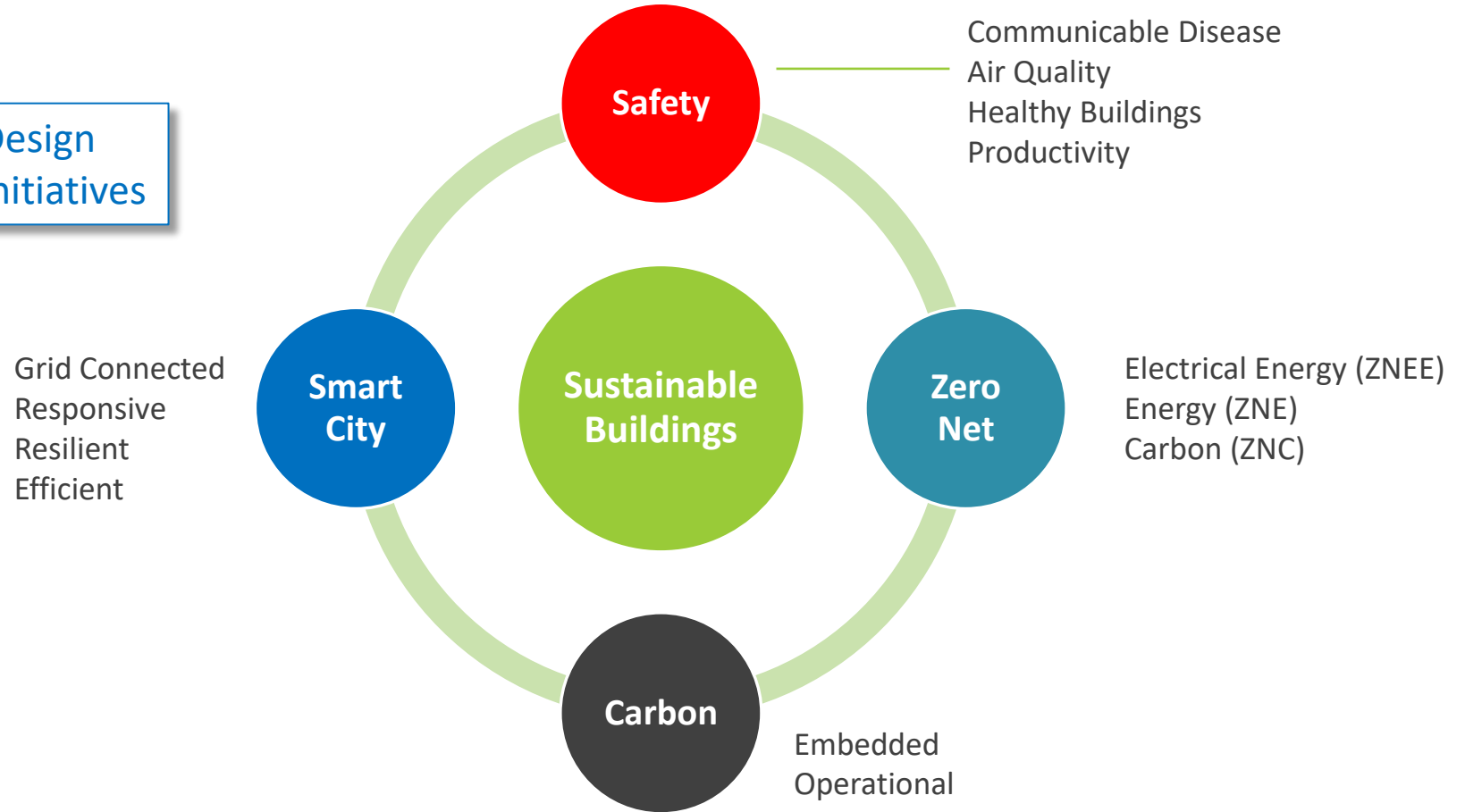
Settle for less of these..... to get these  
(or lower quality)

# Design/Engineering Considerations



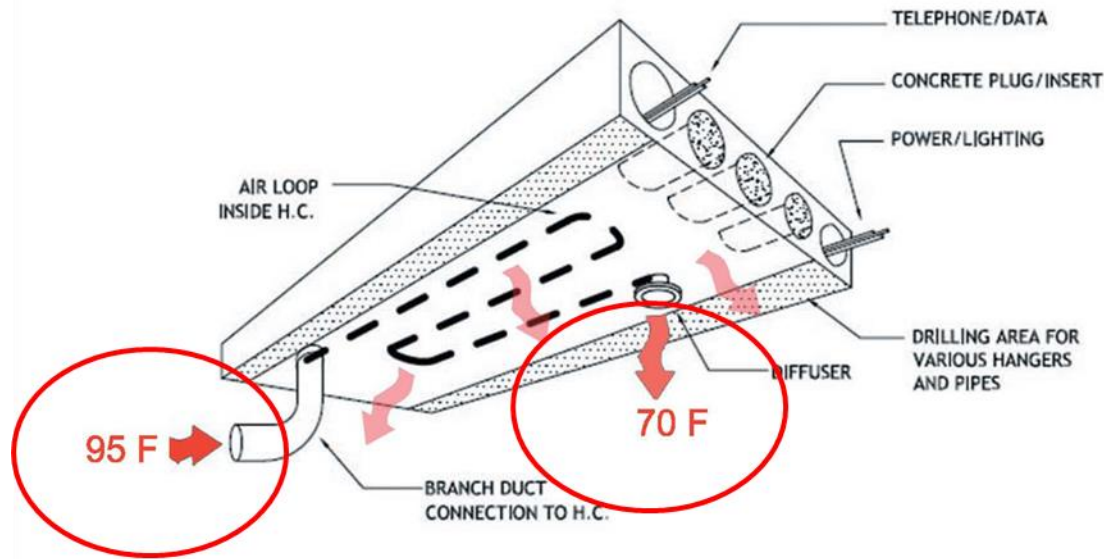
# Key Building Initiatives...

Integrated Ventilation Design  
enables each of these initiatives

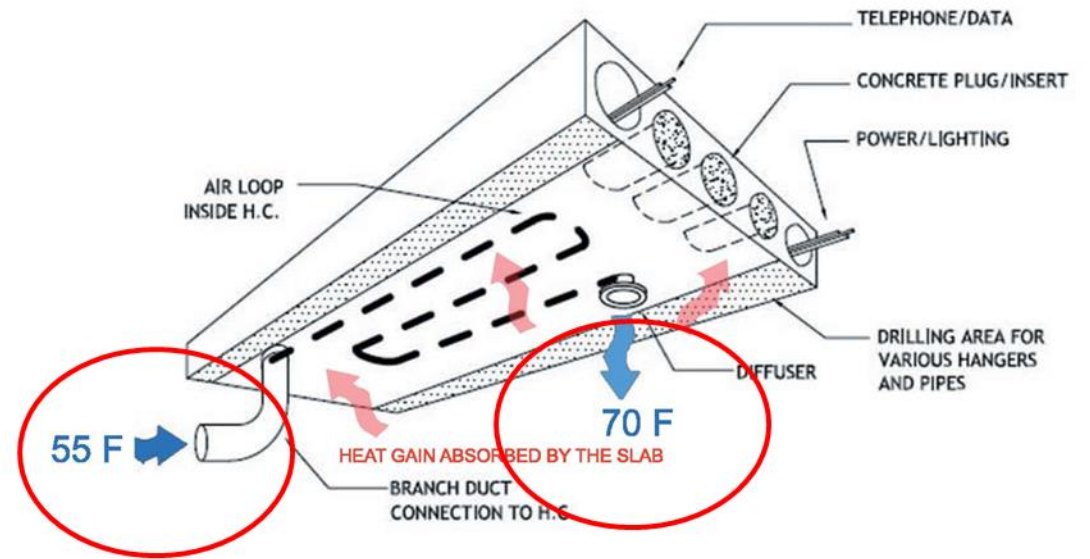


# Heating Mode vs. Cooling Mode

Energy that has been actively stored in the concrete will condition the air before it reaches the indoor space.



Cooling Mode



Heating Mode

# Thermal Properties of Various Building Materials

