

# Passive Energy Storage

## Abstract:

Phase change material (PCM) in a thermal zone can passively regulate the space temperature to improve thermal comfort and reduce heating & cooling energy.

This session will demonstrate how laboratory-validated performance has been replicated with Title 24 Compliance Software.

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C. Eng., ASHRAE Member, BEMP, IBPSA Fellow



# Agenda

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- 1. Types of Energy Storage**
- 2. Model Data Hierarchy**
- 3. Phase Change Materials in Ceiling Tiles**
- 4. Model Results & Lessons Learned**

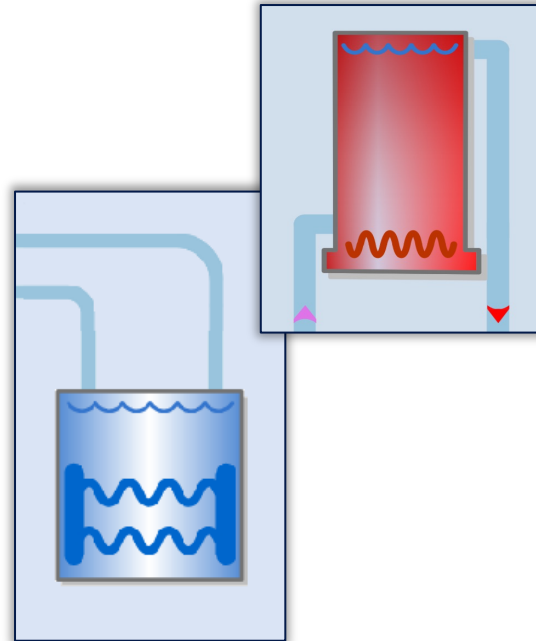
# Three Types of Energy Storage

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## Electric Battery Storage



## Thermal Energy Storage

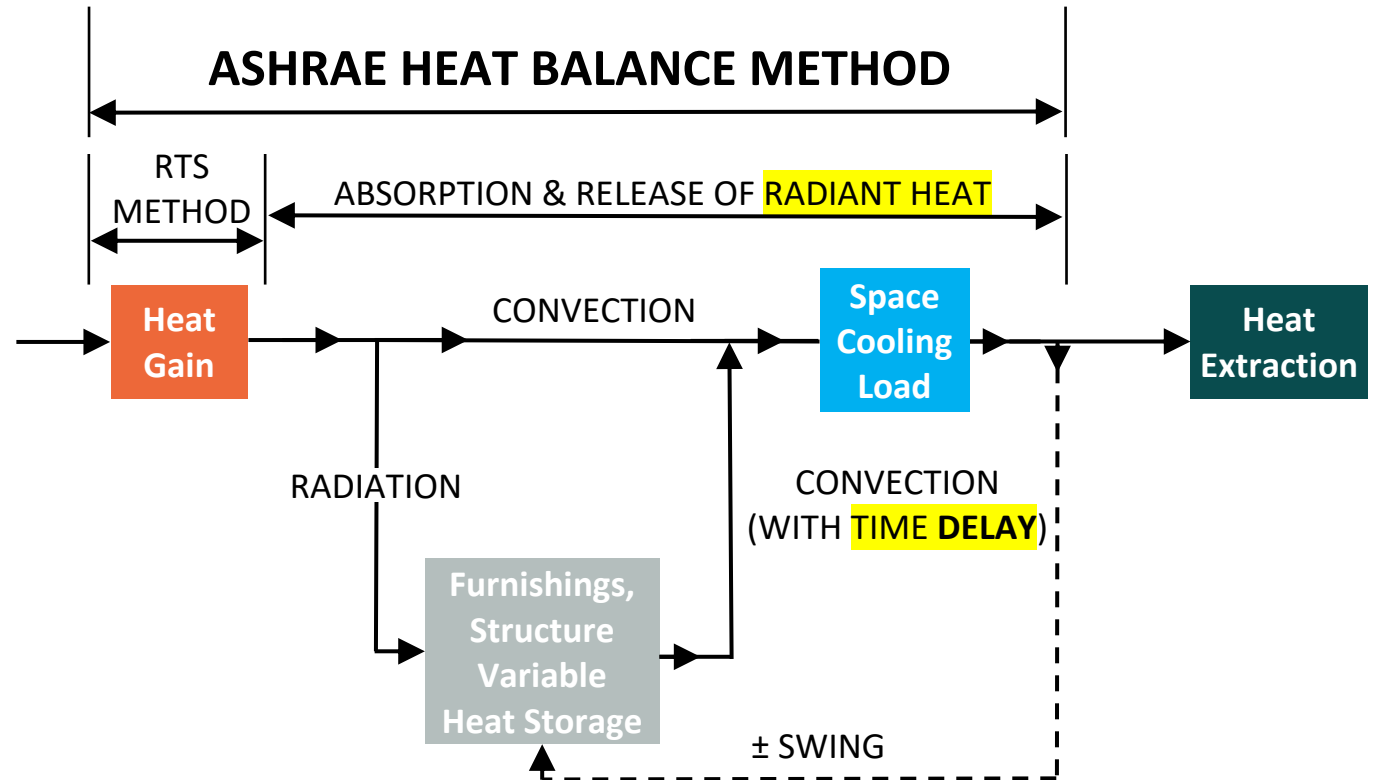
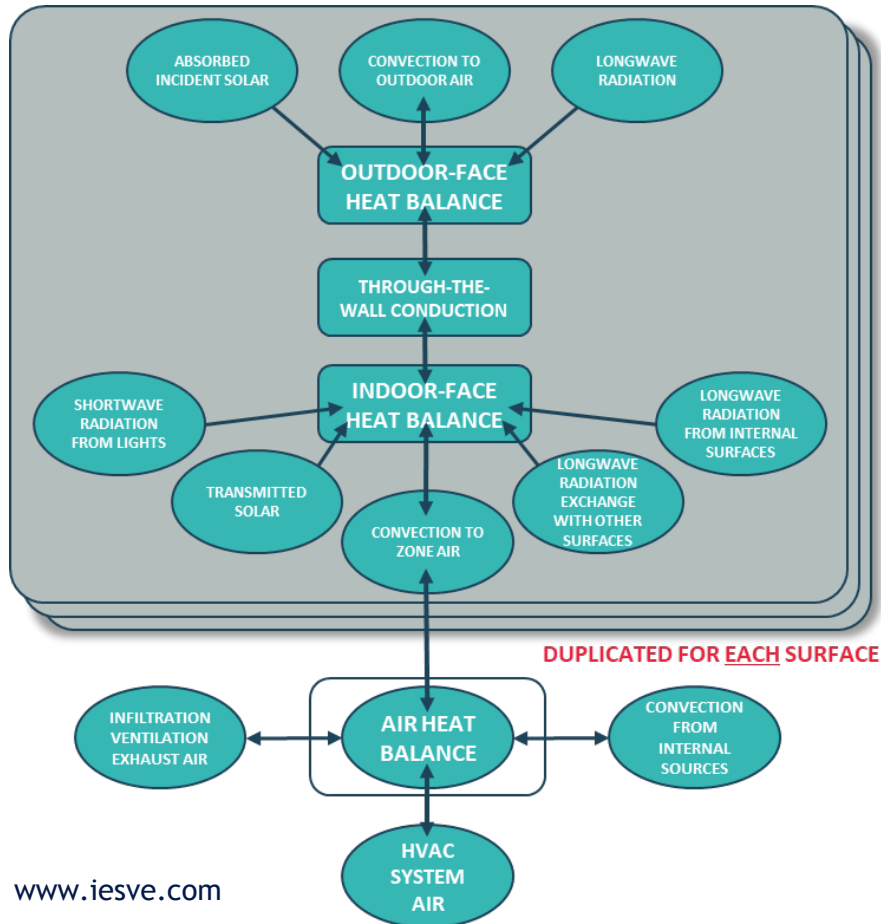


## The Building itself: Thermal Mass



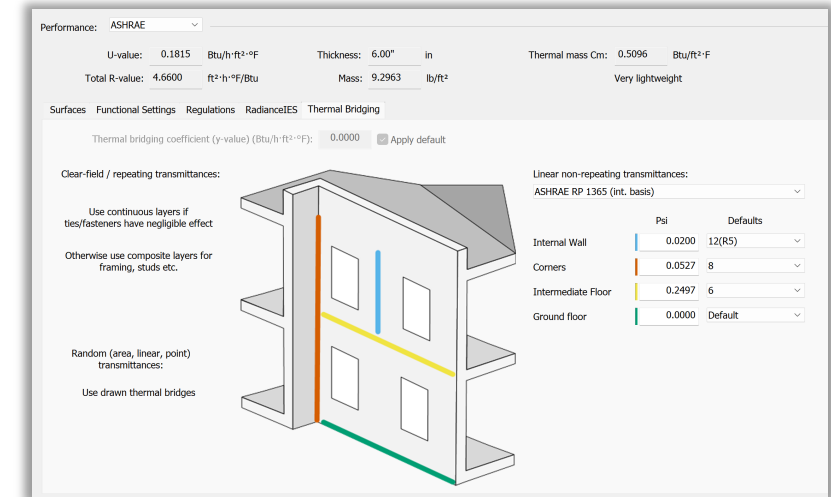
# Thermal Mass: Heat Balance Method

- 1) All surfaces in 3D model
- 2) Radiant heat, with convective time delay



# Model Geometry Data Hierarchy

- Zone
  - Room(s)
    - Surfaces
      - 1) Glazing
      - 2) Holes
      - 3) Doors
      - 4) Other opaque sub-surfaces



Thermal Bridges

Ceiling Tiles

Radiant Panels



# New Ceiling Tile by AWI

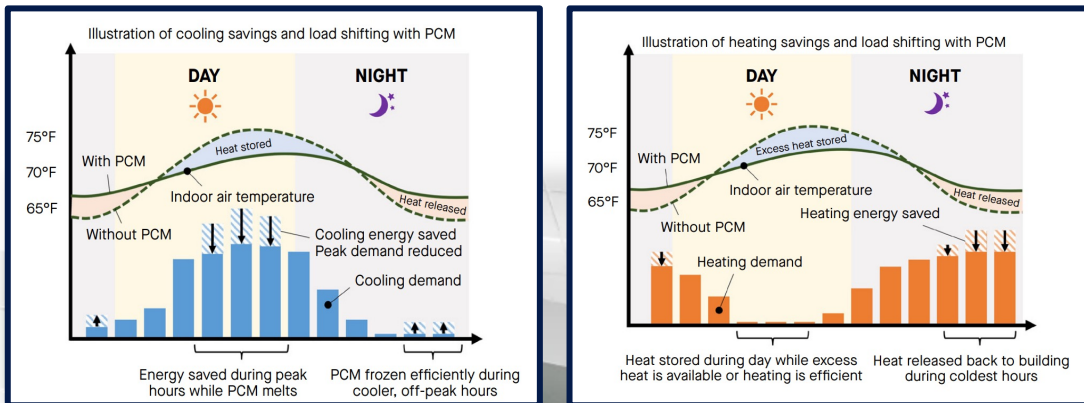


- +160 years, +3,600 employees, +20 Facilities
- Leader in the design and manufacture of ceiling and wall system solutions



# PCM Ceiling Tile - Ultima Templok®

PCM passively regulates the room temperature by releasing/absorbing sufficient energy at phase transition.



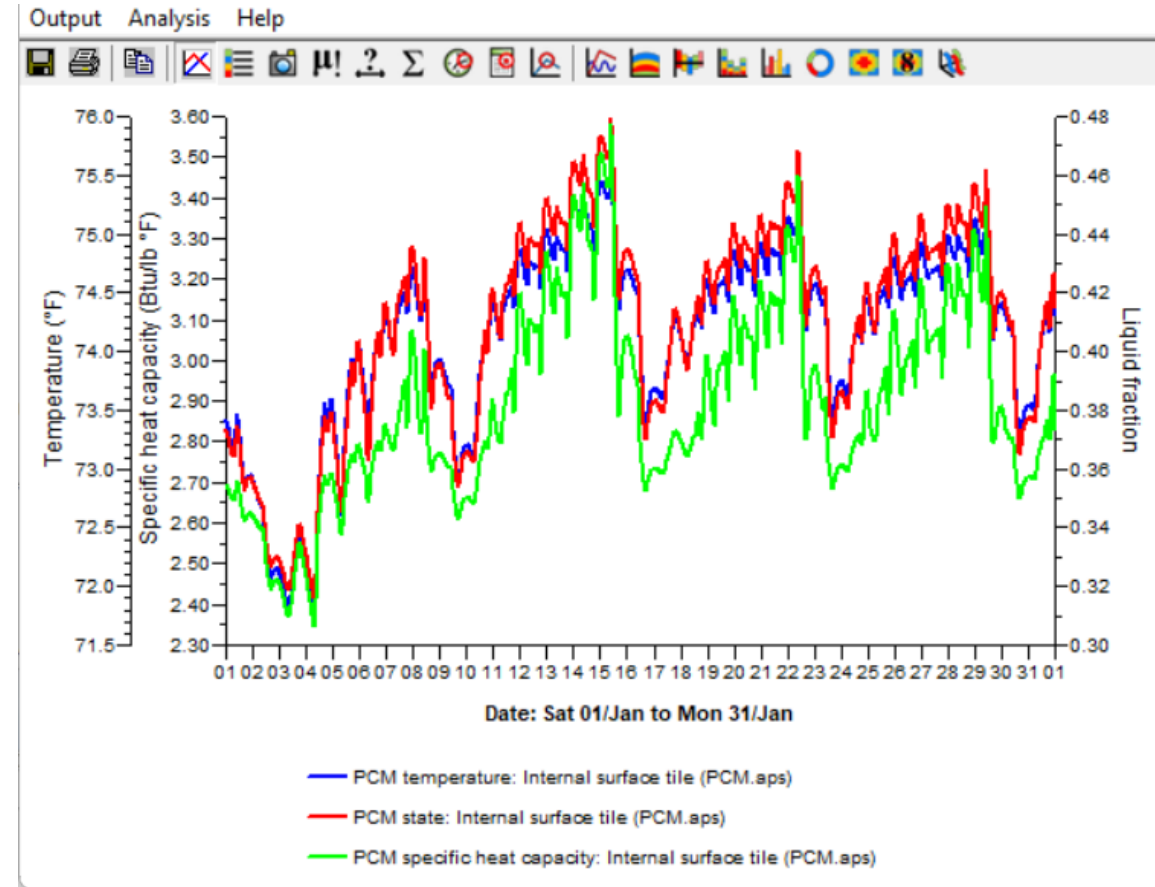
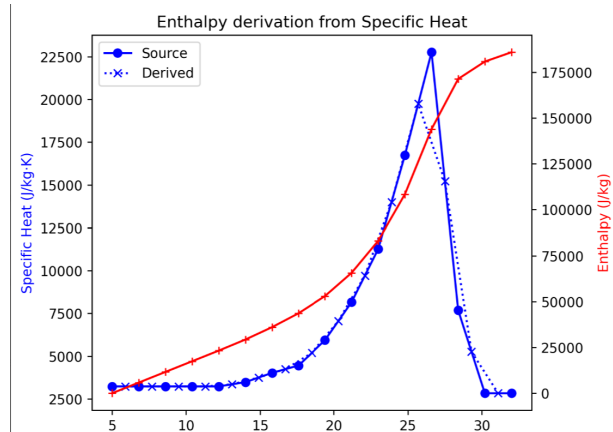
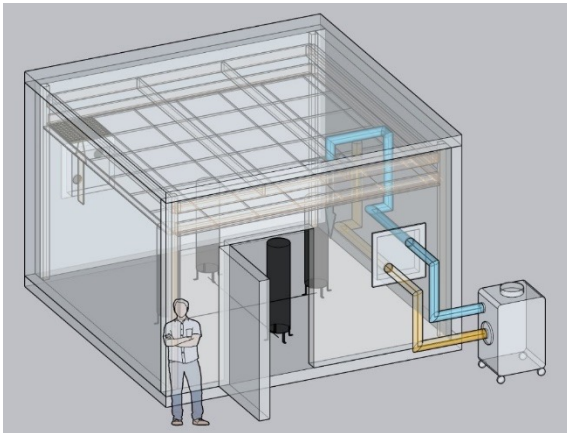
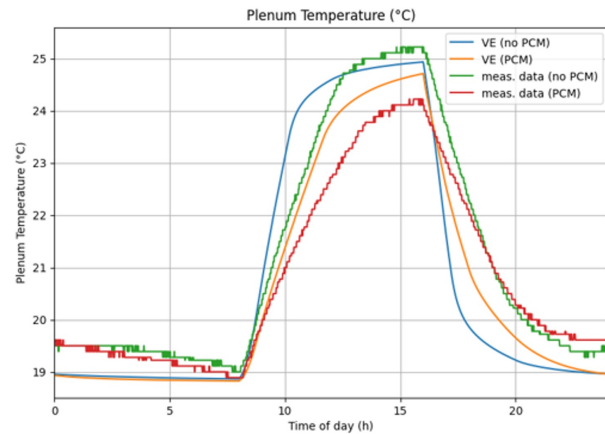
**ULTIMA TEMPLOK**

Fine texture mineral fiber ceiling combines exceptional acoustical performance, energy savings and enhanced thermal comfort using advanced Phase Change Material (PCM) technology.



# Lab Validation

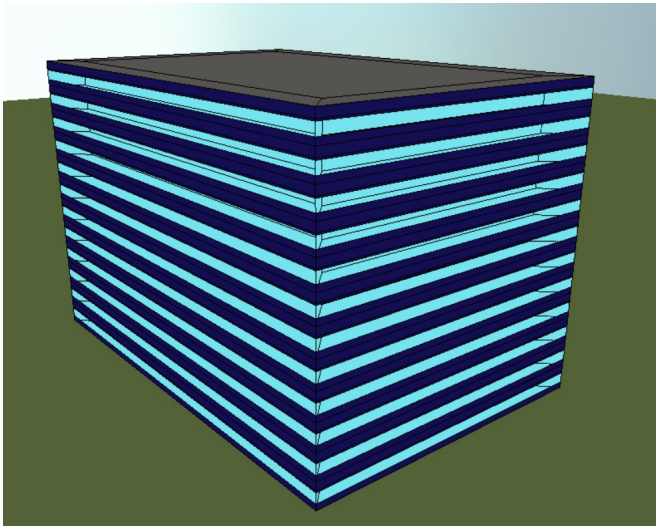
- AWI Test Chamber calibrated with APACHE sim engine
- PCM Temperature, PCM State, PCM Specific Heat Capacity





# PCM Model Results

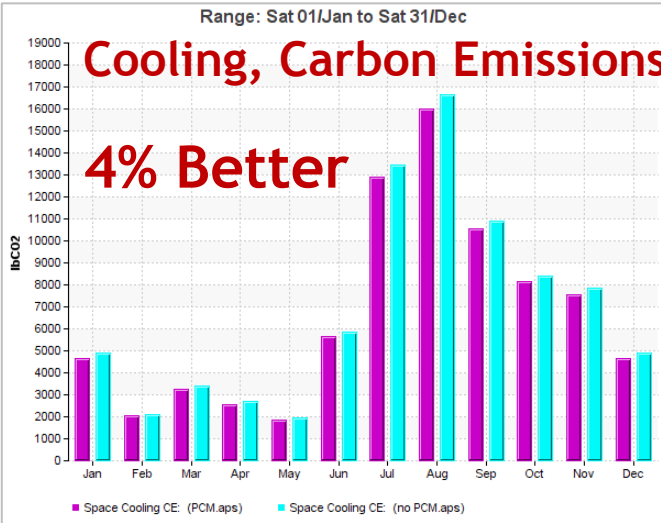
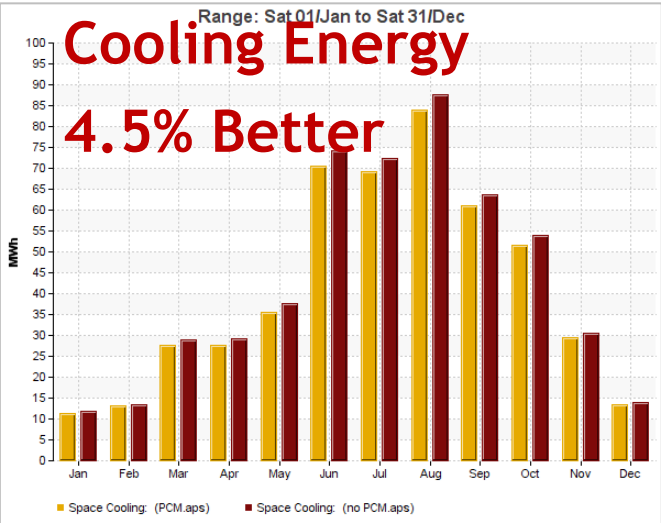
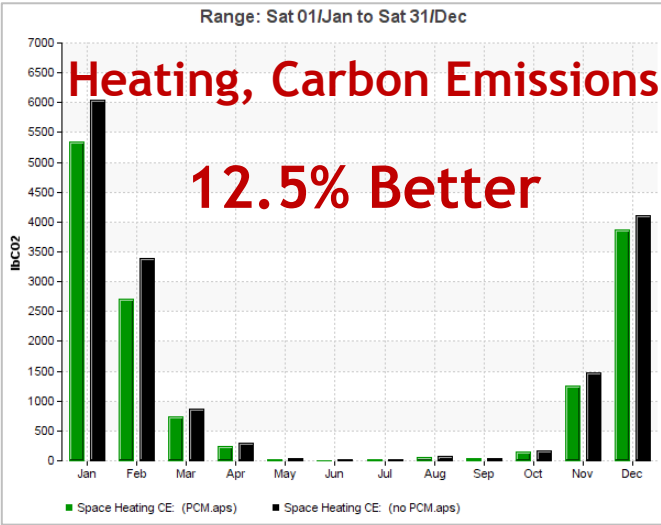
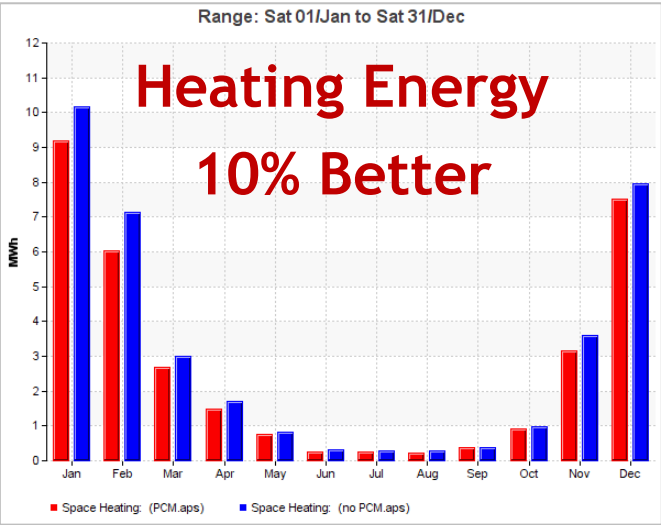
500,000 ft<sup>2</sup> Office,  
Los Angeles, 90% Tile



## Source Energy

Source Energy Use	Source Energy Use
Total <sup>2</sup> (kBtu/ft <sup>2</sup> - yr)	Total <sup>2</sup> (kBtu/ft <sup>2</sup> - yr)
27.46	27.46
50.36	46.58

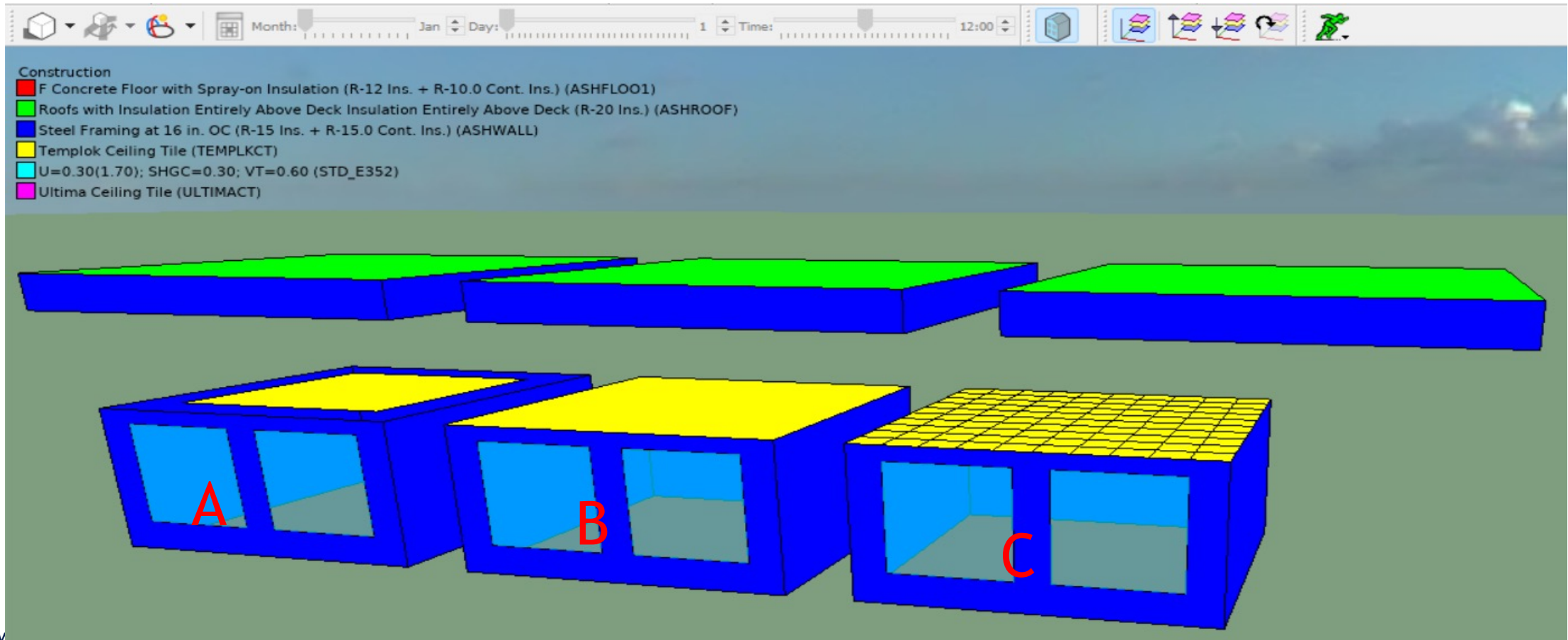
7.5%  
Better



# Lessons Learned from PCM Model

Individual Tiles are unnecessary;

- Use % Tiles (at **B**) = (**C**)

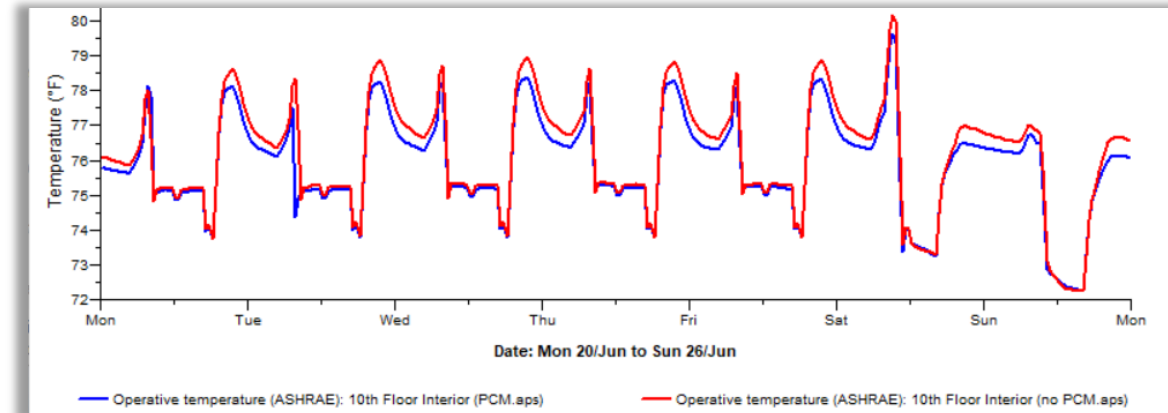
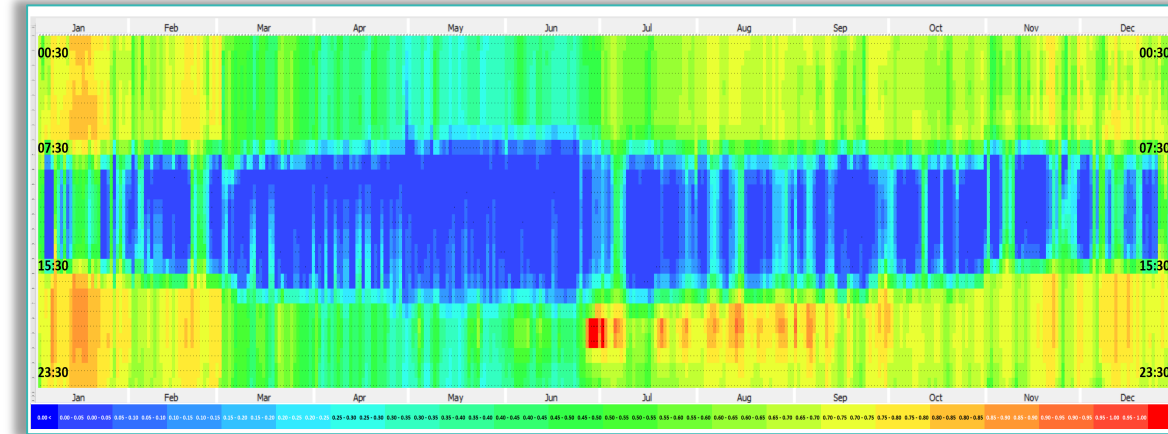


# Lessons Learned from PCM Model

Hourly Metric and Variables;

- CO2, Source, LSC/TDV
- To boost the PCM strategy:
  1. Ramped profiles
  2. Night purge

Operative Temp  
=> Thermal Comfort





# Title 24: PCM Ceiling Tile Layer

## 2022/2025 ACM Reference Manual:

- Nothing regulated for Ceilings

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### 5.5.10 Heat Transfer **between Thermal zones**

#### **PARTITION NAME**

*Applicability:* All partitions, optional.

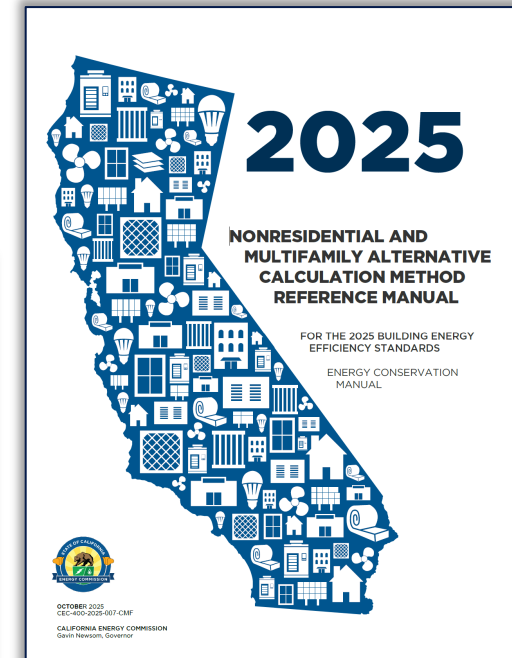
*Definition:* A unique name or code that relates the partition to the construction documents.

*Units:* Text: unique.

*Input Restrictions:* The text should provide a key to the construction documents.

*Standard Design:* **Not applicable.**

*Standard Design: Existing Buildings:* Not applicable.



- PCM tile is within the **same** Thermal Zone
  - 1 Zone: (1 Space + 1 Ceiling Plenum)

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