

Heating/Cooling Benefits of Thermal Mass and High R-Value

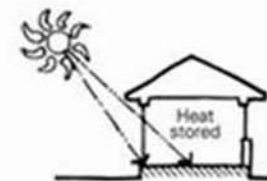
Dr. Kevin Hallinan

Chair – Dept. of
Mechanical

Engineering/Renewable and Clean Energy



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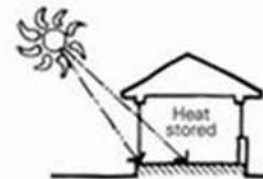


DOE – Building Technologies Goals

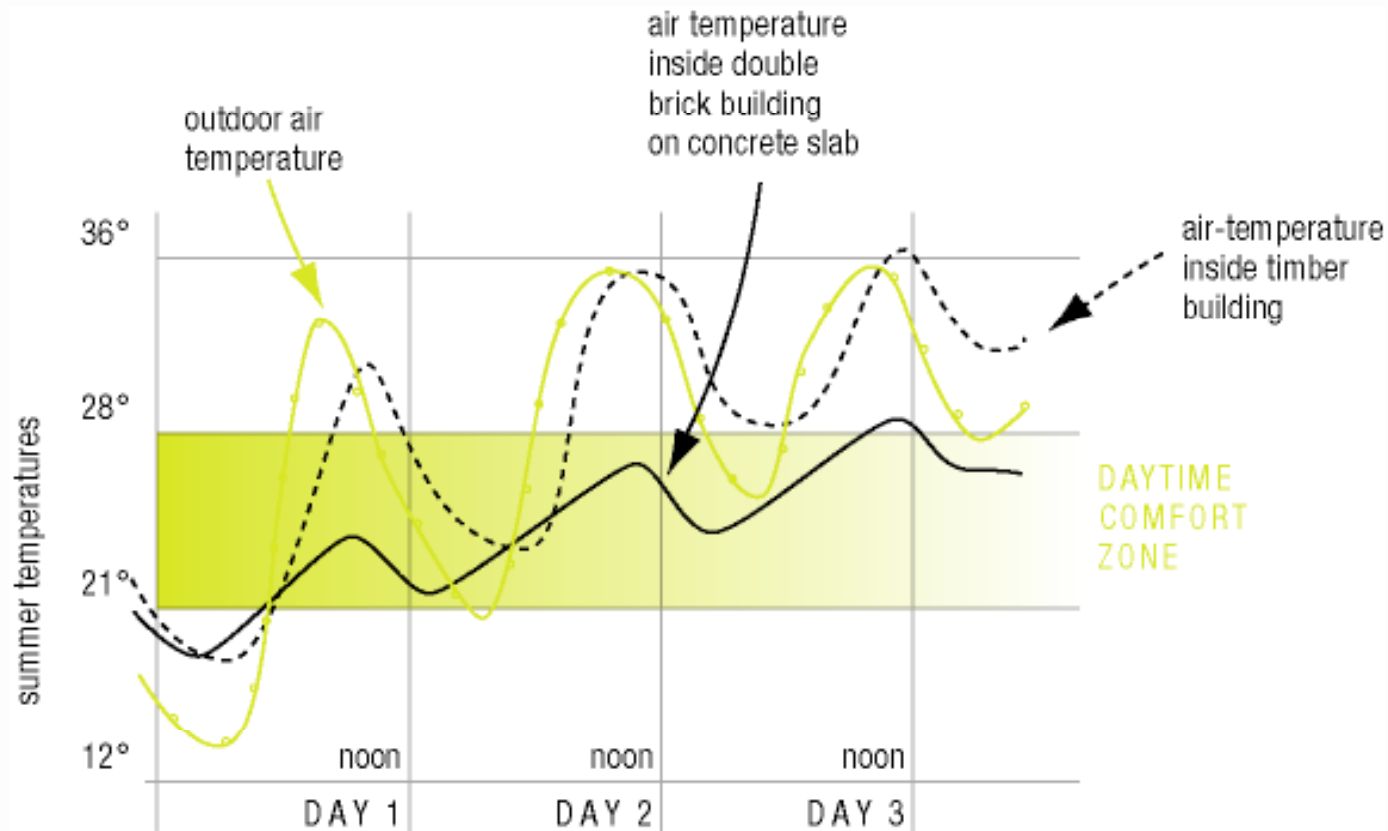
- 50% whole building energy reduction by 2015
- 75% whole building energy reduction by 2025.
- R25+ walls by 2025.



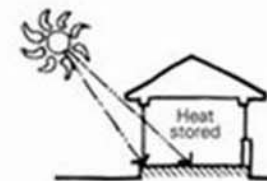
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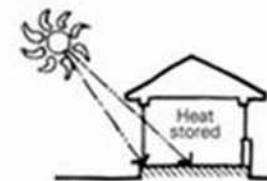
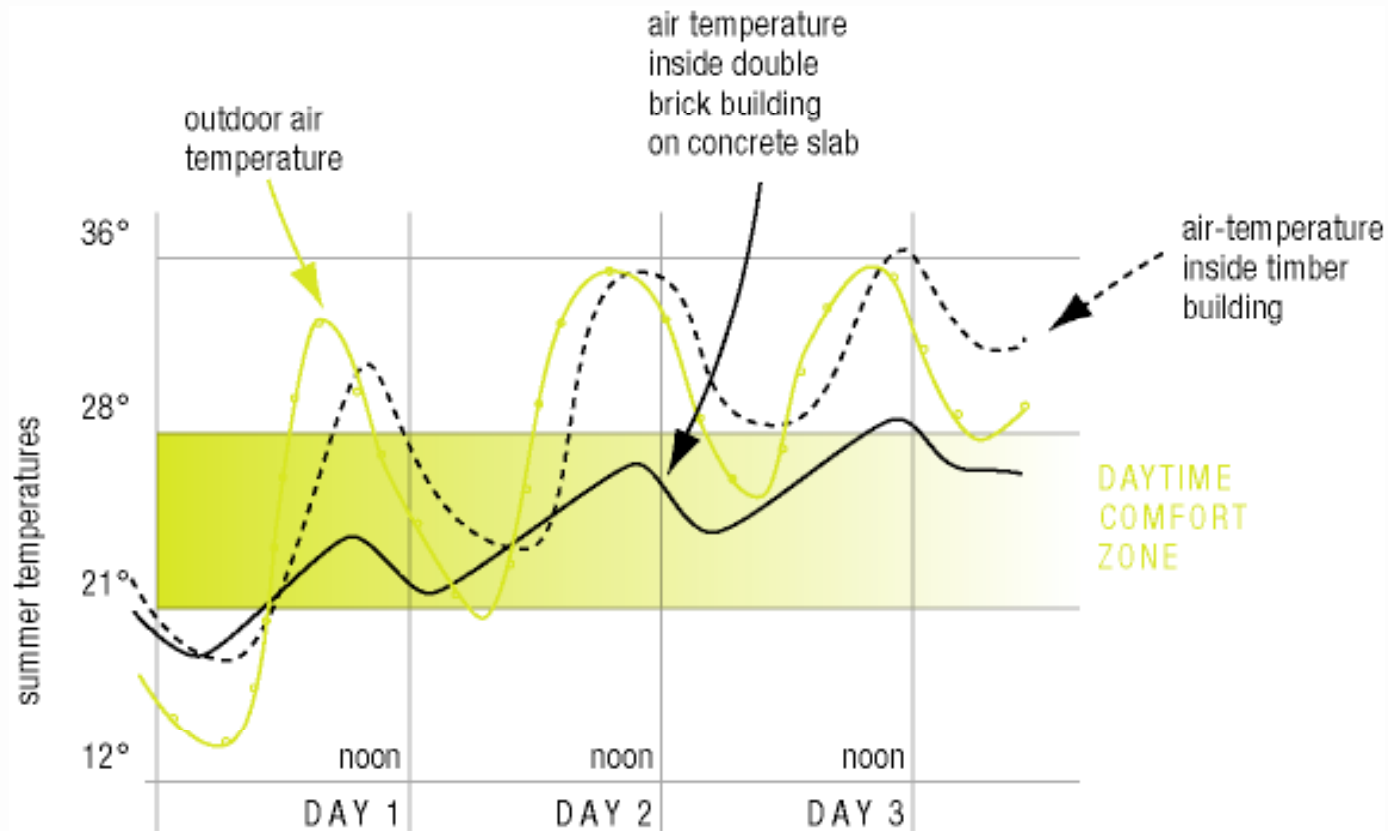
i. Damps out temperature swings



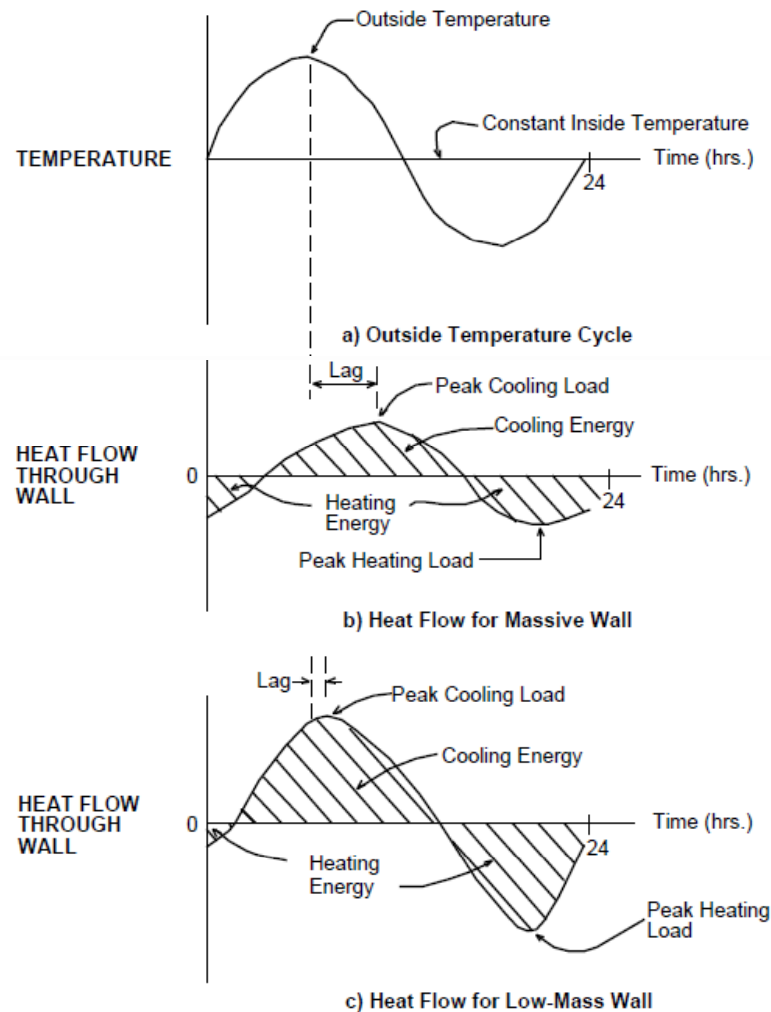
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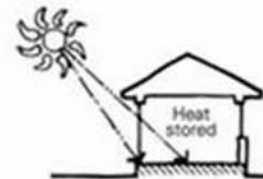
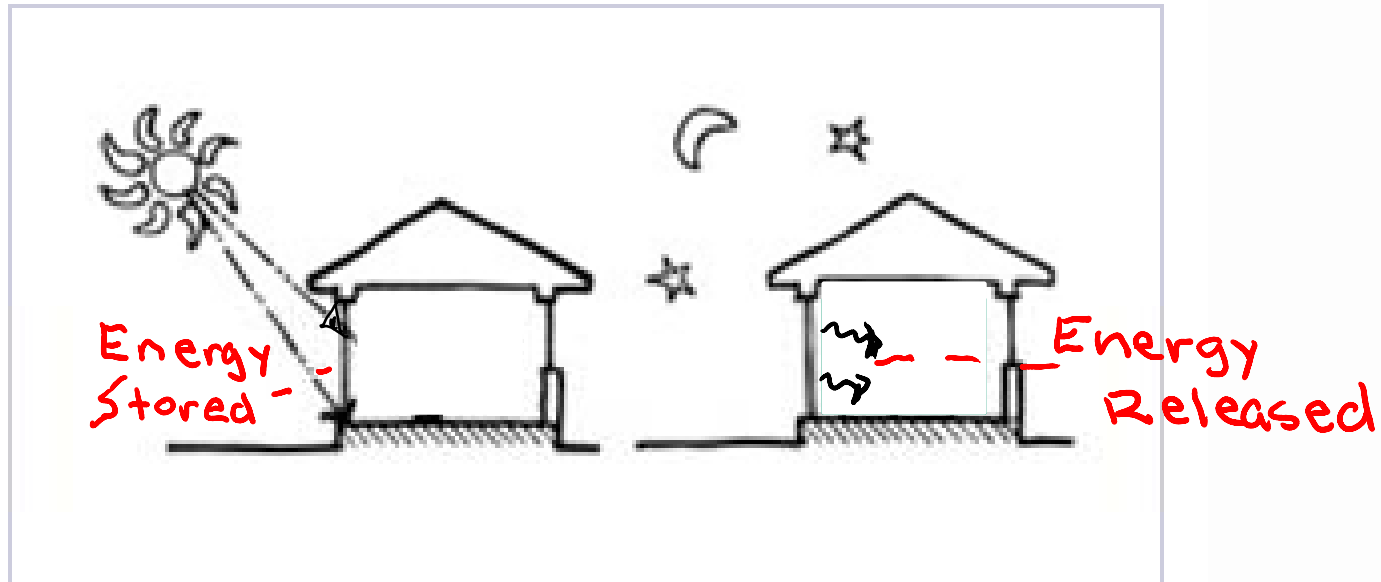
ii. Greater comfort with less reliance on mechanical systems



ii. Yields Lower Peak Loading (Potential to Downsize Heating / Cooling Systems)



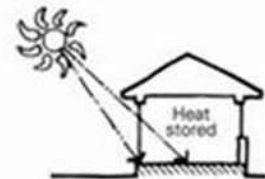
Thermal Mass Stores Solar Energy During the Winter



III. What Do the Building Codes Say About Thermal Mass?



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ASHRAE

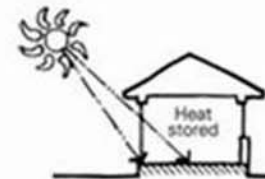
- ASHRAE Standard 90.1 -Energy Efficient Design of New Buildings, 3 options
 1. Prescriptive – Tables
 2. **Overall Building Energy Analysis**
 3. Compare Energy Costs to a Standard Building (e.g., 25% less energy than a standard building)

- ASHRAE Standard 90.2 -Residential

Separate R-value graphs are provided for concrete and masonry walls with interior, exterior, or integral insulation. To use the tables the user only needs to know the heating and cooling degree days at the location where the building is to be located.



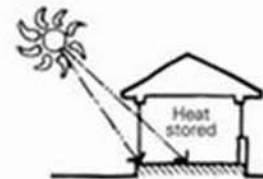
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IV. Effective R-Value of AAC Products – Some Examples and Some Whole Building Simulations



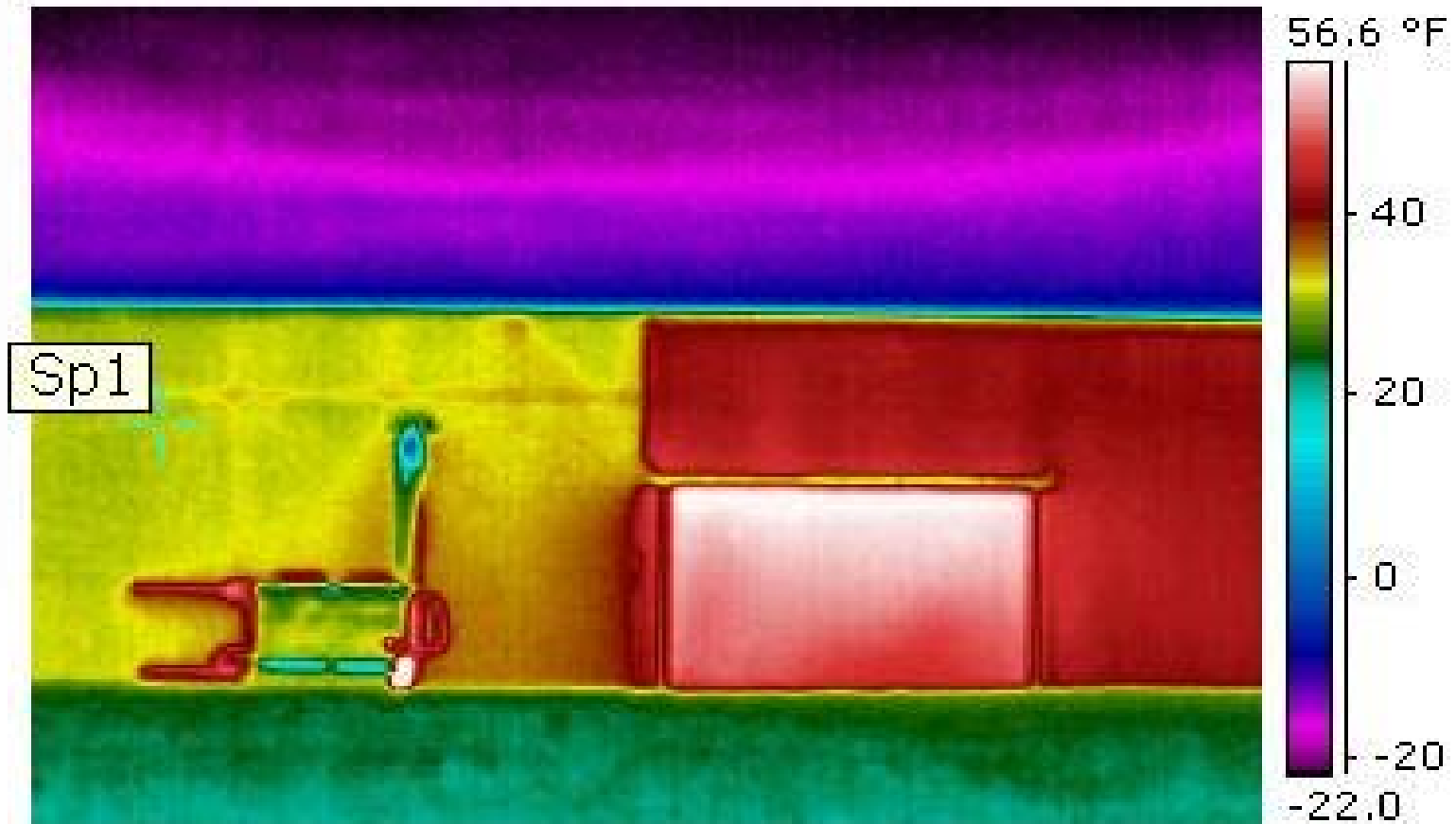
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8:00 AM

Performance temp = 31 F

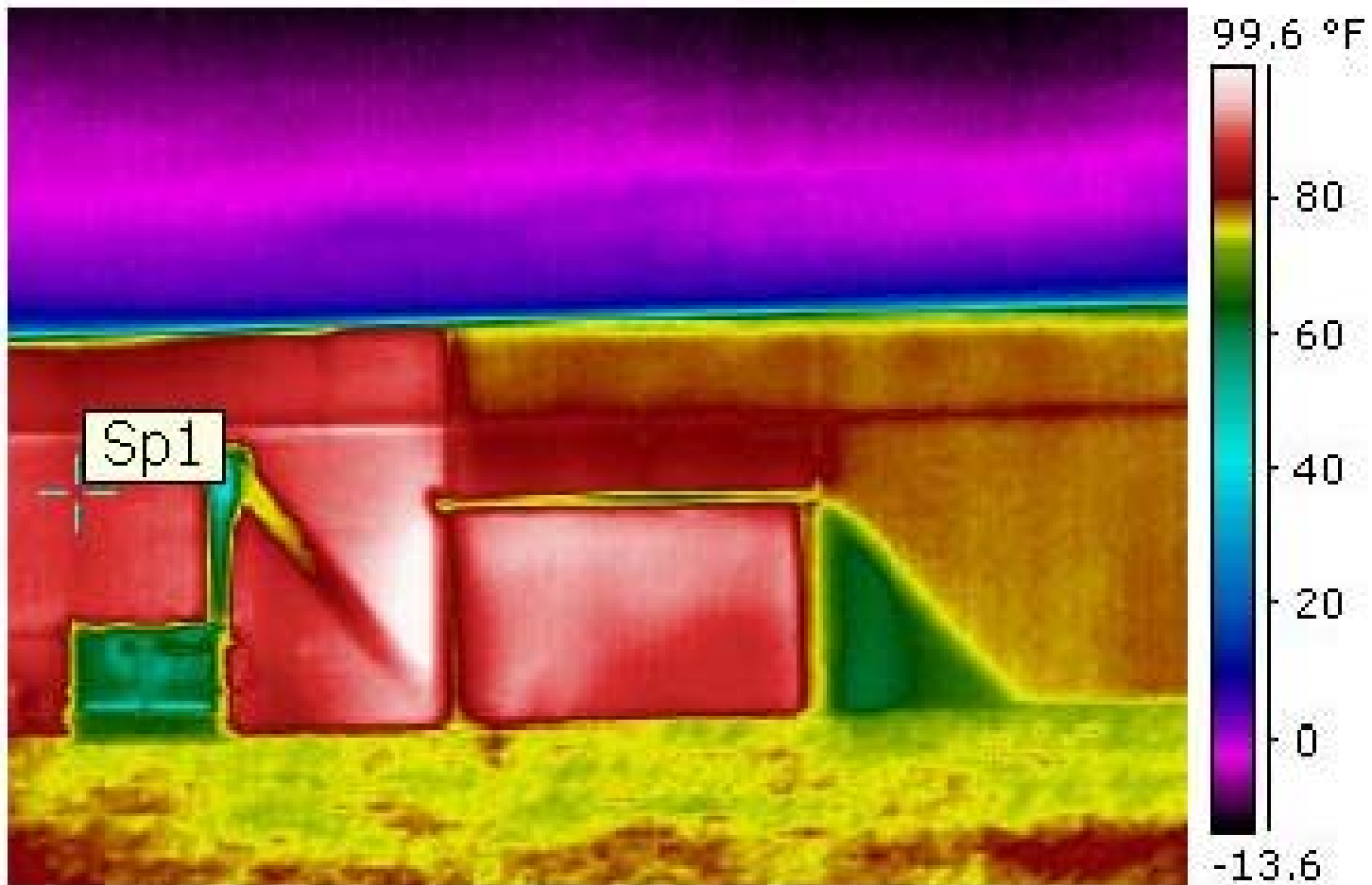
Other temp = 42 F



1:00 PM

Performance temp = 88 F

Other temp = 78 F

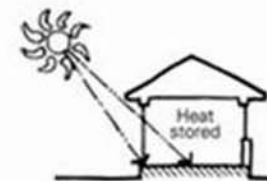


ii. Trotwood Middle School (AAC4 – 8" Walls Reduce Energy

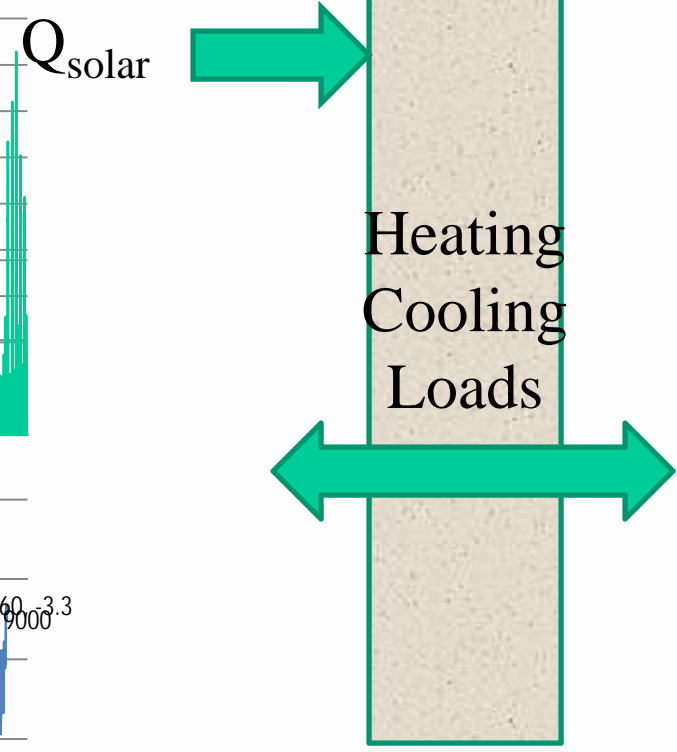
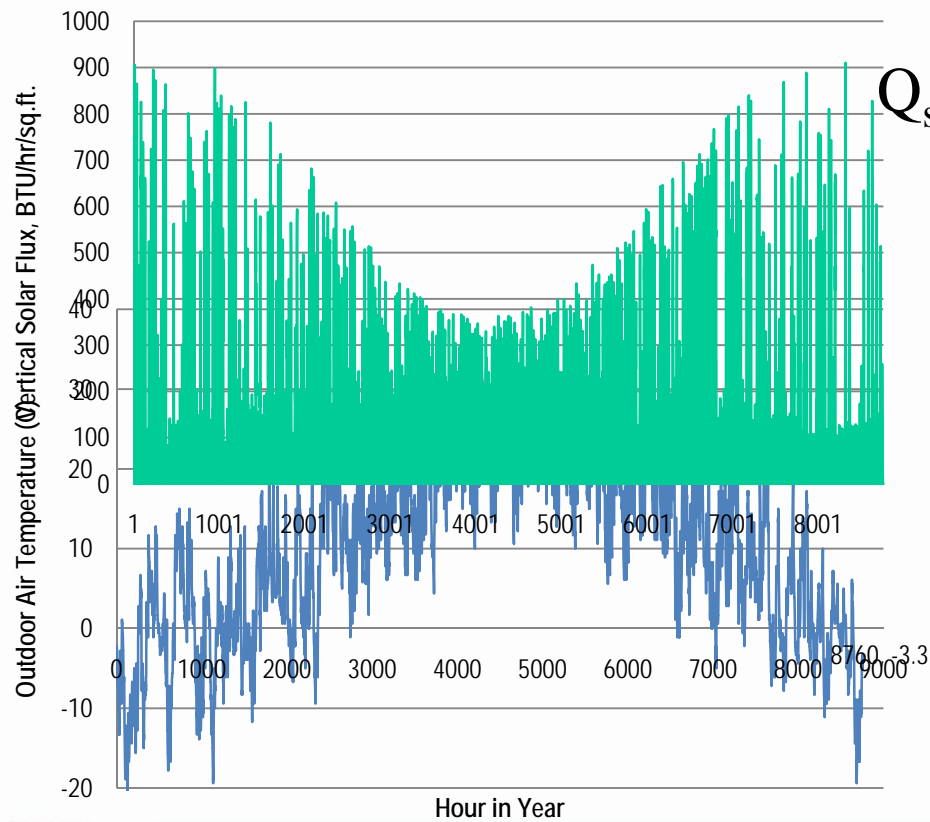
BUILDING NAME	FACILITY SIZE (S.F.)	FUEL KBTU/Sqft	TOTAL ANL COST	TOTAL KBtu/SqFt
High School	230,000	70.17	\$ 457,743	119.89
Middle School*	84,000	47.88	\$ 127,940	92.55
ELC*	66,456	48.65	\$ 100,846	88.98
Madison Park	54,065	75.19	\$ 115,137	119.51
Westbrooke	54,065	71.47	\$ 112,526	119.75



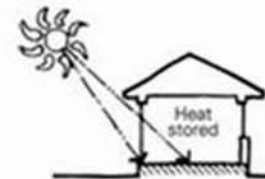
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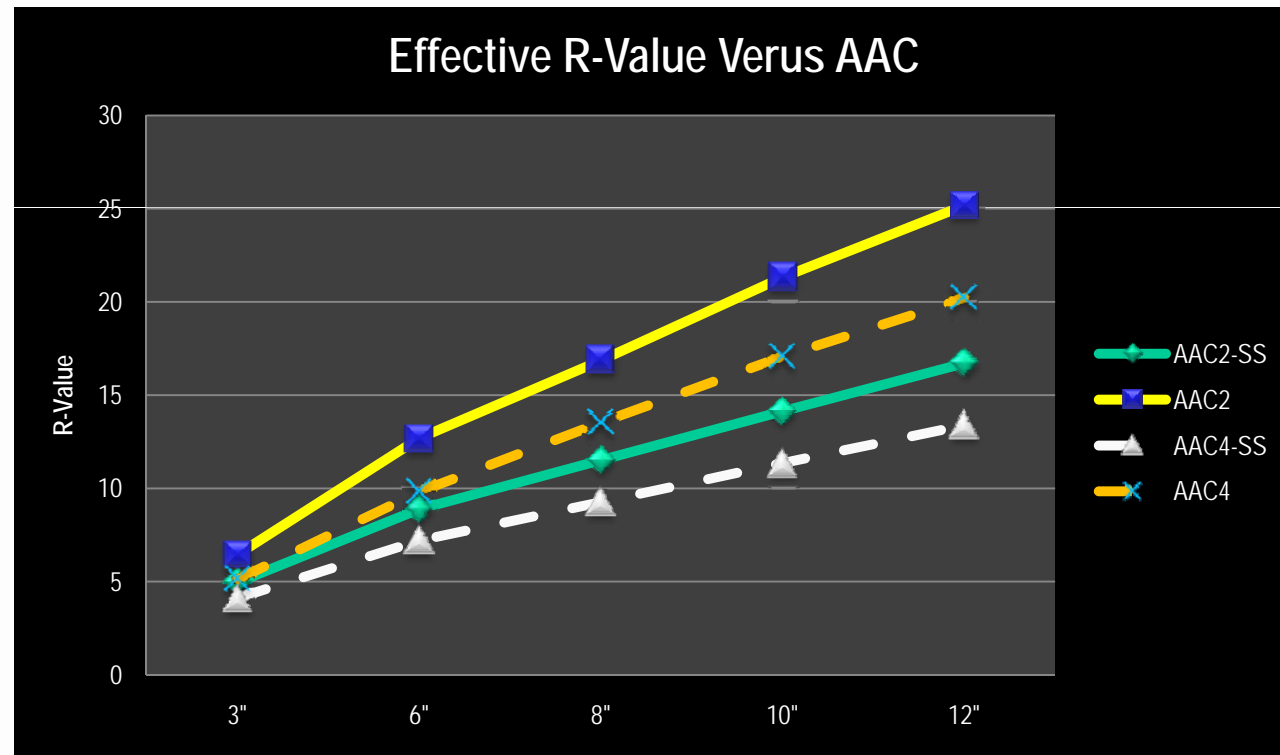
iii. Annual Energy Modeling



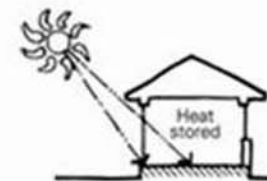
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Results for the Effective R-value for the Bare AAC Walls



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Effective R-Value Calculator Tool

Effective R-Value Calculator Tool

UNIVERSITY of DAYTON Building Energy Center

PERFORMANCE Redefining Concrete

Wall Considered

Performance Concrete Product

AAC Type: AAC4

Wall Thickness: 8"

Construction Type: Blocks

Exterior Finish: none

Interior Finish: none

Wall Construction: Concrete Ti...

Building Characteristics

Dimensions

NS Length (ft): 100

EW Length: 100

Height (ft): 20

Heating Equipment Efficiency or HPSF: 9

Cooling Equipment SEER: 13

City

Dayton

Calculate

Reset

Results

Effective R-Value: 17.04

Wall Cooling/Heating Loads for AAC Walls

Category	Load (kW-hr)
S-AC	~500
S-H	~6000
N-AC N-H	~7500
E-AC E-H	~6000
W-ACW-H	~7000

Annual Heating / Cooling Cost for Walls

Category	Annual Cost (\$)
AAC-C	~200
AAC-H	~1000
Comp-C	~400
Comp-H	~1400



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