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Centre for Industrial Relations and Human Resources

Library Archival Space Project

Team 144

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Preview

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Background

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- Archival Space housed in Library at the Centre for IRHR at 121 St. George St.
- Center is a historical building
- Contains books, film and audio tapes from the 20th century (1950s - 2000s)
- Number of environmental defects that harm the archives

Fig 1. Center for IRHR [1]

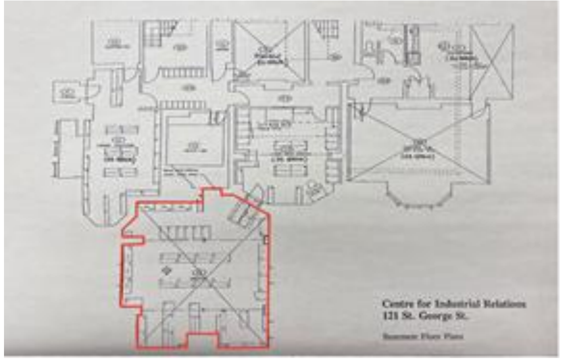


Fig 2. Basement Floor Plan with archive in red

The Problem

Nafew Islam

Want

Redesign of the archive space

- Protect archive content
- Increase storage
- More electrical outlets

Need

Means to regulate the environmental conditions

Scope

Work only on archival room and no other rooms

Pipes will not be operated on

Nafew Islam

Main Claim

The "insulated basement" design is the appropriate design for protecting the archive space by minimising the effect of the environmental defects in the basement.

Our proposed design solution “The Insulated Basement” meets all the client’s needs based on assessing it against project requirements

Nafew Islam

Potential Hazards:

Improper Temperature: 5-27°C
Improper Humidity: 5-100%
Improper Lighting: 1600-3200 lumens
Lack of air particulate control

Client needs derived from potential hazards and wants

Protect contents of the archive

- Hold constant ideal thermal energy
- Minimize light energy
- Minimize Air particulates
- Hold constant ideal humidity

Prioritized objectives:

should be 18-22°C
should be 45-55%
should be 54-107 lumens

+ electrical outlets
+ storage efficiency

Khadija Nebil Mohammed

Our proposed design solution "The Insulated Basement" meets all the client's needs based on assessing it against project requirements

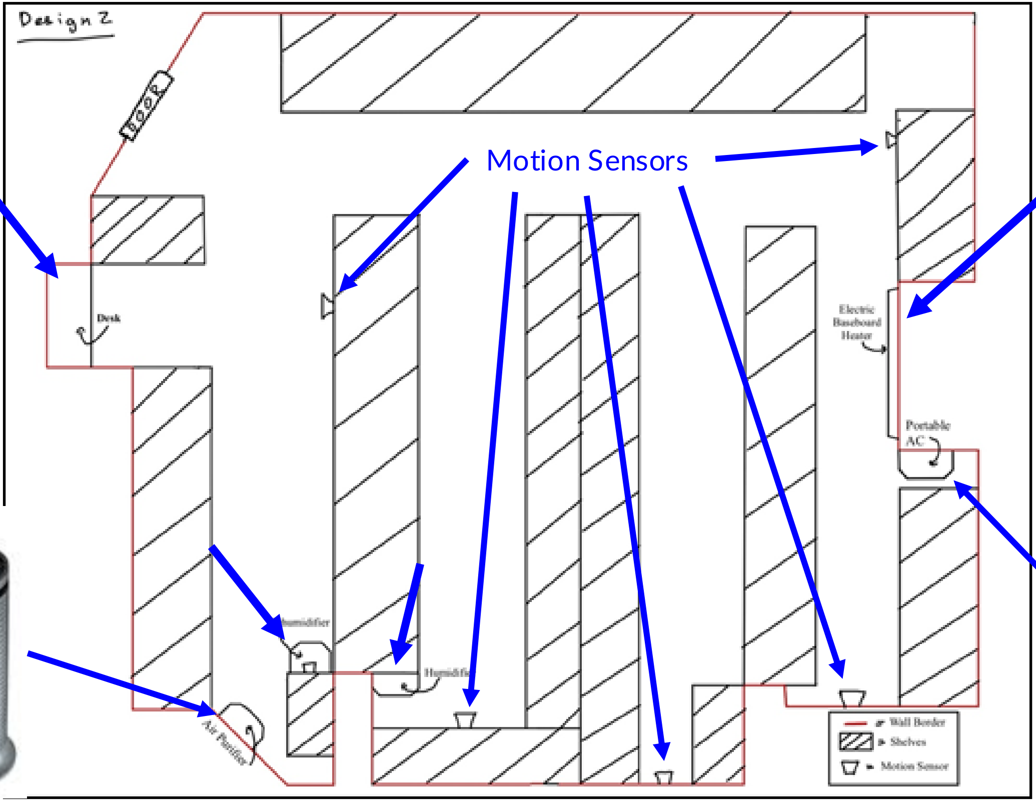


Fig 3. Design 2 Diagram

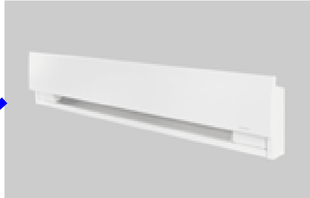


Fig 6. Baseboard Heater. Taken from [2]

Fig 4. Rockwool Insulation. Taken from [3]

Fig 5.Portable A/C. Taken from [4]

Fig 7. Air Purifier. Taken from [5]

Our proposed design solution "The Insulated Basement" meets all the client's needs based on assessing it against project requirements

Khadija Nebil Mohammed

Table 7. Objectives for Design 2

Objectives	Metric	Objective Goal	Result
Temperature controlled	Absolute value of (temperature in °C - 20)	≤ 2	0 (Meets 8th constraint)
Humidity controlled	Absolute value of (relative humidity in % - 50)	≤ 5	0 (Meets 6th constraint)
Air particulate controlled	Level of Filtration (%)	≥ 60	99.97
Light controlled	Average Lux (lx)	≤ 100	17.9 (Meets 7th constraint)
Quick to implement	Week(s) to implement	≤ 1	3.6
Maximize storage space	Storage space area (m^2)	≥ 21.094	22
Maneuverable	Width of aisles (cm)	≥ 106.7	93
Usable for reading and processing	Desk/working area (m^2)	≥ 1.12	1.12
Accessible	Required arms reach (cm)	≤ 84	38
Electrically convenient	Number of available plugs	≥ 8	8

Fig 8. Design 2 Objectives

Objectives based on primary function

Our proposed design best meets the clients needs compared to the other two alternative design solutions

Issa Al Rawwash

Design 1 - Environmentally Controlled Cabinets

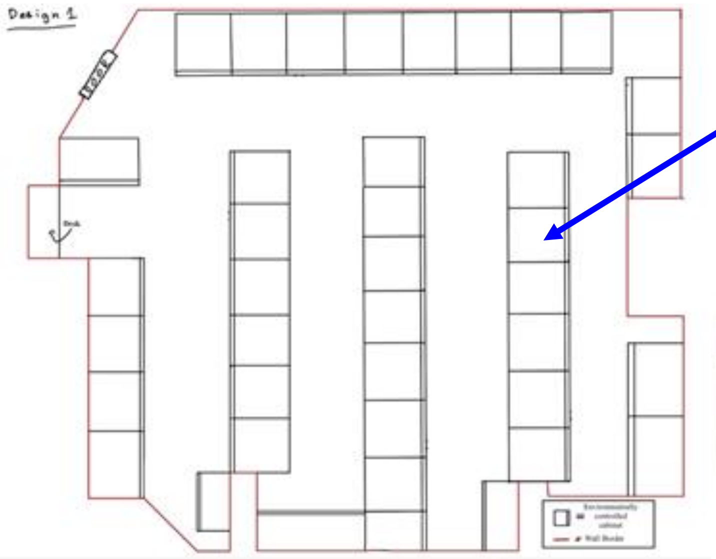


Fig 9a. Design 1 Diagram

Fig 9b. COTS Cabinet . Taken from [6]

Design 3 - Basic Portable HVAC

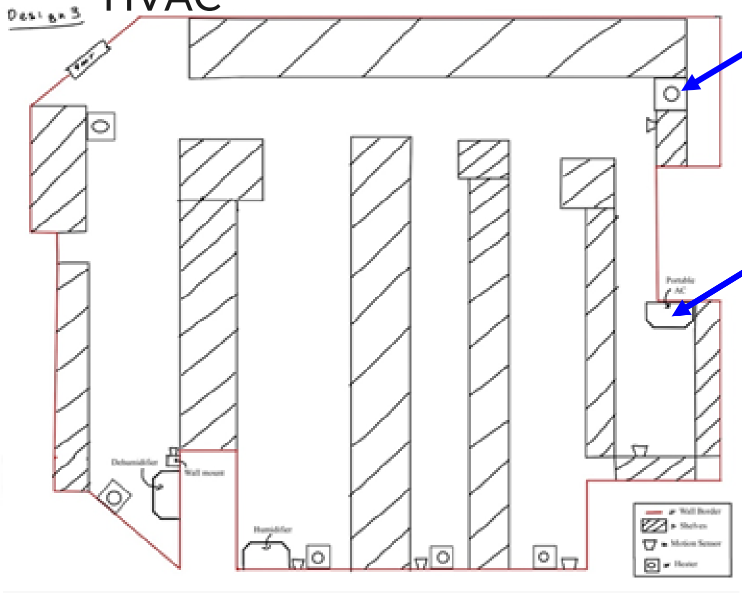


Fig 10. Design 3 Diagram

Fig 10b Portable AC Taken from [7]

Our proposed design best meets the clients needs compared to the other two alternative design solutions

Issa Al Rawwash

Shortcoming of Design 1

Table 9. Pugh Chart

Objectives	Datum	1. Ventilated Boxes	2. Insulation Basement	3. Basic Portable HVAC
Temperature controlled	S	2	2	2
Humidity controlled	S	2	2	2
Air particulate controlled	S	2	2	2
Light controlled	S	2	2	2
Quick to implement	S	-2	-1	0
Maximize storage space	S	0	0	0
Maneuverable	S	-1	0	-2
Usable for reading and processing	S	2	2	2
Accessible	S	2	2	2
Electrically convenient	S	2	2	2
Total Score	S	9	11	10

Fig 11. Pugh Chart Analysis

- ➔ Pugh chart used to analyze alternatives
- ➔ Design 2 scored highest overall
- ➔ Tradeoffs made between objectives
- ➔ Design 2 chosen as best compromise

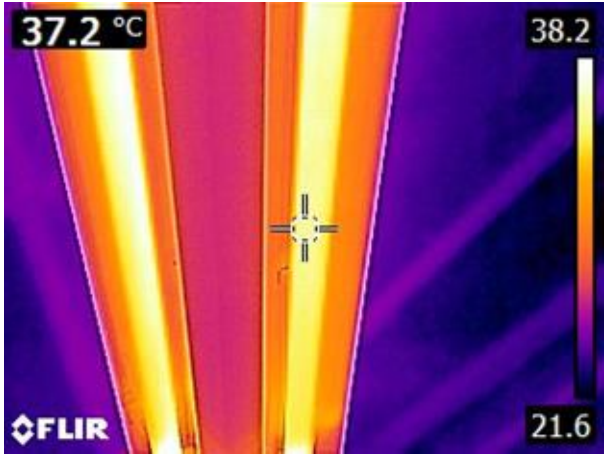
Advantage/Disadvantage of Design 3

William Wen

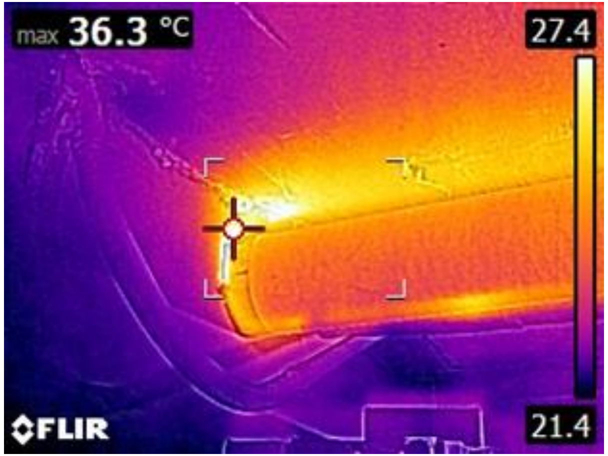
Our design can maintain the temperature goal of 20°C year round and our MoS validates this assertion

Heat Transfer Equation:

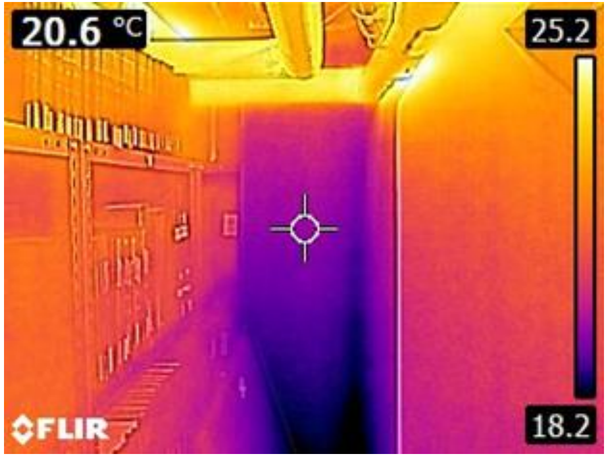
$$Energy\ (W) = \frac{Area\ (m^2) \times Temperature\ Difference\ (K)}{R\text{-}Value\ (m^2 \cdot K/W)}$$



a. Lights



b. Pipes



c. Wall

Fig 12 a, b, c. Various thermal Images

Our design can maintain the temperature goal of 20°C year round and our MoS validates this assertion

William Wen

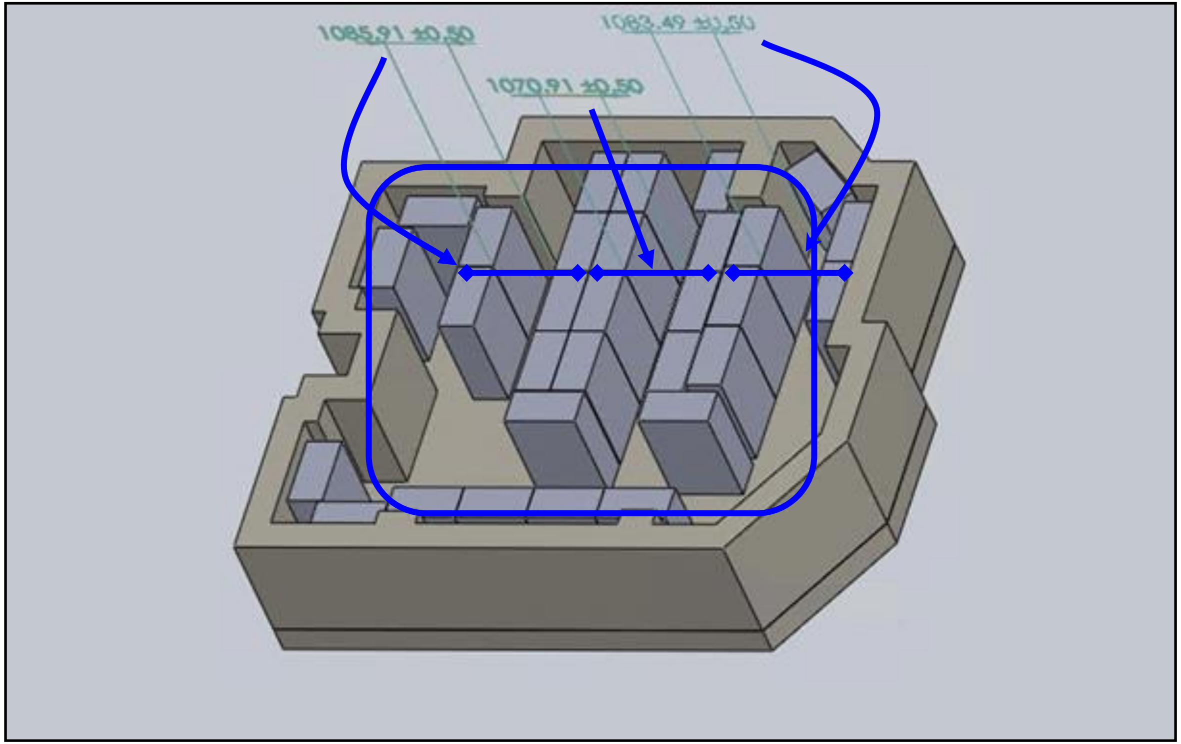


Fig 13. To-scale Digital Prototype

**Measurements in mm

Surface Areas (m^2):
Exterior Walls: 61.72
Interior Walls: 15.92
Ceiling: 61.12
Floor: 61.12

Our design can maintain the temperature goal of 20°C year round and our MoS validates this assertion

Matthew Lee

Layers of wall facing exterior
Brick
Air Gap (2.5 cm)
Plywood Sheathing
Air Gap (5 cm)
Drywall
Rockwool Insulation (100 mm)

R value: 3.29

Layers of ceiling
Wood Floor
Air Gap
Drywall
Rockwool Insulation (100 mm)

R value: 3.176

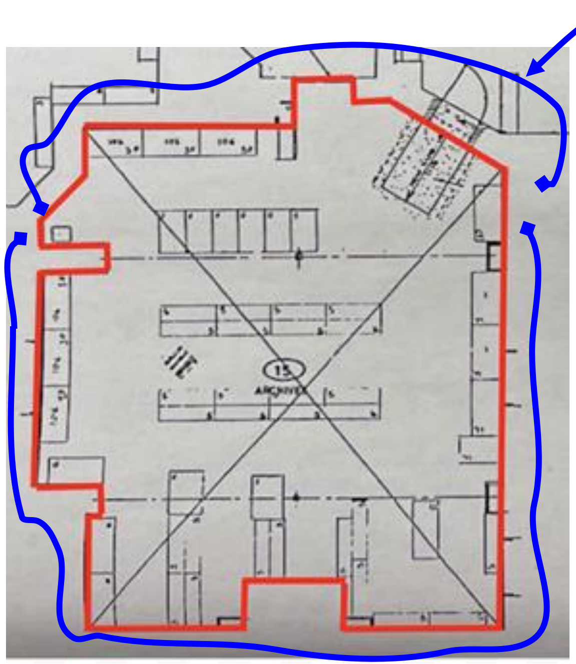


Fig 14. Archive Room outline

Layers of wall facing interior
Drywall
Air Gap
Drywall
Rockwool Insulation (100 mm)

R value: 3.036

Layers of floor
Tile
Concrete Slab

R value: 3.21

$$Energy\ (W) = \frac{Area\ (m^2) \times Temperature\ Difference\ (K)}{\boxed{R\text{-}Value}\ (m^2 \cdot K/W)}$$

Between exterior and interior of surface

Our design can maintain the temperature goal of 20°C year round and our MoS validates this assertion

Matthew Lee

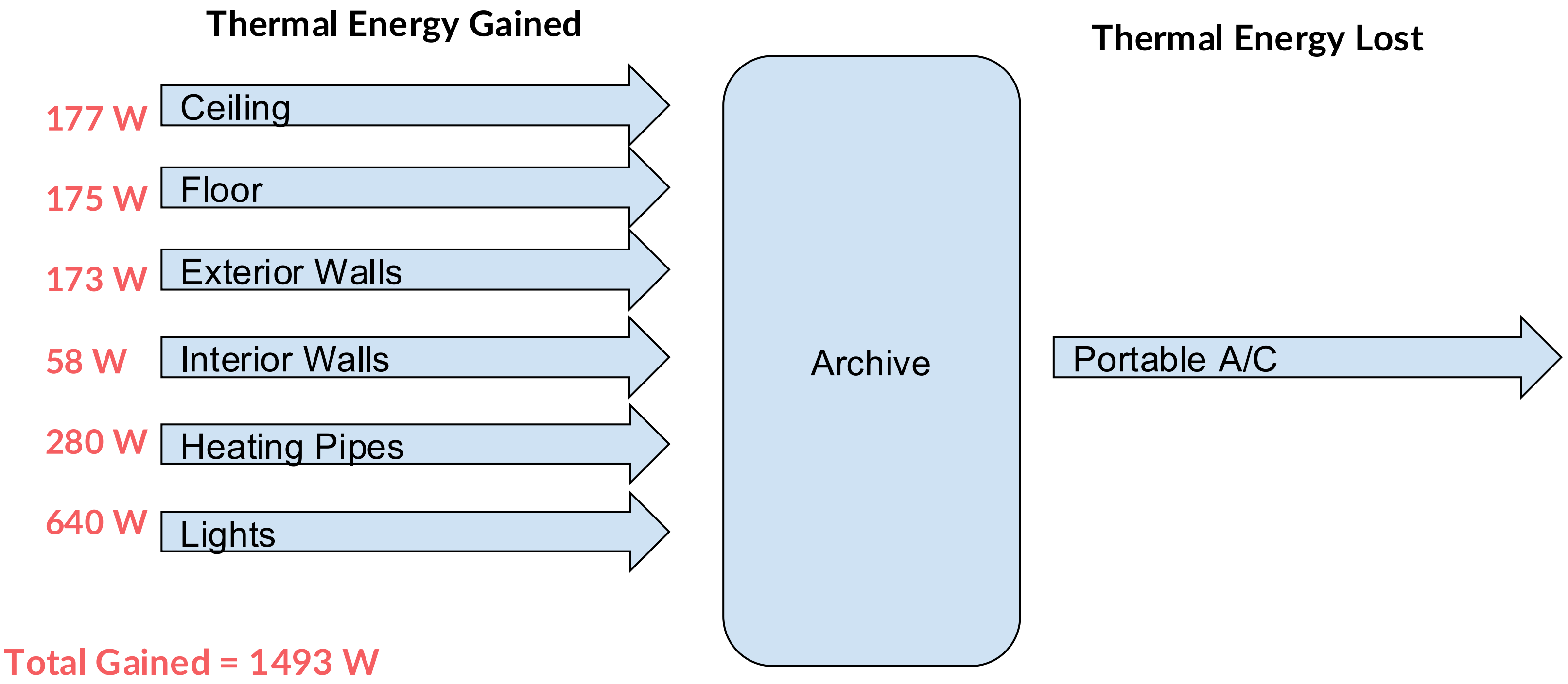


Fig 15. Thermal Energy Model for Summer Scenario

Our design can maintain the temperature goal of 20°C year round and our MoS validates this assertion

Matthew Lee

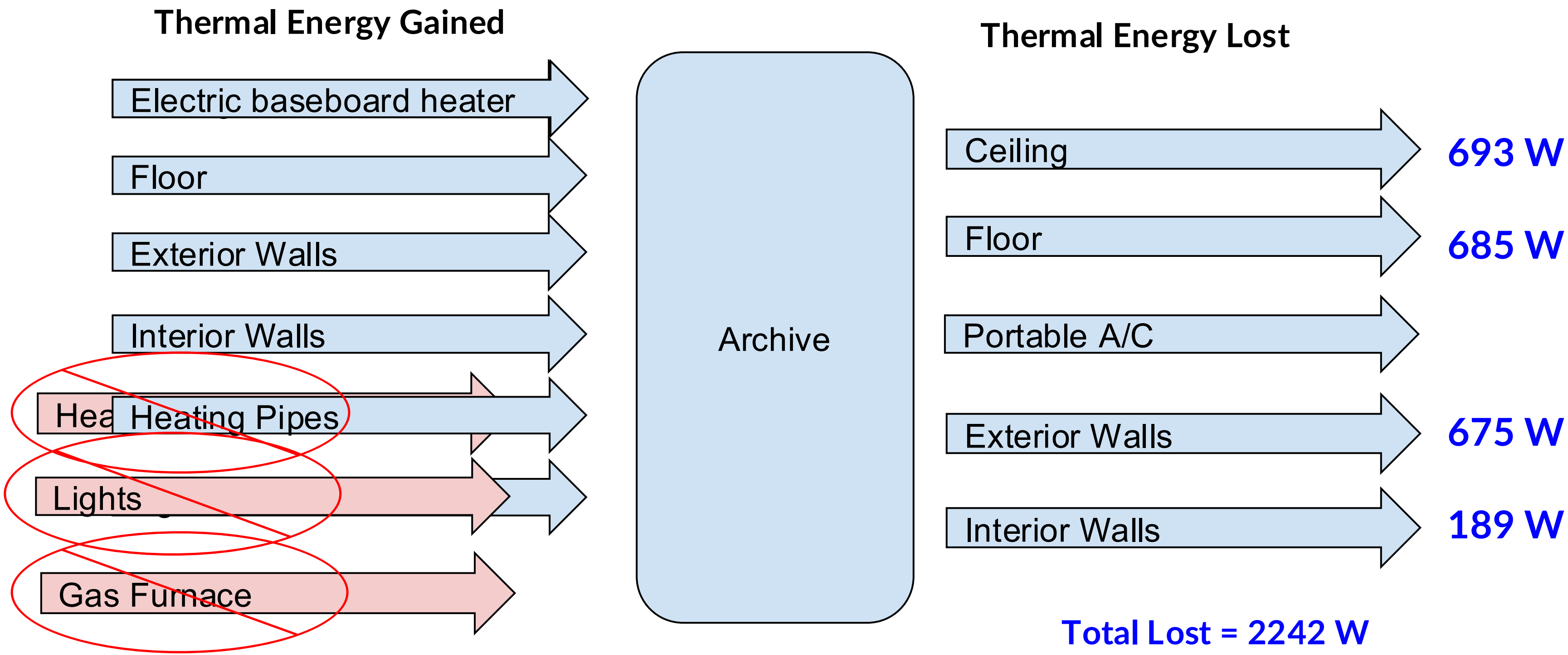


Fig 16. Thermal Energy Model for Winter Scenario

Conclusion

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Why the proposed solution is better:

- Meets all needs of the client after assessing against the requirements
- Best solution compared to alternate designs
- MoS validates designs temperature regulation ability

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The Takeaway

“Insulate that basement, it’s simply the right thing to do”

Thank you!

Questions?

References List

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