# Thermal Insulation in Buildings



By

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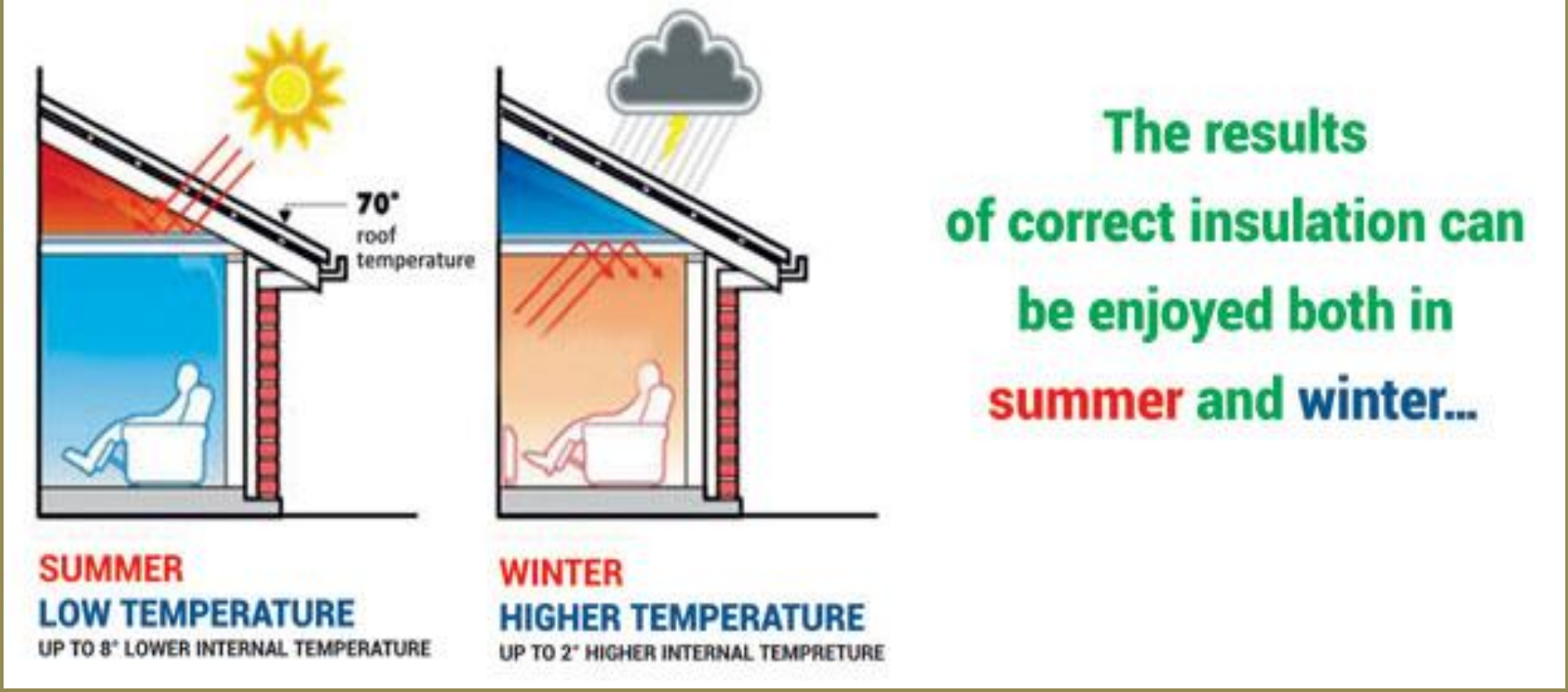
# Thermal Insulation

Using materials has special properties , reduce heat transfer from outside to inside in summer and from inside to out side in winter and has low thermal transmittance



# ADVANTAGES OF THERMAL INSULATION

1. Energy Saving: Due to thermal insulation transfer of heat between inside and outside of the room is restricted. This results in less quantity of energy required for maintaining the desired temperature in the room.

2. Reduce consumption of heating and cooling machines

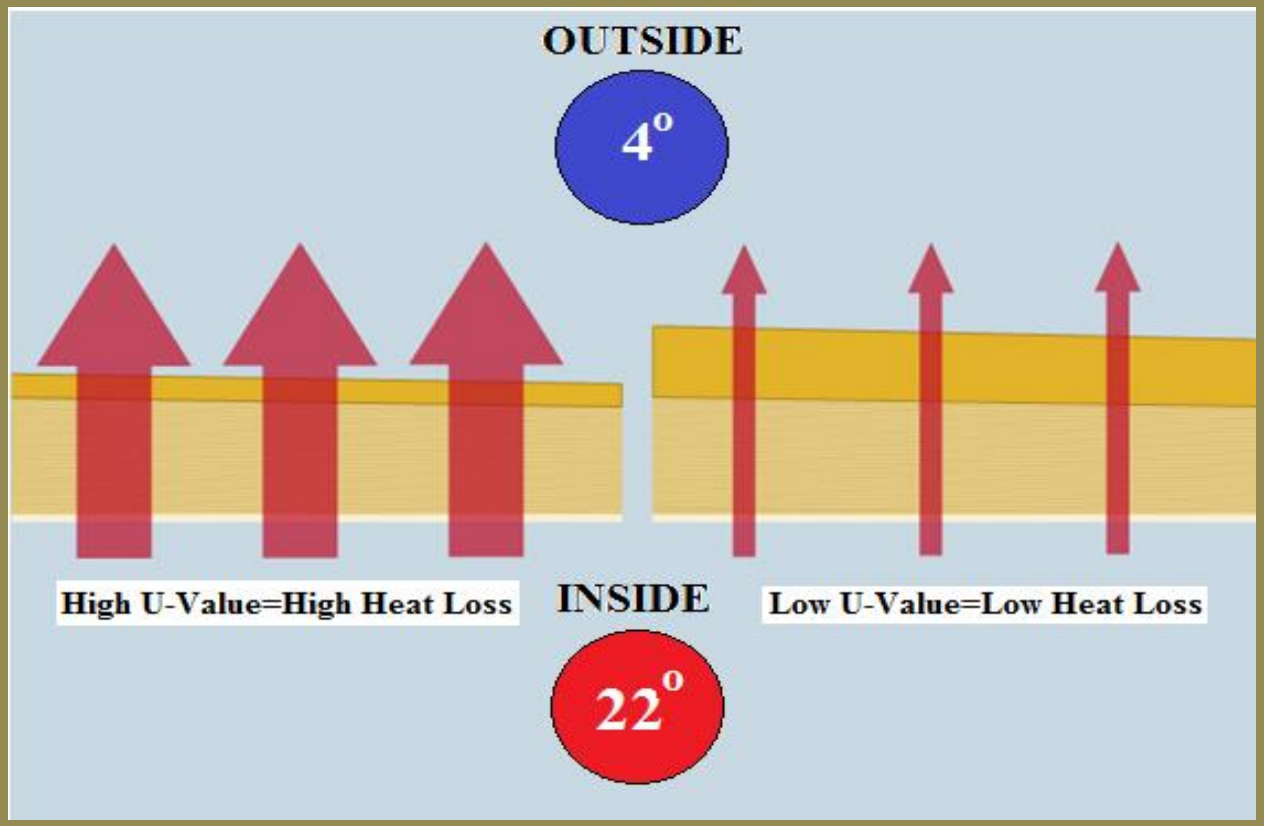
3. Provide Protection for the structural elements against thermal stresses

4. Environmental friendly solution

5. Due to thermal insulation, the room remains cooler in summer and warmer in winter than outside. Hence, a room provided with thermal insulation gives comfort both in summer and winter.

# Thermal transmittance (U-value)

is the rate of transfer of heat (in watts) through one square meter of a structure divided by the difference in temperature across the structure. It is expressed in watts per meters squared Kelvin, or $W/m^2K$ where:



To get efficient thermal insulation in building, the required U-value according to ACI Committee 122 for

Ceiling s not exceeds 0.15 $W/m^2 \cdot K$

Walls , doors and windows not exceeds 0.25 $W/m^2 \cdot K$

Floors not exceeds : 0.2 $W/m^2 \cdot K$

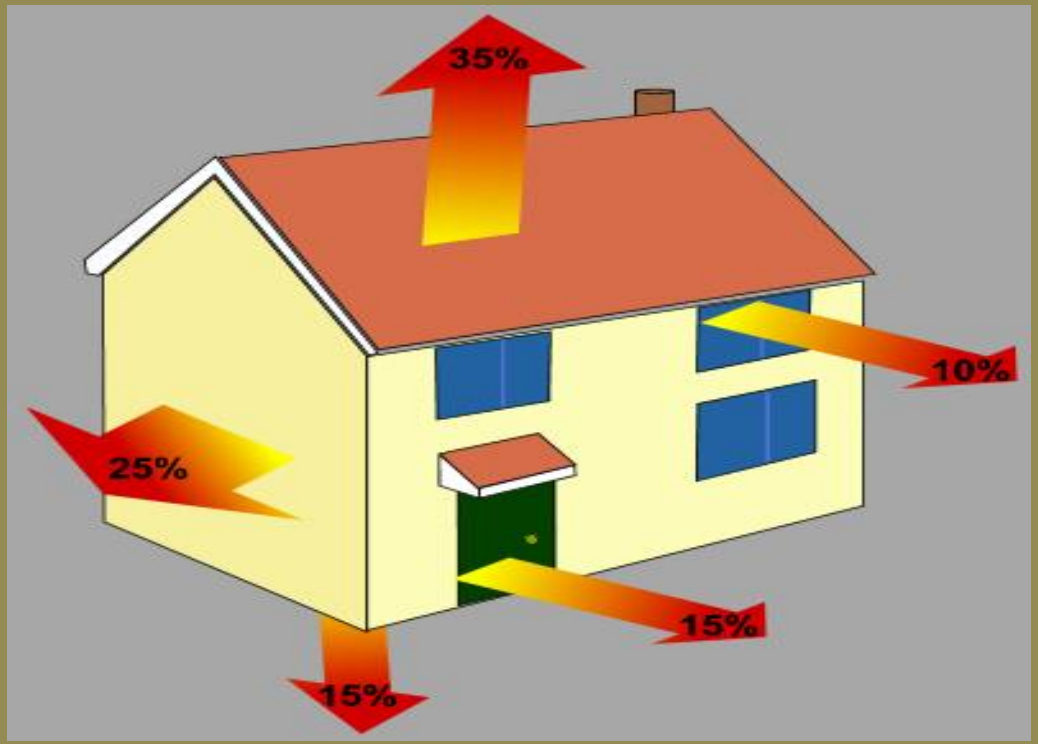
| Material | Density ($kg/m^3$) | Thermal transmittance U-value ($Watt/m^2$. Kelvin)* |
|---|---|---|
| Normal Concrete | 2400 | 1.85 |
| Solid Concrete Block | 1900 | 1.2 |
| Hollow Concrete Block | 1000-1600 | 0.65-1 |
| Solid Brick | 1400-1800 | 0.60-0.79 |
| Perforated Brick | 1000-1200 | 0.47-0.52 |
| Glass window | 2500 | 1.05 |
| wood | 400-700 | 0.12 -0.16 |

* ACI Committee 122 (ACI 122R-02) "Guide to Thermal Properties of Concrete and Masonry Systems"

There is a need to use the integral thermal insulation for roofs, walls, windows and doors and floors

It can be divided the heat which penetrate the building into:

1. Heat penetrate the ceilings (35%)
2. Heat penetrate the walls (25%)
3. Heat penetrate doors  and windows (25%)
4. Heat penetrate the floor (15%)



# Insulation Materials in Buildings

# 1. Glass wool

*The fibers of glass wool are manufactured from fusible glass and weave as natural wool.

*It is excellent thermal isolator material .

*Its thermal transmittance  0.036-0.045

* Excellent sound isolator

*Has high fire resistance

* Low absorption for water

# 2. Rock or Mineral Wool

*fibers manufacture from fusible rocks as basalt rock or slag and weave as natural wool.

*it is excellent thermal isolator material .

*Its thermal transmittance not exceeds 0.036-0.045

* sound isolator

*has high fire resistance

*High absorption for water

# 3. Polystyrene

Polystyrene is produced by  polymerized  the styrene.

*There are two types of Polystyrene : resistant to water and pressure

*it is excellent thermal isolator material .

*Its thermal transmittance 0.029-0.035

*Excellent sound insulator

*No fire resistance

# 4. Polyurethane

Polyurethane is a polymer with very high porosity
Polyurethane produced as solid sheet or as foam

- Its thermal transmittance 0.02-0.029
- Excellent insulator for sound , water and heat
- Low fire resistance

# Thermal Insulation Systems for Walls

There are three thermal insulation systems for walls:

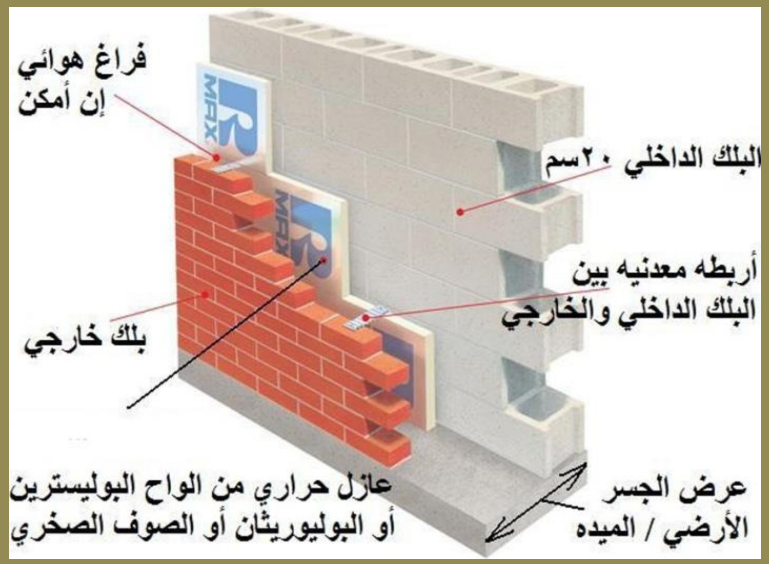
## 1. Wall with thermal insulator units

Thermostone (U-Value 0.12-0.14)

Thermolight block (U-Value 0.08-1)

The major drawback of this system is thermal bridges between the building units

# 2. Wall with cladding system




**U-Value 0.029-0.045**

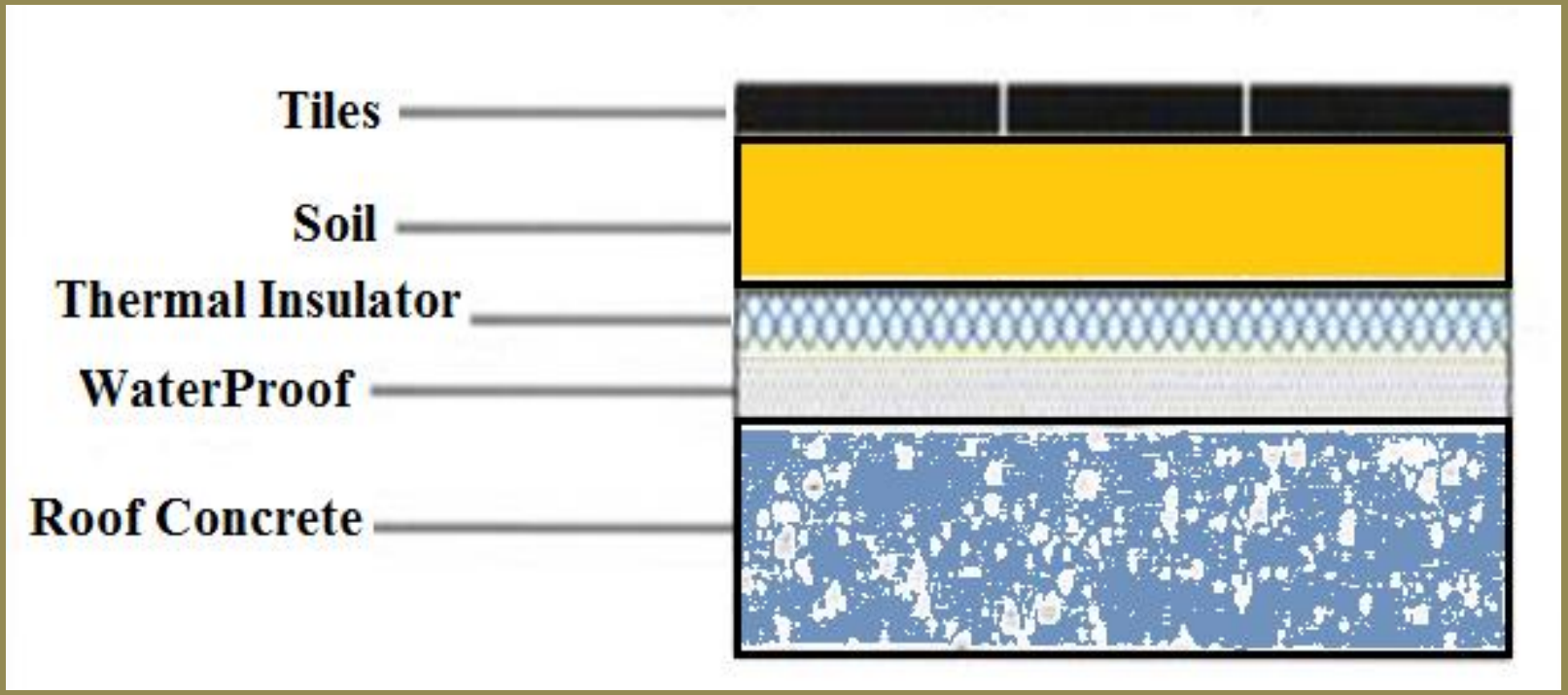
# 3. Wall with polyurethane layer

**U-Value 0.022-0.029**

# Thermal Insulation Systems for Roofs

## 1. Roof insulation system with soil

**ACI Committee :Roofs not exceeds 0.15 W/m²·K**




**Soil >U-Value 1.2**

# 2. Roof insulation system with foam concrete

**ACI Committee :Roofs not exceeds 0.15 W/m²·K**



**U-Value 0.12-0.15**

# 3. Roof Insulation system with composite (thermal insulation material- concrete) tiles



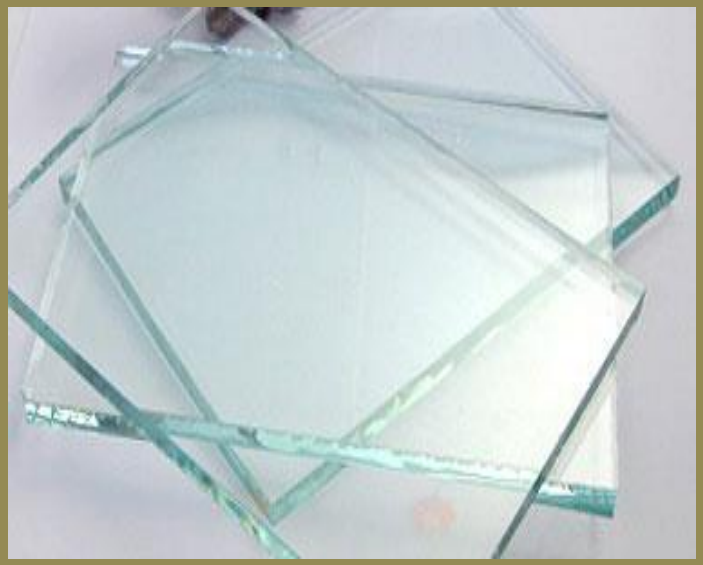

**U-Value 0.035-0.045**

# 4. Roof insulation system with polyurethane foam

U-Value 0.022-0.029

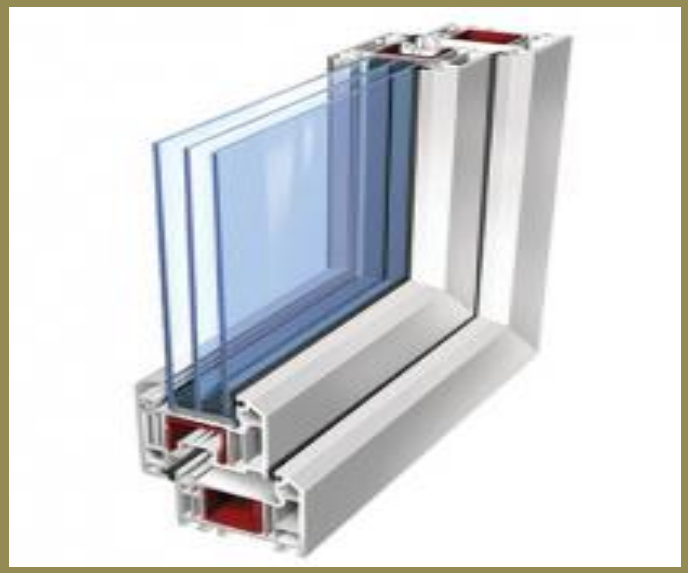
# Windows insulation system

## Normal glass window



U-Value 1.0-1.1

## Double glass window



U-Value 0.04

# Doors insulation system

Iron doors

U-Value 40

Aluminum doors

U-Value 200

wooden doors

U-Value 0.12


Thank you for
your attention

# References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