

Find,  
how huge structures  
are at there best in  
energy saving



# THERMOFREEZE

*Healing structures*

*For better understanding*

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*For better understanding*

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# SYNOPSIS

*Due to the rapid development of technology and its facilities, there is a need to create the structure and material capable of ensuring the rational use of energy sources. The study of the characteristics of thermal insulation materials using experimental methods is an urgent task, as it will allow us to ensure a long life thermal insulation , as a result of safety and reliability. **INSULATION** in your home provides resistance to heat flow and lowers your heating and cooling costs. Properly insulating your home not only reduces heating and cooling costs, but also improves comfort.*

*Whole book in a paragraph*

# OBJECTIVE

*The objective of this book is to introduce the concept of heat transfer modes to the people to understand composites and thermal insulation better. Emphasis will be given to the material iteration , methods of making and its application to industry as well as every day life obstacles.*

# THEN

*In the prehistoric period*

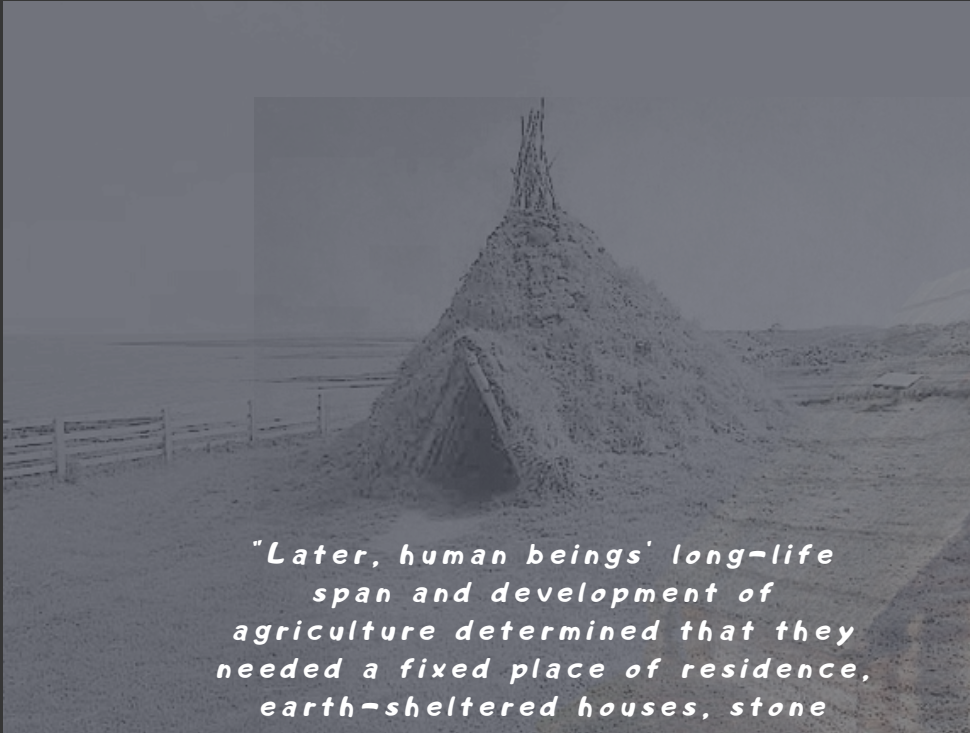


*"The history of thermal insulation is not so long compared with other materials, but human beings have been aware of the importance of insulation for a long time. In the prehistoric time, human beings began their activity of making shelters against wild animals and heavy weather, human beings started their exploration of thermal insulation. Prehistoric peoples built their dwellings\* by using the materials of animal skins, fur, and plant materials like reed, flax, and straw, these materials were first used as clothing materials, because their dwellings were temporary, they were more likely to use the materials they used in clothing, which were easy to obtain and process. The materials of animal furs and plant products can hold a large amount of air between molecules which can create an air cavity to reduce the heat exchange."*

# IN

# BETWEEN

*Struggle to success*



*"Later, human beings' long-life span and development of agriculture determined that they needed a fixed place of residence, earth-sheltered houses, stone houses, and cave dwellings began to emerge. The high density of these materials can cause a time lag effect in thermal transfer, which can make the inside temperature change slowly. This effect keep inside of the buildings warm in winter and cool in summer, also because of the materials like earth or stone is easy to get, this design is popular in many places like Russia, Iceland, Greenland."*

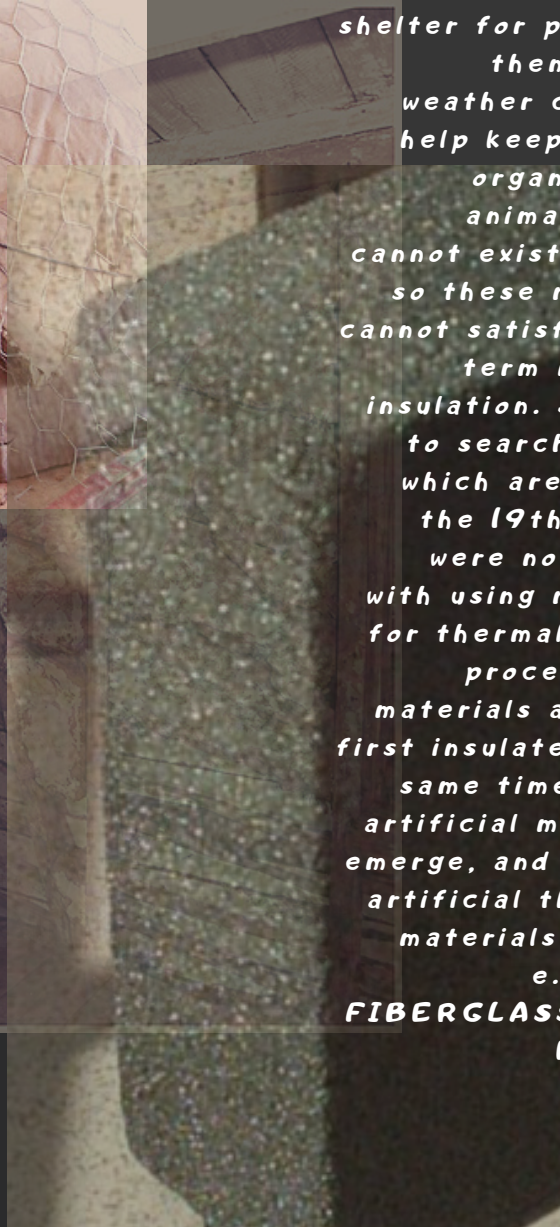


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*Healing structures*

# MILESTONE

*leading towards modern approach*



*Organic materials were the first available to build a shelter for people to protect themselves from bad weather conditions and to help keep them warm. But organic materials like animal and plant fiber cannot exist for a long time, so these natural materials cannot satisfy people's long-term need for thermal insulation. So, people began to search for substitutes which are more durable. In the 19th century, people were no longer satisfied with using natural materials for thermal insulation, they processed the organic materials and produced the first insulated panels. At the same time, more and more artificial materials start to emerge, and a large range of artificial thermal insulation materials were developed, e.g., **ROCK WOOL, FIBERGLASS, FOAM GLASS, HOLLOW BRICK.***

# NOW

*Modern touch to the contemporary world*

Nowadays, the most popular insulation materials are plastic foam and mineral wool, with only a small amount of natural materials being produced. However, regardless the material chosen to be used, any building, either a home or a mall, needs to be well insulated, and the best solution from the standpoint\* of cost and performance could be a combination of two or more different insulations.



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*Healing structures*

Thermal insulation can play a significant role in buildings, great demands of thermal comfort result in a large amount of energy consumed for full-heating for all rooms. Around 40% of energy consumption can be attributed to the building, mainly consumed by heating or cooling. Sufficient thermal insulation is the fundamental task that ensures a healthy indoor environment and against structure damages. It is also a key factor in dealing with high energy consumption, it can reduce the heat flow through the building envelope. Good thermal insulation can also bring the following benefits to the building:

Preventing building damage caused by the formation of moisture on the inside of the building envelope. Thermal insulation makes sure that the temperatures of room surface don't fall below a critical level, which avoids condensation and the formation of mould. According to the Building Damage reports, 12.7% and 14% of building damages were caused by mould problems. If there is no sufficient thermal insulation in the building, high relative humidity inside the building will lead to condensation and finally result in mould problems.



# SIGNIFICANCE

Heating structure FREEZE

Role of thermal insulation in  
our life



*' Producing a comfortable thermal environment for people living in the building. Good thermal insulation allows sufficiently high temperatures inside the building during the winter, and it also achieves the same level of thermal comfort by offering relatively low air temperature in the summer.'*

*" Reducing unwanted heating or cooling energy input. Thermal insulation reduces the heat exchange through the building envelope, which allows the heating and cooling machines to achieve the same indoor air temperature with less energy input."*

# INSULATION ITERATIONS

*With the brief knowledge of  
materials with its  
applications, installation.*

The most common and widely available type of insulation -- comes in the form of batts or rolls. It consists of flexible fibers, most commonly (and slag) wool, plastic fibers, and natural fibers, such as cotton and sheep's wool.

### APPLICABLE ON

Unfinished walls, including foundation walls  
Floors and ceilings

### INSTALLATION METHODS

Fitted between studs, joists, and beams.

### PROS.

Do-it-yourself.  
Suited for standard stud and joist spacing that is relatively free from obstructions. Relatively inexpensive.

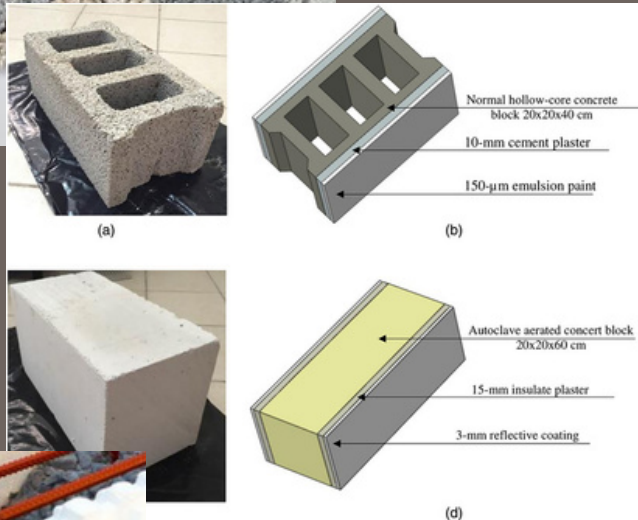
### MATERIALS

Fiberglass  
Mineral (rock or slag) wool  
Plastic fibers  
Natural fibers

# BLANKET INSULATION



Concrete blocks are used to build home foundations and walls, and there are several ways to insulate them. If the cores aren't filled with steel and concrete for structural reasons, they can be filled with insulation, which raises the average wall R-value. It is more effective to install insulation over the surface of the blocks either on the exterior or interior of the foundation walls. Placing insulation on the exterior has the added advantage of containing the thermal mass of the blocks within the conditioned space, which can moderate indoor temperatures.



## APPLICABLE ON

Unfinished walls, including foundation walls  
New construction or major renovations  
Walls (insulating concrete blocks)

## INSTALLATION METHODS

Require specialized skills  
Insulating concrete blocks are sometimes stacked\* without mortar (dry-stacked) and surface bonded.

## PROS.

Insulating cores increases wall R-value.  
Insulating outside of concrete block wall places mass inside conditioned space, which can moderate indoor temperatures.  
Autoclaved\* aerated\* concrete and autoclaved cellular concrete masonry units have 10 times the insulating value of conventional concrete.

## MATERIALS

Foam board, to be placed on outside of wall (usually new construction) or inside of wall (existing homes):  
Some manufacturers incorporate foam beads or air into the concrete mix to increase R-values

# CONCRETE BLOCK INSULATION

Heating systems

THERMOFREEZE

Foam boards -- rigid panels of insulation -- can be used to insulate almost any part of your home, from the roof down to the foundation. They are very effective in exterior wall sheathing, interior sheathing for basement walls, and special applications such as attic\* hatches\*. They provide good thermal resistance (up to 2 times greater than most other insulating materials of the same thickness), and reduce heat conduction through structural elements.

### APPLICABLE ON

Unfinished walls, including foundation walls  
Floors and ceilings  
Unvented low-slope roofs

### INSTALLATION METHODS

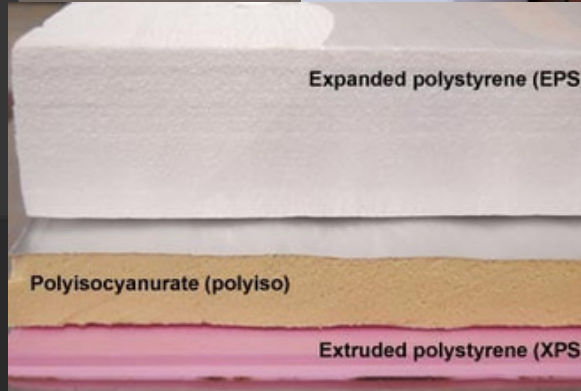
Interior applications: must be covered with 1/2-inch gypsum board or other building-code approved material for fire safety.  
Exterior applications: must be covered with weatherproof facing.

### PROS.

High insulating value for relatively little thickness.  
Can block thermal short circuits when installed continuously over frames or joints.

### MATERIALS

Polystyrene  
Polyisocyanurate  
Polyurethane  
Phenolic



# FOAM BOARD OR 22 RIGID FOAM

Loose-fill insulation consists of small particles of fiber, foam, or other materials. These small particles form an insulation material that can conform to any space without disturbing structures or finishes. This ability to conform makes loose-fill insulation well suited for retrofits\* and locations where it would be difficult to install other types of insulation.

The most common types of materials used for loose-fill insulation include cellulose, fiberglass, and mineral (rock or slag) wool. All of these materials are produced using recycled waste materials.



### APPLICABLE ON

Enclosed existing wall or open new wall cavities  
Unfinished attic floors  
Other hard-to-reach places

### INSTALLATION METHODS

Blown into place using special equipment and, although not recommended, sometimes poured in.

### PROS.

Good for adding insulation to existing finished areas, irregularly shaped areas, and around obstructions.

### MATERIALS

Cellulose  
Fiberglass  
Mineral (rock or slag) wool

# LOOSE-FILL AND BLOWN-IN Heating & Cooling

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Unlike most common insulation systems, which resist conductive and convective heat flow, radiant barriers and reflective insulation work by reflecting radiant heat. Radiant barriers are installed in homes -- usually in attics -- primarily to reduce summer heat gain, which helps lower cooling costs. Reflective insulation incorporates reflective surfaces -- typically aluminum foils -- into insulation systems that can include a variety of backings, such as kraft paper, plastic film, polyethylene bubbles, or cardboard, as well as thermal insulation materials.

### APPLICABLE ON

Unfinished walls, ceilings, and floors

### INSTALLATION METHODS

Foils, films, or papers fitted between wood-frame studs, joists, rafters, and beams.

### PROS.

Do-it-yourself.

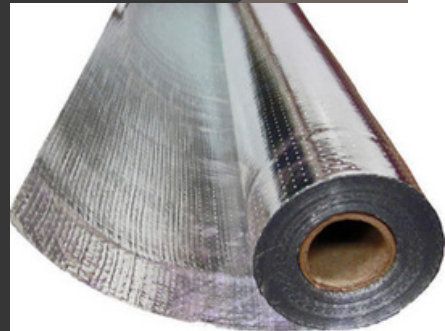
Suitable for framing at standard spacing.

Bubble-form suitable if framing is irregular or if obstructions are present.

Most effective at preventing downward heat flow, effectiveness depends on spacing and number of foils.

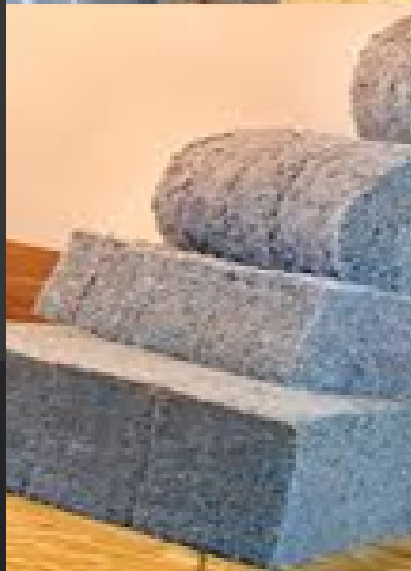
### MATERIALS

Foil-faced kraft paper, plastic film, polyethylene bubbles, or cardboard



# REFLECTIVE SYSTEM AND RADIANT 26BARRIER

Rigid fiber or fibrous board insulation consists of either fiberglass or mineral wool material and is primarily used for insulating air ducts in homes. It is also used when there's a need for insulation that can withstand high temperatures. These products come in a range of thicknesses from 1 inch to 2.5 inches.



## APPLICABLE ON

Ducts in unconditioned spaces  
Other places requiring insulation that can withstand high temperatures

## INSTALLATION METHODS

HVAC contractors fabricate the insulation into ducts either at their shops or at the job sites.

## PROS.

Can withstand high temperatures

## MATERIALS

Fiberglass  
Mineral (rock or slag) wool

# RIGID FIBER BOARD INSULATION

Liquid foam insulation materials can be sprayed, foamed-in-place, injected, or poured. Foam-in-place insulation can be blown into walls, on attic surfaces, or under floors to insulate and reduce air leakage. Some installations can yield a higher R-value than traditional batt insulation for the same thickness, and can fill even the smallest cavities, creating an effective air barrier. You can use the small pressurized cans of foam-in-place insulation to reduce air leakage in holes and cracks, such as window and door frames, and electrical and plumbing penetrations

APPLICABLE ON

- Enclosed existing wall
- Open new wall cavities
- Unfinished attic floors

INSTALLATION METHODS

Applied using small spray containers or in larger quantities as a pressure sprayed (foamed-in-place) product.

PROS.

Good for adding insulation to existing finished areas, irregularly shaped areas, and around obstructions.

MATERIALS

- Cementitious
- Phenolic
- Polyisocyanurate
- Polyurethane



# SPRAYED FOAM AND FOAMED-IN-

Structural insulated panels (SIPs) are prefabricated insulated structural elements for use in building walls, ceilings, floors, and roofs. They provide superior and uniform insulation compared to more traditional construction methods (stud or "stick frame"), offering energy savings of 12% to 14%. When installed properly, SIPs also result in a more airtight dwelling, which makes a house energy efficient, quieter, and more comfortable.

## APPLICABLE ON

Unfinished walls, ceilings, floors, and roofs for new construction

## INSTALLATION METHODS

Construction workers fit SIPs together to form walls and roof of a house.

## PROS.

SIP-built houses provide superior and uniform insulation compared to more traditional construction methods; they also take less time to build.

## MATERIALS

Foam board or liquid foam insulation core  
Straw core insulation



# STRUCTURAL INSULATED PANELS

*SIPS: Healing structure*

# PLACES TO INSTALL INSULATION IN HOME

## Detailed Description

1. In unfinished attic spaces, insulate between and over the floor joists to seal off living spaces below. If the air distribution is in the attic space, then consider insulating the rafters to move the distribution into the conditioned space.  
(1A). Insulate the attic access door

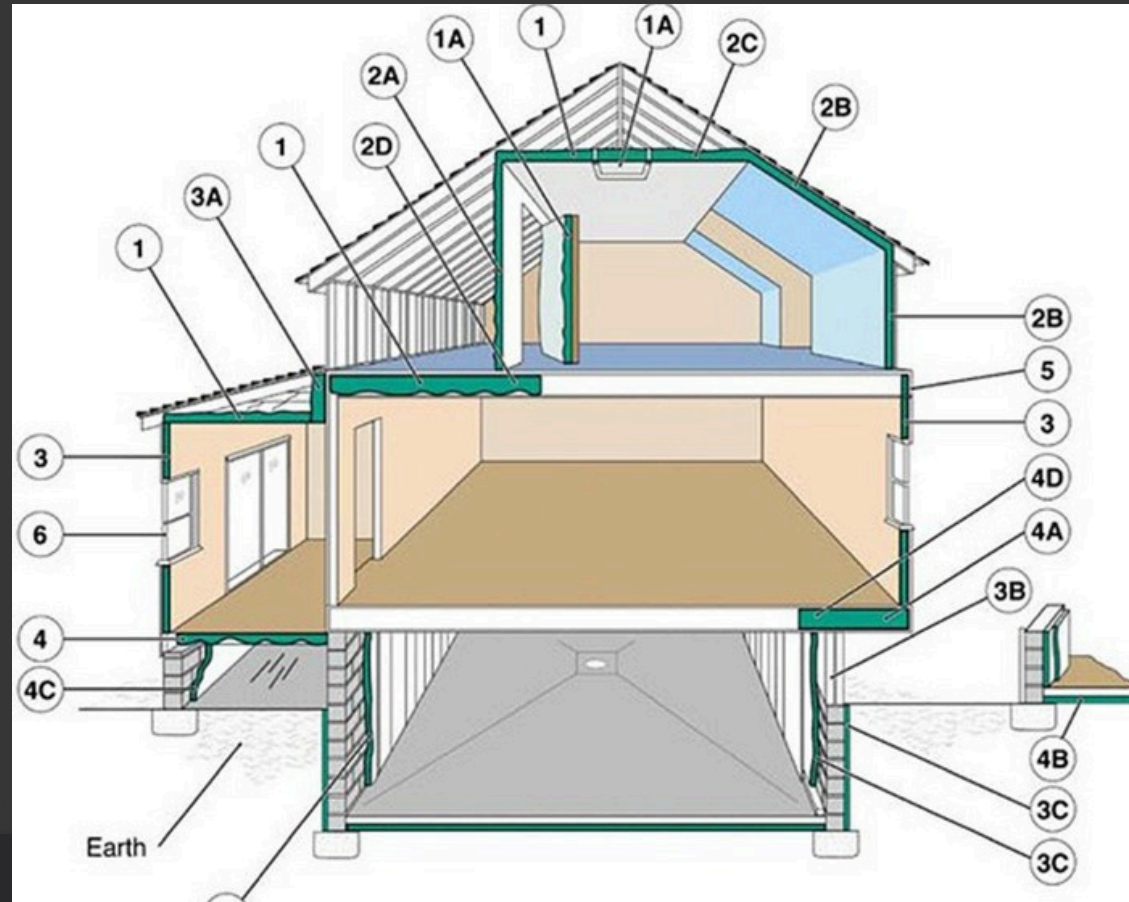
2. In finished attic rooms with or without dormers\*, insulate.  
(2A) between the studs of "knee" walls.  
(2B) between the studs and rafters of the exterior walls and the roof.  
(2C) and ceilings with unconditioned spaces above.  
(2D) Extend insulation into joist\* space to reduce air flows.

3. Insulate all exterior walls, including  
(3A) walls between living spaces and unheated garages, shed roofs, or storage areas;  
(3B) foundation walls above ground level;  
(3C) foundation walls in heated basements.

4. Apply insulation to floors above unconditioned spaces, such as vented crawl spaces and unheated garages. Also insulate  
(4A) any portion of the floor in a room that is cantilevered beyond the exterior wall below;  
(4B) slab floors built directly on the ground;  
(4C) as an alternative to floor insulation, foundation walls of unvented crawl spaces.  
(4D) Extend insulation into joist space to reduce air flows.

5. Do not forget to insulate the band joists\*.

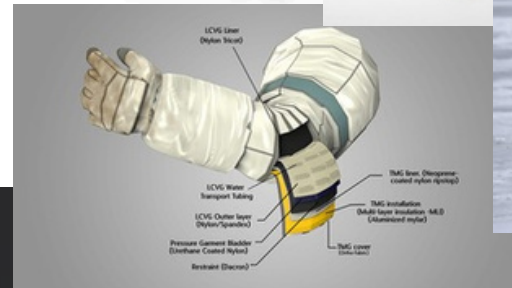
6. Caulk and seal around all windows and doors.





# INSULATION OTHER THAN BUILDING

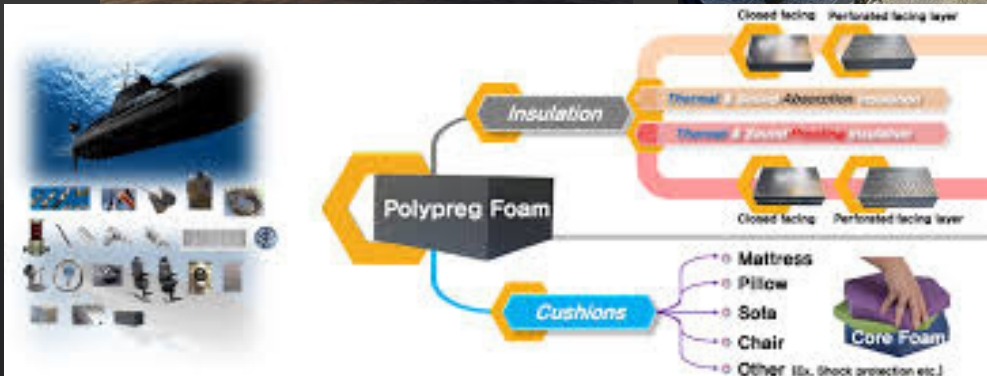
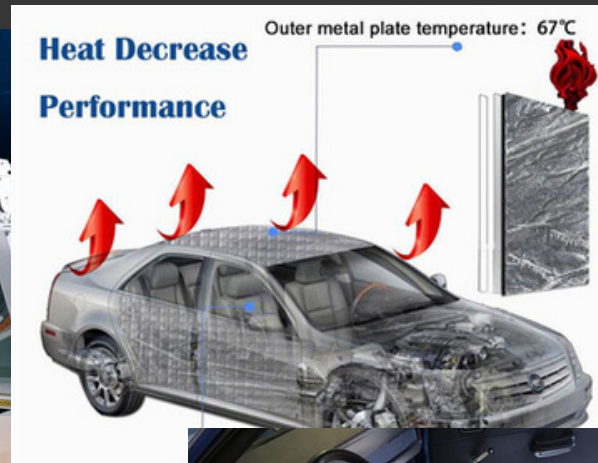
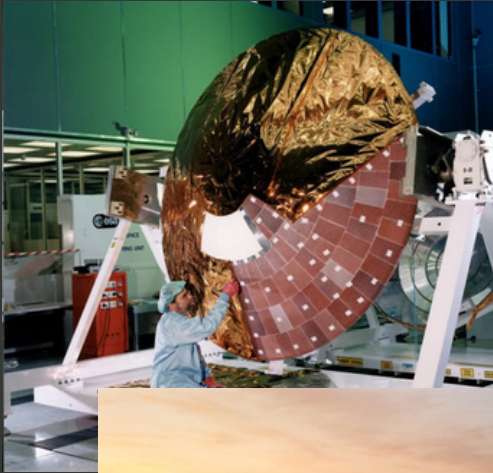
Insulation in clothing works by trapping tiny pockets of warm air close to the skin. Air is a poor conductor of heat, and is therefore ideal as an insulating element.



## INSULATION IN CLOTHES

# INSULATION IN AUTOMOTIVES

Automotive cabin insulation material is a material or a combination of materials that retard the flow of heat energy, absorb vibration and reduce the squeaking\* sounds in automobiles. This material helps maintain the automotive cabin temperature at a desired level and prevents or reduces damage to vehicles from exposure to fire and corrosive atmospheres.



# INSULATION IN WARES



# INSULATION IN REFRIGERATOR



Polyurethane rigid foam is the insulating material which is most widely used throughout the world for refrigerators and freezers. The insulation efficiency of polyurethane foams is a key property for the low temperature preservation of food during processing, storage and distribution to the consumer.

Thermal insulation is an important technology to reduce energy consumption in buildings by preventing heat gain/loss through the building envelope. Thermal insulation is a construction material with low thermal conductivity, often less than  $0.1\text{W/mK}$ .

These materials have no other purpose than to save energy and protect and provide comfort to occupants. Of the many forms, shapes and applications of thermal insulation,

WHY IT IS  
IMPORTANT

???

Building envelope thermal insulation products have been widely used in temperate regions. In many developed and industrialised countries, thermal insulation is a regulatory requirement for energy efficiency and occupant health purposes, which provide a fairly constant market for the thermal insulation manufacturers. The market for building fabric thermal insulation products is not as large in hot and humid tropical regions, where natural ventilation, not air-tightness, is a more appropriate strategy for thermal comfort.

In this context the use of thermal insulation is not extensive, and the use of an air gap in the cavity wall for the west facing façade to prevent heat gain from hot afternoon sun is found to be sufficient. Roof insulation, however, is applicable in all climate regions, including the hot tropical belt. In the Caribbean, for example, roof insulation has generally been accepted as a “proven energy conservation solution” with mineral (glass) fibre generally the lead product.

## CURRENT STATUS AND FUTURE MARKET POTENTIAL OF THERMAL INSULATION

# CONTRIBUTION TO SOCIO-ECONOMIC DEVELOPMENT AND ENVIRONMENTAL PROTECTION IN DEVELOPING COUNTRIES

*The primary contribution of building envelope thermal insulation is to provide thermal comfort to its occupants. This supports healthy living environments and better productivity at workplaces.*

*Thermal insulation reduces unwanted heat loss or heat gain through a building envelope. This, in turn, reduces energy demand for cooling and heating of buildings, and thus is a mitigation\* measure to reduce GHG emissions.*

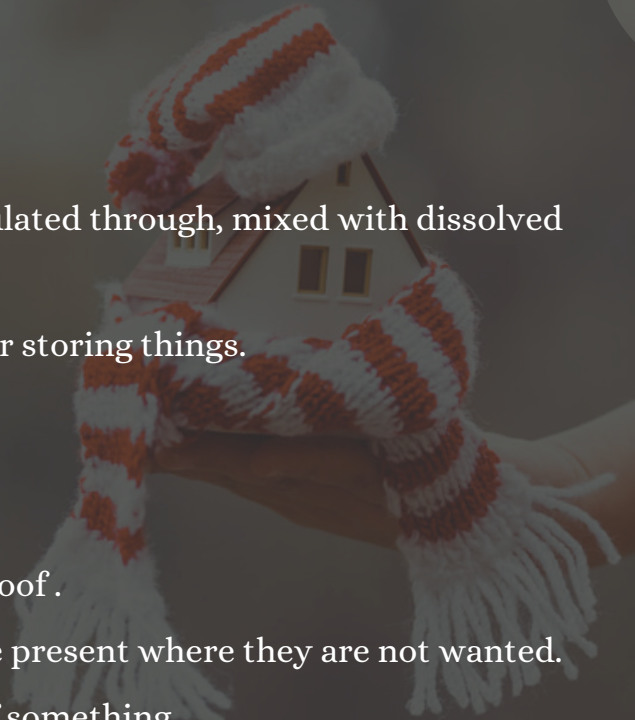
*Large-scale implementation of thermal insulation has also been proven to be an economic stimulus. In the European region alone, there were nearly 12,000 companies, with a total of 400,000 employees, operating in the value stream derived from cellular plastic products (ISOPA & Polyurethanes, 2009). There are ample business and job creation opportunities for developing countries, if successful North-South and South-South transfer programmes for building envelope thermal insulation are in place.*

# FINANCIAL REQUIREMENT AND COST OF THERMAL INSULATION

*Financial requirement for building envelope thermal insulation includes the costs of the products and their installation.*

*The product and installation costs of thermal insulation are computed based on per unit of area and per unit of thermal conductivity value. The installation cost for loose fill products are lower than that of other insulation products, because it is easy to install. .*

However, due to the lack of additional protection from moisture and vermin infestation, long-term durability is a consideration.

- 
- **Aeration** - Aeration (also called aerification) is the process by which air is circulated through, mixed with dissolved in a liquid or substance.
  - **Attic** - The space or room at the top of a building, under the roof, often used for storing things.
  - **Dwelling** - A shelter (such as a house) in which people live.
  - **Hatched** - A small door or opening.
  - **Dormer** - A window set vertically in a structure projecting through a sloping roof .
  - **Infestation** - A large number of animals and insects that carry disease, that are present where they are not wanted.
  - **Mitigation** - The action of reducing the severity, seriousness, or painfulness of something.
  - **Stacked** - A large usually conical pile (as of hay, straw, or grain in the sheaf) left standing in the field for storage.
  - **Standpoint** - a position from which objects or principles are viewed and according to which they are compared and judged.
  - **Squeaking** - to make a short, very high cry or sound.
  - **Retrofits** - to furnish (something, such as a computer, airplane, or building) with new or modified parts or equipment not available or considered necessary at the time of manufacture.

# GLOSSARY

*Healing structures MOORE*

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# BIBLIOGRAPHY

# THERMOFREEZE

*Healing structures*



THERMOFREEZE" is a captivating coffee table book that offers detailed visual presentations on the significance of thermal insulation in buildings and beyond. It explores the features and applications of thermal insulation in various industries, showcasing its importance in energy conservation and temperature regulation. The book highlights the emergence of innovative materials and technologies, documenting key milestones and advancements. It also focuses on upgrading and evolving thermal insulation solutions, demonstrating how these developments have shaped modern practices. With stunning visuals, "THERMOFREEZE" provides an insightful journey into the world of thermal insulation, illustrating its growing impact across diverse sectors.

*For better understanding*

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