ACHIEVING ENERGY EFFICIENCY THROUGH THERMAL INSULATION OF BUILDINGS

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Energy saving has assumed great significance in view of shortage of energy generation and also rising cost of crude oil. Due to Global warming, weather patterns are changing and we expect to see rise in temperatures, specially in urban clusters. This coupled with the fact that due to globalisation, more and more multinationals are starting operations in India and most of these operations require air-conditioned environment, demands on energy are rising fast. Indian operations also, with increasing sophistication, are looking for air-conditioned environments.

It is, therefore, very important that operating costs as well capital costs for environmental control are minimized. Thermal insulation of buildings is a very essential step in this direction. The argument to control environmental temperature are valid for both summers and winters. Only the direction of heat flow changes.

The term thermal insulation is used for materials, which reduce the rate of heat transfer, or the methods and processes used to reduce heat transfer. Heat energy can be transferred by conduction, convection, or radiation. Flow of heat can be delayed by addressing one or more of these mechanisms and is dependent on the physical properties of the material employed to do this.

We are reproducing below an extract of the talk given by Mr. Pankaj Dharkar, President, Pankaj Dharkar & Associates at a recent seminar on *GREEN BUILDINGS.*

Quote

GREEN BUILDINGS - NEED OF THE HOUR

Today's modern buildings are no doubt a marvel in terms of architecture and technology, but have also led to an adverse impact on the environment. The new-age buildings account for 12% of water usage, 30% of green house gas (GHG) emissions, 65% of waste output and 70% of electrical consumption.

In contrast, 'Green' buildings are eco friendly and can contribute towards a cleaner environment by reducing the amount of energy used to light, heat, cool and operate buildings and GHG and other harmful emissions. Recognising the need for green buildings, several individuals as well as organizations are making efforts towards increasing the awareness of their importance and the challenges that need to be tackled.

A building's initial construction cost may represent only 20 – 30% of its building's entire useful life costs. Usually, the cost of constructing green buildings is higher by 15 – 20%, but they save around 30% on energy usage annually. Hence, there is a need to create awareness about not only the 'First' cost, but also year – to – year operating costs for any project. Builders as well as users should remember that life cycle benefits of a Green design more than make up for the additional initial costs. In order to appreciate the cost effectiveness of green buildings over a period of time, adopting the practice of separating capital and operating cost is necessary.

Unquote

ADVANTAGES OF THERMAL INSULATION

I. 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.

II. **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.

III. **Prevention of thermal stress on roofs**. Due to thermal stresses, roof decks tend to crack. These would be reduced to a great extent.

IV. Generally over-the-deck insulation materials are much lighter than the currently used brickbat coba or concrete, resulting in reduced deadweight on the roof slab.

V. Non-Toxic, Environmental friendly solutions.

VI. Energy saving resulting in reduced costs of
- Running cost of Air-conditioning.
- Capital equipment cost reduction.

VII. No Heat absorption and subsequent dissipation.

VIII. Can avoid Expansion Joints.

IX. Temperature drop of 5ºC to 10ºC depending on outside Temperature.

X. Composite approach to:
- Thermal Insulation.
- Waterproofing
- Slope Creation.

SOURCES OF HEAT TRANSFER

1. ***Roof Decks:***

The upper roof surface is exposed for the longest duration directly to almost intense perpendicular solar heat radiation. The heat accumulated on the roofing material is transmitted gradually through the roof into the rooms below and keeps transmitting the heat accumulated in the roof during the day even after the sunsets. Incase we insulate the roof top, we stop accumulation of heat on roof and its transmission in to the rooms below, thus bringing the temperatures in the rooms significantly down. This reduces period of use of

cooling devices such as coolers and Air Conditioners, thus saving in energy costs.

2. ***Wall:***
   - Walls, specially west facing walls, cause transfer of heat in summers from outside.

3. ***Glass Windows/Doors/Panels:***
   - These are also a major source of heat transfer from outside into building.

HOLISTIC APPROACH TO CREATE ENERGY EFFICIENT BUILDING

I. Salient Features of Treatment:

- Environmental Friendly
- Energy Saving
- Dead Weight Reduction
- Long Lasting
- No Heat Transmission to Surroundings

II. Why Insulate:

- Heating & Cooling (Space Conditioning) account for **50% to 70%** of the total energy used in a typical commercial establishment.
- On the other hand, lighting and appliances and everything else account for **10% to 30%** of the energy used in most buildings.
- Inadequate insulation and air leakages are leading causes of energy waste.
- Insulation saves money and energy resources

III. Thermal Insulation of Roofs:

a) Conventional Method of Thermal Insulation:

Under Deck Thermal Insulation:

- **DISADVANTAGES**
  - Scheme allows heat energy to be absorbed by top deck. This hot mass of concrete radiates heat in the environment.
  - Waterproofing not available.

b) Method Proposed by us:

- Over the Deck Thermal Insulation.
- Thermal Insulation ensures negligible heat absorption by Deck.
- Materials have good bonding and excellent water resistance.
- Light Weight Materials

c) Solution must incorporate:

- EFFECTIVE & LONGLASTING WATERPROOFING.
- GRADIENT FOR BAILING OUT RAIN WATER.
- THERMAL INSULATION.

THERMAL INSULATION MATERIALS

For the last few years, lightweight micaceous minerals like Vermiculite / Perlite have been used. The problem with these products is that they are very porous in nature and absorb water profusely and therefore their usage is limited unless they are waterproofed which is an extra expense. Moreover these materials are soft and most of the time tiles have to be laid over them. Tech-Dry (I) Pvt. Ltd., have after considerable research, changed the water absorption as well as strength of these materials to make them suitable for over-the-deck insulation.

Recently ceramic microspheres and some natural clay along with redispersable spray dried polymers have played a key role towards thermal insulation by radiation / reflection. These materials are coated as self contained materials or as paint additives.

THERMAL INSULATION OF ROOF

Treatment Details

a. WATERPROOFING:

- Chipping, Cleaning & Testing.
- Defect Removal : Repair of Construction Joints.
- Honeycomb / Hollowness
- Crystallisation application.
- 2 coats of Eleastomeric coatings.

b. SLOPE CREATION WITH THERMAL INSULATION MATERIAL:

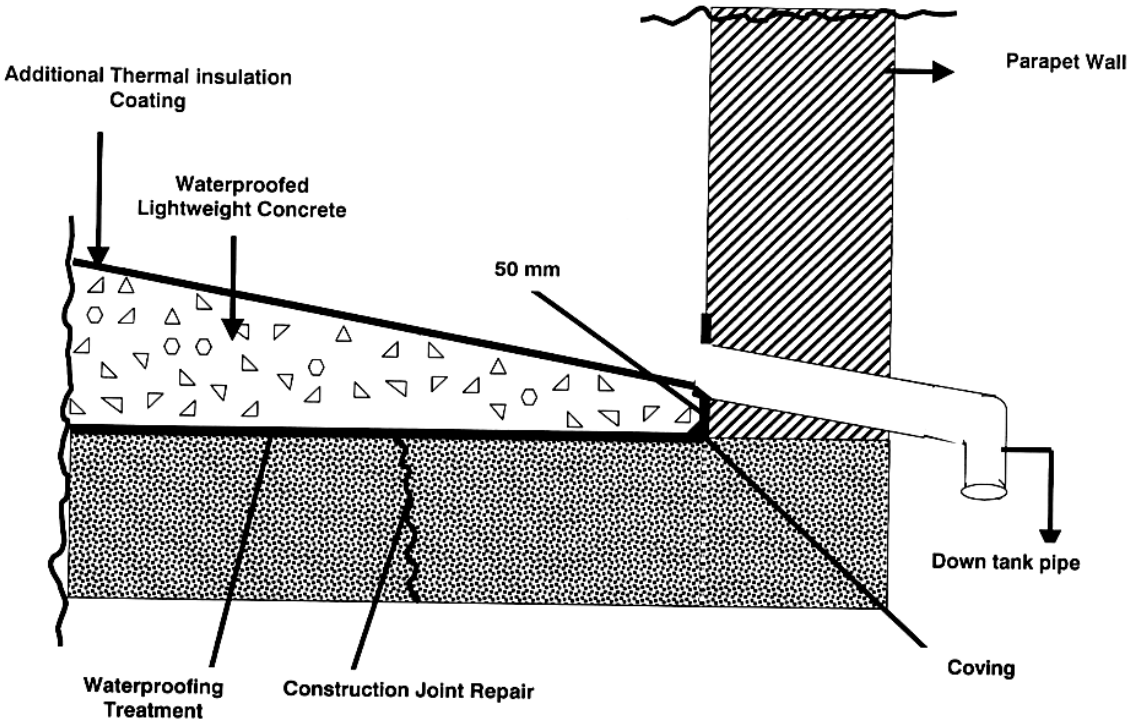
- Density = 780 Kg/Cu. M
- Strength = > 10 mpa
- Av. Thickness = 100 mm
- Thermal Conductivity = 0.125 Kcal/hrs/m^2/C

c. PLASTERING LAYER OF 15MM TO 18 MM

- 1:4 Mix.
- Emulsion KR2 added.
- Fibre mesh applied

d. ADDITIONAL THERMAL SHIELD:

- 2Coats of Protekta Thermal Flexicoat.
- Thermal Conductivity = 0.032 Kcal/hrs/m^2/C
- Average thickness = 1 mm to 1.5 mm.



THERMAL INSULATION SCHEME

e. CONDUCTIVITY COMPARISON OF VARIOUS MATERIALS

Sl. No	Materials	Density (Kg/Cu. M]	Kcal/hrs/m²c
1.	Asbestos cement sheet	1520	0.25
2.	Brick Bat coba	1900	0.84
3.	Cement Concrete (1:2:4)	2240 to 2480	1.24
4.	Fibreboard	240 to 400	0.046 to 0.056
5.	Ordinery Bricks	1760	0.70 to 1.44
6.	Plastering	1280 to 1600	1.24
7.	Sand-lime bricks	1840	0.93
8.	Sandstone	2000	1.12
9.	Protekta Light Weight concrete	780	0.125
10.	Protekta KP	Negligible Weight	0.032

THERMAL INSULATION OF WALLS, COLUMNS & BEAMS

There are 2 options to prevent heat transfer into buildings through walls.

Option: I

Thermal Insulation plaster instead of standard wall plastering. This will not only reduce the heat transfer, but will also act as sound barrier.

Option: II

- **Protekta Paint Insulate additive to wall paint**. This additive is a combination of micro spheres and redispersible powders, which will convert an ordinary paint to heat reflecting, insulating and thermal barrier coating. This additive is completely inert and can be mixed into any paint, composite or coating.

- **How do the additives work:**

  When solar radiation strikes an uncoated roof, it is converted into infra Red radiation. This radiated energy passes down through the roof, and is absorbed by everything inside the building. The internal temperature then continually rises throughout the day, which is why air-conditioning runs continuously in the summertime.

An average uncoated roof reflects about 20% of the available solar radiation and absorbs about 80%. This energy is then radiated into the building below. Circulating air absorbs this heat from the underside of the roof and increases the overall inside temperature.

A coated roof reflects and emits about 90% of the Infra Red radiation striking it.

HEAT TRANSFER INTO BUILDING THROUGH WINDOWS

Generally double glazed glasses with an air gap or film between them act as good thermal and sound insulation. This has been found to be very effective and will definitely reduce heat entry through glass windows / panels.

HOW USE OF THESE MATERIALS HELP IN DESIGN OF GREEN BUILDINGS

We use environmental friendly green materials, some of them are:

- **By-product:** Unused or waste material from one manufacturing or energy producing process that can be used in another manufacturing or energy-producing process. eg. Furnace slag.

- **Diversion:** Avoidance of landfill disposal of a material or product through reuse or recycling

- **Life Cycle:** All stages of production, including raw materials extraction, manufacturing, distribution, use, maintenance, reuse or recycling, disposal, and all transportation

- **Rapidly renewable:** Materials that are replenished relatively quickly, usually in less than 10 years

- **Recyclable:** Having the potential for being recycled by possessing such traits as highly recoverable, easily separated from other materials, not contaminated by toxic coating etc.,

- **Solid waste:** Material or product, typically long lasting and not biodegradable, disposed of in landfills or incinerators

CONCLUSIONS:

Global warming and green concrete are the subjects, which are attracting attention of the whole scientific community. Thermal insulation has been misunderstood subject and there has been a myth that Brick bat coba, surkhi provide thermal insulation, but it is not true and they play minimal role in providing thermal insulation.

It is important that the key persons in the field of real estate and construction industry should appreciate the advantages of green building and its benefits, but unfortunately they miss the cost benefit of these green buildings.

Existing technologies combined with common sense design can increase energy efficiency by 35 percent and reduce heating costs by 80 percent for the average building.

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