Improving Energy Efficiency in Green Buildings

Amol Desai
Supreme Petrochem Ltd
Supreme Petrochem Ltd
A brief profile

- Promoted by Supreme Industries Ltd & R Raheja group
- Largest Polystyrene manufacturer in India with an installed capacity of 272,000 Mtpa.
- Expandable Polystyrene (EPS) beads producer with an installed capacity of 75,000 Mtpa
- First producer of XPS Insulation Boards in India
- Manufactures Masterbatches, Colour & Specialty Compounds
Typical Building Energy Consumption

Boukhanouf et al., Researchgate 2013
Green Building Definition

- Green building refers to both a structure and the application of processes that are **environmentally responsible** and **resource-efficient** throughout a building's life-cycle: from planning to design, construction, operation, maintenance, renovation, and demolition.

- The Green Building practice expands and complements the classical building design concerns of economy, utility, durability, and comfort.

- The common objective of green buildings is to reduce the overall impact of the built environment on human health and the natural environment by:
  - Efficiently using energy, water, and other resources
  - Protecting occupant health and improving productivity
  - Reducing waste, pollution and environmental degradation
Energy Efficiency

- Green buildings often include measures to reduce energy consumption,
  - the embodied energy required to extract, process, transport and install building materials,
  - operating energy to provide services such as heating and power for equipment.

- To reduce operating energy:
  - reduce air leakage through the building envelope.
  - specify high-performance windows and extra insulation in walls, ceilings, and floors.
  - Orientation of windows and walls and place awnings, porches, and trees to shade windows and roofs during the summer while maximizing solar gain in the winter.
  - provide more natural light and lessen the need for electric lighting during the day.
  - Use of solar energy
Building Envelope

- The term building envelope is given to the physical separation between the inside conditioned space and the outside unconditioned space of a building.
- Envelopes generally have six sides and are composed of four basic elements:
  - 1. water barrier
  - 2. air barrier
  - 3. vapor barrier
  - 4. thermal barrier
- These four elements need to be selected holistically and work together as a system in order to perform properly and to provide a comfortable, energy efficient, and durable building.
Continuous Insulation

- CI is insulation that is continuous across all structural members without thermal bridges other than fasteners and service openings.
- It is integral to any opaque surface of the building.
- CI not only helps to save energy by reducing thermal bridging, but it also helps to reduce damage to the structure and therefore increase the life of building.
- Options include:
  - 1. extruded polystyrene (XPS)
  - 2. expanded polystyrene (EPS)
  - 3. mineral wool (also called mineral fiber)
  - 4. spray polyurethane foam (SPF)
  - 5. polyisocyanurate (polyiso)
XPS Insulation Boards

THERMAL INSULATION MATERIAL WITH A CONCEPT OF ENVELOPE THE BUILDINGS
XPS (Extruded Polystyrene)

- SPL has forward integrated into manufacturing of XPS boards with capacity of 100,000 cubic meter per annum
- First manufacturer of XPS boards in India
- XPS boards are premier insulating material for all sorts of buildings due to:
  - Low thermal conductivity
  - Excellent compressive strength
  - Resistance to moisture
• Extruded Polystyrene Insulation has a number of unique characteristics that make it an essential component of energy efficient design.
  • Closed Cell Rigid Foam Insulation
    Moisture absorption is negligible
  • Long Term Guaranteed Thermal Performance
    XPS boards maintain its R Value
  • Life Time Performance:
    A fifty year plus lifetime.

How many building materials actually contribute to energy reduction for their lifetime?
XPS – Sustainable Building Material

- Light Weight & Inert - *Safe to handle*
- Good Insulation – *Saves Energy*
- No Ageing – *Constant performance for years*
- Reusable – *No degradation*
- Recyclable – *Same or other form*

- Recent Development – *SPL has updated its plant to use CO₂ as blowing agent which is in accordance to International requirements*
• Improved energy efficiency is achieved by using XPS as a thermal barrier under the slab and around the exposed slab perimeter.
XPS - Concrete Roof Insulation

• New construction and refurbishment of existing roofs

• Protected Roof Membrane Assembly is a method of insulating roofs by placing insulation above the waterproofing membrane, therefore protecting the membrane.

• The insulation is held in place with specified ballast, usually gravel or cement pavers.

• Unlike most other insulation materials, because XPS has a closed cell structure, it maintains its ability to insulate in the presence of water.

• Its high compressive strength make it excellent insulation for all roofing applications.
Overdeck Insulation

Sketch showing INSUboard for OVAR-DECK application
Underdeck Insulation

Fig:2 Application of **INSUboard** in Ceiling
Extruded Polystyrene is the ideal insulation for a green garden roof assembly.

It provides no nutritional value to plants or animals and has a guaranteed long term thermal value.

Its high moisture resistance and superior strengths makes it ideal for protecting the roofing membrane, increasing the roof’s life-cycle, plus reducing maintenance costs and energy demands.

Un-insulated Green Roofs have a very low thermal resistance value, especially when soil is wet.

The long term thermal and physical performance increases the energy efficiency benefits of Green Roof Systems.
• Fixing XPS insulation boards on the walls eliminates the heat movement / thermal bridging

• High R Value (R2.67/75m) finished with a new generation Acrylic Render System provides a pleasing aesthetic as well as an energy efficient envelope to the home.

• An insulated wall is up to 30% more energy efficient.
Wall Insulation

Fig: 1 Application of INSUboard in Wall
## Case study – Saudi Arabia

![Rear Elevation Diagram](image.png)

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<th>Insulation (mm)</th>
<th>Peak Load (KBTU/hr)</th>
<th>Annual Energy (MWh)</th>
<th>Peak Cooling (KW)</th>
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A two storey villa with a roof area of 245sq mtr and a wall area of 250 sq mtr
Payback period is 2 years
Smaller A/c units can be installed
• EIFS – External Insulation Finishing System

• It can be defined as a non load bearing, exterior wall cladding system that consists of an insulation board attached either adhesively or mechanically, or both, to the substrate; an integrally reinforced base coat; and a textured protective finish coat.

• Today EIFS with Drainage system is preferred since it provides a way for moisture that may accumulate in the wall cavity to evacuate.
EIFS Components

- Water – resistive barrier over the substrate (Optional)
- Drainage plane – vertical ribbons of adhesive applied between WRB and insulation board
- Insulation board typically made of EPS / XPS which is secured with an adhesive or mechanically to the substrate
- Glass-fibre reinforcing mesh embedded in the base coat
- A water resistant base coat applied on top of the insulation to serve as a weather barrier
- A finish coat that typically uses colourfast and crack resistant acrylic or silicon resin.
EPS Decorations

![EPS Decorations](image_url)
EIFS – Performance

- Tested and well researched for more than 50 years
- Best performance cladding in relation to thermal and moisture control when compared to brick, stucco and cementitious fibreboard siding
- Compliance with modern building codes
- Maximum energy saving because of continuous insulation
- Improved indoor air quality because of continuous air barrier
- Reduced environmental impact over the life of the structure
- Unlimited decorative choices – profiles, colour, texture
EPS – Sustainable Building Material

- Ideal choice for green building designs
  - Energy efficiency
  - Indoor environmental quality
  - Localized manufacturing
  - Reduced jobsite waste and labor costs
  - Superior insulating properties
  - Improve overall performance of the building envelope
Sandwich Panels

- Simple sandwich structure
- Made up of two major elements:
  - Core of EPS
  - The skin - the outer layers - of Galvanized Steel, Al, PVC, cement fiber board, etc.
SIP (Structural Insulated Panel)

Pre-reinforced sandwich panel with galvanized steel cage

Polystyrene Slab for thermal insulation

3,5 cm Shotcrete on each side for structural resistance

Monolithic building shell

Supports any surface finishing
SIP (Structural Insulated Panel)

- SINGLE
- DOUBLE
- FLOOR - ROOF
- STAIRS
Building With SIP
Application Examples
SOLUTIONS FOR EVERY APPLICATION

- **RESIDENTIAL**
  - Social Housing
  - Multistoried Load-Bearing
  - Mobile Homes

- **COMMERCIAL**
  - Hotels
  - Public Buildings
  - Shaped Solutions
  - Farming
  - Industrial Buildings

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BETTER BUILDING WITH EPS

BETTER CONSTRUCTION
- Durable
- Fast
- Versatile
- Cost-effective

BETTER PERFORMANCE
- Sustainability and Energy Saving
- Fire
- Earthquake
- Blast & Explosion
- Hurricane & Tornado

BETTER COMFORT
- Thermal resistance
- Acoustic resistance

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EPS beads/Light Weight Concrete
Summary

• Building energy consumption will grow with increasing construction activities
• Government policies and programs on energy efficient buildings.
• New buildings to be designed using energy efficient products and services
• Energy inefficient buildings built before need to be retrofit with EIFS
• Building Codes and Insulation must be made mandatory
Thank You

Contact
Amol Desai
GM – Applications & Business Development (EPS)
Mob.: +91-9820122232
Email: amol_desai@spl.co.in