Bureau of Energy Efficiency

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ANGAN
Augmenting Nature by Green Affordable New-habitat

A Courtyard for Revolutionary Change in Building Energy Efficiency

An International Conference on Building Energy Efficiency

9th-11th September, 2019 | Hotel The LaLiT, New Delhi

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FOR THE SESSION:

" Embodied Energy and the Life Cycle Approach"

DURING ANGAN 2019

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LIFE-CYCLE ENERGY FOR BRICKS: A CASE STUDY

Sameer Maithel, ANGAN

New Delhi, 11 September 2019

SMART GHAR 3: PROJECT DESCRIPTION

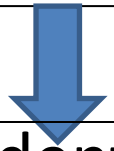
- Smart GHAR III (Green Homes at Affordable Rate) is an affordable housing project in Rajkot under the Pradhan Mantri Awas Yojana (PMAY) Untenable Slum Redevelopment.
- The project is being executed by the Rajkot Municipal Corporation.

- **Site Area: 17,593 m2**
- **Built-up Area: 57,408 m2**
- **No. of dwelling units (DU): 1176 (all 1 BHK)**
- **11 residential towers**
- **Stilt + 7 storeys**
- **DU size: 33.6 m^2 built-up / 28 m^2 carpet**

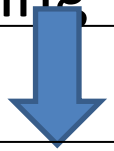
METHODOLOGY

Collection of drawings and bill of quantities

Calculations of Embodied Energy (EE) with different types of bricks

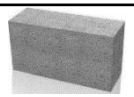
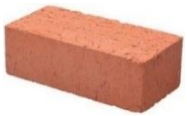
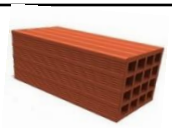


Calculations of Residential Envelope Transmission Value and operational energy(OE) for cooling



Calculations of Life Cycle Energy for 50 years

BRICK TYPES COVERED

		Embodied Energy (MJ/m^3)	U value of (200 mm + 15 mm plaster on both sides) (W/m^2-K)
Solid Concrete Block		770	**2.55**
Solid Clay Brick (Coal Clamp fired)		**2880**	1.46
Flyash cement brick		700	1.30
Hollow Clay Block (Tunnel Kiln)		1300	1.0
AAC		1300	0.7

Source: GKSPL (2016); CEPT & GKSPL (2019)

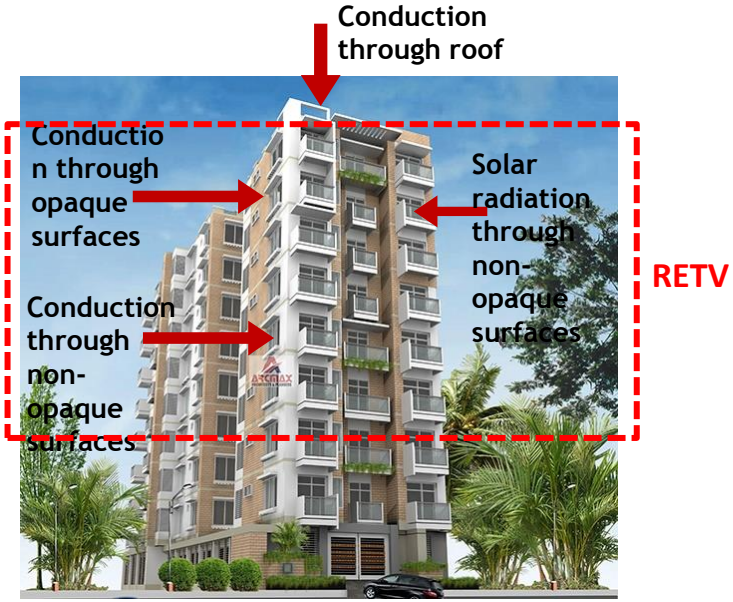
Significant variations in embodied energy and "U" value (~1:4)

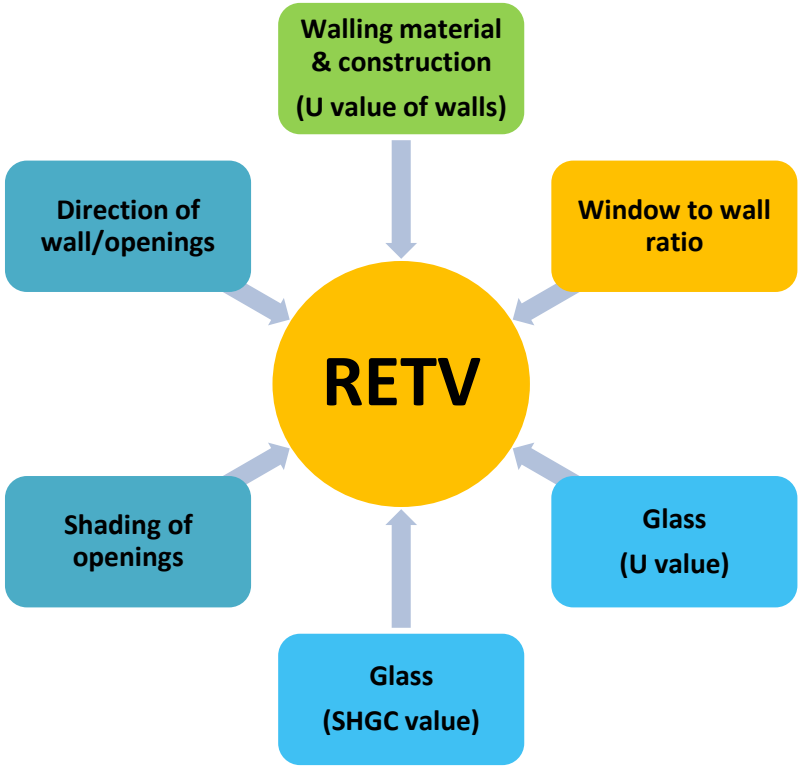
EMBODIED ENERGY (MJ/m^2)

		Embodied Energy Contribution of brick (MJ/m^2)	Embodied Energy (Cement + Steel + Aggregate) (MJ/m^2)	**Total Embodied Energy (GJ/m^2)**
Concrete Block		145	2604	**2.74**
Solid Clay Brick (Coal Clamp fired)		542	2604	**3.14**
Flyash cement brick		132	2604	**2.73**
Hollow Clay Block (Tunnel Kiln)		240	2604	**2.84**
AAC		240	2604	**2.84**

70-90% of the embodied energy is accounted by cement and steel. The brick contributes ~ 5 -17 %.

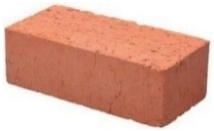
Residential Envelope Transmission Value (RETV)





Residential Envelope Transmittance Value (RETV) is the net heat gain rate (over the cooling period) through the building envelope (excluding roof) of the dwelling units divided by the area of the building envelope (excluding roof) of the dwelling units. The cut-off value of RETV is 15 W/m^2 as per Eco-Niwas Samhita.

Operational Energy For Cooling (kWh/m²)

		RETV (W/m²)	Cooling Electricity for maintaining 26°C (kWh/m²/year)	Operational energy for cooling over 50 years lifetime (GJ/m²)
Concrete Block		19.7	50	9
Solid Clay Brick (Coal Clamp fired)		12.7	35	6.3
Flyash cement brick		11.9	33	5.9
Hollow Clay Block (Tunnel Kiln)		10.3	28	5.1
AAC		9.1	25	4.5

Life Cycle Energy (EE + OE over 50 years) in GJ/m²

~40% reduction in AAC blocks compared to solid concrete block.

Strong Case For A Market Transformation Initiative for Low Energy Bricks

Need for a focused initiative to promote low energy bricks (e.g. hollow clay bricks, AAC blocks)

Market Transformation

- Labelling/Rating/Certification
- Procurement
- Consumer awareness
- Skilling for application/maintenance
- Technical and financing support to manufacturers

Policy & Regulation

- Implementation of ECBC & ECBC-R
- Industrial policy for brick.

THANK YOU !

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