# Prioritizing Materials in Sustainable Design

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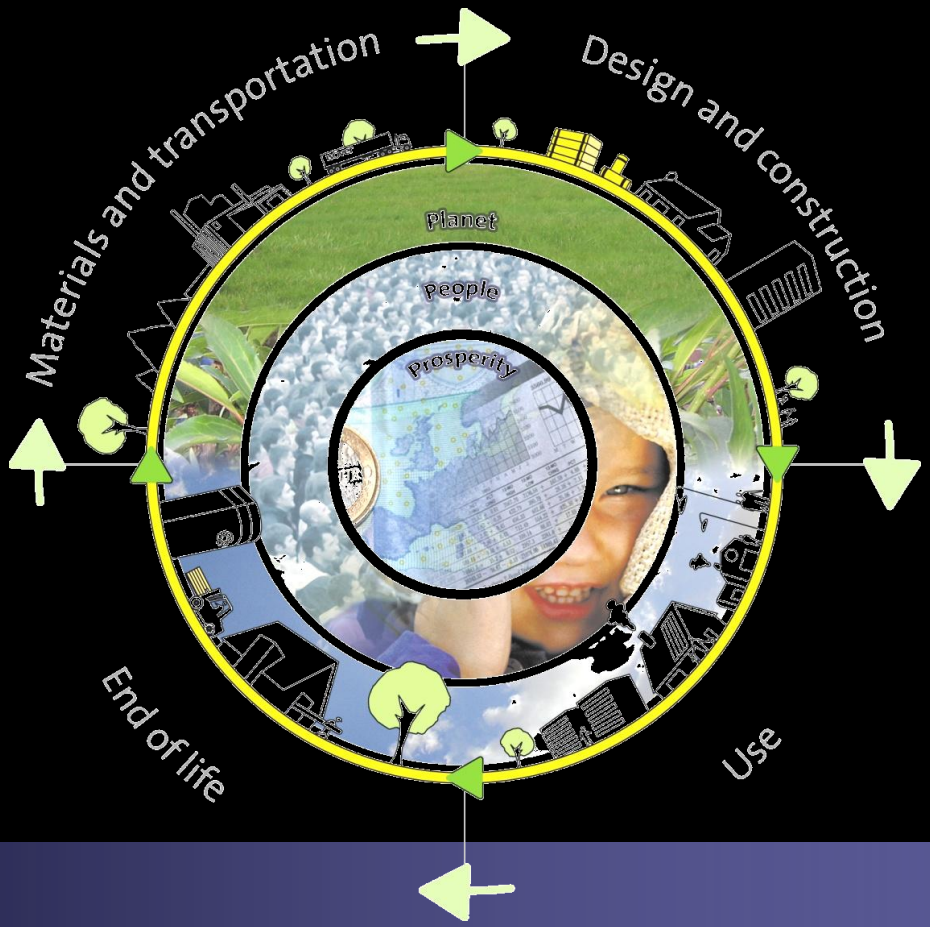
# Sustainability in Building Materials

-Energy Usage for creating building materials is slated to double by 2020

By sustainability in materials, we refer to the sustenance of that material over a longer period with minimal impact on resource availability & environment



- Can we say definitely that a material is sustainable ?

...changes as per on context & sustainability is in the “choice criterion”

# The Debate Rages on…

- Individual sustainability criterion might cancel out one other ?

… a “local” material, Stone could cause “Env. Damage” by mining

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-Does Life Cycle Analysis provide the complete answer?

... Limited information available currently.

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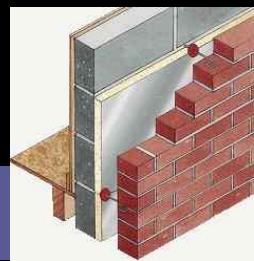
-Are Green material certificates the answer?

…So what’s the Priority in criterion in choosing sustainable materials ?





# The Sustainability Criterion…..

The Priority for Sustainability can help in thinking out the following:

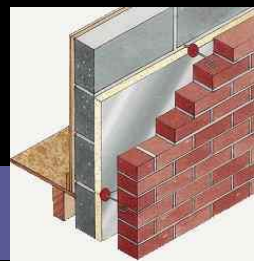
- Relevance of a material in a region
- Developing Local Usage Methods of the material
- Developing Local Variations of the Material

As the Priority starts from the most important criterion, in considering any Sustainability criterion…

- Considering the Upper Criterion is essential
- Considering the Lower Criterion is desirable





# *A. Minimum Environmental damage in its extraction from nature*

**Deforesting an area for its “local” wood resource**

# *A. Minimum Environmental damage in its extraction from nature*

Stone might be “local” but could lead to erosion due to excessive mining. Stone Crushers might lead to air pollution

Govt. now evolving sustainable “Mining” development framework

# *A. Minimum Environmental damage in its extraction from nature*

Bauxite, the main ore for manufacturing aluminum, in its extraction produces a large amount of toxic waste known as red sludge which can harm soil and subsoil water.

# *A. Minimum Environmental damage in its extraction from nature*

**Soil for Bricks might denude the top soil, which is precious**

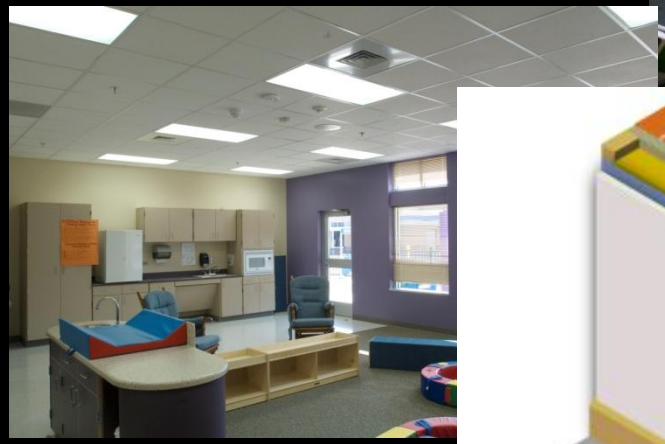
# *A. Minimum Environmental damage in its extraction from nature*

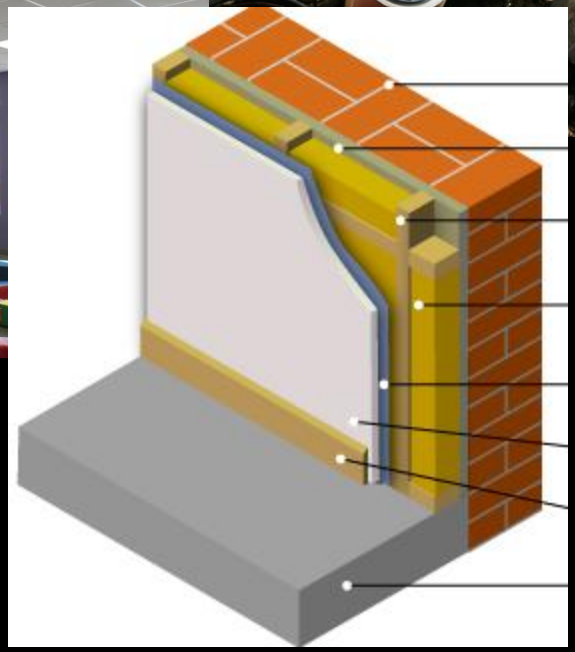
In damaging the environment, its ability to offer habitat and holistic resource gets reduced.

Instead utilize renewable resources or contain the damage

For.e.g. Use the Stone Dust and Chips for making concrete blocks

# *A2. No harmful effluents into environment in installation & usage*





**Certain foam products might give out ozone depleting substances**

# *B. Local availability of materials of reasonable quality*

| Flyash blocks | Stabilized Earth Blocks |
| --- | --- |
| (EEV) / brick = 2.32 MJ | (EEV) / brick = 2.79 MJ |

Distance is an important criterion.

Flyash block has lesser EEV, but is competitive only if it travel less than 50 km

# *C. Availability of local expertise and possibility of local employment*

*…If Material unavailable, skills do not help, But if Material available, skills can be created through training programs…*

For e.g. Wood usage, a sustainable Forest approach might help use wood on a regular basis, which allows excellent workability, sense of local identity & insulation.

# *C. Availability of local expertise and possibility of local employment*

School Done with Local Skilled Labour while reducing Steel Consumption

# *D. Durability and longevity of the material*



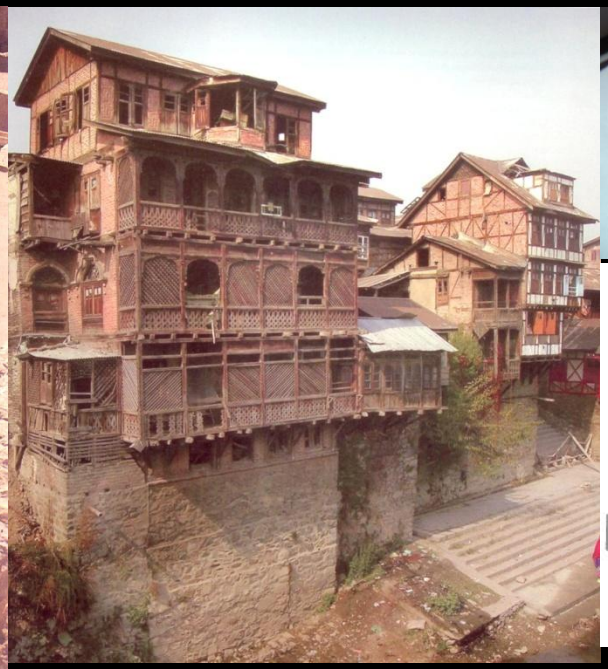
| Marble flooring<br>(Assume 18mm stone) | Terrazzo flooring<br>(Assume 30mm terrazzo) |
|---|---|
| EEV = 90 MJ/sqm | EEV = 72 MJ/sqm |
| Life approx. 80 years | Life approx. 40 years |

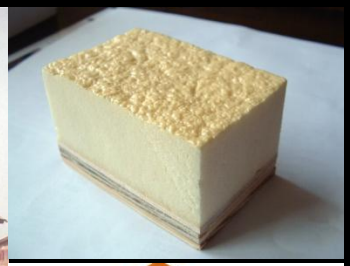
2x durability means 1/2 energy for extraction, processing, installation & disposal
- Durability also reduces Maintenance Energy.
- Natural Stone costly due to mining curbs, but since durable, so lifecycle cost lesser.

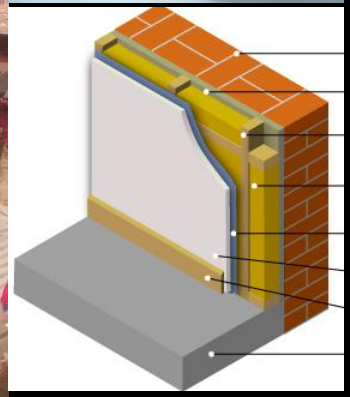
***…Sometimes Materials might be durable, but not local, say Stone in the North East, so people cannot replace, repair them easily…***

# *E. Response of the material to the climate in creating comfort*

(Not material configuration)







…Decision making to follow the priority…

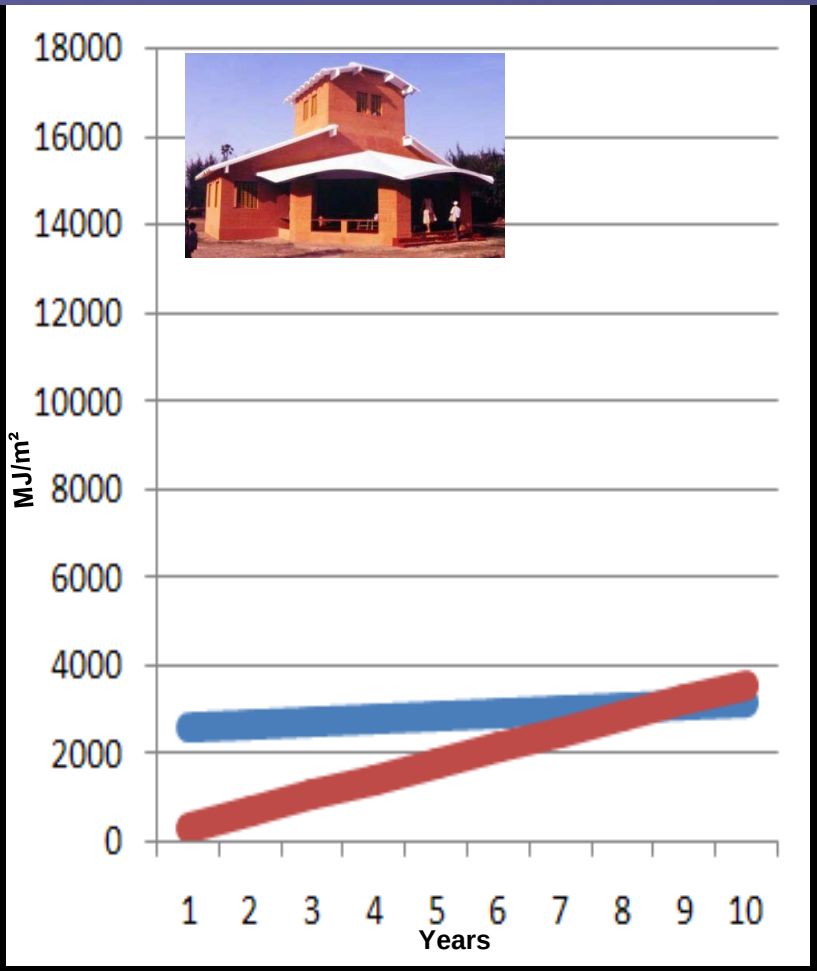
*- If "Local" material + Insulates as well = Usable*

*- If "Local skills" help modulate it for insulation, for,e,g, Rat Trap Bond, Hollow Concrete Blocks = Usable*

*-If Material Durable, for.e.g Stone, but not insulating = Still Usable & add insulation through cavities*

*- Does it make sense to import high grade insulation and increase EE ?*

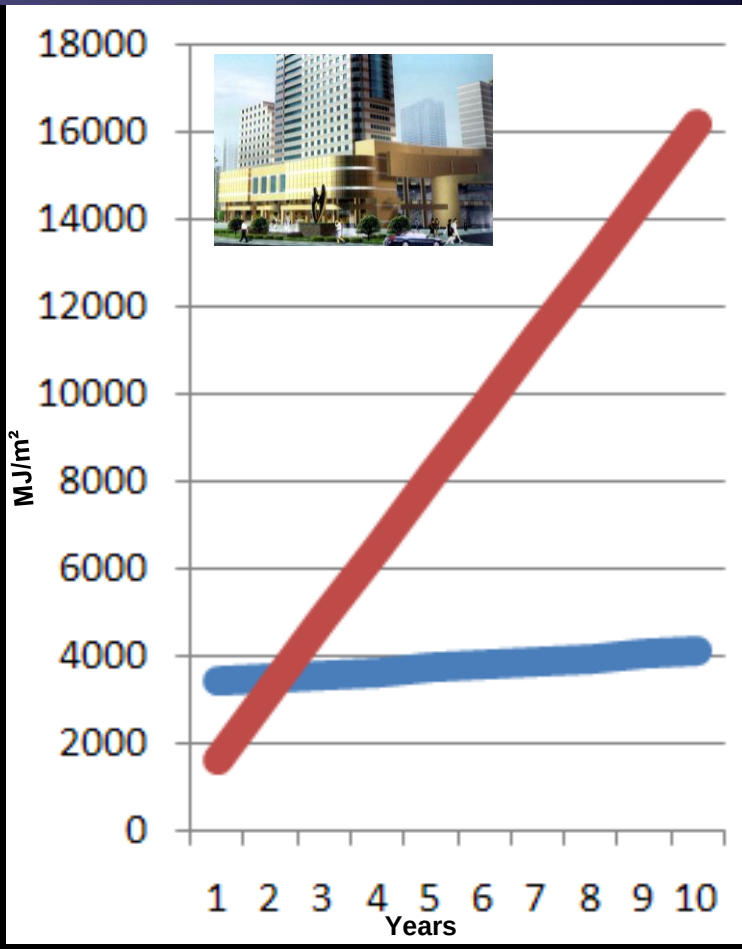
# E. Response of the material to the climate in creating comfort




Non AC Bldg with Low EE materials

OE (Operation Energy cumulative)

EE (Embodied Energy cumulative Assuming 2% investment in maintenance every year

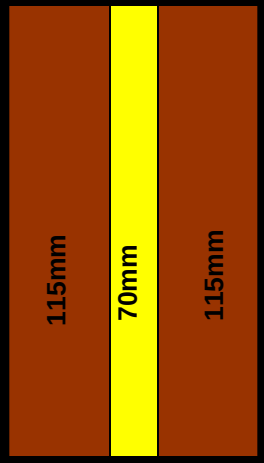



AC Bldg with Low EE materials and GRIHA Benchmark Performance

Alternative for Modern High Performance Buildings

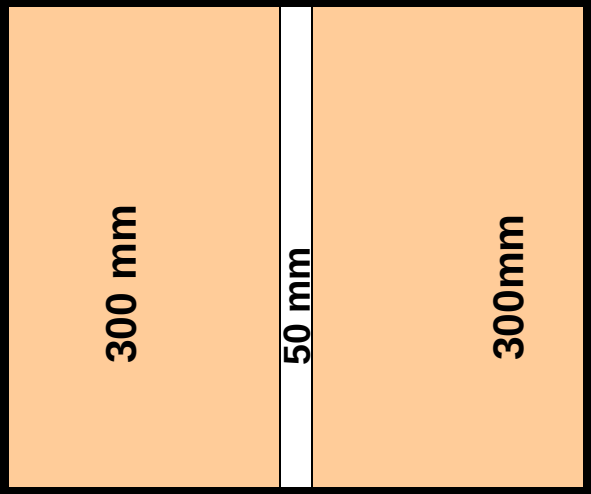
Here Embodied energy is a smaller component of overall energy (EE + OE)

# *E. Response of the material to the climate in creating comfort*




Wall Sections showing ECBC through different configurations.
Material's insulation and architectural relevance is important

**R=2.1: Brickwall with EPS (EE is higher)**




**R=2.1: Soil Block with 50 mm Air Gap (EE is much lesser)**
**R=2.1: Also achieved by 300 mm AAC Block**

# *F. Low embodied energy only in creation of building material*

(Not including Tpt. Energy.)

**…Recycled material like Steel Sheets or Construction Debris Blocks further reduces EEV, but if it does not offer insulation, the OE impact is unsustainable…**

| | |
|---|---|
| RCC Slab | EEV = 548 MJ/sqm |
| Recycled GI Sheets<br>(Assume 1mm sheet) | EEV = 280 MJ/sqm |

**- Recycling brings down EEV**

| | |
|---|---|
| New Aluminum | EEV = 227 MJ/kg |
| Recycled Aluminum | EEV = 8 MJ/kg |

**- Material Choices vis-à-vis EEV (Window of 1200 x 1200 with DGU)**

| | |
|---|---|
| Aluminum Windows | 5470 MJ/sqm |
| PVC Windows | 2470 MJ/sqm |
| Timber Windows | 490 MJ/sqm |

# *F. Low embodied energy only in creation of building material*


**-Reducing the WWR reduces heat gain while also reducing Embodied Energy from 4500 to 550 MJ/sqm**

# *G. Ability to reuse with minimum processing*

This is for future planning, in essence a “hope”.

For e.g. Iron Is Superior to Aluminum due to ease with which it can be recast and reutilized.

For this planning for disassembling is important

## *What about Material cost ?*

For.e.g. In a mountainous area, How can metal angles be cheaper than stone blocks

A parallel between energy economy & money economy, i.e. between Joules and Rupees, is required.

This would make higher embodied energy materials more expensive

***Create a parallel between Joules & Rupees***

# *Thank you*


***deependra @ intbau . in***

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