

Eco-Friendly Building Materials

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Presentation by

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For

Ecohousing Brainstorming for MCGM

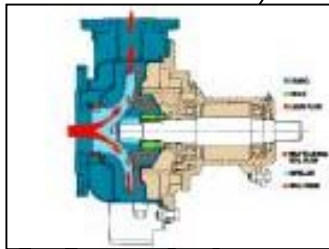
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Engineering Applications- Classification



Structures

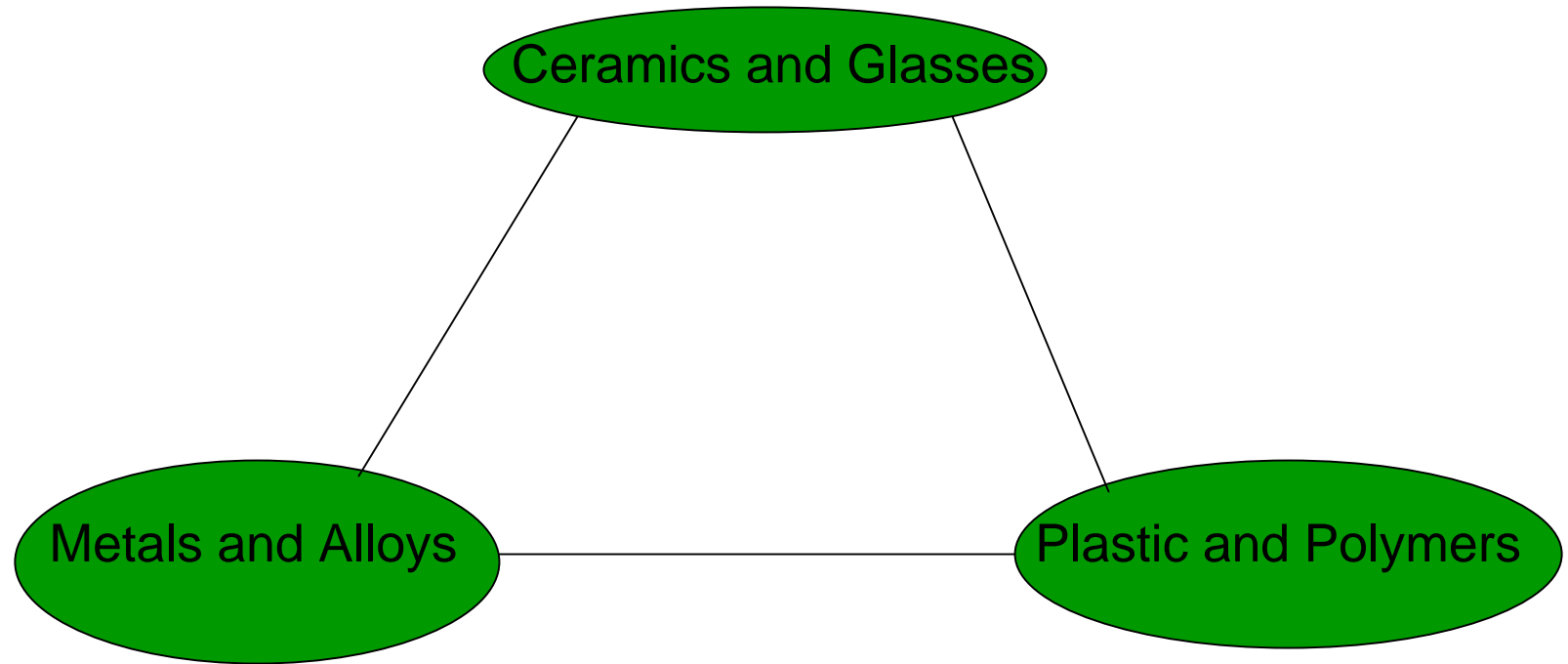


Machines



Devices

Engineering Materials-Classification



Building Materials

Categorized based on Activity and Vendor Specific

1. Civil materials
2. Water-proofing and Chemical additives
3. Paving, flooring, dado and similar finishes
4. Paints, colors, white washing, distemping and wood finishes
5. Wood work
6. Roofing and ceiling
7. Doors and windows
8. Water supply and sanitary fittings
9. Electrical works
10. Fire fighting system
11. Miscellaneous
12. Excavation work
13. Road works

Material Sources

A. Natural and Processed

- ★ Depletable
- ★ Renewable

B. Industrially Produced

- ★ Recyclable
- ★ Waste Generator

Why eco-friendly materials?

- ★ Phenomenal growth in the construction industry that depends upon depletable resources.
- ★ Production of building materials leads to irreversible environmental impacts.
- ★ Using eco-friendly materials is the best way to build a eco-friendly building.



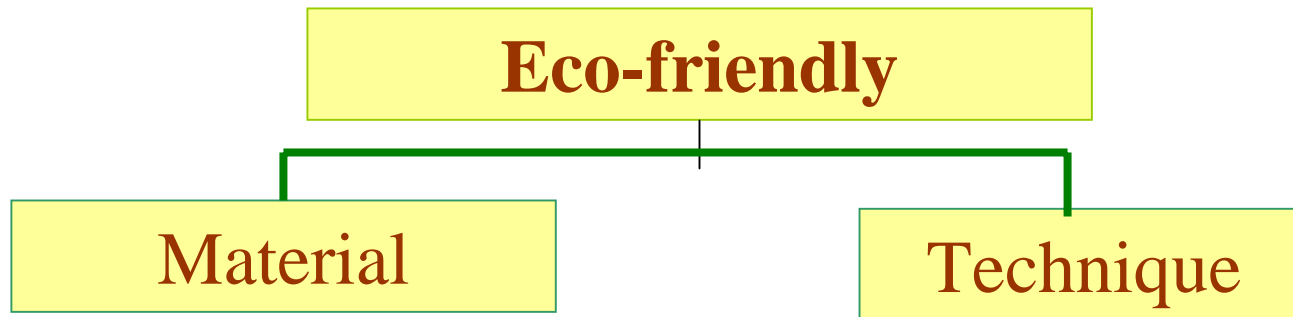
Evaluating Eco-friendly Materials



What is Eco-friendly material ?

- ★ **Dictionary:** describes a product that has been designed to do the least possible damage to the environment
- ★ **US EPA - EPP program defines as:**
"...products or services that have a lesser or reduced effect on human health and the environment when compared with competing products or services that serve the same purpose..."

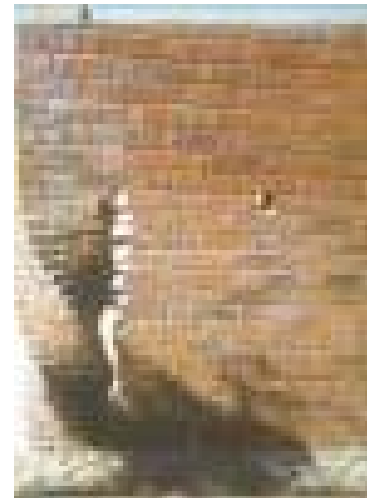
Eco-friendly Aspects



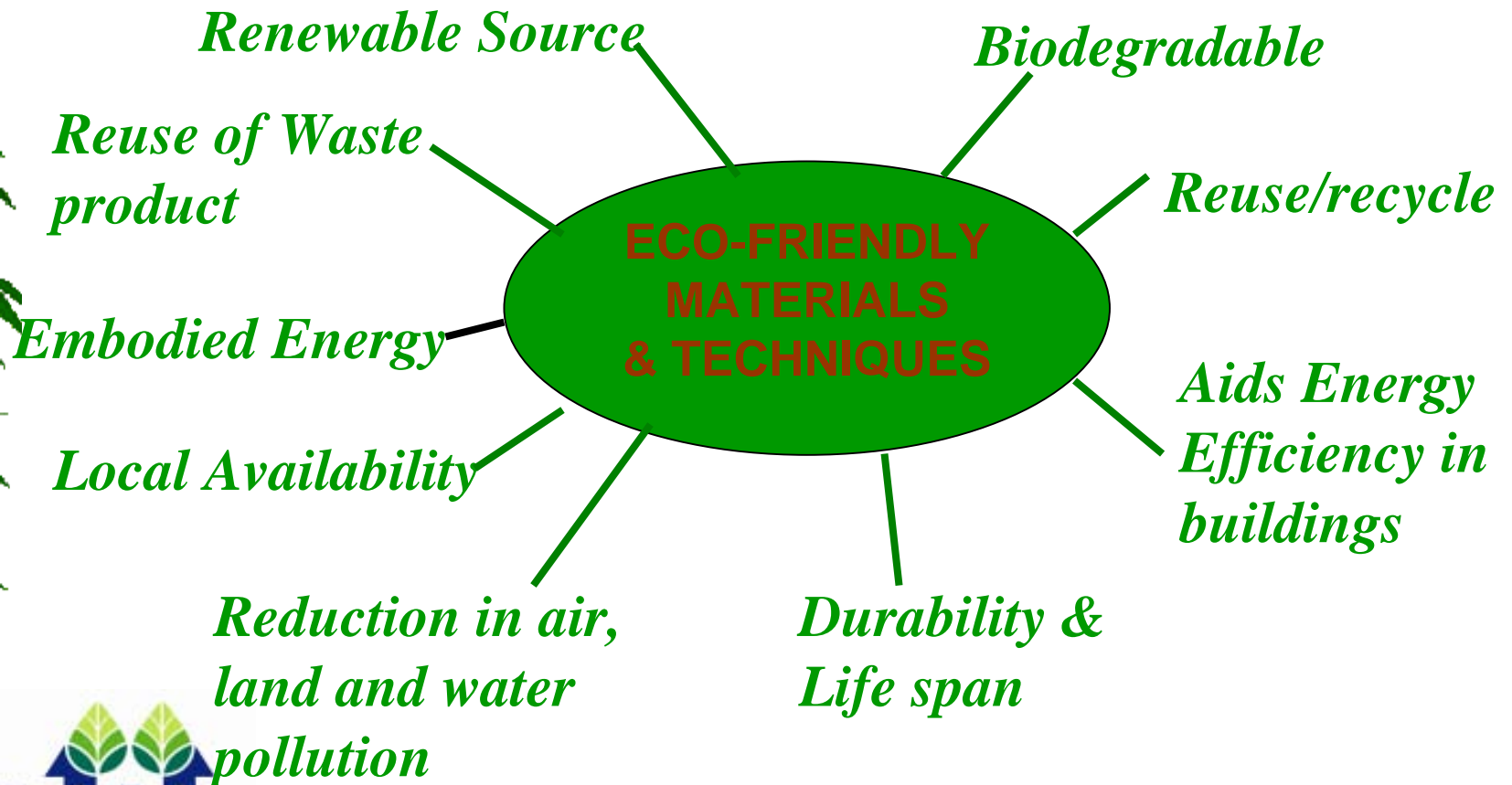
Bamboo



Rat Trap Bond



Relevant Properties



Source of Material

a. Renewable source

Rapidly renewable sources

e.g. *wood from certified forests*



b. One Time Usable

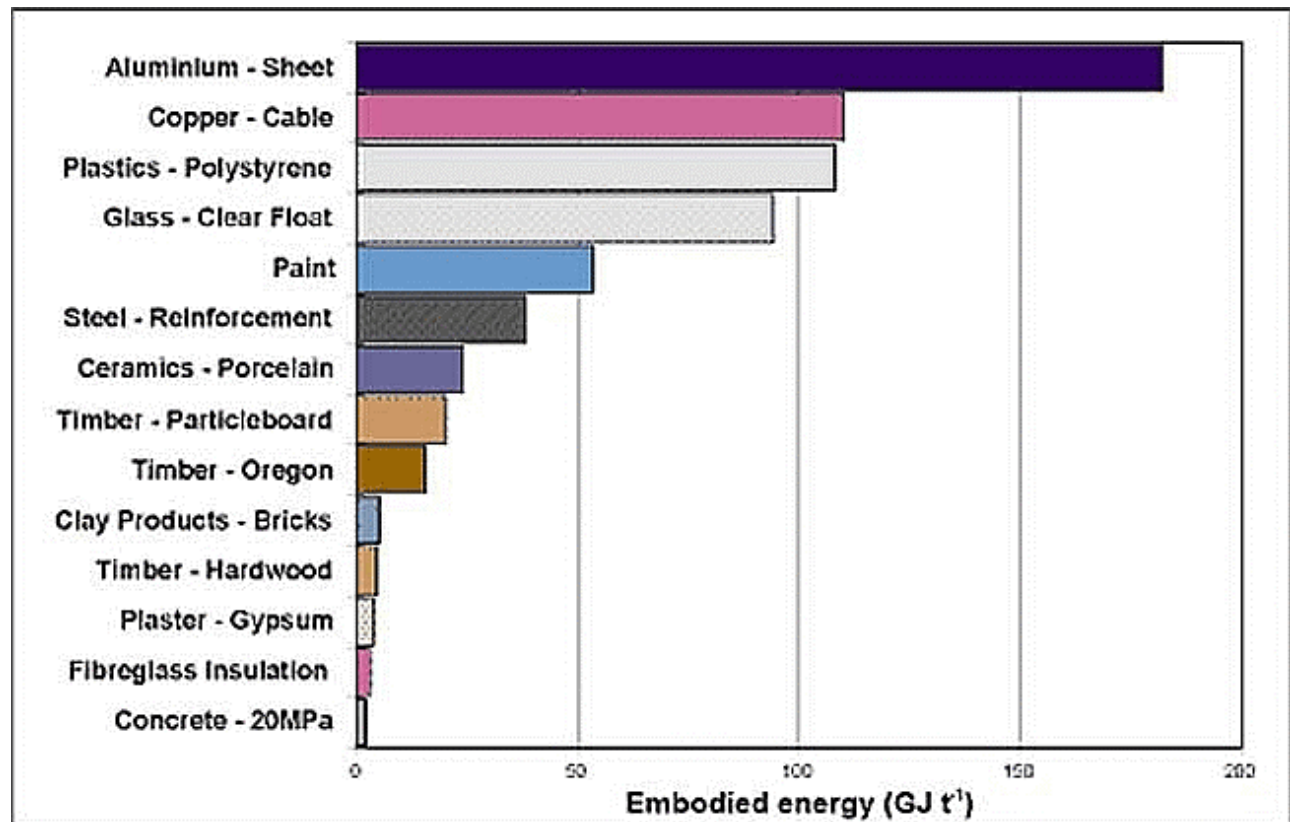
eg. Paint

c. Reusable/Reprocessable

* Interior/Metallic materials

Embodied Energy

Scalar total of energy input required to produce the product including transporting them to the building site



Some Aspects of Eco-friendly Materials

a. Reduce Pollution

- * Air Pollution- Use of materials with low VOC emissions e.g. *Cement Paints*

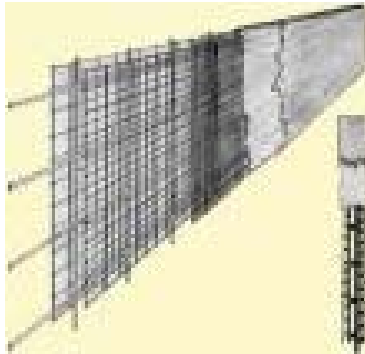


- * Land Pollution- Materials that reuse waste that would otherwise have resulted in landfill. e.g. *Flyash Bricks*.

- * Water Pollution – Materials that prevent leaching.

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b. Performance



* Durability & Life Span

Material that are exceptionally durable, or require low maintenance e.g *PVC pipes*.

- * Reduce material use
These are energy efficient and also help reduce the dead load of a building. e.g. *Ferrocement*



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c. Energy Conservation

- * Materials that require less energy during construction e.g. *precast slabs*.



- * Products that conserve energy – e. g. *CFL lamps*.



- * Materials that help reduce the cooling loads- e.g – *aerated concrete blocks*.

- * Fixtures & equipments that help conserve water e.g. *Dual flush cisterns*

Contd...

d. Recyclability

- * Reuse or Recycle as different product e.g. *steel, aluminum.*
- * Biodegradable – that decompose easily e.g *wood or earthen materials.*



Evaluating System

International

- ★ US EPA – Env preferable purchasing (EPP)
- ★ Green Seal
- ★ Greenspec products
- ★ BEES (Buildings for Environmental and Economic Sustainability)
- ★ JIS – Japanese Industrial Standards

Evaluating System

National

MOEF – Proposed certification of all eco-friendly products as ‘Ecomark’

CPCB is entrusted with the task of developing the standards for certification.

Evaluating System

Constraints

- ★ To qualify any material as eco-friendly it is necessary to conduct a life cycle analysis of each material.
- ★ Each study has to be on a product to product basis

Scoring System-Suggestive

- * A Eco-Points Scoring System was derived based on a Life Cycle Assessment of each product.

- * Life Cycle Stages

1. **Manufacture/Extraction/Production**

2. **Usage/Implementation**

3. **Maintenance/Operational life**

4. **Disposal**

Scoring System-Suggestive

- ★ The entire life cycle spans over 150 points
- ★ Each stage has a percentage contribution depending on their individual impacts.
- ★ The higher the score the more eco-friendly the material.
 - **Class 'A' Materials** – 100 and above (Excellent)
 - **Class 'B' Materials** – 60 - 99 (Good to moderately good)
 - **Class 'C' Materials** – below 60 (Poor to Bad)

Eco-friendly Materials



Conventional Eco-friendly materials

1. Bamboo, Bamboo Based Particle Board & Ply Board, Bamboo Matting
2. Bricks sun dried
3. Pre-cast cement concrete blocks, lintels, slab. Structural and non-structural modular elements
4. Calcined Phospho-Gypsum Wall Panels
5. Calcium silicate boards and Tiles
6. Cellular Light Weight Concrete Blocks
7. Cement Paint
8. Clay roofing tiles
9. Water, polyurethane and acrylic based chemical admixtures for corrosion removal, rust prevention, water proofing
10. Epoxy Resin System, Flooring, sealants, adhesives and admixtures

Conventional Eco-friendly materials

11. Ferro-cement boards for door and window shutters
12. Ferro-cement Roofing Channels
13. Fly-ash Sand Lime Bricks and Paver Blocks
14. Gypsum Board, Tiles, Plaster, Blocks, gypsum plaster fibre jute/sisal and glass fibre composites
15. Laminated Wood Plastic Components
16. Marble Mosaic Tiles
17. MDF Boards and Mouldings
18. Micro Concrete Roofing Tiles
19. Particle Boards
20. Polymerised water proof compound

Conventional Eco-friendly materials

21. Polymerised water proof compound
22. Portland Pozzolana Cement Fly-ash / Calcinated Clay Based
23. Portland Slag Cement
24. RCC Door Frames
25. Ready Mix Cement Concrete
26. Rubber Wood Finger Joint Board
27. Stone dust
28. Water proof compound, adhesive, Polymer, Powder

Evaluating Parameters Life Cycle Stages

1. Manufacture/Extraction/Production - 60% (90 pts)
 - Use of recycled resource (13pts)
 - Use of renewable resource (13pts)
 - Use of waste materials (13pts)
 - Energy consumption (11pts)
 - Emissions and human safety factor (11pts)
 - Water consumption (10pts)
 - Waste production (10pts)
 - Virgin resource consumption. (9pts)

Evaluating Parameters

2. Usage/Implementation – 18% (21pts)
- Material wastage (8 pts)
 - Transportation (7pts)
 - Ease of usage/ storage/ workability (6 pts)

Evaluating Parameters

3. Maintenance/Operational life 14% (12pts)

- Building energy load reduction (6 pts)
- Average life span (years) (6 pts)

Evaluating Parameters

4. Disposal – 8% (27pts)

- Biodegradability (10pts)
- Recycle/ Reuse factor (10pts)
- Ease of removal/Disposal (7pts)

Potential Eco-friendly materials & techniques

1. Bagasse Board – *BMTPC* (Building Material Technology & Promotion Council), New Delhi.
2. Bricks from Coal Washery Rejects – *CBRI* (Central Building Res. Institute), Roorkee
3. Building Blocks From Mine Waste – *SERC* (Structural Engineering Res. Centre), Chennai
4. Burnt Clay FlyAsh Bricks - *CBRI, Roorkee*
5. Coir Cement Board - *CBRI, Roorkee*
6. Compressed Earth Blocks - *BMTPC*
7. EPS Composites and Door Shutters -*CBRI, Roorkee*
8. Fibre Flyash Cement Boards -*BMTPC*
9. Fibre Reinforced Concrete Precast Elements, Wall panels, Blocks, Manhole Covers - *SERC*
10. Fibrous Gypsum Plaster Boards - *CBRI, Roorkee*

Potential Eco-friendly materials & techniques

11. Flyash Cellular Concrete, Flyash Cement Brick, Blocks - *BMTPC*
12. Flyash Lime Cellular Concrete - *CBRI, Roorkee*
13. Flyash Lime Gypsum Brick - *BMTPC*
14. Insulating Bricks from Rice Husk Ash- *Central Glass and Ceramic Research Institute, Kolkata*
15. Jute Fibre Polyester -*BMTPC*
16. Non Erodable Mud Plaster - *CBRI, Roorkee*
17. Polytiles - *CBRI, Roorkee*
18. Timber from trees such as Poplar, Rubber, Eucalyptus - *BMTPC*
19. Precast walling roofing components - *CBRI, Roorkee*
20. Prefab Brick Panel System - *CBRI, Roorkee*

Possible Eco-friendly Alternatives

1. Structural System –

Alternatives to Cement Concrete (plain / reinforced) - cement, sand, aggregate, steel
Base Materials for R.C.C. and Steel Systems

- a. Pozzolana Material content (Fly-ash / Slag / Calcinated Clay) attained through use of Blended Portland Cement (BPC) and /or direct addition of pozzolana material
- b. Sand and aggregate from pulverized debris and /or sintered fly-ash for concrete and mortar
- c. Recycled steel forms and reinforcement bars

Alternatives Systems

- a. Ferro cement and
- b. Pre-cast components for columns, beams, slabs, lofts, balconies, roofs etc.
- c. Ready Mix Concrete
- d. Use Resinous curing agents

Contd...

2. Masonry

Alternatives to Fired clay bricks, cement concrete blocks, stone

- a. Use of Fly ash + sand + lime bricks / blocks
- b. Pulverized debris + cement bricks / blocks,
- c. Industrial waste based bricks / blocks,
- d. Aerated lightweight BPC concrete blocks,
- e. Phospho-Gypsum based blocks
- f. Lato blocks (laterite + cement)



3. Mortar

- a. Sand from pulverized debris and / or sintered flyash
- b. Pozzolana Material content

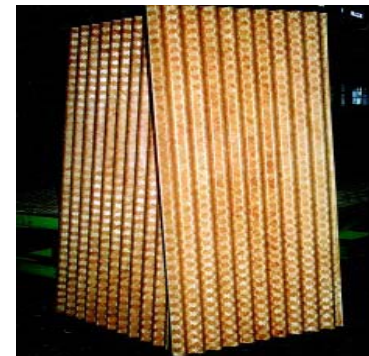
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4. Plastering – *Alternatives to Cement, sand, plaster of paris, gypsum*

- a. **Calcium Silicate Plaster**
- b. **Cement Plaster**
- c. **Use of Fiber reinforced clay plaster**
- d. **Phospho-Gypsum Plaster**
- e. **Non-erodable Mud Plaster**
- f. **Use Resinous curing agents**

5. Roofing and ceiling- *Alternatives to Ferrous / non-ferrous sheets, tiles, thatch*

- a. **Fibre Reinforced Polymer Plastics instead of PVC and Foam PVC, Polycarbonates, acrylics & plastics**
- b. **Micro Concrete Roofing Tiles**
- c. **Bamboo Matt Corrugated Roofing Sheets**



Contd...

6. Flooring, paving and road work — *Alternatives to wood, stone, ceramics, concrete*

- a. Fly ash / industrial waste / pulverized debris blocks in BPC
- b. Lime-pozzolana concrete paving blocks for all outdoor paving.
- c. Bedding sand from pulverized debris

7. Tiles for interiors

- a. Terrazzo floor for terraces and semi covered area
- b. Ceramic tiles (non-vitrified)
- c. Mosaic Tiles/ Terrazzo Flooring
- d. Cement Tiles
- e. Phospho-Gypsum Tiles
- f. Bamboo Board Flooring



Contd...

8. Windows, Doors and openings –

Steel, aluminum, timber, glass, R.C.C., PVC, Stone

- a. **Ferro cement and Pre-cast R.C.C. lintel, chajja and jalis**
- b. **Masonry bond combinations for jali work**

Alternatives to ***Timber and Aluminum / Steel frames***

- a. **Ferrocement**
- b. **Pre-cast R.C.C. Frames/ Frameless Doors**
- c. **Bamboo Reinforced Concrete Frames**
- d. **Hollow recycled steel channels and recycled Aluminium Channels and Components**

Shutters and Panels – alternatives to timber, plywood, glass, aluminum

- a. **Red Mud based Composite door shutters,**
- b. **Laminated Hollow Composite Shutters**
- c. **Other wood alternatives**

Contd...

9. Electrical

Alternatives for Aluminum, brass, PVC, G.I., S.S.

- a. Use unplasticised PVC or HDPE products
- b. Where applicable use products with recycled aluminum and brass components

10. Water supply, Sanitary and Plumbing System

- a. R.C.C., unplasticised PVC, G.I., C.I. pipes instead of lead, A.C. pipes
- b. Where applicable use products with recycled aluminum and brass components for fittings, fixtures and accessories
- c. Use Polymer Plastic (Random) hot / cold water system instead of G.I.
- d. Manholes and covers - use Pre-cast cement concrete and high strength uPVC instead of C.I.

Contd...

11. Wood

- * Renewable timber from plantations with species having not more than 10 year cycle or timber from a government certified forest / plantation or timber from salvaged wood
- * Plywood should be phenol bonded and not urea bonded
- * Use of MDF Board
- * Instead of Plywood:
Bamboo Ply/Mat Board/ Fibre Reinforced Polymer Board,/ Bagasse Board /Coir Composite Board /Bamboo mat Veneer Composite/ Finger Jointed Plantation Timber Board / Recycled Laminated Tube Board / Aluminium-Foil+Paper+Plastic Composite Board.
- e. Use of Mica Laminates and Veneer on Composite boards instead of natural timber.

Contd...

12. Water proofing chemicals, additives, sealants and adhesives

- a. **Use of water based chemicals instead of solvent based.**
- b. **Epoxy resins instead of tar felt / pitch**

13. Painting, Polishing, Priming and similar surface finishing

- a. **Use of Cement Paint / Epoxy Resin Paint for external surfaces**
- b. **Use of Water based paints, enamels, primers and polishes**

Thank you

