Bureau of Energy Efficiency

सत्यमेव जयते
Government of India
Ministry of Power

german cooperation
DEUTSCHE ZUSAMMENARBEIT

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

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

Bureau of Energy Efficiency

सत्यमेव जयते
Government of India
Ministry of Power

german cooperation
DEUTSCHE ZUSAMMENARBEIT

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

THIS PRESENTATION WAS SHARED BY

Shailesh Agarwal

Building Materials & Technology Promotion Council (BMTPC)

FOR THE SESSION:

"Circular Economy (Waste or Resource)"

DURING ANGAN 2019

Knowledge Partner

teri The Energy and Resources Institute
Creating Innovative Solutions for a Sustainable Future

Event Partner

TEC INDIA
Event & Brand Management Co.

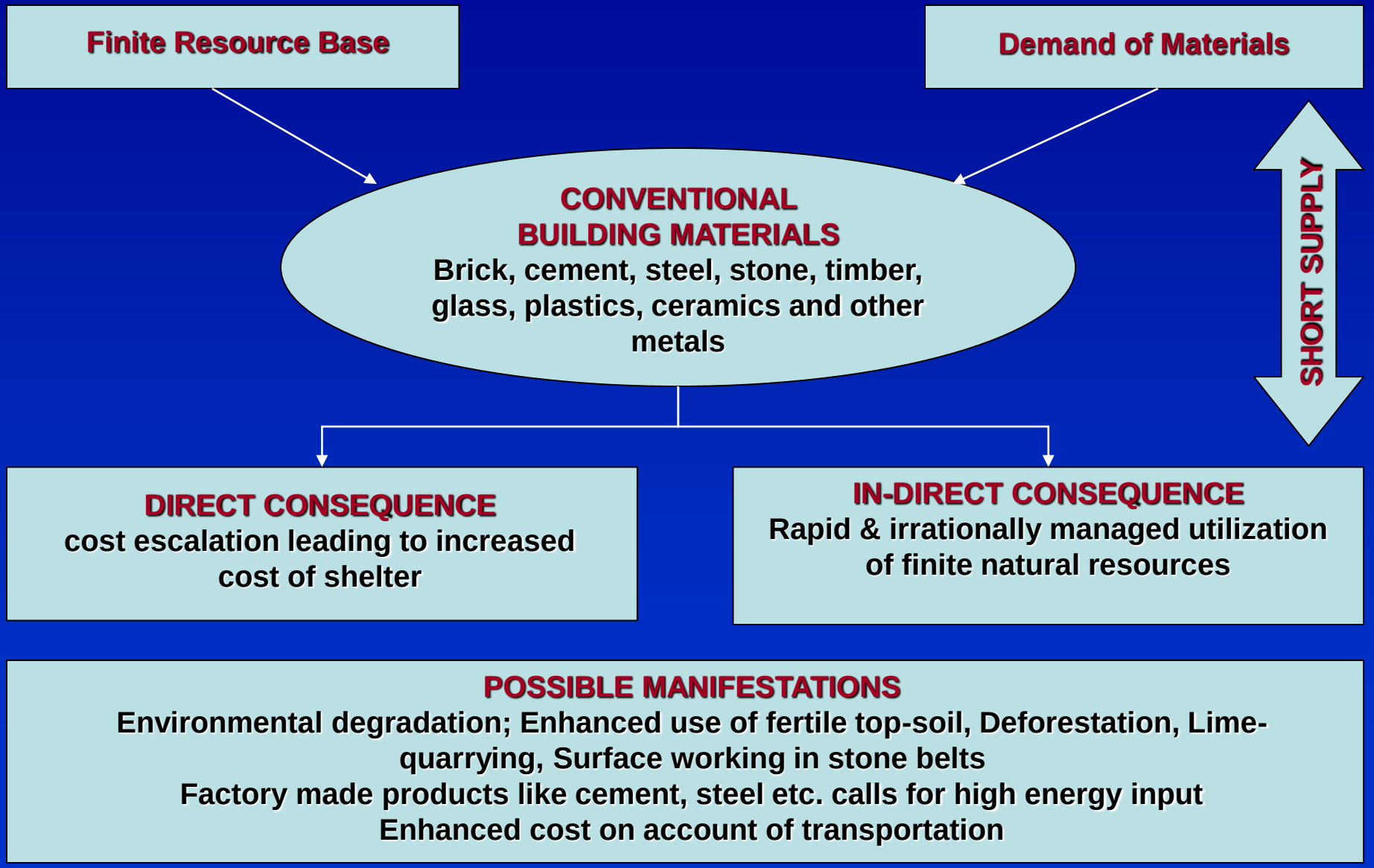
Augmenting Nature by Green Affordable New-habitat (ANGAN)
- A courtyard for revolutionary change in Building Energy Efficiency
The International Building Energy Efficiency Conference
9 - 11 September 2019, New Delhi

Sustainable Building Materials & Construction Technologies

Dr. Shailesh Kr. Agrawal
Executive Director

Building Materials & Technology Promotion Council
Ministry of Housing & Urban Affairs
Government of India

Conventional Building Materials



Green Aspects Ignored?

- Resource Efficiency
- Energy Efficiency

SOURCE : INTERNET

SOURCE : INTERNET

- Eco-friendliness
- Health

Need of the Hour

- Use of renewable resources f building materials
- Use of raw materials resource based on waste products
- Efficient use of existing conventional materials by producing factory made (pre-cast) building components
- Affordability and sustainability
- Industrialization of housing sector

Inorganic Industrial Wastes Production in India and their potential uses

S. No.	Waste	Annual Generation (Mt)	Potential Uses
1	Blast furnace slag 	11	PSC, SSC, oil well cement, aggregate, ceramics
2	Ferro-alloys slag 	3.5	Masonry cement, blended, cement, ceramics, aggregate
3	Flyash 	140	Cement, PPC, concrete, cellular concrete, lightweight aggregate, calcium silicate brick, clay flyash brick
4	By-product gypsum 	4.0	Cement additive, plaster, building blocks and fibrous gypsum board, special cement

Inorganic Industrial Wastes Production in India ...contd.

S. No.	Waste	Annual Generation (Mt)	Potential Uses
5	Red Mud 	3.5	Cement raw material, brick and tiles, sintered aggregate
6	Mine tailings (zinc, copper, gold) 	6.50	Filler in concrete, calcium silicate brick, cellular concrete, clay brick and cement
7	Iron tailing 	10.50	For making stabilized and burnt clay building bricks, high strength bricks

Inorganic Industrial Wastes Production in India ...contd.

S. No.	Waste	Annual Generation (Mt)	Potential Uses
8	Waste Glass 	--	In the manufacture of mosaic and glazed tiles and light weight aggregate, brick making
9	Water works silts 	10	For manufacture of structural clay product, light weight bloated clay aggregate, high strength bricks
10	Marble dust 	8	Walling and flooring tiles, bricks and blocks
11	Coal mine and washery waste 	50	Manufacture of bricks, tiles, lightweight aggregates, fuel substitute in the burning of bricks

Inorganic Industrial Wastes Production in India ...contd.

S. No.	Waste	Annual Generation (Mt)	Potential Uses
12	Gypsum mine waste 	1.50	Gypsum building plaster, ready made plaster with lime
13	Kiln dust 	2.00	In the cement industry, as a hydraulic binder
14	Lime stone waste 	17.80	For production of masonry cement and activated lime pozzolana mixture

Inorganic Industrial Wastes Production in India ...contd.

S. No.	Waste	Annual Generation (Mt)	Potential Uses
15	Lime sludge 	4	For the manufacture of Portland cement, masonry cement, sand lime bricks, building lime pozzolana mixture
16	Paper waste 	--	For the manufacture of pitch fibre pipes, asphaltic corrugated roofing sheets, egg/apple/fruit pack trays, pulp moulded packaging materials
17	Cinder 	1	Manufacture of lime cinder mortar, production of concrete building blocks, production of bricks from black cotton soil

Agricultural Waste Production in India and their potential use

S. No	Item	Source	Qty. (in MT/Yr.)	Application in Building Materials
1	Rice Husk 	Rice mills	20	As fuel, for manufacturing building materials and products for production of rice husk binder, fibrous building panels, bricks
2	Banana Leaves/Stalk 	Banana plants	0.20	In the manufacture of building boards, fire resistance fibre board
3	Coconut Husk 	Coir fibre industry	1.60	In the manufacture of building boards, roofing sheets, insulation boards, building panels, as a lightweight aggregate, coir fibre reinforced composite, cement board, geo-textile, rubberised coir

Agricultural Waste Production in India and their potential use

S. No	Item	Source	Qty. (in MT/Yr.)	Application in Building Materials
4	Groundnut Shell 	Groundnut oil mills	11.00	In the manufacture of buildings panels, building blocks, for making chip boards, roofing sheets, particle boards
5	Jute Fibre 	Jute Industry	14.40	For making chip boards, roofing sheets, door shutters
6	Rice/Wheat Straw 	Agricultural farm	12.00	Manufacture of roofing unit and walls panel/boards
7	Bagasse 	Sugar Industries	90	For manufacture of insulation boards, wall panels, etc.

Agricultural Waste Production in India and their potential use…contd.

S. No	Item	Source	Qty. (in MT/Yr.)	Application in Building Materials
8	Saw Mill Waste 	Sawmills/ wood	2.00	Manufacture of cement bonded wood chips, blocks, boards, particle boards, insulation boards, briquettes
9	Sisal Fibres 	Sisal plantation	.023 (Asia)	For plastering of walls and for making roofing sheets, composite board with rice husk, cement roofing sheet, roofing tiles, manufacturing of paper and pulp
10	Cotton Stalk 	Cotton plantation	1.10	Fibre boards, panel, door shutters, roofing sheets, autoclaved cement composite, paper, plastering of walls

Fly Ash Bricks (Fal-G)

(Substitute to Burnt Clay Bricks)

Ingredients:

Fly ash	60-65%
Lime	20-25%
Gypsum	10%
Sand	optional
Cement	optional

Sizes in mm:

Modular
- 190 x 90 x 90
- 190 x 90 x 90

Non-Modular
- 230 x 110 x 70
- 230 x 110 x 30

Typical requirement:

Compressive strength : 60-150 Kg/cm^2

Water absorption : 5-12 %

Technology based on age-old Pozzolanic chemistry proven for its strength and durability.

Special features:

- Eco friendly Green Technology
- Saves fertile top soil
- Does not require steaming & autoclaving, only water cured.
- Firing process is avoided thus saves energy.
- Utilizes fly ash - *an Industrial Waste from Thermal Power Plants*.
- Can be produced at site with simple machines.

IS 12894:1990 - Specification for Pulverised Fuel Ash Lime Bricks

bmtpc
Building Materials & Technology Promotion Council
Ministry of Housing & Urban Poverty Alleviation
Government of India

Modular Fly Ash Clay Bricks

(Substitute to Burnt Clay Bricks)

Sizes (modular) in mm:

190 x 90 x 40

190 x 90 x 90

Made of Soil + fly ash (up to 20%)

Compressive strength 3.5- 30 N/mm²

Water absorption ≥ 20% (upto class 12.5)

≥ 15% (higher classes)

Special features:

- Use of Flyash - *an Industrial Waste from Thermal Power Plants*.
- Saving in space of floor area.
- Economy in cost of brick masonry.
- Saving in labour cost.
- Less consumption of mortar.
- Better exposed appearance.

IS 13757:1993 - Specifications for burnt Clay Fly Ash Building Bricks.

bmtpc
Building Materials & Technology Promotion Council
Ministry of Housing & Urban Poverty Alleviation
Government of India

Building Materials and Technologies
IDENTIFIED, ASSESSED AND PROMOTED by BMTPC

Precast Solid Cement Concrete Block

Developed by	Working specification by BMTPC including manufacturing method	National standard framed
CBRI, Roorkee	BC 01	IS 2185

Number of machines developed. Very popular walling technology. Being produced by various Building Centres and private entrepreneurs.

Precast Concrete Stone Masonry Blocks

Developed by	Working specification by BMTPC including manufacturing method	National standard framed
CBRI, Roorkee	BC 02	IS 12440: 1985 IS 14213: 1994

Good options where stones are available. Being produced with good exterior textures.

Stabilized Interlocking Blocks

(Substitute for conventional Bricks & mortar based technology)

Raw Material Mix:

Flyash Cement Block	*Stablized Earth Block*
Flyash : upto 60%	Soil upto 70%
Coarse Sand : upto 30%	Coarse sand upto 30%
Stablizer : 5 - 15% (Cement/lime/gypsum)	Cement - 5-10%

170 Blocks needed to construct one cu.m. wall (Density of Masonry : 1300 - 1700 kg/m^3) as against 500 conventional burnt clay bricks (1920 kg/m^3).

Performance Characteristics:

Compressive Strength:

Stablized Block	30-75 N/mm^2
Flyash Block	75-125 N/mm^2

Water Absorption:

Stablized block	upto 15%
Flyash block	upto 12 %

Special features:

- Environment friendly Green technology
- Cost effective
- Better thermal insulation
- Use of local resources
- Less energy intensive
- Less mortar, faster to construct, better aesthetic
- Compressed by different types of manual or motor driven press machine.

bmTpc
Building Materials & Technology Promotion Council
Ministry of Housing & Urban Poverty Alleviation
Government of India

Building Materials and Technologies
IDENTIFIED, ASSESSED AND PROMOTED by BMTPC

Hollow and Solid Light Weight Concrete Block

Developed by	Working specification by BMTPC including manufacturing method	National standard framed
CBRI, Roorkee	BC 03	IS 2185: (Pt 2)1983

Number of machines developed. Very popular walling technology. Being produced by various Building Centres and private entrepreneurs.

Cellular Light-weight Concrete

(Substitute for conventional Bricks & mortar based technology)

A version of light-weight concrete that is produced like normal concrete under ambient condition.

Production:

Make a slurry of cement + sand+flyash (constituting 26-34%) + water. Add pre-formed stable foam in concrete mixer under ambient tempreture. Mixture is poured or pumped into assembled moulds of blocks or formwork of reinforced structural elements or poured into flat roofs or voids for thermal insulation.

Special features:

- Optimum thermal insulation
- Substantial weight reduction
- Improved fire rating
- Maximum sound absorption
- Fast progress in construction
- Saving in raw material (no gravel)
- Saving in steel reinforcement in high rise buildings
- Energy efficient and environment-friendly

Uses:

Low Density	400-600 kg/m^3	Ideal for thermal insulation application (alternate to EPS, glasswool, woodwool etc.)
Medium Density	800-1000 kg/m^3	Precast blocks for non-load bearing walling masonry in framed structures
High Density	1200-1800 kg/m^3	For structural applications

bmtpc
Building Materials & Technology Promotion Council
Ministry of Housing & Urban Poverty Alleviation
Government of India

Filler Slab Roof

(Substitute for In-situ RCC Slab)

Principle: Removing concrete from lower part of slab experiencing tensile force where concrete play the role of holding the reinforcement together

Putting low cost and light weight filler materials like:

- Country tiles
- Hollow Blocks
- Manglore tiles
- Treated coconut Shells
- Earthen pots
- Thermocol
- Bricks

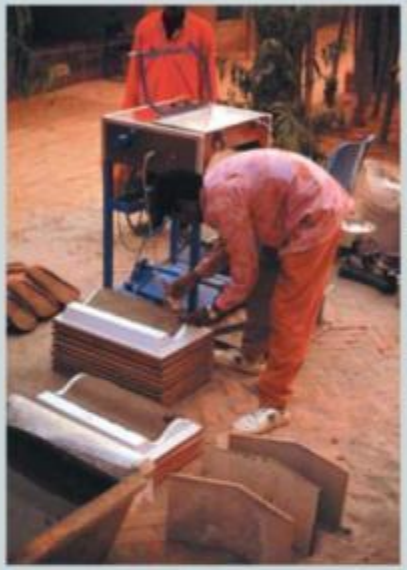
Special features:

- Due to reduction of concrete volume, (upto 30%) the overall cost of slab is lower than RCC slab.
- Consumption of steel is lesser than that of the RCC slab where more reinforcement is required due to added load of concrete.
- Filler material could be utilised for aesthetic pattern

bmtpc
Building Materials & Technology Promotion Council
Ministry of Housing & Urban Poverty Alleviation
Government of India

Micro Concrete Tiles

(Substitute for Country & Mangalore Tiles)



Available Profiles:

Pan Type : 240 mm x 488 mm
Roman Type : 240 mm x 480 mm

Thickness : 8mm - 10 mm
Weight : 2.25 kg (8 mm); 2.75 kg (10 mm)
Loading capacity :
60 kg/m^2 (8 mm) 80 kg/m^2 (10 mm)

Special features:

- Replaces conventional pitched roofs
- Highly energy efficient, eco friendly and low cost roofing element.
- Uses lighter structure as compared to asbestos and tin sheets.
- MCR system conducts less heat.
- Can be made colorful by applying oil paint and are reusable.
- Can be produced locally, thus encourages micro enterpreneurs.

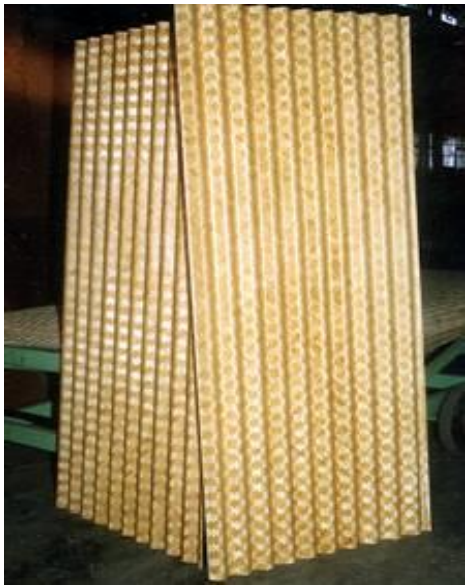
Made with specially designed plastic moulds & power operated table vibrator machine. Using micro-chips (4mm down), coarse sand, cement & water.

Production of 200 tiles by 4 persons on one machine per 8 h shift.

bmtpc
Building Materials & Technology Promotion Council
Ministry of Housing & Urban Poverty Alleviation
Government of India

Building Materials & Technologies
DEVELOPED, EVALUATED AND COMMERCIALISED by BMTPC

Bamboo Mat Corrugated Roofing Sheets



Raw Material	Status	Joint Developer
Bamboo mat, Phenol formaldehyde resin, Polyurethane coating	A Pilot Production Unit for manufacture of sheets has been set up in Meghalaya with production capacity of 3000 sheets per month.	Indian Plywood Industries Research & Training Institute, Bangalore

Indian Standards (IS:15476:2004) formulated with BIS

RCC Door & Window Frames

(Substitute for Timber/MS Frames)

Precast using high strength concrete not less than M-20 and necessary reinforcement with/ without machines.

Precast as one piece or separate pieces of vertical members & horizontal members

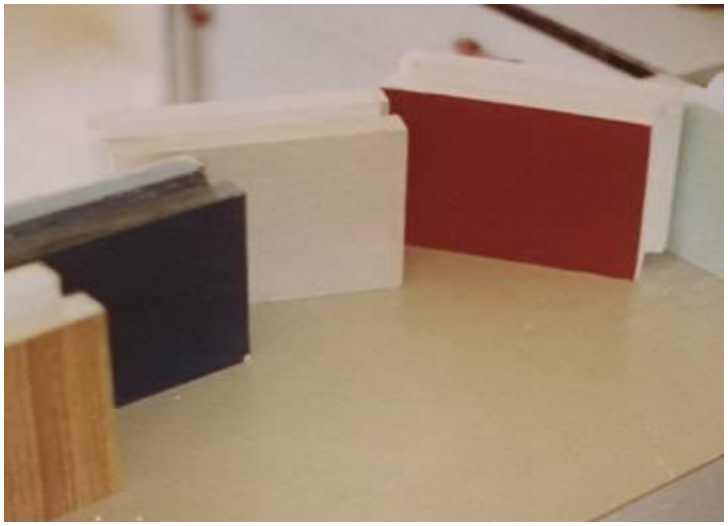
Special features:

- Cost effective
- Easy and safe to clean
- Can be painted to give natural appeal of wood.
- Can be produced at site or factory made
- Fire & termite resistant.
- Best suited for wet areas of building
- Durable

bmtpc
Building Materials & Technology Promotion Council
Ministry of Housing & Urban Poverty Alleviation
Government of India

Building Materials and Technologies
IDENTIFIED, ASSESSED AND PROMOTED by BMTPC

Fibrous Gypsum Plaster Board



Working specification by BMTPC including manufacturing method	National standard framed
BM 06	**IS 8272:1994**

Being produced by various private entrepreneurs.

Flyash/Red Mud Polymer Door Shutters

Raw Material	Status	Joint Developer
Red Mud/Flyash, Sisal fibre, Phenol formaldehyde resin	Product also tested and approved by CPWD, IIT Chennai and Delhi.	Regional Research Laboratory, Bhopal

Tested as per IS:4020.

Building Materials & Technologies
DEVELOPED, EVALUATED AND COMMERCIALISED by BMTPC

Rubber wood Flush Door Shutters

Raw Material	Status	Joint Developer
Rubberwood, Phenol formaldehyde resin (Use of rubber-wood for 1st time in India as building material)	**Product also tested and approved by CPWD**	**Jambhekar Management Consultant Pvt.Ltd., Thane**

Tested as per IS:4020.

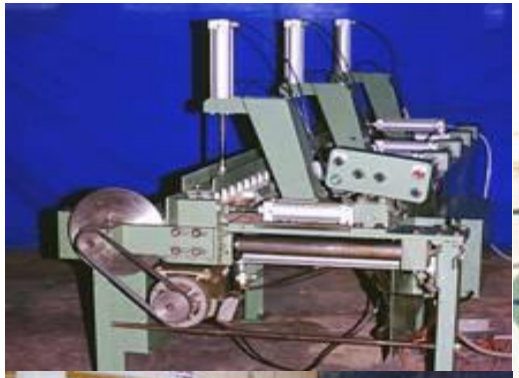
Poplar wood Flush Door Shutters

Raw Material	Status	Joint Developer
Poplarwood, Phenol formaldehyde resin	Product also tested and approved by CPWD	Jambhekar Management Consultant Pvt.Ltd., Thane

Tested as per IS:4020.

Building Materials & Technologies
DEVELOPED, EVALUATED AND COMMERCIALISED by BMTPC

Finger jointing & shaping technology



Raw Material	Status	Joint Developer
Plantation timber (rubber, poplar, eucalyptus etc.) Cutting & joining of slender pieces to make longer pieces	Being manufactured at Ahmedabad by M/s Laxmi Engineers.	HBR Consultants, Bangalore (2001) and for further developing machine with Indian Plywood Industries Research & Training Institute, Bangalore

Earlier this machine was to be Imported from Scandinavian countries at a cost of Rs.40 to 45 lakhs. With the development of machine by BMTPC, the cost is now reduced by 1/3rd.

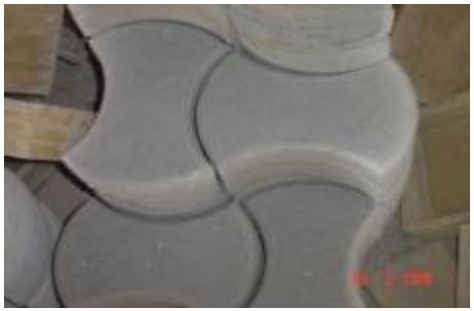
Building Materials & Technologies
DEVELOPED, EVALUATED AND COMMERCIALISED by BMTPC

Glass Fibre Reinforced Polymer doors and door frames

Raw Material	Status	Joint Developer
Glass fibre, Phenol formaldehyde resin, secondary species of timber	Technology transferred to 40 entrepreneurs in the country jointly by NSIC, RV-TIFAC and BMTPC. Plan to have more 100 units in next 2 years.	RV TIFAC Composite Design Centre, Bangalore

Tested as per IS:14856. Being used in demonstration housing under VAMBAY.

Granite Slurry Blended Floor Tiles and Paver Blocks



Raw Material	Status	Joint Developer
Granite Slurry waste	Product tested. A pilot plant is being set up in Ongole District in Andhra Pradesh.	Andhra Pradesh Technology Development and Promotion Centre

The products have been developed after conducting field experiments by substituting sand with granite slurry.

Thank you for your kind attention

www.bmtpc.org

"Creating Enabling Environment for Affordable Housing for All"