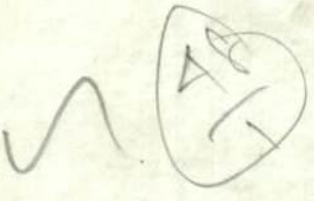
Strengthening the Technological Base of the Building Materials Industry

This brochure provides information on technical, application and economic aspects of some of the viable technologies



bmtpc

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Building Materials from Recycled Waste

Illustrated overview of availability and use of industrial, urban and agricultural wastes in India.

ITEM	SOURCE		Qty in MT/Yr.	Application in Building Material
Flyash	Thermal power stations		95	Portland pozzolana cement, bricks, lime pozzolana mixture, lightweight aggregate, cellular concrete, door shutters, blocks, tiles, kerb stone, controlled low strength flowable slurry, as partial replacement of fine aggregate in concrete
Blast furnace slag	Steel plants		11	Production of Portland blast furnace slag cement, super sulfate cement, as an aggregate in concrete, as substitute for sand, light weight concrete, Road Construction.
Cinder	Thermal power stations/ railways		1	Manufacturing of lime cinder mortar, production of concrete building blocks, production of bricks from black cotton soil.
Coal mine & washery waste	Coal mines		50	Manufacture of bricks, tiles, lightweight aggregates, fuel substitute in burning of bricks.
Copper tailings	Copper mines		3.84	For manufacture of stabilized and high strength° bricks, cellular concrete and masonry cement, Pressed burnt clay bricks, blended cement, calcium silicate bricks.
Gypsum mine	Gypsum mines		1.50	Gypsum building plaster, ready made plaster with lime.
Iron tailing	Iron ore mines		10.50	For making stabilized and burnt clay building bricks, high strength bricks, masonry cement, mortar, concrete
Kiln dust	Cement plants		2.00	In the cement industry, as a hydraulic binder.
Limestone waste	Limestone quarry		17.80	For production of masonry cement and activated lime pozzolana mixture.
Lime Sludge	Sugar, fertilizer, calcium carbide paper, acetylene		4	For the manufacture of portland cement , masonry cement, sand lime bricks, building lime pozzolana mixture.
Paper Waste	Paper, city garbage			For manufacture of pitch fibre pipes, asphaltic corrugated Roofing sheets, Egg/apple/fruit pack trays, pulp moulded packaging materials
Phospho-gypsum	Hydrofluoric/ phosphoric acid, amm. phosphate		4	For making gypsum plaster, fibrous gypsum boards and blocks, cement clinker, as a solid retarder and for making super sulfate cement.
Red mud	Aluminium extraction plant		3.50	For production of building bricks and tiles, lightweight structural blocks, roofing sheets and as an additive to concrete, Paint, Wood substitute, glass ceramic.
Zinc tailings	Zinc mines		2.80	For making cellular concrete, sand lime bricks, precast blocks, concrete flooring tiles, calcium silicate bricks, as filler in mortar, plaster and precast concrete products, cement concrete tiles.
Bagasse	Sugar industries		90	For manufacture of insulation boards, wall panels, printing paper, corrugating medium and other non-permanent paper.

ITEM	SOURCE		Qty in MT/Yr.	Application in Building Material
Waste glass	Glass plant			In the manufacture of mosaic and glazed tiles and lightweight aggregate, brick making, Glass silicate tiles, blunt sand.
Waterworks silts.	Waterworks Settings tanks.		10	For manufacture of structural clay product, lightweight bloated clay aggregate, high strength bricks.
Rice husk	Rice mills		20	As fuel, for manufacturing building materials and products for production of rice husk binder, fibrous building panels, bricks, acid proof cement
Banana leaves/stalk	Banana plants		0.20	In the manufacture of building boards, fire resistance fibre board.
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
Groundnut shell	Groundnut oil mills		11.00	In the manufacture of buildings panels, building blocks, for making chip boards, roofing sheets, particle boards.
Jute fibre	Jute Industry		14.40	For making chip boards, roofing sheets, door shutters.
Rice/wheat straw	Agricultural farm		12.00	Manufacture of roofing units and walls panel / boards.
Saw mill waste	Sawmills/ wood		2.00	Manufacture of cement bonded wood chips, blocks, boards, particle boards, insulation boards, briquetts
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 & pulp
Cotton stalk	Cotton plantation		1.10	Fibre boards, panel, door shutters, roofing sheets, autoclaved cement composite, paper, plastering of walls
Marble dust	Marble Industry		6	Walling and flooring tiles, bricks and blocks

1

Indian Scenario and the Role of BMTPC

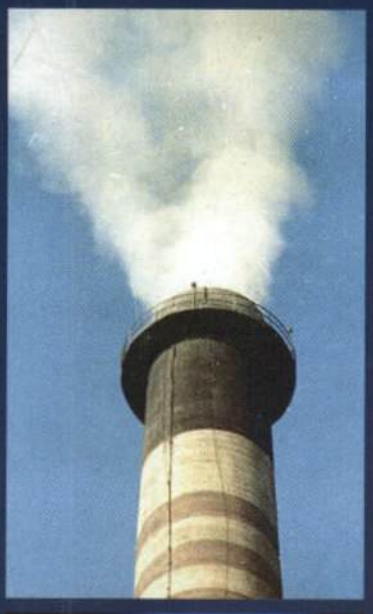
From Lab to Land

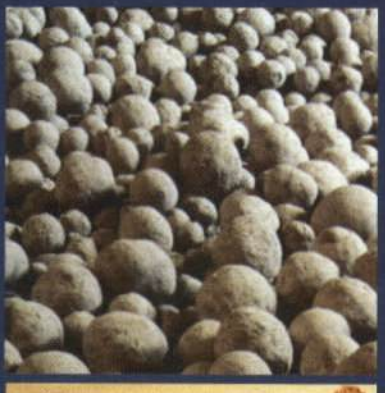
Our research institutions have developed a large number of alternate materials and construction systems, based on utilisation of agro-industrial wastes which otherwise cause severe environmental problems.

To improve the awareness about these innovative building materials, and to facilitate their transfer from lab to land, the Building Materials & Technology Promotion Council (BMTPC) had been set up in 1990 by the Government of India as an inter-ministerial apex organisation, under the aegis of the Ministry of Urban Development and Poverty Alleviation. The Council coordinates with various institutions involved in R&D, financial & industrial promotion and housing to promote innovative technologies, scale up proven technologies, materials & products and facilitate establishment of manufacturing/ production units.

BMTPC's working strategy:

- Promotion of sound design practices based on local materials and cost effecative, innovative technologies.
- Promotion of building materials, components, products and systems based on indigenous raw materials, agro-industrial wastes and cost and energy efficient processes.
- Quality improvement and cost reduction through standardisation and adoption of modern information and management systems.
- Technical, financial, and fiscal policy support to enhance production & marketability.





- Power station chimney
- Various kinds of building materials from flyash
- Flyash dumped on prime urban land

2

Flyash : A Problem of Pollution and Disposal

Sources of Flyash

72% of India's power plants are coal based. These power stations generate nearly 95 million tonnes of flyash annually.

Nature of Pollution

Flyash causes severe pollution of air and water, and its disposal gobbles up large tracts of land. Well planned programmes for proper management of flyash are therefore being undertaken to enhance the use of flyash in various applications, so that our already perilously imbalanced environment can be protected.

Recycling of Flyash

Bricks, Portland pozzolana cement, blocks, tiles, light weight aggregates,door shutters and hollow blocks are produced utilising flyash as raw material. Mechanised manufacture of flyash lime bricks is a major thrust area. The twofold aim is to utilise bulk quantities of flyash and help bridge the huge shortfall of bricks and other building materials required by the constantly rising construction activity.

Advantages of flyash bricks:

- Several load bearing grades.
- Savings in mortar, plastering.
- Smart looking brickwork.

- Hydraulic brick press with auto lifting and stocking facility
- Industrial autoclaves

3

Technology for the Manufacture of Flyash Bricks

Material handling, storage, transportation equipment:

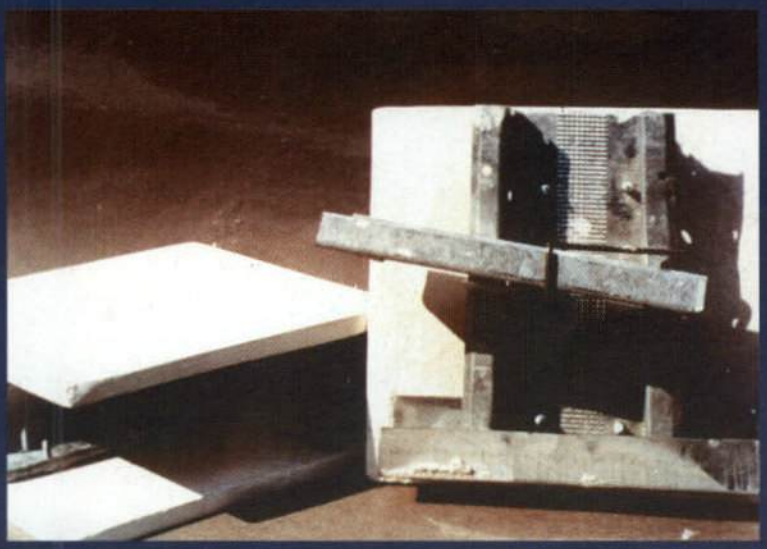
Material hoppers, vibratory feeders, weigh hoppers; silos, screw and belt conveyors; brick transfer cars; brick wagons for charging autoclaves.

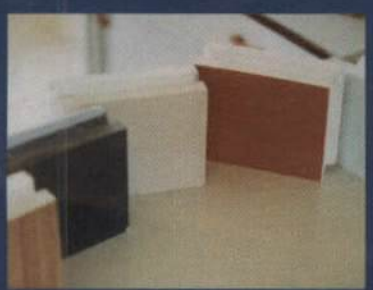
Basic process equipment:

High speed batch mixer; double shaft mixer, hydraulic brick press with automatic lifting and stocking; Industrial autoclaves of boiler grade steel designed to specified operating steam pressure; Industrial steam boiler for continuous steam at pressure to the autoclaves.

Ancillary/auxillary equipment:

Crane; fork lift, power supply, destination and control station; air compressor; weigh bridge for trucks; water tube well; piping for air and water; air conditioners; spares; workshop and control laboratory equipment; electrical and light fittings etc. Diesel generator.





Hardware fixing system for gypsum board / ceiling partitions

Office interiors with phosphogypsum panels for partitions and false ceilings

Gypsum slotted panels

Sample pieces of gypsum slotted tiles in various finishes

Partition panels in phosphogypsum

4

Phosphogypsum as a Land and Water Pollutant

Sources of Phosphogypsum

Phosphogypsum is generated as a by-product of the phosphoric acid based fertiliser industry. The interaction of ground phosphate rock with sulphuric acid produces 10-40% free moisture along with phosphogypsum. 4 million tonnes is generated per year in India. Over 12 million tonnes has accumulated at plant sites.

Nature of Pollution

The fluoride content of phosphogypsum causes land and water pollution.

Recycling of Phosphogypsum

This pollutant by-product from the fertiliser industry can be used to make several building materials:

- Gypsum plaster, boards, tiles.
- As set controller in the manufacture of Portland cement.
- Non-shrinking cement, super sulphated/anhydride cement.
- As a hydraulic binder
- As mineraliser
- Simultaneous manufacture of cement and sulphuric acid
- Artificial marble, fibre boards

- Views of plant manufacturing panels, tiles and blocks from phosphogypsum

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Technology for Manufacturing Gypsum Walling Panels

A plant has been set up in India to produce walling blocks, ceiling tiles and binder from Phosphogypsum.

The following steps convert phosphogypsum to commercially gypsum plaster boards:

1. Grinding of calcined gypsum, and its storage.
2. Proportioning and mixing of gypsum plaster with water. Set controller and filler is added to this slurry with a small quantity of glass fibre as reinforcement;
3. Casting of board with the board forming machine.
4. Carrying the 'green' board on a belt conveyor until the core sets and edges are stuck.
5. Cutting boards with a rotary knife into lengths of 1m to 6m before the 'green' board reaches the end of the machine belt.
6. Drying of boards by passing them through a tunnel kiln. Hot-air/steam allow recirculation of air. Natural drying is possible for small production. Drying is a very sensitive operation requiring careful attention.
7. Transferring of dry boards on to portable platform and transportation to the warehouse.

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Red Mud - a Resource for Building Componenets

Sources of Red Mud:

During aluminium production, bauxite ore is digested with caustic soda, when most of the aluminium passes into solution as aluminate. The muddy red residue consists of alumina, iron oxide, titanium oxide and small quantities of silica, calcium oxide and alkali. India generates over 4 million tonnes of this by-product annually which is not otherwise put to any use.

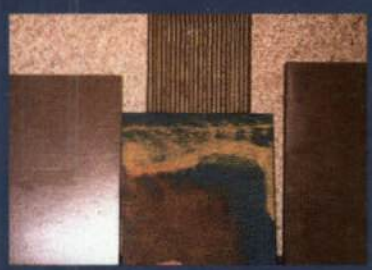
Nature of Pollution

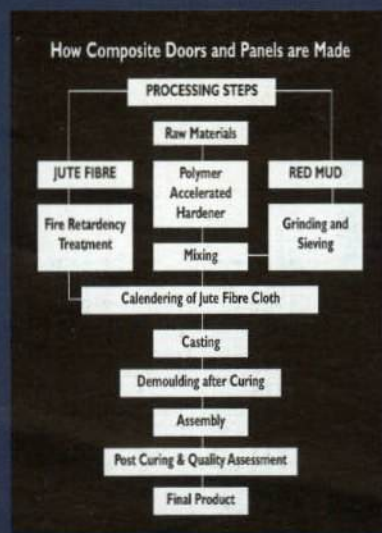
Red mud is usually disposed off in ponds. During monsoons, the waste may carry by run-off to surface water courses and cause ground water contamination due to leaching.

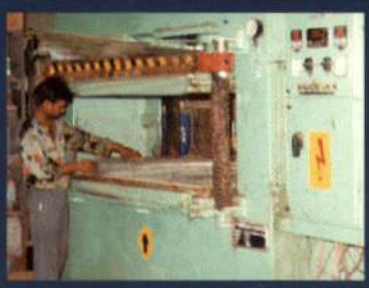
Recycling of Red Mud

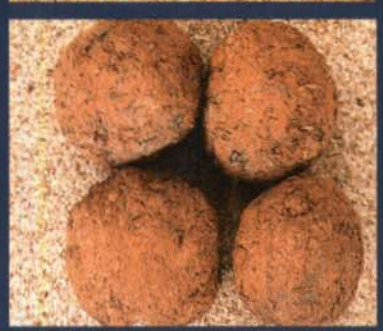
Red mud can be used for making high quality exposable bricks, tiles, corrugated roofing sheets, and as binder for several useful products including composite doors, panels etc.

- Various kinds of red mud polymer composite tiles and corrugated sheets
- Dry Red Mud - the basic raw material
- Flow diagram of how composite door panels are made









- Red Mud shutter
- Press for making RFPC sheets
- Manual application of binder
- Testing apparatus at RRL, Bhopal
- Red mud doors being tested
- Compnents of RFPC:
  red morrum, Jute fibre cloth, lime, rice husk, laddoos, cementitious binder and mixing of binder

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Red Mud - a Resource for Building Componenets

BMTPC has produced a composite from red mud, polymer and natural fibres, called Red Mud Jute Fibre Polymer Composite (RFPC), to replace wood in the wood based panel products in the building industry. This product uses zero energy aided raw materials and conserves energy by room-temperature processing.

Known as Red Mud Jute Fibre Polymer Composite (RFPC), this composite contains ferric oxide, alumina and titanium oxide from red-mud, 82.5% cellulose and 11.3% lignin from its jute component (jute is 15% of the total volume of the shutter).

This newly developed material is particularly suitable for door shutters, ensuring significant savings in initial as well as maintenance costs. There is a huge market for composite doors and panels, with the potential waiting to be tapped both in developing and developed countries.

RFPC can also be used for furniture, flooring and panelling work, electrical switch boxes and insulating sheets for housing.

- A view of plant for Production of Flyash/ Redmud door shutters
- Flyash / Redmud door shutters

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Flyash/Redmud Ploymer Door Shutter

BMTPC, in association with the Regional Research Laboratory, Bhopal has developed a technology for the manufacture of flyash/red mud polymer door shutters, panels etc. This technology has been licensed to M/s Dual Build Tech Ltd., Chennai for large scale commercial production of door shutters, panels etc. A pilot plant for the manufacture of flyash/ red mud polymer door shutters and panels has been set up at Pondicherry.

Production Capacity

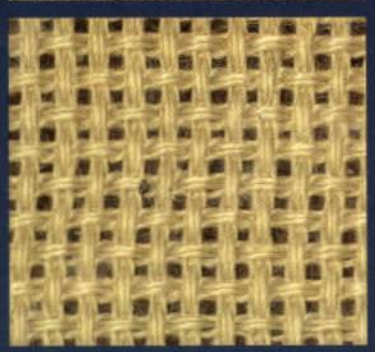
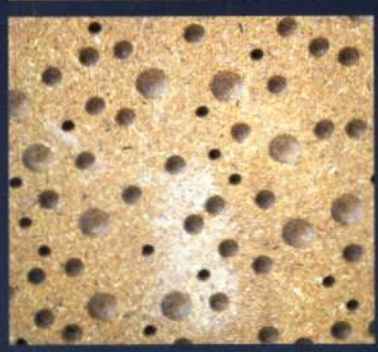
The pilot plant has a capacity to produce 12 to 15 door shutters of standard size per day.

Labour

At 100% utilisation, labour component requirement is 8 skilled and 12 unskilled workers.

Pilot Resin Manufacturing Plant

In order to produce the specific type and quality of polyester resin required to manufacture red mud/flyash polymer door shutters, panels etc., a pilot plant to manufacture polyester resin has been set up at the door manufacturing unit itself. The capacity of this resin plant is 250 Kg (batchsize) per day. The resin so produced will be used in the pilot plant for the manufacture of red mud/flyash polymer door shutters. This has helped in reducing costs and improving the quality and surface finish of red mud/ flyash polymer door shutters and panels.

- Agro-waste recycled into boards, mouldings, doors, panelling and ceiling applications.

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Agro Waste Recycling into Building Materials

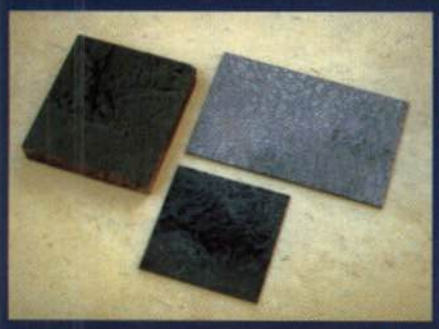
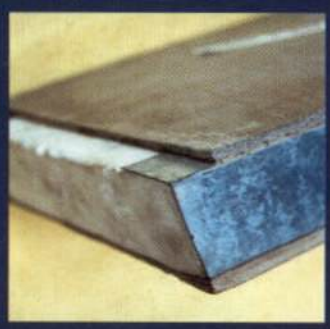
Agro waste as raw material

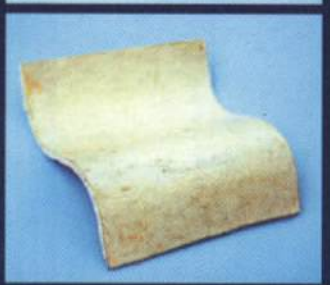
India is primarily an agricultural country. In the absence of organised data, exact estimates of the agricultural wastes such as bagasse, banana leaves and stalks, saw mill waste, sisal fibre, rice husk, jute stalk etc., are not available, but their availability in the country is more than 500 million tonnes per year.

Recycling Agro Waste

The building materials industry is gainfully utilising these wastes in a wide range of applications, many of which can serve as timber substitutes for wood-based products. By their very nature, fibrous wastes along with suitable binders under pressure are eminently suitable for making several kinds of insulation boards, panels and roofing sheets. These products can be strong, lightweight and also find aesthetic acceptance.

Environm friendly Materials & Techniques



Alternative to the conventional construction materials and technologies for various applications in the buliding industry

10

Composite Materials

Historically composite building materials for housing and building needs were based on timber, bamboo, jute and a large variety of vegetable fibres such as reinforced mud-blocks for walls, panels for partitioning and roofing. In the modern context a vast variety of industrially produced composites have come into existence.

Multitude of metal composites are now being used with a high degree of confidence for the most intricate structures. Subsequent developments in the discovery of very tough fibres such as glass, carbon, boron and kevlar made it possible to manufacture and use several high performance composites with matrices of synthetic resins such as polyesters, phenolics and epoxies.

Search for stronger and stiffer fibres and feasibility to utilise widespread inorganic wastes and by-products have provided directions to the production and use of vegetable fibres, such as coir, banana, sunhemp, jute, sisal etc., as quite inexpensive and effective reinforcing fibres, and hydraulic binders as alternative to cements made of industrial wastes like flyash, waste limes, by-product gypsum and mine tailings. Technologies have been developed to manufacture building compoenets and products which are environment friendly and energy efficient.

These developments have mainly taken place to meet housing and building requirements of ever growing world population, particularly in developing parts of the world.

Urban plastic waste from various sources

11

Recycling of Plastic Waste for Building Products

Source of plastic waste

In the latter half of the 20th century, the use of plastics has become widespread in all kinds of products and everyday objects. Not surprisingly, plastics constitute a large part of a city's garbage, and are nearly impossible to dispose of as plastic waste is not biodegradable.

Recycling of Plastics

Mixed & multilayer plastics containing several grades of plastic material can be made into pallets. Pallets can take the shape of tile flooring, waste containers, planks, profiles, railway sleepers etc.

Plastic Waste as Binder

Plastic that cannot be further recycled can be used with fillers for processing composites, useful for applications like fence posts, park benches, pallets, street furniture, as substitute to timber and concrete products.

Recycled PET

Unsaturated polyester resin from recycled PET can replace the conventional high cost resin for use in GRP products, polymer concrete/ polymer mortar, and industrial floorings.

Temporary hut using GRP/ composite building products

Testing of GRP/ composite door shutters

Types of GRP/ composite door shutters

12

Glass Reinforced Plastics/ Composite Building Products

GRP / Composites: An Obvious Choice for Building Products

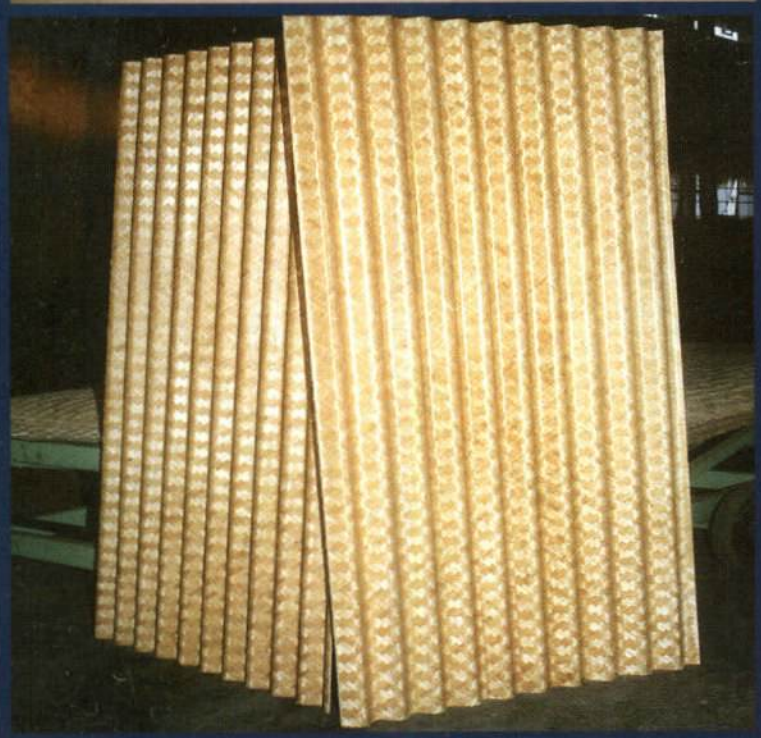
The indiscriminate use of wood has led to serious environmental and ecological crisis and the rapid reduction of the forest cover. Therefore, there is an urgent and imperative need to develop suitable substitutes to wood-based building products. GRP and composite materials, with their superior properties and lower costs, are the obvious choice for making building products in volumes.

Composites The Wonder Material

Glass Reinforced Plastics (GRP) and composites material are being looked upon now as the most popular and versatile man-made wonder materials which are increasingly replacing wood, metals and concrete in thousands of applications, ranging from aerospace and defence to housing, construction, transportation, chemical, energy and other engineering industries all over the world. It is reported that about 40,000 GRP / composite products are currently in use worldwide for many applications.

Technologies Developed for GRP / Composites Building Products

The RV-TIFAC Composites Design Centre, Bangalore, has successfully developed a number of GRP/composite building products - doors, door frames, window shutters and frames, wall/partition panels, staircase railings, roofing sheets, kitchen cabinets and other household furniture items etc., at very reasonable costs.



- Hot press for manufacture of bamboo mat corrugated roofing sheet
- Full size bamboo-mat corrugated roofing sheet
- Samples of bamboo mat corrugated roofing sheet with uv resistant coating
- Sheds constructed with bamboo mat corrugated roofing sheet

13

Bamboo mat Corrugated Roofing Sheet

Recognising the urgent need for an appropriate and cost effective roofing technology for North-Eastern and other bamboo growing regions, and disaster prone areas, a technology for manufacture of laminated bamboo mat corrugated roofing sheets has been developed at the Indian Plywood Industries Research and Training Institute, Bangalore in collaboration with the Building Materials and Technology Promotion Council, New Delhi.

This would be an alternative for existing roofing sheets like corrugated A.C. sheets, G.I. sheets, Aluminium sheets, FRP, Red Mud and Ashphaltic sheets.

The sheets possess excellent physico-mechanical properties and are based on renewable resources requiring low energy. It may also find use as value added products in the areas as an aesthetically pleasing material.

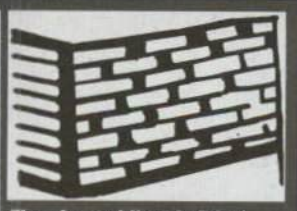
These sheets are not only highly water and weather resistant but also resistant to decay, termites and insects.

For production of Bamboo mat Corrugated Roofing sheets in sizes 1.8x0.9m and 1.8x0.75m, a one day- light hydraulic hot press and commercial model of the press have been developed.

Environ Friendly Materials & Techniques

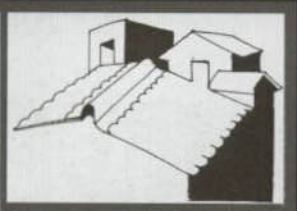
Alternative to the conventional construction materials and technologies for various applications in the buliding industry

Walling



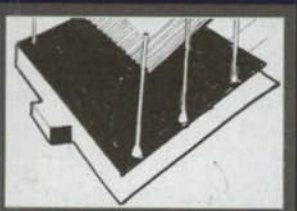
Flyash sand lime bricks/ tiles, red mud bricks/tiles, compressed earth blocks, precast stone faced blocks, clay flyash bricks.

Roofing



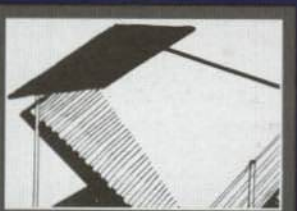
MCR tiles, red mud/bamboo mat corrugated sheets, ferrocement channels, funicular shells, adobe vaults, local stone.

Flooring



Red mud tiles, precast concrete blocks.

False Ceiling

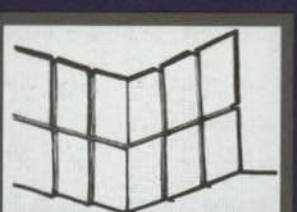


Aluminium rolled and extruded sections, gypsum fibre boards, MDF boards.

Partitions

Plastic/PVC, MDF boards, gypsum fibre boards, rice husk boards

Panelling



Particle boards, MDF boards, aluminium, wood and plastic composites.

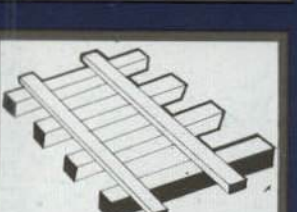
Door Frames

Rolled steel, pressed steel, extruded aluminium, extruded PVC, Precast RCC, Ferrocement, rubber wood, poplar wood.

Shutters

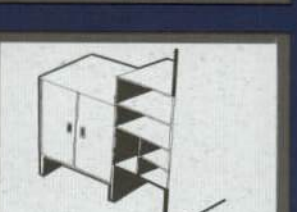
Red mud jute polymer/lyash polymer composites, ferro-cement, steel, aluminium, MDF board, cement fibre board, rubber/poplar wood.

Rafter/Purlin



Ferrocement, steel, precast RCC, laminated wood plastic components.

Cabinets



RCC, ferrocement, MDF, various particle boards.

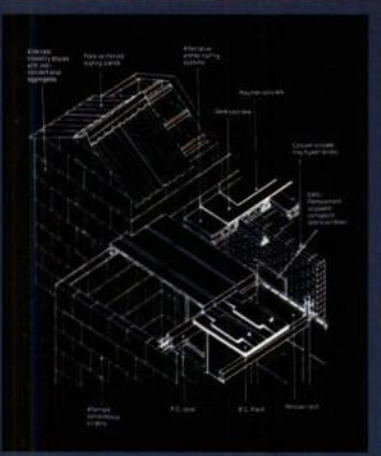
14

Choosing Environment Friendly Materials

By and large, conventional building technologies like burnt bricks, steel and cement are high in cost, utilise large amount of non-renewable natural resources like energy, minerals, top-soil, forest cover etc. These increase dependence on external materials and manpower, harm the local economy and are generally polluting in nature.

The materials and technologies chosen for construction must, in addition to functional efficiency, fulfil some or more of the following criterion, for the cause of sustainability and a better quality environment:

- not endanger bio-reserves and be non-polluting;
- be self-sustaining and promote self-reliance.
- recycle polluting waste into usable materials
- utilise locally available materials
- utilise local skills, manpower and management systems
- benefit local economy by being income generating
- utilise renewable energy sources
- be accessible to the people
- be low in monetary cost



- Sketch showing applications of various prefabricated components in construction
- Hollow concrete blocks under production
- Precast roofing panels
- Ferrocment Roofing Channels
- Ferrocement Rafters

15

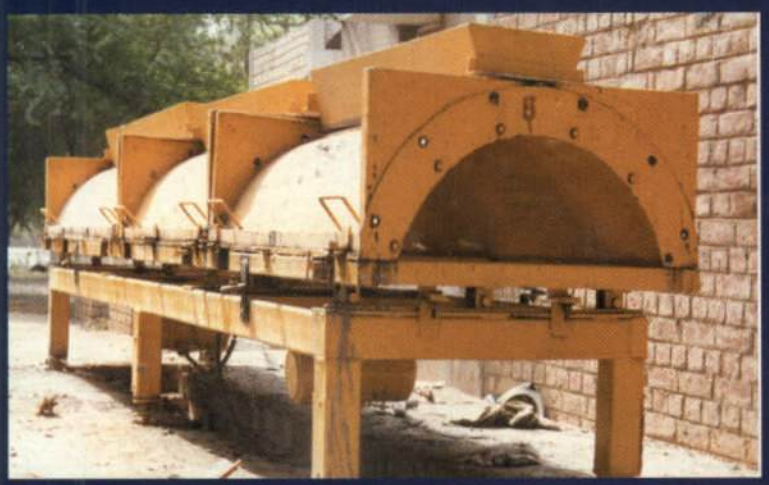
Open Prefab Systems for Small Building Components

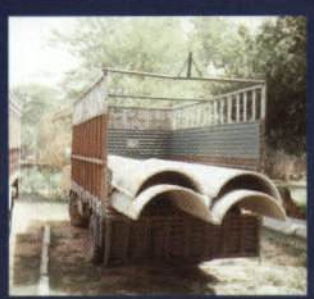
Partial Prefabrication

Open prefab systems based on an appropriate production level and small, easily to handle elements with rationalised production methods have attracted the attention of housing experts as an important option for arresting the rapidly rising escalation in the costs of material and labour. Building Centres in different regions of India have been instrumental in propagating several of these prefab systems at the grass-root level.

Partial prefabrication can be usefully employed for practically every part of a building - foundations, walling systems, doors and windows, roofing systems, lintels and staircase elements. Costs of a roof being one of the major components of the construction outlay in any building project, one of the thrust areas has been the prefabrication of roofing elements.

Machines developed by BMTPC





- Ferrocement roofing channels, rafters, wall panels being produced and put in use.

16

Ferrocement Roofing Components

Mechanization production

Ferrocement roofing channels are produced at manual scale. In this project technology development has not been limited to finalising designs, optimising production parameters such as mortar proportion, reinforcement, labour productivity, etc. Production methods with various degrees of mechanisation have been explored. The analysis has been subjected to different economic scales of operation wherein investment, operating costs, and the complete production economics will be different from that of manual operation. The mechanisation process not only enables scaling of production from business economics point of view but also enhancing quality assurance considerations.

Advantages

- Higher strength to weight ratio than R.C.C
- 20% savings on materials and cost
- Prefabricated elements and light structures
- Suitability for precasting
- Flexibility in cutting, drilling and jointing
- Very appropriate for developing countries.

- Production of CLC blocks
- Multistorey building construction using CLC blocks at Chennai and Gurgaon

17

Cellular Light-Weight Concrete

Cellular Lightweight Conctrete (CLC) has been used in over 40 countries over the past 25 years to produce over hundred thousand houses and apartments, apart from schools, hospitals, industrial and commercial buildings. CLC is an air-cured lightweight concrete with flyash as a major ingredient, that can be produced at large project sites just like traditional concrete, utilising equipment and moulds normally used for traditional concreting. It is especially suitable in India for low-rise loadbearing constructions and for partitioning work in multistorey blocks.

CLC behaves like conventional concrete. It ages well, increasing in sretngth by 50% between 28 and 90 days after pouring. It keeps increasing in strength as long as it draws humidity from the environment. CLC can be easily nailed, sawed, drilld or grinded. Curing of CLC takes the same time as normal concrete. If cast in the morning, demolding can be done next morning. Heat, steam or chemical accelerators can be used to speed up curing. Ordinary mortar or plaster, or even paint is sufficient for finishing the surface. CLC may even be pigmented and left exposed.

With the use of flyash, CLC blocks are most competetive in price and can be produced at site, saving transport and multiple handling costs. Popular sizes are: 600x200x200mm; 500x250x200mm; 500x400x100mm. In view the use of flyash (33%) in CLC and this being a good substitute of ordinary clay bricks (which use high energy and precious agricultural topsoil) the Govt. of India has given special import duty concessions for specialised equipment.

Machines Developed by BMTPC

- Precast concrete door frames being made using semi- mechanised process for large scale use

18

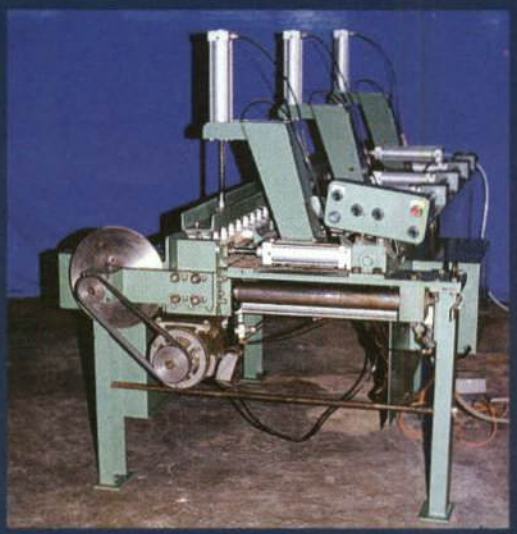
Precast Concrete Door/Window Frames

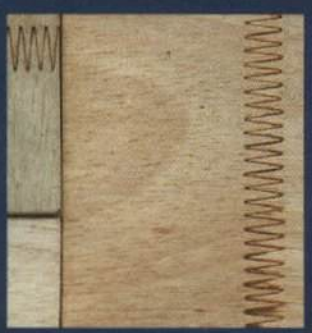
Concrete door and window frames are comparable in strength, durability and quality to traditional timber door & window frames at a substantial cost saving. Commercial levels of production can be taken up at a low level of investment and with minimal training.

Precast Concrete Door/Window frames are made out of cement, sand aggregates mixed in suitable proportions to obtain the desired strength. The mix is vibrated to compact the concrete. Steel bars are used as reinforcement. Compared to timber frames, this product is more durable and immune to attack of termites, fungii widely prevalent in most areas. The innovative technology being demonstrated has been recently developed by BMTPC, using a new production methodology based on patented machines. Advantages:

- Conservation of forest reserves of timber.
- Termite and white ant proof.
- High quality, long lasting and durable.
- Much cheaper than timber alternatives.
- High rate of production.
- Minimal requirement of raw materials.
- Fire proof.
- Water proof.
- Produced utilising unskilled labour.
- Save on the cost of lintels.
- Limited mechanisation resulting in high per capita output.
- Possibility of using waste industrial product like flyash, blast furnace slag, etc.

Machines developed by BMTPC





- Machine for finger-jointing
- Finger jointed plantation wood
- Kiln seasoning
- Poplar plantations

19

Doors/Windows from Plantation Timbers

The ban on the use of timber for government construction does not cover the use of plantation timbers and rubber wood and poplar wood have been recognised as sustainable timber species which will be available without any future scarcity. However, owing to the nature of plantation timber, processing of the wood is necessary to enable its use in shutters and other building applications.

Capabilities Of the Machine

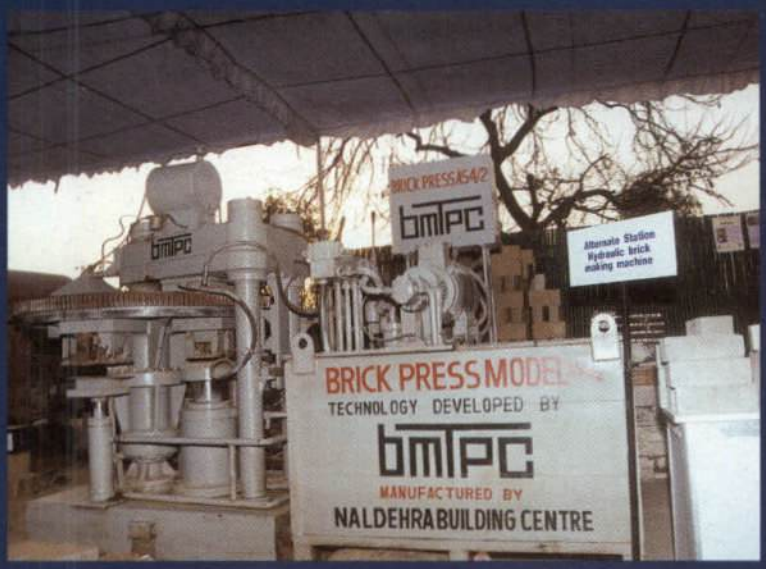
- That the machines is capable of processing both soft woods and hard woods.
- The largest dimension to be processed is 110 mm x 100 mm.
- The machine is capable of both face finger jointing as well as butt finger jointing.
- The machines is capable of utilising both thermoplastic and thermo setting resin adhesive systems.

The finger jointing line consist of 2 machines: THE FINGER SHAPERand THE PRESS:

The Tools

There are different types of finger jointing that is possible. Depending upon the design of the finger joints, suitable tools have to be selected. At the moment, all finger jointing tools have to be imported. But soon, finger jointing cutters will be available inIndia itself. The tools need to be resharpened periodically for good results.

Machines developed by BMTPC



- Equipment for small scale manufacture of flyash sand-lime bricks.

20

Flyash Sand-Lime Bricks

Rectangular faced with sharp corners, solid, compact and uniformly shaped with/ without frog, sand lime bricks are free from visible cracks, warpage, organic matter, pebbles and nodules of free lime, and have a uniform color. These are high quality masonry units that can be used to advantage in exposed brickwork.

Calcium Silicate Bricks are made of finely ground sand/siliceous rock with clay and silt content less than 5 percent and class C hydrated lime. Suitable additives can be used to provide early strength and or colour.

Dimensions and Tolerances

190 mm x 90 mm x 90 mm

190 mm x 90 mm x 40 mm

Frog size 100mmx40mm

(10mm to 20mm deep on one of its flat side)

Classification

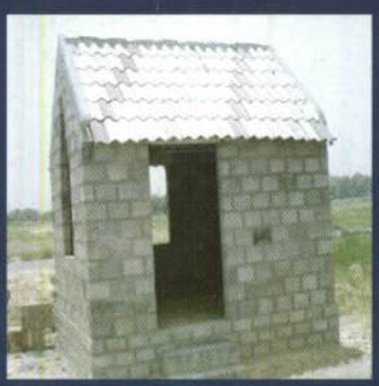
Sand lime/calcium silicate bricks are of 4 classes depending on average compressive strength:

Class Desig.	Ave. Compressive Strength (Kg/cm^2)	
	Not less than	Less than
75	75	100
100	100	150
150	150	200
200	200	-

Drying Shrinkage

Class Designation	Drying Shrinkage (% of Wet Length)
75	0.06
100	0.06
150	0.04
200	0.04

Machines promoted by BMTPC



Mechanised production of solid/hollow concrete blocks.

21

Solid/Hollow Concrete Blocks

Concrete block making machine developed by Central Building Research Institute (CBRI), Roorkee, can be used for production of all types of concrete blocks including solid and hollow blocks (of different shapes and sizes), stone blocks and large size aggregate blocks by replacing the mould.

Salient Features:

- Egg laying type portable machine
- Casts six blocks in one operation
- Capable of casting 1000 blocks of size 290 x 190 x 140 mm in one shift of 8 hrs.
- Proper compaction of concrete by pressure vibration technique
- Simple technology
- Low investment with high return
- Crushing strength of blocks 70-100 kg/cm^2 can be economically produced
- Generation of employment opportunity
- Leaner mix 1:4:4:8 can be used for production of blocks to achieve desired strength.
- The plant can be conveniently shifted
- Uniform vibrations
- Less labour requirement
- Industrial wastes like flyash, blast furnace slag etc. can also be used for production of blocks

22

Micro-Concrete Roofing Tiles

- Production of MCR Tiles
- Houses constructed with MCR tiles
- MCR Tiles on wooden and steel under structure

Developing nations are affected due to the supply gap in roofing materials between the expensive industry produced (Corrugated galvanised iron sheets, Reinforced cement concrete, Asbestos Cement Corrugated Sheets.) and traditionally produced materials (Biomass, Country tiles, Slate, Burnt clay tiles).

A technology for producing Micro Concrete Roofing Tiles have been developed which help in optimising resources, energy consumption and costs.

Advantages

- MCR is cheaper than ACC on steel and country tiles roofing below spans of 5 mts.
- Decentralised production makes it more energy efficient.
- Construction and finishing time reduced
- Manageable tile size makes the structure relatively lighter.
- Upto 40% savings in cement, sand and steel, 100% savings in aggregates.
- Production under controlled conditions.
- Special tiles are available in 4 different types depending on their functionality.

Dissemination of Information

Priced publications

DIRECTORY OF INDIAN BUILDING MATERIALS & PRODUCTS (with information on Nepal & Bhutan) 2000-2001
550 pages, Rs. 1000 + 100 postage

STANDARDS AND SPECIFICATIONS FOR COST EFFECTIVE INNOVATIVE BUILDING MATERIALS AND TECHNIQUES
128 pages, Rs. 200 + 50 postage

MANUAL FOR REPAIR AND RECONSTRUCTION OF HOUSES DAMAGED IN EARTHQUAKE of Oct.91 in the Garhwal Region of U.P.
81 pages, Rs. 150 + 50 postage

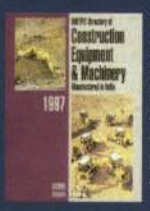
STABILISED MUD BLOCKS AND THEIR USE - GUIDEBOOK FOR TECHNICIANS AND CONSTRUCTION WORKERS (IN HINDI)
131 pages, Rs. 80 + 25 postage

INSTRUCTION MANUAL FOR APPROPRIATE BUILDING SYSTEMS
64 pages, Rs. 150 + 50 postage

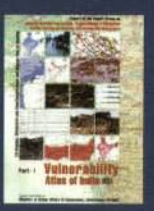
HOUSING AND KEY BUILDING MATERIALS IN INDIA - A LONG TERM PERSPECTIVE - 98 pages, Rs. 700 + 50 postage

BUILDING WITH COMPRESSED EARTH BLOCKS
28 pages, Rs. 60 + 25 postage

ARCHITECTURE OF SAARC NATIONS.
196 pages, Rs. 250 + 50 postage



DIRECTORY OF CONSTRUCTION EQUIPMENT AND MACHINERY MANUFACTURED IN INDIA - 450 pages, Rs. 600 + 50 postage
– *Also available on CD-ROM*



VULNERABILITY ATLAS OF INDIA (1997) - Earthquake, Windstorm and Flood Hazard Maps and Damage Risk to Housing, 712 pages, Rs. 3000 + 200 postage
– State and Union Territories - wise VULNERABILITY ATLASES - Rs.800 + 50 postage for each

BUILDING MATERIALS IN INDIA : 50 YEARS - 560 pages, Rs.1500 + 200 postage

PRECAST BUILDING COMPONENTS - 28 pages, Rs. 150 + 25 postage and packing

GUIDELINES FOR DAMAGE ASSESSMENT AND POST EARTHQUAKE ACTION - JABALPUR
Part 1: Earthen Houses with Clay Tile Roofing;
Part 2: Brick Houses with Clay Tile Roofing;
Part 3: Brick Houses with RC slab or Stone Patti Roofing or with RC frames
- Rs. 250 + 50 postage for each part

GUIDELINES FOR DAMAGE ASSESSMENT AND POST EARTHQUAKE ACTION
Part 2: Repair and Retrofitting of Buildings in the Chamoli Earthquake Affected Areas;
Part 3:Reconstruction & New Construction of Buildings in Chamoli Earthquake Affected Areas
- Rs. 250 + 50 postage and packing for each part

GUIDELINES FOR IMPROVING EARTHQUAKE RESISTANCE OF HOUSING - 76 pages, Rs. 350 + 50 postage

GUIDELINES FOR IMPROVING WIND/CYCLONE RESISTANCE OF HOUSING - 50 pages, Rs. 350 + 50 postage

Publications may be obtained by sending Demand Draft, drawn in favour of BMTPC payable at New Delhi

Publications of BMTPC

Unpriced publications

1. Areas of activity
2. An IDNDR International And Regional Project - Implementation of available know-how for the protection of non-engineered housing from Natural Hazards
3. BMTPC helps in commercialisation of innovative building materials technologies
4. BMTPC News Letters
5. Build Your Home with Earthquake Protection
6. Environment Friendly Building Materials & Construction Technologies
7. Guidelines for Cyclone resistant houses
8. Grah Nirman Mein Vishesh Savdhaniyan
9. Investing in Building Materials and Construction Industry in India
10. Reconstruction of Earthquake Resistant Houses in Garhwal Region - Guidelines in Hindi
11. Retrofitting of Stone Houses in Marathwada Area of Maharashtra
12. Saste Makan: Vibhinn Vikalp Avam Suvidhain - in Hindi
13. Technology Profiles
14. Useful tips for House Builders
15. Strengthening Technological Base of the Building Materials Industry
16. Local Vegetable Fibres + Industrial & Mineral Waste for Composite materials
17. Machines developed by BMTPC
18. An Introduction to the Vulnerability Atlas of India
19. Performance Appraisal Certification Scheme
20. Catalogue for Machines

MISSION STATEMENT

Develop and operationalise a comprehensive and integrated approach for technology development, transfer and investment promotion to encourage application of environment-friendly & energy-efficient innovative materials manufacturing technologies and construction practices for housing and buildings in urban and rural areas.

OBJECTIVES

1. To promote development, production, standardisation and large-scale application of cost-effective innovative building materials and construction technologies in housing and building sector.

2. To undertake such activities as required for promoting manufacturing of new waste-based building materials and components through technical support, facilitating fiscal concessions and encouraging entrepreneurs to set up production units in different urban and rural regions.

3. To provide support services to professionals, construction agencies and entrepreneurs in selection, evaluation, upscaling, design engineering, skill upgradation , marketing and technology transfer. To promote investment and technical cooperation between India and other countries.

THRUST AREAS

- **Improving the policy environment for sustained growth of low cost building materials, production and availability.**
- **Promotion of production units of building materials / components based on Flyash, Redmud, Phosphogypsum, agricultural residues and other wastes & by-products.**
- **Modernisation of small scale and village level building materials production units in rural and urban areas.**
- **Promoting economy in construction costs.**
- **Formulation of standards for local building materials.**
- **Strengthening industrial extension Services for attracting more investment in building materials sector by working with National and International agencies.**
- **Upscaling of technologies, know-how acquisition, absorption and dissemination.**
- **Assessing vulnerability and risk in natural disaster prone areas.**
- **Promoting disaster resistant construction technologies.**
- **Global technology search and encouraging joint ventures in building materials and construction sector.**

BMTPC's Activities

Interact, assist and collaborate with R&D, standardisation and academic institutions and industries in India and abroad to ensure continuous development and promotion of alternate and cost efficient building materials and construction technologies.

Identify and develop technologies and building materials based on agricultural and industrial wastes and promote proven technologies for rural and urban housing construction.

Sponsor and assist financially and in other appropriate ways building material industries and related activities in urban and rural areas.

Promote waste utilisation, wood substitution and plastics and polymers in building material and construction industry and encourage pilot plants and demonstration units/projects.

Promote and assist building materials industries in production of construction components/systems and make recommendations to Government on matters of equity participation, venture capital support.

Taking note of special needs of each region in the areas of building materials and construction technologies, undertake studies for forecasting technological requirement, social and environmental implications of various technologies and support further research and development.

Persuade Central & State Government agencies, housing development and construction agencies and organisations in private and community sectors for application of proven cost and energy efficient building materials and construction technologies.

Advise entrepreneurs in technology selection, prototype development, commercial production and marketing and extend appropriate support for development of processes/technologies and procuring equipment etc.

Identify, evaluate and undertake feasibility studies on innovative energy-efficient building materials/ products and construction systems for extension of grass-root level through linkages with public, professionals, voluntary agencies and individuals.

Review the various laws, fiscal provisions and pricing of building materials and advise Government in consultation with concerned Ministries/Departments on fiscal concessions, policy on subsidy, excise duty, tax concessions for promotion of appropriate building materials and technologies.

Promote appropriate institutions in different parts to improve production and application of relevant building materials, skills and manpower development through Building Centres, Building Materials Estates, Housing Guidance Centres and Artisans/Management Training Centres.

Act as clearing house of technology transfer from lab to land, through production and application and act as repository of information on all types of building materials including conventional and newly developed, under development in India and abroad.

Develop and promote disaster resistant construction technologies for building programmes in disaster prone areas.

Promote new technologies through Performance Appraisal Certification Scheme and validation of new technologies and building materials.

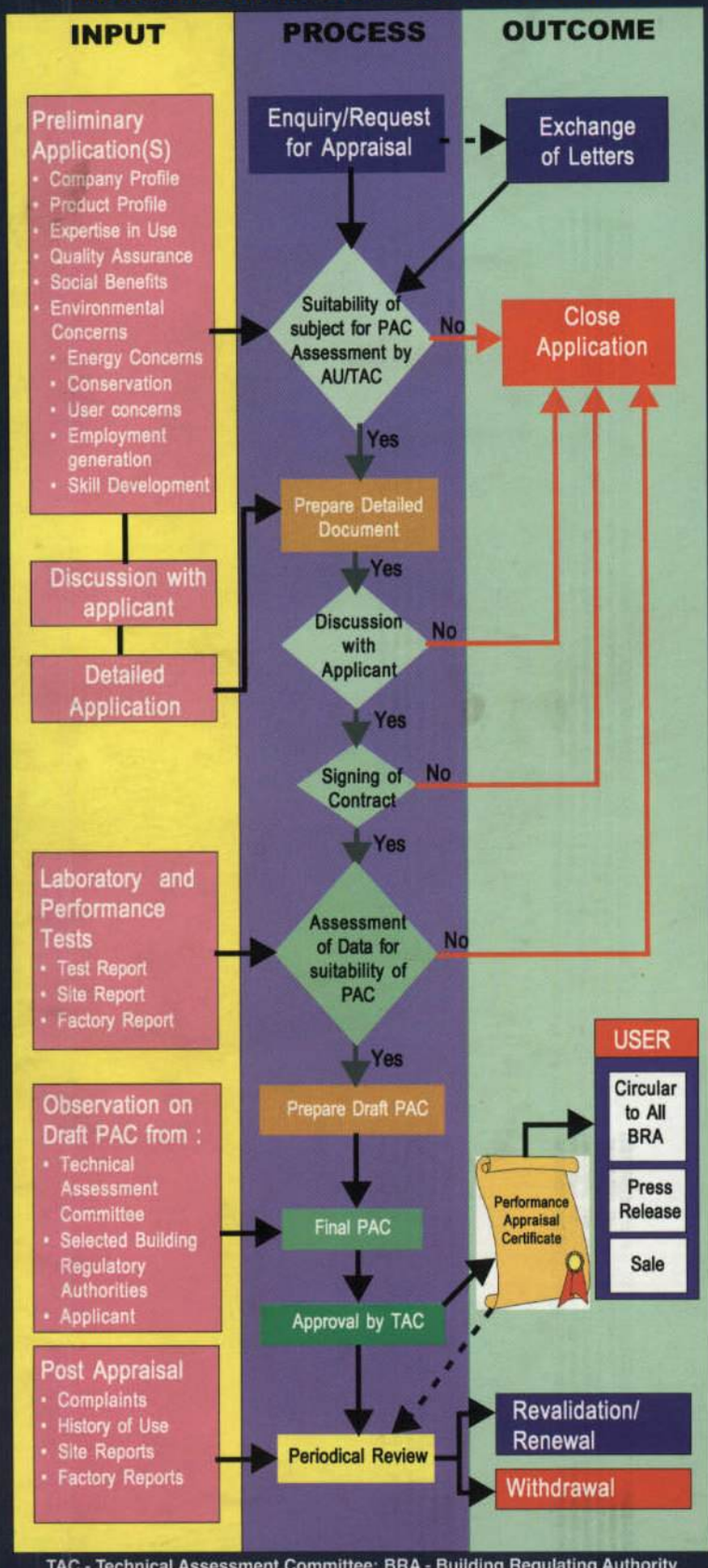
Performance Appraisal Certification Scheme

PACS

Objective

To encourage and support introduction of innovations in the building industry through systematic technical investigations, testing, independent appraisal, assessment and evaluation of building materials, products, components and systems for applications based on performance.

PERFORMANCE APPRAISAL CERTIFICATION PROCESS



TAC - Technical Assessment Committee; BRA - Building Regulating Authority

Source of Authority

The Ministry of Urban Develop Poverty Alleviation, Government under the Gazette notification No 5/99-H-II in the Gazette of India dated 4th December 1999, has au the Building Materials and Tec Promotion Council to issue **Perfo Appraisal Certificates** (PAC independent opinion of the fit intended use of new building m components, products, el construction systems and assem yet covered by the Indian Standa

- **PACS** is not mandatory but a Scheme for manufacturers and of materials, components, s interested in exploring wide potential.
- **BMTPC BOARD OF AGREEM** been constituted for manag scheme and providing auth technical appraisal certificat Board is a representative decision makers, professior experts of Central, State, R standardisation and major con organisations, CIDC, BAI, CPC

Process of Certification includes:

- Establishing criteria for perfor the product
- Verifying through lab and fi conformity to requireme satisfactory performance, dura safety
- Operation of a Quality As Scheme by the manufacturer installer
- Providing, necessary data to a designers, engineers, users an
- The operation of PACS in mechanism for obtaining proa feedback
- Issuence of certificates will b payment of fees by applicant

- An effective tool for transfer of new innovative technologies to field
- for further details contact BMTPC

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