Environment Friendly Indian Building Material Technologies for Cost Effective Housing
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Introduction

This booklet includes variety of production technologies of building materials as developed and practised in India. These technologies utilize locally available raw materials, wastes and by-products from industry, agriculture and natural fibres.

The technologies included here indicate several options which have been developed in India and are being extensively utilized in the construction of low-income housing both in rural and urban areas.

The variety of machines and equipment developed in India have been shown in this publication and these can be easily procured by agencies engaged in/and/or supporting programmes of construction of cost effective housing, health centres, schools and other community buildings in developing countries of Latin American, African and Asian regions.

The technological details, photographs of products, machines and buildings using these technologies have been frequently taken from published literature of Building Materials & Technology Promotion Council (BMTPC), Central Building Research Institute (CBRI) and other Research Institutes engaged in R&D in the area of development of environment friendly, energy efficient and cost effective materials and technologies. These technologies have been successfully utilized for environmental protection, employment generation and housing construction in rural and urban settlements in India and several other countries.

The costs mentioned for different technologies and project costs are based on present level of pricing as obtaining in India. For utilization of indicated technologies prospective users are advised to get the final projects designed and costed before undertaking production of materials, construction of buildings and establishment of Technology Demonstration, Production & Training Centres.
Flyash-Sand-Lime-Gypsum Bricks

Use
For walls in housing and all types of building construction, boundary walls.

Salient Features
- Environment friendly
- Accurate dimensions and excellent surface finish
- Excellent strength
- Quick drying of bricks
- Reduced water absorption and shrinkage
- Reduction in mortar consumption
- Utilization of industrial wastes (ashes/sludges) and volcanic ash.

Size of product
230 x 115 x 75 mm

Properties of product

<table>
<thead>
<tr>
<th></th>
<th>Hydraulic Vibro Compaction</th>
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<td>Unit weight:</td>
<td>3 – 3.5 kg/brick</td>
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<tr>
<td>Water absorption:</td>
<td>8 – 10%</td>
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Raw Material:
Flyash/Volcanic Ash (60%),
Sand (20%),
Lime (15%),
Gypsum (5%)

Option I: Vibro Press (Sakar Machine)

Production Capacity
1.8 million bricks per annum (2 shifts of 8 hours each)

Equipment/Machinery
Brick making machine (Sakar), Pan mixer, Extra Moulds

Land requirement
- Open area: 2000 sq.m.
- Covered area: 150 sq.m.

Power
- KW: 12.75
- Three phase
- Voltage: 440V, 50 Hz.
**Manpower:** Skilled (Nos.): 4  
Unskilled (Nos.): 20

**Tentative Project Cost**

<table>
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<th>Total</th>
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**Option II: Vibro Press (C-Brick Machine)**

**Production Capacity**
1.8 million bricks per annum (2 shifts of 8 hours each)

**Equipment/Machinery**
Brick making machine (C-Brick), Pan mixer, Pallets

**Land requirement**
- Open area: 2000 sq.mt.
- Covered area: 150 sq.mt.

**Power**
- KW: 12.75
- Three phase
- Voltage: 440V, 50 Hz.

**Manpower:** Skilled (Nos.): 4  
Unskilled (Nos.): 15

**Tentative Project Cost**

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Option III(a): Bi-Directional Press (Hydraulic Vibro Compaction Type) capacity 3000 bricks per day

Production Capacity
1.8 million bricks per annum (2 shifts of 8 hours each)

Equipment/Machinery
Bi-Directional Vibro Press (AS-189), Pan mixer, Belt conveyor, Box feeder, Pallets

Land requirement
- Open area: 2000 sq.m
- Covered area: 150 sq.m

Power
- KW: 18.75
- Three phase
- Voltage: 440V, 50 Hz.

Manpower: Skilled (Nos.): 4
Unskilled (Nos.): 10

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Option III(b): Bi-Directional Press (Hydraulic Vibro Compaction Type) capacity 5000 bricks per day

Production Capacity
3 million bricks per annum (2 shifts of 8 hours each)

Equipment/Machinery
Bi-Directional Vibro Press (AS-1818), Pan mixer, Belt conveyor, Box feeder, Pallets

Land requirement
- Open area: 3000 sq.m
- Covered area: 200 sq.m

Power
- KW: 22
- Three phase
- Voltage: 440V, 50 Hz.
Manpower: Skilled (Nos.): 4
Unskilled (Nos.): 12

Tentative Project Cost

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Option III(c): Bi-Directional Press (Hydraulic Vibro Compaction Type) capacity 7000 bricks per day

Production Capacity
4.2 million bricks per annum
(2 shifts of 8 hours each)

Equipment/Machinery
Bi-Directional Vibro Press (AS-1824), Pan mixer, Belt conveyor, Box feeder, Pallets

Land requirement
- Open area: 3000 sq.mt.
- Covered area: 200 sq.mt.

Power
- KW: 25.5
- Three phase
- Voltage: 440V, 50 Hz.

Manpower: Skilled (Nos.): 4
Unskilled (Nos.): 12

Tentative Project Cost

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Option IV: Hydraulic Brick Press (Rotary Type)

Production Capacity
6 million bricks per annum (2 shifts of 8 hours each)

Equipment/Machinery
Hydraulic brick press, Pan mixer,
Belt conveyor, Box feeder, Pallets, Trolleys,

Land requirement
- Open area: 4000 sq.m.
- Covered area: 200 sq.m.

Power
- KW: 31.5
- Three phase
- Voltage: 440V, 50 Hz.

Manpower: Skilled (Nos.): 4
Unskilled (Nos.): 20

Tentative Project Cost

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Option V: Hydraulic Brick Press

Production Capacity
6 million bricks per annum (2 shifts of 8 hours each)

Equipment/Machinery
Brick making machine, Pan mixer,
Belt Conveyor, Box Feeder, Pallets

Land requirement
- Open area: 4000 sq.m.
- Covered area: 200 sq.m.

Power
- KW: 35
- Three phase
- Voltage: 440V, 50 Hz.
Manpower: Skilled (Nos.): 4  
Unskilled (Nos.): 15

Tentative Project Cost

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Compressed Earth / Fly Ash Sand Lime Gypsum Blocks (Interlocking Type)

Use
For walling compressed earth / fly ash sand lime gypsum blocks.

Salient Features
- The interlocking blocks required minimum quantity of mortar, plaster in the masonry work.
- Faster masonry
- Improved performance of masonry because of less number of joints
- Environment friendly, energy efficient technology with very low consumption of energy
- The production plant can work on electrical or diesel
- Machines utilised for manufacturing blocks are mobile and can be shifted from site to site, either near the raw material source or near the construction site
- The product can be designed for use in earthquake/ cyclone prone region
- Volume of 1 block is equivalent to 3 standard size bricks
- Use of marble powder/stone dust is possible

Production Capacity
3,60,000 blocks per Annum (8 hrs shift)

Size of product
Width: 220 mm, 140 mm, 115 mm
Length: Flexible to make block from 100 to 240 mm
Height: 115 mm

Properties of product
Compressive strength:
- Compressed Earth Blocks: 50 - 100 kg/sq.m.t.
- Fly Ash-Sand-Lime-Gypsum Blocks: 100-250 kg/sq.m.t.
Water absorption: 5 - 7 %

Main equipment
- Interlocking type block making machine
- Pan mixer
- Trolleys

Land requirement
- Open area: 3000 sq.m.t.
- Covered area: 200 sq.m.t.
Raw Material:
A. Compressed Earth Blocks:
   Soil with minimum 20% of clay
   Cement 5-10% depending upon the strength
B. Fly Ash-Sand-Lime-Gypsum Blocks:
   Fly Ash, Sand, Lime, Gypsum

Power
Diesel operated
   • 13 HP Engine
Electricity operated
   • 25 KW
   • Three phase
   • Voltage: 440V, 50 Hz.

Manpower:
   • Skilled (Nos.): 2
   • Unskilled (Nos.): 10

Tentative Project Cost

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<tr>
<td>Working Capital (one month)</td>
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</table>
Compressed Earth Bricks/Blocks

Use
Can be used in walling in a variety of ways to construct buildings that are aesthetic, efficient and easy to build. Particularly suitable for rural areas.

Salient Features
- Energy efficient, eco-friendly technology
- Bricks produced are of accurate dimensions and excellent surface finish
- Better thermal insulation
- Cost effective technology
- External and internal plastering not essential.

Raw Material:
Soil with minimum 20% clay, cement 5-10% depending upon the strength requirement.

Option I: Manual Compression Earth Brick Machine (Balram)

Production Capacity
3,60,000 Bicks per Annum (8 hrs shift)

Size of product
230 x 109 x 76 mm

Properties of product
- Wet compressive strength: 20 - 30 kg/cm²
- Water absorption: < 15 % by weight
- Erosion: <5% by weight
- Surface characteristics: No pitting on the surface

Main equipment
- Manual block forming machine
- Pan mixer
- Trolleys

Land requirement
- Open area: 3000 sq.mt.
- Covered area: 100 sq.mt.

Power
- KW: 11.25 (for mixer)
- Three phase
- Voltage: 440V, 50 Hz.
Manpower:
- Skilled (Nos.): 1
- Unskilled (Nos.): 8

<table>
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Option II: Compressed Earth Block Machine (Mardini)

Production Capacity
1,50,000 Blocks per Annum (8 hrs shift)

Size of product
230 x 190 x 100 mm or
305 x 143 x 100 mm

Properties of product
Compressive strength: 30 - 40 kg/cm²
Water absorption: < 15 % by weight

Main equipment
- Manual block forming machine
- Pan mixer
- Trolleys

Land requirement
- Open area: 2000 sq.mt.
- Covered area: 100 sq.mt.

Power
- KW: 11.25 (for mixer)
- Three phase
- Voltage: 440V, 50 Hz.

Manpower:
- Skilled (Nos.): 1
- Unskilled (Nos.): 8
## Tentative Project Cost

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## Option III: Hydraulic Brick Press (Rotary type)

### Production Capacity
6 million bricks per annum (2 shifts of 8 hours each)

### Equipment/Machinery
Hydraulic brick press, Pan mixer,
Belt conveyor, Box feeder, Pallets, Trolleys,

### Land requirement
- Open area: 4000 sq.mt.
- Covered area: 200 sq.mt.

### Power
- KW: 31.5
- Three phase
- Voltage: 440V, 50 Hz.

### Manpower:
- Skilled (Nos.): 4
  - Unskilled (Nos.): 20

## Tentative Project Cost

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Clay Flyash Burnt Bricks

Use
For walling in the same manner as conventional burnt clay bricks

Salient Features
- Environment friendly and energy efficient technology
- Un-burnt carbon present in flyash helps in reduction of fuel consumption
- Reduction in drying shrinkage and efflorescence as compared to clay bricks
- Reduction in weight
- Better thermal insulation
- Less reduced emissions from kilns
- Percentage of 1st class bricks is very high
- Consumption of coal is 50% less than conventional kiln
- Kiln used is a covered kiln therefore can work throughout the year and is not weather dependent

Production Capacity
7.5 million bricks per annum (8 hrs shift)

Size of product
230 x 115 x 75 mm

Properties of product
- Compressive strength: 75 - 150 kg/cm²
- Water absorption: 12 - 18%
- Unit weight: 2.5 - 3 kgs
- Bulk density: 1700 - 1900 kg/cm²
- Colour: Red

Main equipment
Extruder, Pug mill, Belt Conveyor, Box feeder, Pallets, High Drought Kiln/Verticle Shaft Kiln, Wheel barrows

Land requirement
- Open area: 10,000 sq.mt.
- Covered area: 300 sq.mt.

Raw Material:
Soil (with minimum of 20% clay), Flyash, Sand, Fuel coal
Power
- KW: 112/100
- Three phase
- Voltage: 440V, 50 Hz.

Manpower:
- Skilled (Nos.): 5
- Unskilled (Nos.): 30

Tentative Project Cost

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Marble Slurry Bricks

Use
For walling as an alternative to conventional clay bricks.

Salient Features
- Environment friendly and energy efficient technology
- High volume utilization of waste
- Saves construction cost & time
- Much stronger than clay bricks
- Good heat and sound insulation
- Fire resistant technology
- 28% less consumption of mortar
- 32% less consumption of labour
- Plastering can be avoided
- High load bearing capacity

Size of product
230 x 115 x 75 mm

Properties of product
- Compressive strength: 93 kg/cm²
- Water absorption: 14%
- Volume of brick: 1687.5 cm³
- Color: White/Grey

Raw Material
Marble slurry (83%), Cement (7%), Sand (10%)

Option I: Vibro Press (Sakar)

Production Capacity
1.8 million bricks per annum (2 shifts of 8 hours each)

Equipment/Machinery
Brick making machine (Sakar), Pan mixer, Extra Moulds

Land requirement
- Open area: 3000 sq.mt.
- Covered area: 150 sq.mt.

Power
- KW: 12.75
- Three phase
- Voltage: 440V, 50 Hz.
Manpower: Skilled (Nos.): 4  
Unskilled (Nos.): 20

Tentative Project Cost

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Option II: Bi-Directional Press (Vibro Hydraulic Compaction Type - AS 1818)

Production Capacity
3 million bricks per annum (2 shifts of 8 hours each)

Equipment/Machinery
Bi-Directional Vibro Press (AS-1818), Pan mixer, Belt conveyor, Box feeder, Pallets

Land requirement
- Open area: 3000 sq.m.
- Covered area: 200 sq.m.

Power
- KW: 22
- Three phase
- Voltage: 440V, 50 Hz.

Manpower: Skilled (Nos.): 4  
Unskilled (Nos.): 12

Tentative Project Cost

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</table>
Solid/Hollow Concrete Blocks

**Use**
For walls in housing and building construction as substitute to bricks.

**Salient Features**
- Cost effective walling option
- Environment friendly and energy efficient
- Simple manufacturing process
- Industrial wastes like Fly Ash, Blast Furnace Slag etc. can be utilised
- Less consumption of mortar
- Leaner mix for production of blocks
- Faster masonry

**Size of product**
- Solid Concrete Blocks: 300 x 200 x 150 mm
- Hollow Concrete Blocks: 400 x 200 x 200 mm or 400 x 200 x 150 mm

**Properties of product**
- Compressive strength: 40 – 150 kg/cm²
- Water absorption: <10% by weight

**Raw Material:**
Cement, Sand, Aggregates

**Option 1: Hand Held Type Block Machine (Petrol/Diesel Driven)**

**Production Capacity**
150,000 blocks per annum
(2 shifts of 8 hours each)

**Equipment/Machinery**
Hand held type block making machine,
Mixer, Moulds

**Land requirement**
- Open area: 1500 sq.mt.
- Covered area: 50 sq.mt.

**Power**
- KW: 5
- Three phase
- Voltage: 440V, 50 Hz.

**Manpower:** Skilled (Nos.): 1
Unskilled (Nos.): 5
Tentative Project Cost

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Option II: Stationery Block Machine

**Production Capacity**
150,000 blocks per annum (2 shifts of 8 hours each)

**Equipment/Machinery**
Stationery block making machine, Mixer

**Land requirement**
- Open area: 1500 sq.mt.
- Covered area: 100 sq.mt.

**Power**
- KW: 6
- Three phase
- Voltage: 440V, 50 Hz.

**Manpower:**
- Skilled (Nos.): 1
- Unskilled (Nos.): 5

Tentative Project Cost

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Option III: Standing Type Block Machine

Production Capacity
3,00,000 blocks per annum (2 shifts of 8 hours each)

Equipment/Machinery
Standing type block making machine, Mixer, Pallets

Land requirement
- Open area: 2000 sq.m.
- Covered area: 100 sq.m.

Power
- KW: 7.5
- Three phase
- Voltage: 440V, 50 Hz.

Manpower: Skilled (Nos.): 1
Unskilled (Nos.): 5

Tentative Project Cost

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Option IV: Concrete Block Machine (Sakar)

Production Capacity
6,00,000 blocks per annum (2 shifts of 8 hours each)

Equipment/Machinery
Concrete block making machine (Sakar), Mixer, Moulds

Land requirement
- Open area: 2000 sq.m.
- Covered area: 150 sq.m.

Power
- KW: 6.5
- Three phase
- Voltage: 440V, 50 Hz.
Manpower: Skilled (Nos.): 2
Unskilled (Nos.): 8

Tentative Project Cost

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Option V: Egglaying Type Block Machine

Production Capacity
6,00,000 blocks per annum (2 shifts of 8 hours each)

Equipment/Machinery
Egglaying type block making machine, Mixer, Moulds

Land requirement
- Open area: 3000 sq.mt.
- Covered area: 200 sq.mt.

Power
- KW: 9.5
- Three phase
- Voltage: 440V, 50 Hz.

Manpower: Skilled (Nos.): 1
Unskilled (Nos.): 4

Tentative Project Cost

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Option VI(a): Bi-Directional Press (Vibro Hydraulic Compaction Type - AS 189)

Production Capacity
2,400,000 blocks per annum
(2 shifts of 8 hours each)

Equipment/Machinery
Bi-Directional Vibro Press (AS-189),
Belt conveyor, Box feeder, Concrete mixer, Pallets

Land requirement
- Open area: 2000 sq.m.
- Covered area: 150 sq.m.

Power
- KW: 8.50
- Three phase
- Voltage: 440V, 50 Hz.

Manpower:
Skilled (Nos.): 4
Unskilled (Nos.): 10

Tentative Project Cost

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Option VI(b): Bi-Directional Press (Vibro Hydraulic Compaction Type - AS 1818)

Production Capacity
600,000 blocks per annum (2 shifts of 8 hours each)

Equipment/Machinery
Bi-Directional Vibro Press (AS-1818), Belt Conveyor,
Box feeder, Concrete mixer, Pallets

Land requirement
- Open area: 3000 sq.m.
- Covered area: 200 sq.m.

Power
- KW: 12
- Three phase
- Voltage: 440V, 50 Hz.
**Manpower:** Skilled (Nos.): 4  
Unskilled (Nos.): 12

### Tentative Project Cost

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Option VI(c): Bi-Directional Press (Vibro Hydraulic Compaction Type - AS 1824)

#### Production Capacity
1200,000 blocks per annum  
(2 shifts of 8 hours each)

#### Equipment/Machinery
Bi-Directional Vibro Press (AS-1824), Belt conveyor, Box feeder, Concrete mixer, Pallets

#### Land requirement
- Open area: 3000 sq.mt.
- Covered area: 200 sq.mt.

#### Power
- KW: 16
- Three phase
- Voltage: 440V, 50 Hz.

**Manpower:** Skilled (Nos.): 4  
Unskilled (Nos.): 12

### Tentative Project Cost

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Cellular Light Weight Concrete

Use
In building construction as substitute to conventional bricks/blocks particularly in multi-storey buildings as it helps in substantial reduction of dead weight leading to reduction of cost of foundations.

Salient Features
- Environment friendly
- Make use of Fly Ash/Volcanic Ash as one of the major constituents.
- Depending upon application the density can be designed.
- Being light weight material, reduces dead load which results in saving of steel in structure & foundation
- High thermal insulation - particularly suitable to air-conditioned buildings
- Less consumption of mortar as compared to brick masonry
- Energy efficient
- The components can be manufactured at site
- Substantial material saving

Production Capacity
15000 cu.mt. per Annum (8 hrs shift)

Size of product
600 x 200 x 200 /100 mm
500 x 250 x 200 /100 mm
500 x 400 x 100 mm
or as desired can be used in-situ construction of walls.

Properties of product
Range of densities: 400 - 1800 m³
Compressiven strength: 10 - 250 kg/sq.cm.
Water absorption: 5% by weight
Thermal conductivity: 0.082 - 0.555 w/mk

Main equipment
- Foam generator
- Mixer
- Compressor
- Steel moulds
- Water sprinklers
Land requirement
- Open area: 2000 sq.m.t.
- Covered area: 100 sq.m.t.

Raw Material:

Power
- KW: 10
- Three phase
- Voltage: 440V, 50 Hz.

Manpower:
- Skilled (Nos.): 3
- Unskilled (Nos.): 12

Tentative Project Cost

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Ferrocement Wall Panels

Use
For walling particularly suitable where speedy construction is required.

Salient Features
- Cost effective technology
- Energy efficient
- Dimensional regularity in shape & size
- Reduction in construction & finish time
- Components can be retrieved for construction on other sites.

Production Capacity
3,000 Panels per Annum (8 hrs shift)

Size of product
1200 x 900 mm or 1200 x 1200 mm or any other size to suit the requirement
Flange depth: 150 mm
Thickness: 25 mm

Properties of product
Compressed strength: 150 kg/cm²
Water absorption: <5%

Main equipment
- Wall panel casting machine
- Moulds
- Concrete mixer
- Lifting arrangement

Land requirement
- Open area: 1000 sq.m.
- Covered area: 100 sq.m.

Raw Material:
Cement, Coarse Sand, Aggregates, Polypropylene fibre, Admixtures, Welded mesh

Power
- KW: 6.5
- Three phase
- Voltage: 440V, 50 Hz.
Manpower:

- Skilled (Nos.): 2
- Unskilled (Nos.): 6

**Tentative Project Cost**

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Rat Trap Bond Brick Masonry

About the Rat Trap Bond
Bricks placed on edge in 1:6 cement sand mortar as shown is a rat trap bond wall.

Use
For walling as an alternative to conventional English/Flemish bond

Salient Features
- Reduction in consumption of bricks by 25% as compared to 230 mm thick solid brick wall
- Reduction in mortar consumption
- Reduction in load of walls in foundation as Rat Trap Bond load is 80% of solid walls
- Good thermal insulation
- Equal strength compared to other conventional bonds
- Same stability as that of solid walls
- No need of plaster in wall surface
- Considered as Earthquake Resistant Technology
- Labour intensive technology
- Upto 3 storeyed buildings can be constructed with this bond

Strength of Bricks Required
For 1 storey building: 20 kg/cm²
For 2 storeyed building: 35 kg/cm²
For 3 storeyed building: 75 kg/cm²

Production Capacity
0.3 million tiles per Annum (8 hrs shift)

Raw Material (for 1 cu.m. of masonry)
Bricks: 400 nos.
Cement: 36 kgs.
Sand: 0.15 m³
Scaffolding: 2.00 m³

Manpower (for 1 cu.m. of masonry)
Skilled: 1.60 mandays
Unskilled: 4 mandays
Labour: 0.5 mandays
Micro Concrete Roofing Tiles

Use
Cladding for sloping roofs of different types of buildings, as an substitute to country tiles, asbestos and other corrugated sheets.

Salient Features
- Highly cost effective
- Production under controlled condition
- More durable and strong in different climatic conditions
- Can be colored to specification
- No noise during rain
- Decentralised production makes it more energy effective
- Manageable tile size make the structure relatively lighter.
- Reduction in construction and finishing time

Production Capacity
60,000 Tiles per Annum (8 hrs shift)

Size of product
240 x 488 x 8 mm

Properties of product
Shape: Corrugated (Two shapes available)
Weight: 2.25 kg/tile
Loading capacity: 60 kg/sq.mt.
Water absorption: 10%

Main equipment
- Tile making machine
- Concrete mixer
- Plastic moulds

Land requirement
- Open area: 500 sq.mt.
- Covered area: 100 sq.mt.

Raw Material:
Cement, Fine Aggregates (5 mm & below), Sand.

Power
- KW: 4
- Single phase
- Voltage: 220V, 50 Hz.
Manpower:
  - Skilled (Nos.): 1
  - Unskilled (Nos.): 3

Tentative Project Cost

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Ferrocement Roofing Channels

Use
For roof and intermediate floor construction as a substitute to RCC slabs particularly suitable for large spans as required in schools, health centres, community halls, etc.

Salient Features
- Speedy installation - No shuttering required
- 30% cost saving over RCC roofing
- Lower dead load on walls
- Usable as an intermediate floor
- High strength to weight ratio
- Elegant profile and unique size
- Large span upto 6.1 mtr.
- Light weight, slender element and shell structure

Production Capacity
9,000 running meter per Annum (8 hrs shift)

Size of product
- Clear bay length: 750 mm
- Outer - outer dimension: 840 mm
- Rise of arch: 290 mm
- Shell thickness: 25 mm
- Bottom Nib dimension: 40 x 45 mm
- Span: Upto 6.1 mtrs.

Properties of product
- Unit weight: 70 kg/mtr
- Density: 2400 kg/m³
- Water absorption: <5% by weight of channel
- Saving in dead weight: 66% to 75% with respect to weight of RCC

Main equipment
- Ferrocement roofing channel making machine
- Concrete mixer
- Demoulding frame
- Chain & Pully arrangement

Land requirement
- Open area: 1000 sq.mt.
- Covered area: 150 sq.mt.

Raw Material:
Cement, Fine Aggregates (10 mm & below), Sand, Steel, Chicken Mesh, Welded Mesh.
Power
- KW: 6.75
- Three phase
- Voltage: 440V, 50 Hz.

Manpower:
- Skilled (Nos.): 2
- Unskilled (Nos.): 6

Tentative Project Cost

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RCC Planks and Joists

Use
For structural roofing in load bearing structure and framed structures.

Salient Features
- Sturdy and higher strength
- Dimensional regularity in shape and size
- Saving in time, energy resources
- Cost effective roofing option
- No shuttering required

Size of product
Planks: 1500 x 300 x 30 - 60 mm
Joists: Length - Upto 4500 mm
Cross-sectional size - 100 x 125 or 150 x 150 or any other sizes

Properties of product
Compression strength: 150 kg/cm²
Thermal transmission (U) value: 2.189 kcal/hr/m²/°C
Thermal performance index: 130
Fire resistance : 1 hr. 45 min.
Rain penetration: No seepage
Impact noise rating: 16.6 db.

Raw Material:
Cement, Sand, Stone Aggregates, Steel, Binding wire

Option I: RCC Planks & Joists Machine (Platform Type)

Production Capacity
RCC Planks: 7500 pieces per Annum (8 hrs shift)
RCC Joists: 4500 pieces per Annum (8 hrs shift)

Main equipment
- RCC Planks casting machine
- RCC Joists casting machine
- Moulds
- Concrete mixer
- Lifting arrangement with gantry
- Chain and pulley

Land requirement
- Open area: 1000 sq.mt.
- Covered area: 150 sq.mt.
Power
- KW: 9.75
- Three phase
- Voltage: 440V, 50 Hz.

Manpower:
- Skilled (Nos.): 3
- Unskilled (Nos.): 10

Tentative Project Cost

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Option II: RCC Plank & Joist Machine (Egglaying Type)

Production Capacity
RCC Planks: 48000 pieces per Annum
   (2 shifts of 8 hrs.each)
RCC Joists: 24000 pieces per Annum (8 hrs shift)

Main equipment
- RCC Plank casting machine (Egglaying Type)
- RCC Joist casting machine (Egglaying Type)
- Concrete mixer
- Pallets

Land requirement
- Open area: 2000 sq.mt.
- Covered area: 200 sq.mt.

Power
- KW: 9.50
- Three phase
- Voltage: 440V, 50 Hz.

Manpower:
- Skilled (Nos.): 4
- Unskilled (Nos.): 15
**Tentative Project Cost**

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</tr>
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</table>

**Option III: RCC Plank (Rotating Type) & Joist Machine (Egglaying Type)**

**Production Capacity**
- RCC Planks: 48000 pieces per Annum
  
  (2 shifts of 8 hrs each)
- RCC Joists: 24000 pieces per Annum (8 hrs shift)

**Main equipment**
- RCC Plank casting machine (Rotating Type)
- RCC Joist casting machine (Egglaying Type)
- Concrete mixer
- Pallets

**Land requirement**
- Open area: 2000 sq.m.
- Covered area: 200 sq.m.

**Power**
- KW: 9.50
- Three phase
- Voltage: 440V, 50 Hz.

**Manpower:**
- Skilled (Nos.): 4
- Unskilled (Nos.): 15

**Tentative Project Cost**

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Reinforced Brick Panels & Joists

Use
For roofing as an alternative to conventional RCC Slab.

Salient Features
- Economy in steel, cement, labour, time & cost
- Simple technology
- No shuttering is required
- Same structural stability and durability as that of conventional RCC slab
- Suitable for rural areas

Production Capacity
Reinforced brick panel: 1,20,000 brick panels per day (8 hrs shift)
RCC joist: 24,000 joists per annum (8 hrs shift)

Size of product
Reinforced brick panel: 1200 x 530 x 75 mm
RCC joist: 130 x 100 x 3600 mm

Properties of product
Compressed strength: 150 kg/cm²

Main equipment
Wooden moulds, RCC joist casting machine (Egglaying Type), Concrete mixer

Land requirement
- Open area: 2000 sq.m.
- Covered area: 150 sq.m.

Raw Material:
Cement, Bricks, Sand, Aggregates, Steel

Power
- KW: 7
- Three phase
- Voltage: 440V, 50 Hz.

Manpower:
- Skilled (Nos.): 6
- Unskilled (Nos.): 20
**Tentative Project Cost**

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Precast Concrete L-panels

Use
For sloping roofs as an alternative to conventional RCC slab, particularly suitable for coastal areas prone to cyclones/hurricanes.

Salient Features
- Reduction in both live and dead load resulting in an economic design of foundation and other supportive structure
- Easy to construct a roof
- More durable
- Also suitable for temporary construction
- Cost effective
- L-panels can be used in high rainfall areas
- Suitable for rural areas and creating employment

Production Capacity
3,000 L-panels per annum (8 hrs shift)

Size of Product
Length: Upto 4000 mm
Width: 380 mm
Depth of rib: 120 mm
Flange thickness: 30 mm

Properties of Product
Compressive strength: 150 kg/cm²

Main Equipment
- L-Panel casting machine
- Concrete mixer
- Moulds
- Welding machine
- Lifting arrangement with chain & pulley

Land Requirement
- Open area: 1000 sq.m.
- Covered area: 100 sq.m.

Raw Material:
Cement, Sand, Aggregates, Steel, Polypropylene fibre, Admixtures
Power

• KW: 8
• Three phase
• Voltage: 440V, 50 Hz.

Manpower:

• Skilled (Nos.): 2
• Unskilled (Nos.): 6

Tentative Project Cost

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Ferrocement C-Beams/Rafters

Use
For structural application as beams in roofing.

Salient Features
- Cost effective prefab technology
- Dimensional regularity in shape & size
- Reduction in construction time
- Simple technology
- Two C-Beam joined in opposite direction makes an I-Beam

Production Capacity
9,000 C-Beams per Annum (8 hrs shift)

Size of product
300 x 150 x 3600 mm or any other size to suit the requirement
Thickness: 25 mm

Properties of product
Compressed strength: 250 kg/cm²

Main equipment
- C-Beam making machine
- Moulds
- Concrete mixer
- Lifting arrangement with chain & pulley
- Welded mesh

Land requirement
- Open area: 1000 sq.m.
- Covered area: 100 sq.m.

Raw Material:
Cement, Sand, Aggregates, Steel, Polyproplye fibre, Admixtures, Welded mesh

Power
- KW: 6.5
- Three phase
- Voltage: 440V, 50 Hz.

Manpower:
- Skilled (Nos.): 2
- Unskilled (Nos.): 9
### Tentative Project Cost

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Precast Concrete Door/Window Frames

Use
For all applications where standard door & window openings are provided as a substitute to wood.

Salient Features
- Environment friendly,
- Termite proof & rot free,
- Fire & water proof,
- High quality & long life,
- Produced with a moderate level of skill and a simple technology.
- In-built provision for hinges, locks, towerbolts and other hardware

Production Capacity
6000 Frames per Annum (8 hrs shift)

Size of product
- Cross sectional dimensions
  Single Rebate: 60 mm x 100 mm
  Double Rebate: 60 mm x 120 mm
- Height and Width
  All standard sizes can be produced.

Properties of product
Compressive strength: 200 kg/cm²
Unit weight: 14.40 kg/mtr.
Density: 2400 kg/cumt.

Main equipment
- Door/window frame making machine
- Concrete mixer
- Tach welder
- Lifting arrangement with chain and pulley

Land requirement
- Open area: 1000 sq.mt.
- Covered area: 200 sq.mt.

Raw Material:
Cement, Coarse Sand, Aggregates (10 mm & below), steel, Binding wire, Admixture, Polypropylene fibre, Consumables.
Power

- KW: 7
- Three phase
- Voltage: 440V, 50 Hz.

Manpower:

- Skilled (Nos.): 2
- Unskilled (Nos.): 6

Tentative Project Cost

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Concrete Paving Blocks

Use
For paving of roads, pavements, driveways, streets, platforms, etc.

Salient Features
- High compressive strength
- Good abrasion resistance
- Flexible design of shape and size
- Interlocking provides variety of patterns
- Re-usable

Size of product
250 x 75 - 115 mm x 40 - 100 mm
or any other size & shape

Properties of product
Compressive strength: 350 - 550 kg/cm²
Flexural strength: > 35 kg/cm²
Abrasion resistance: > 35 mm
Water absorption: < 9%
Density: 1800 kg/m³

Raw Material:
Cement, Sand, Aggregates, Superplasticiser, Pigments

Option I: Paving Block Machine (Sakar)

Production Capacity
600,000 paving blocks per annum
(2 shifts of 8 hours each)

Equipment/Machinery
Block making machine (Sakar),
Mixer, Moulds

Land requirement
- Open area: 2000 sq.m.
- Covered area: 150 sq.m.

Power
- KW: 6.5
- Three phase
- Voltage: 440V, 50 Hz.

Manpower: Skilled (Nos.): 2
Unskilled (Nos.): 8
Tentative Project Cost

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Option II: Hydraulic Paving Block Machine (ECO)

Production Capacity
0.9 million paving blocks per annum (8 hours shift)

Equipment/Machinery
Hydraulic Paving block making machine, Mixer, moulds

Land requirement
- Open area: 2000 sq.m
- Covered area: 150 sq.m

Power
- KW: 10
- Three phase
- Voltage: 440V, 50 Hz

Manpower: Skilled (Nos.): 2
Unskilled (Nos.): 8

Tentative Project Cost

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</table>
Option III: Hydraulic Paving Block Machine (AS 189)

Production Capacity
4,80,000 paving blocks per annum (2 shifts of 8 hours each)

Equipment/Machinery
Bi-directional vibro press (AS 189)
Concrete Mixer, Belt conveyor, Box feeder, Pallets

Land requirement
- Open area: 2000 sq.m.
- Covered area: 150 sq.m.

Power
- KW: 8.5
- Three phase
- Voltage: 440V, 50 Hz.

Manpower:  
Skilled (Nos.): 1  
Unskilled (Nos.): 5

Tentative Project Cost

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Option IV: Hydraulic Paving Block Machine (AS 1818)

Production Capacity
1.5 million paving blocks per annum (2 shifts of 8 hours each)

Equipment/Machinery
Bi-directional vibro press (AS 1818)
Concrete Mixer, Belt conveyor, Box feeder, Pallets

Land requirement
- Open area: 3000 sq.m.
- Covered area: 200 sq.m.

Power
- KW: 12
- Three phase
- Voltage: 440V, 50 Hz.
**Manpower:** Skilled (Nos.): 1  
Unskilled (Nos.): 5

**Tentative Project Cost**

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**Option IV: Hydraulic Paving Block Machine (AS 1824)**

**Production Capacity**
3 million paving blocks per annum (2 shifts of 8 hours each)

**Equipment/Machinery**
Bi-directional vibro press (AS 1824)  
Concrete Mixer, Belt conveyor, Box feeder, Pallets

**Land requirement**
- Open area: 3000 sq.mt.
- Covered area: 200 sq.mt.

**Power**
- KW: 16  
- Three phase  
- Voltage: 440V, 50 Hz.

**Manpower:** Skilled (Nos.): 1  
Unskilled (Nos.): 5

**Tentative Project Cost**

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Mosaic & Checkered Flooring Tiles

Use
Mosaic Tiles: For flooring in housing and building construction
Checkered Tiles: For pedestrian pathways, garages, ramps of houses etc.

Salient Features
- High abrasion resistance
- High impact strength
- Speedy construction
- High quality

Production Capacity
0.3 million tiles per Annum (8 hrs shift)

Size of product
250 x 250 x 25 mm

Properties of product
Compressed strength: 200 kg/cm²
Weight: 3.5 kgs
Flexural strength: 30 kg/cm²

Main equipment
Tile press, Concrete mixer, Tile material mixing ball mill, Tile grinder, Racks

Land requirement
- Open area: 2000 sq.m.
- Covered area: 200 sq.m.

Raw Material:
Cement, Sand, Aggregates (6-12mm), Pigment, Marble chips, Marble powder

Power
- KW: 15
- Three phase
- Voltage: 440V, 50 Hz.

Manpower:
- Skilled (Nos.): 3
- Unskilled (Nos.): 6
### Tentative Project Cost

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<td>US$ 4,000</td>
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</table>
Bamboo Mat Corrugated Roofing Sheets

Use
For roofing as an alternative to Galvanised Iron/Asbestos Corrugated Sheets.

Salient Features
- Environment friendly roofing alternative
- Light but strong and posses high resilience
- Good thermal insulation
- Low cost of understructure due to its light weight
- Load bearing capacity is comparable to Galvanised Iron/Asbestos Corrugated Sheets.
- Efficient use of renewable resources
- Water proof and termite proof
- Resistant to fire with desired fire rating
- Aesthetically good
- Also suitable for disaster prone and heavy rainfall areas.
- Very energy efficient roofing material
- Excellent income generating activity for local population in bamboo growing regions.

Production Capacity
36000 sheets per annum (8 hrs shift)

Size of product
2440 x 1050 mm x 3.8 mm
1830 x 1050 x 3.8 mm

Properties of product
Weight: 8 kgs.
Load bearing capacity: 4.77 N/mm²
Deflection at breaking point: 85 mm
Thermal conductivity: 0.1928 Kcal/m²°c
Modulus of rupture: 40 - 45 N/mm²
Internal bond strength: 1.3 - 1.4 N/mm²
Maximum load: 1907 N.

Main equipment
6-day light Hot Press with platens, Glue applicator, Dryer, Boiler, DD shaw, Sender, Resin plant, Generator

Land requirement
- Open area: 5000 sq.m.
- Covered area: 2000 sq.m.

Raw Material:
Bamboo mats, polymer, preservatives, brush bond coating
Power
- KW: 150
- Three phase
- Voltage: 440V, 50 Hz.

Manpower:
- Skilled (Nos.): 10
- Unskilled (Nos.): 30

Tentative Project Cost

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Bamboo Mat Boards

Use
For partitions, False ceiling, Door/window shutters, Infills panelling, Partitions, Table tops, Cladding, Prefab huts as an alternative to commercial plywood.

Salient Features
- Environment friendly and energy efficient technology
- Compare favourably with plywood in terms of durability, stability and versatality
- Highly resistant to water, termites, borer, insects, wood rotting fungi
- More durable and able to withstand severe climatic conditions
- More stronger than plywood

Production Capacity
45,000 boards or 134,000 sq.mt.
per annum (8 hrs shift)

Size of product
2440 x 1220 mm x 3 - 25 mm

Properties of product
Density: 790 kg/m³
Tensile strength: 29.5 N/mm²
Compressive strength: 35.3 N/mm²
Modulus of rupture: 59.4 N/mm²
Modulus of elasticity: 3144 N/mm²
Modulus of rigidity: 6066 N/mm²

Main equipment
Hot Press (6-day light), Glue applicator, Dryer, Boiler, DD shaw, Sander, Resin kettle, Blowers, Scissors, Lifter, Trolleys, Generator

Land requirement
- Open area: 5,000 sq.mt.
- Covered area: 2,000 sq.mt.

Raw Material:
Bamboo mats, polymer, preservatives
Power
- KW: 50
- Three phase
- Voltage: 440V, 50 Hz.

Manpower:
- Skilled (Nos.): 6
- Unskilled (Nos.): 24

Tentative Project Cost

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Coir Polymer Composite Boards & Ply

**Use**
Boards/Ply are ideal for door shutters, door inserts, false ceilings, Table tops, Partitioning, Automobile panels, Furniture etc.

**Salient Features**
- Environment friendly technology
- Has all properties of phenol bonded ply/boards with added strength
- Has both vertical and horizontal load bearing strengths
- Natural, smooth, glossy finishes on both sides
- Can be painted, polished or laminated
- Low consumption of paint and varnishes
- High degree of surface abrasion resistance
- Termite/insect resistant
- Fire retardant
- Can be formed in virtually any shape
- Can be nailed or screwed
- Exterior grade hard boards can also be produced
- Maintenance free

**Production Capacity**
12000 cu.mt. per annum (8 hrs shift)

**Size of product**
2440 x 1220 mm x 3 - 50 mm

**Properties of product**
- Density: 748 kg/m³
- Moisture content: 6.5 %
- Glue shear strength: 1720 N/mm²
- Water resistance: No delamination
- Tensile strength: 23.6 N/mm²
- Compression strength: 51.02 N/mm²
- Modulus of elasticity: 6440 N/mm²
- Modulus of rupture: 47.5 N/mm²
- Nail holding capacity: 50 kgs.
- Screw holding capacity: 245 kgs.

**Main equipment**
Fibre extraction equipment, Fibre sorting equipment, Low load fibre strength testing equipment, Fibre pretreatment unit, Fibre weaving or knitting equipment, Filament winding equipment, Hand layup composite fabrication equipment, Polymer fibre spray unit for spray formed composite, composite testing equipment, cutters, etc.
Land requirement
- Open area: For loading and movement of vehicles
- Covered area: 5000 sq.mt.

Raw Material:
Coconut fibre (Coir), Polymer

Power
- KW: 150
- Three phase
- Voltage: 440V, 50 Hz.

Manpower:
- Skilled (Nos.): 48
- Unskilled (Nos.): 72

Tentative Project Cost

<table>
<thead>
<tr>
<th></th>
<th>USD 6525,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>USD 6525,000</td>
</tr>
<tr>
<td>Main equipment</td>
<td>USD 5250,000</td>
</tr>
<tr>
<td>Essential Spareparts &amp; tools</td>
<td>USD 200,000</td>
</tr>
<tr>
<td>Civil Construction</td>
<td>USD 200,000</td>
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<tr>
<td>Design &amp; installation</td>
<td>USD 100,000</td>
</tr>
<tr>
<td>Other expenses</td>
<td>USD 50,000</td>
</tr>
<tr>
<td>Working Capital (one month)</td>
<td>USD 725,000</td>
</tr>
</tbody>
</table>
Flyash/Red Mud Polymer Doors and Panel Products

Use
A very good wood substitute for Doors, Windows, Ceiling, Partitions, Furniture, etc.

Salient Features
- Environment friendly technology
- Fruitful utilisation of industrial waste such as flyash, red mud
- Energy efficient production technology
- Products stronger than wood
- Weather resistant and durable
- Termite, fungus, rot & rodant resistant
- Fire resistant
- Cheaper than natural wood
- Less maintenance cost

Production Capacity
12000 m² doors/panels per annum (8 hrs shift)

Size of product
Door: 2100 x 900 x 25-30 mm or any other size
Panel: 1800 x 900 x (3-25 mm)

Properties of product
Density: 1.65 to 1.70 gm/cc
Modulus of rupture: 85 - 95 N/mm²
Tensile strength: 22 - 24 N/mm²
Moisture content: 0.2 - 0.38 %
Compression perpendicular to surface: 78 - 101 N/mm²
Compression parallel to surface: 44 - 51 N/mm²
Swelling in water
  Length: 0 - 0.36%
  Width: 0 - 0.47%
  Thickness: 0 - 1.38%
Water absorption
  2 hours: 0.15 - 0.4%
  24 hours: 1.1 - 1.5%
Fire retardancy: Self extinguishing in 15 Seconds
Main equipment
Hydraulic press, calendering machine, mixing plant, moulds, sander, grinder, shearing machine, oven, resin cattle, curing chamber, cutter

Land requirement
- Open area: 3,000 sq.mt.
- Covered area: 500 sq.mt.

Raw Material:
Red Mud/Flyash Polymer, Additives, Woven jute mats.

Power
- KW: 40
- Three phase
- Voltage: 440V, 50 Hz.

Manpower:
- Skilled (Nos.): 4
- Unskilled (Nos.): 24

Tentative Project Cost

<table>
<thead>
<tr>
<th>Total</th>
<th>US$ 263,000</th>
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<tbody>
<tr>
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<td>Essential Spareparts &amp; tools</td>
<td>US$ 10,000</td>
</tr>
<tr>
<td>Civil Construction</td>
<td>US$ 15,000</td>
</tr>
<tr>
<td>Design &amp; installation</td>
<td>US$ 5,000</td>
</tr>
<tr>
<td>Other expenses</td>
<td>US$ 3,000</td>
</tr>
<tr>
<td>Working Capital (one month)</td>
<td>US$ 45,000</td>
</tr>
</tbody>
</table>
Glass Reinforced Polymer (GRP) Door Shutters & Frames

Use
For use in residential houses, offices, schools, hospitals, hotels, laboratories etc. as an substitute to wooden door shutters and frames.

Salient Features
- Cost effective and environment friendly technology
- Strong, durable and impact resistant
- Superior quality and finish
- Moisture resistant
- Boiling water resistant
- Maintenance free
- Termite resistant
- Ready to fix and no hassles of carpenter
- No painting required for life
- Provide sound and thermal insulation

Production Capacity
6,000 doors and door frames per annum (8 hrs shift)

Size of product
Door
- Height & width any standard sizes
- Thickness - 32 - 40 mm
Door frames
- Height and width: Any standard sizes
- Cross sectional dimension: 65 x 90 - 125 mm

Properties of product
- Density: 1.44 gms/cc
- Young’s modulus: 6890 N/mm²
- Tensile strength: 74.40 N/mm²
- Shear modulus: 2970 N/mm²
- Shear strength: 16.40 N/mm²

Main equipment
- Moulds, Moulding tables, Hand/Power operated press,
- Hand planning machine, Hand shearing machine, Bent vice, Sander machine, Hand grinding machine, Drilling & welding machine, Painting unit, etc.
Land requirement
- Open area: 70 sq.mt.
- Covered area: 330 sq.mt.

Raw Material:
Glass fibre (E-glass fibre, chopped strand mat), Natural fibres, Polyurethane foam, Polyester resin, Curing agents etc.

Power
- KW: 7.5
- Three phase
- Voltage: 440V, 50 Hz.

Manpower:
- Skilled (Nos.): 10
- Unskilled (Nos.): 10

Tentative Project Cost

<table>
<thead>
<tr>
<th>Total</th>
<th>US$ 73,500</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main equipment including kiln</td>
<td>US$ 20,000</td>
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<td>Essential Spareparts &amp; tools</td>
<td>US$ 2,000</td>
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<td>Civil Construction</td>
<td>US$ 21,000</td>
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<tr>
<td>Design &amp; installation</td>
<td>US$ 2,000</td>
</tr>
<tr>
<td>Other expenses</td>
<td>US$ 500</td>
</tr>
<tr>
<td>Working Capital (one month)</td>
<td>US$ 28,000</td>
</tr>
</tbody>
</table>
Finger Jointed Lumber from Plantation Timbers

Use
To join smaller sections of plantation timber for bringing them upto useable length for panelling, partitions, panel doors, flush doors, furniture, joinery etc.

Salient Features
- Utilisation of plantation wood, thereby saving finger wood
- Minimise wastege of wood
- Reduced consumption of glue
- Horizontal, vertical and inclined finger joints can be produced
- High productivity
- Joint strength upto75% of original wood
- Removal of defects and rejoining
- Both soft & hard woods can be processed

Production Capacity
1680 cu.mt. per annum (2 shifts of 8 hrs each)

Size of product
100 (max.) x 150 (max.) x 2500 - 4600 (max.) mm

Properties of product
Modulus of rupture of finger jointed timber sections
1. Rubber wood: 60 N/mm²
2. Poplar wood: 45 N/mm²
3. Silver oak: 50 N/mm²
4. Eucalyptus: 65 N/mm²

Main equipment
Finger shaping machine, Glue applicator,
Finger pressing machine, Dust extractor,
Air compressor

Land requirement
- Open area: 2,400 sq.mt.
- Covered area: 300 sq.mt.
**Raw Material**
Plantation timbers like Rubber wood/Poplar wood/Silver oak/Eucalyptus and adhesives

**Power**
- KW: 16
- Three phase
- Voltage: 440V, 50 Hz.

**Manpower:**
- Skilled (Nos.): 3
- Unskilled (Nos.): 10

**Tentative Project Cost**

<table>
<thead>
<tr>
<th></th>
<th>US$ 92,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td></td>
</tr>
<tr>
<td>Main equipment</td>
<td>US$ 55,000</td>
</tr>
<tr>
<td>Essential Spareparts &amp; tools</td>
<td>US$ 5,000</td>
</tr>
<tr>
<td>Civil Construction</td>
<td>US$ 15,000</td>
</tr>
<tr>
<td>Design &amp; installation</td>
<td>US$ 5,000</td>
</tr>
<tr>
<td>Other expenses</td>
<td>US$ 2,000</td>
</tr>
<tr>
<td>Working Capital (one month)</td>
<td>US$ 10,000</td>
</tr>
</tbody>
</table>
Technology for Retrievable Structures

Use
For use of residential, working spaces, field hospitals, dormitories, etc. in remote areas where safe buildings with varying uses are required with 6 to 10 years life and can be shifted to other sites.

Salient Features
- Easy to transport because of their prefabricated and foldable nature
- Basic frames and claddings all can be prefabricated at a central location and transported to remote areas (flat and mountaneous terrain) for immediate occupation. Normally such structures are recommended for remote areas where camps for army, refugees/returnees along with other infrastructure like hospital, gymnasium, large kitchens, dining spaces etc. are required.
- Saves construction cost & time
- The structural frame can be prefabricated using timber or steel sections and requires simple erection techniques with nuts/bolts/clamps.
- After use retrievalability of the structures is upto 90% and can be transported and erected on the other sites.

Size of the Enclosures
The basic frame provides a module of 6.7 meter (22 feet) x 2.4 meter (8 feet) and the frames can be erected to provide shelters/enclosures of variable sizes and configurations.

Raw Material
Steel/Timber for frames, Locally available hand made or machine made clay bricks or stone for foundation and plinth or pretreated lumber/particle boards for cladding, small quantities of cement, sand, aggregates.

Manpower
Supervisor : 1, Mason : 1, and local labour : 10-15 depending upon the number of structures to be put at one location

Cost
Construction cost of enclosure of 6.7 meter x 9.6 meter is US$ 12,500 depending upon the location, terrain and locally available raw materials.
# Other Machines Available

<table>
<thead>
<tr>
<th>Machine Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>TNG Rural Housing Kit</td>
<td><em>Use:</em> For Production of building components for a complete house using local materials.</td>
</tr>
<tr>
<td>Combination Machine</td>
<td><em>Use:</em> For Production of Ferrocement C-Section, lintels and shelves which replaces similar elements made of steel and timber.</td>
</tr>
<tr>
<td>Bar and Pipe Cutting Machine</td>
<td><em>Use:</em> For cutting bars and pipes to suit the requirement.</td>
</tr>
<tr>
<td>Multipurpose Stone Processing Machine</td>
<td><em>Use:</em> Versatile stone drilling, cutting and polishing machine for semi-precious stone furniture and decorative items for rural and cottage industries.</td>
</tr>
<tr>
<td>Stone/Coal Disintegrator</td>
<td><em>Use:</em> For crushing of stone/boulders/coal at site.</td>
</tr>
<tr>
<td>Ferrocement Door Casting Machine</td>
<td><em>Use:</em> For Production of ferrocement door shutters.</td>
</tr>
</tbody>
</table>
Setting up a Technology Demonstration cum Production Centre for Manufacturing of Prefab Building Components

Production Capacity

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Production Capacity</th>
<th>Per Annum (in Nos.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Flyash Sand Lime Gypsum Bricks</td>
<td>3.00 millions</td>
</tr>
<tr>
<td>2.</td>
<td>Solid/Hollow Concrete Blocks</td>
<td>0.3 million</td>
</tr>
<tr>
<td>3.</td>
<td>Compressed Earth Block (interlocking type)</td>
<td>0.36 million</td>
</tr>
<tr>
<td>4.</td>
<td>RCC Planks</td>
<td>48,000</td>
</tr>
<tr>
<td>5.</td>
<td>RCC Joists</td>
<td>24,000</td>
</tr>
<tr>
<td>6.</td>
<td>Ferrocement Roofing Channels</td>
<td>1,500</td>
</tr>
<tr>
<td>7.</td>
<td>MCR Tiles</td>
<td>60,000</td>
</tr>
<tr>
<td>8.</td>
<td>Concrete Door/Window Frames</td>
<td>6,000</td>
</tr>
<tr>
<td>9.</td>
<td>RCC Lintels</td>
<td>3,600</td>
</tr>
<tr>
<td>10.</td>
<td>Paving Blocks</td>
<td>0.75 million</td>
</tr>
</tbody>
</table>

Size of product

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Production Capacity</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Flyash Sand Lime Gypsum Bricks</td>
<td>230x115x75 mm</td>
</tr>
<tr>
<td>2.</td>
<td>Solid/Hollow Concrete Blocks</td>
<td>300x200x150 mm</td>
</tr>
<tr>
<td>3.</td>
<td>Compressed Earth Block (interlocking type)</td>
<td>240x220x115 mm</td>
</tr>
<tr>
<td>4.</td>
<td>RCC Planks</td>
<td>1500x300x30-60 mm</td>
</tr>
<tr>
<td>5.</td>
<td>RCC Joists</td>
<td>3600x150x150 mm</td>
</tr>
<tr>
<td>6.</td>
<td>Ferrocement Roofing Channels</td>
<td>4500x845x340x25 mm</td>
</tr>
<tr>
<td>7.</td>
<td>MCR Tiles</td>
<td>488x240x8 mm</td>
</tr>
<tr>
<td>8.</td>
<td>Concrete Door/Window Frames</td>
<td>2100x100x60 mm</td>
</tr>
<tr>
<td>9.</td>
<td>RCC Lintels</td>
<td>1200x230x75 mm</td>
</tr>
<tr>
<td>10.</td>
<td>Paving Blocks</td>
<td>230x75x60 mm</td>
</tr>
</tbody>
</table>

Capacity Utilisation

1st year: NIL
2nd year: 65%
3rd year: 80%
4th year: 100%

Land requirement

- Open area: 8,000 sq.mt.
- Covered area: 1000 sq.mt.
Main equipment
Hydraulic brick press, Bi-directional vibro press (AS 1818), RCC plank casting machine (egglaying type), RCC joist casting machine (egglaying type), Precast concrete door/window frame machine with 5 moulds, MCR tile machine with 200 moulds, Compressed earth block machine (interlocking type), Precast concrete lintel & shelves casting machine with 3 moulds, Ferrocement roofing channel machine with 5 moulds, Concrete mixers, Pan mixers, Belt conveyors, Box feeders, Lifting arrangements with chain, pully & girder, Pallets, Trolleys, Demoulding device.

Raw Material:
Flyash, sand, lime, gypsum, cement, aggregates, steel, binding wire, polypropylene fibre, chicken mesh, welded mesh, inserts, gullies, bolts, clay.

Power
• KW: 115
• Three phase
• Voltage: 440V, 50 Hz.

Manpower:
• Manager (No.): 1
• Supervisors (Nos.): 2
• Machine operator (Nos.): 8
• Skilled (Nos.): 15
• Unskilled (Nos.): 65

Tentative Project Cost

<table>
<thead>
<tr>
<th>Total</th>
<th>US$ 325,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main equipment</td>
<td>US$ 160,000</td>
</tr>
<tr>
<td>Essential Spareparts &amp; tools</td>
<td>US$ 10,000</td>
</tr>
<tr>
<td>Civil Construction</td>
<td>US$ 40,000</td>
</tr>
<tr>
<td>Design &amp; installation</td>
<td>US$ 15,000</td>
</tr>
<tr>
<td>Training of local technicians</td>
<td>US$ 35,000</td>
</tr>
<tr>
<td>Other expenses</td>
<td>US$ 5,000</td>
</tr>
<tr>
<td>Working Capital (one month)</td>
<td>US$ 60,000</td>
</tr>
</tbody>
</table>
Setting up a Technology Demonstration cum Production Centre

Layout Plan of a Technology Demonstration cum Production Centre

Land: 9,000 sq.mts.
## Production Days for Components of a House (60 sq.mts) with Various Walling & Roofing Options

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Wall/Roof Type</th>
<th>Production Days</th>
<th>Maximum Time Required</th>
<th>Houses Constructed in One Month (25 working days)</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Flyash sand lime gypsum bricks with RCC planks &amp; joists</td>
<td>5 days 2 days 2 days</td>
<td>5 days</td>
<td>10 houses</td>
<td>Machine for making bricks has to run in two shifts</td>
</tr>
<tr>
<td>2</td>
<td>Flyash sand lime gypsum bricks with ferrocement roofing channel</td>
<td>5 days 3 days 2 days</td>
<td>5 days</td>
<td>10 houses</td>
<td>Machine for making bricks has to run in two shifts</td>
</tr>
<tr>
<td>3</td>
<td>Solid concrete block with RCC plank and joist</td>
<td>3 days 2 days 2 days</td>
<td>3 days</td>
<td>8 houses</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Solid concrete block with ferrocement roofing channel</td>
<td>3 days 3 days 2 days</td>
<td>3 days</td>
<td>8 houses</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Hollow concrete blocks with RCC plank and joist</td>
<td>3 days 2 days 2 days</td>
<td>3 days</td>
<td>8 houses</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Hollow concrete blocks with ferrocement roofing channels</td>
<td>3 days 3 days 2 days</td>
<td>3 days</td>
<td>8 houses</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Compressed earth bricks with RCC plank and joist</td>
<td>3 days 2 days 2 days</td>
<td>3 days</td>
<td>8 houses</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Compressed earth bricks with ferrocement roofing channels</td>
<td>3 days 3 days 2 days</td>
<td>3 days</td>
<td>8 houses</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>TNG Rural Housing Kit</td>
<td>7 days 7 days 7 days</td>
<td>7 days</td>
<td>6 houses</td>
<td>2 nos TNG kits are required</td>
</tr>
<tr>
<td>10</td>
<td>Compressed earth blocks (interlocking type) with RCC plank and joist</td>
<td>5 days 2 days 2 days</td>
<td>5 days</td>
<td>5 houses</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Compressed earth blocks with ferrocement roofing channels</td>
<td>5 days 3 days 2 days</td>
<td>5 days</td>
<td>5 houses</td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>84 houses</strong></td>
<td></td>
</tr>
</tbody>
</table>

**Note:** Components of 84 houses can be produced in a month using different machines.
<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Industrial waste/by-product</th>
<th>Application in building materials as alternative to traditional materials</th>
<th>Traditional material saved fully or partly (20 - 30%)</th>
<th>Natural resources saved fully or partly (10 - 20%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Blast furnace slags</td>
<td>• Dense aggregate in concrete or road</td>
<td>• Rock, stone</td>
<td>• Stone</td>
</tr>
<tr>
<td></td>
<td>(i) air cooled</td>
<td>• Light wt. aggregate for concrete</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(ii) foamed</td>
<td>• Portland-slag cement super sulphate cement</td>
<td>• Traditional light wt. (high energy)</td>
<td>• Clay, slate, shale</td>
</tr>
<tr>
<td></td>
<td>(iii) granulated</td>
<td></td>
<td>• Ordinary portland cement (OPC)</td>
<td>• Limestone, clay</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>sulphate resisting portland cement</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Ferro-alloys and other</td>
<td>• Pozzolana-metallurgical masonry cement</td>
<td>• OPC</td>
<td>• Limestones (for pozzolana)</td>
</tr>
<tr>
<td></td>
<td>metallurgical slags</td>
<td>• Lime pozzolana</td>
<td>• Fine aggregate</td>
<td>• Limestone</td>
</tr>
<tr>
<td>3.</td>
<td>Flyash (Pulverised fuel</td>
<td>i) Portland-pozzolana</td>
<td>• Other L.W. aggregate</td>
<td>• Sand, crushed stone</td>
</tr>
<tr>
<td></td>
<td>ash)</td>
<td>ii) Concrete filler</td>
<td>• Sand-lime brick</td>
<td>• Clay, shale, slate</td>
</tr>
<tr>
<td></td>
<td></td>
<td>iii) Sintered light wt. aggregate</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>iv) Lime-flyash calcium silicate brick</td>
<td>• Cement-sand based cellular concrete</td>
<td>• Clay</td>
</tr>
<tr>
<td></td>
<td></td>
<td>v) Cellular concrete (flyash-lime)</td>
<td>• Burnt-clay brick</td>
<td>• Traditional road material, clay</td>
</tr>
<tr>
<td></td>
<td></td>
<td>vi) Clay-flyash brick</td>
<td>• Road materials &amp; other fillers</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>vii) Stabilisation in roads, mines, lagoons</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>etc.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>fertiliser, hydro fluoric</td>
<td>• Gypsum plaster &amp; blocks</td>
<td></td>
<td>• Mineral gypsum</td>
</tr>
<tr>
<td></td>
<td>acid, boric acid)</td>
<td>• Gypsum plaster fibrous board</td>
<td></td>
<td>• Clay &amp; limestone</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Special cements</td>
<td></td>
<td>• Limestone</td>
</tr>
<tr>
<td>5.</td>
<td>Lime sludges form</td>
<td>• Raw meal component in cement</td>
<td>Raw meal in cement Traditional L.P. Lime from limestone Limestone based masonry cement</td>
<td>• Limestone &amp; clay</td>
</tr>
<tr>
<td></td>
<td>acetylene, sugar, paper</td>
<td>• Lime pozzolana mixture, (L.P.)</td>
<td></td>
<td>• Limestone</td>
</tr>
<tr>
<td></td>
<td>&amp; fertiliser industries</td>
<td>• Building lime</td>
<td></td>
<td>• Limestone</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Masonry cement</td>
<td></td>
<td>• Limestone</td>
</tr>
<tr>
<td>6.</td>
<td>Red mud (from alumina in</td>
<td>• Cement raw meal</td>
<td>Farraginous mairer High strength brick Stone and other aggregates</td>
<td>• Oxides of iron</td>
</tr>
<tr>
<td></td>
<td>aluminium)</td>
<td>• Bricks and tiles</td>
<td></td>
<td>• Clay, feldspar</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Sintered aggregate</td>
<td></td>
<td>• Clay, shale, slate</td>
</tr>
<tr>
<td>7.</td>
<td>Mine tailings (from zinc,</td>
<td>• Filler in concrete</td>
<td>Fine aggregates Sand (in sand-lime brick)</td>
<td>• Sand</td>
</tr>
<tr>
<td></td>
<td>copper, gold, iron mines)</td>
<td>• Calcium silicate bricks</td>
<td>Ground sand</td>
<td>• Sand</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Cellular concrete</td>
<td>Clay bricks</td>
<td>• Clay</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Tailing-clay brick</td>
<td>Limestone-cement based</td>
<td>• Limestone</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Masonry cement (tailing + cement)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
For further details please contact:

President
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