Environment Friendly Indian Building Material Technologies for Cost Effective Housing

SHEE

Contents

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	*Hydraulic Vibro Compaction*	*Vibro Compaction only*
Compressive strength:	80 – 150 kg/cm^2	60 – 120 kg/cm^2
Unit weight:	3 – 3.5 kg/brick	3 – 3.5 kg/brick
Water absorption:	8 – 10%	8 – 10%
Density:	1800 – 1950 kg/cumt.	1650 – 1800 kg/cumt.

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.mt.
- Covered area: 150 sq.mt.

Power

- KW: 12.75
- Three phase
- Voltage: 440V, 50 Htz.

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

Tentative Project Cost

Total	**US$ 25,600**
Main equipment	US$ 8,600
Essential Spareparts & tools	US$ 1,000
Civil Construction	US$ 6,000
Design & installation	US$ 2,000
Other expenses	US$ 1,000
Working Capital (one month)	US$ 7,000

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 Htz.

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

Tentative Project Cost

Total	**US$ 27,400**
Main equipment	US$ 10,900
Essential Spareparts & tools	US$ 1,000
Civil Construction	US$ 6,000
Design & installation	US$ 2,000
Other expenses	US$ 1,000
Working Capital (one month)	US$ 6,500

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.mt.
- Covered area: 150 sq.mt.

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

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

Tentative Project Cost

Total	**US$ 36,200**
Main equipment	US$ 19,200
Essential Spareparts & tools	US$ 2,000
Civil Construction	US$ 6,000
Design & installation	US$ 2,000
Other expenses	US$ 1,000
Working Capital (one month)	US$ 6,000

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.mt.
- Covered area: 200 sq.mt.

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

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

Tentative Project Cost

Total	**US$ 47,700**
Main equipment	US$ 25,200
Essential Spareparts & tools	US$ 2,000
Civil Construction	US$ 8,000
Design & installation	US$ 2,500
Other expenses	US$ 1,000
Working Capital (one month)	US$ 9,000

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 Htz.

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

Tentative Project Cost

Total	**US$ 58,500**
Main equipment	US$ 33,000
Essential Spareparts & tools	US$ 2,000
Civil Construction	US$ 8,000
Design & installation	US$ 2,500
Other expenses	US$ 1,000
Working Capital (one month)	US$ 12,000

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.mt.
- Covered area: 200 sq.mt.

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

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

Tentative Project Cost

Total	**US$ 72,000**
Main equipment	US$ 41,000
Essential Spareparts & tools	US$ 2,000
Civil Construction	US$ 8,000
Design & installation	US$ 2,000
Other expenses	US$ 1,000
Working Capital (one month)	US$ 18,000

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.mt.
- Covered area: 200 sq.mt.

Power
- KW: 35
- Three phase
- Voltage: 440V, 50 Htz.

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

Tentative Project Cost

Total	**US$ 107,000**
Main equipment	US$ 74,000
Essential Spareparts & tools	US$ 2,000
Civil Construction	US$ 8,000
Design & installation	US$ 2,000
Other expenses	US$ 1,000
Working Capital (one month)	US$ 20,000

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:
a. Compressed Earth Blocks: 50 - 100 kg/sq.mt.
b. Fly Ash-Sand-Lime-Gypsum Blocks: 100-250 kg/sq.mt.
Water absorption: 5 - 7 %

Main equipment

- Interlocking type block making machine
- Pan mixer
- Trolleys

Land requirement

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

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 Htz.

Manpower:

- Skilled (Nos.): 2
- Unskilled (Nos.): 10

Tentative Project Cost

Total	**US$ 34,100**
Main equipment	US$ 16,900
Essential Spareparts & tools	US$ 2,000
Civil Construction	US$ 8,000
Design & installation	US$ 2,000
Other expenses	US$ 1,000
Working Capital (one month)	US$ 4,200

Compressed Earth Bricks/Blocks

Use
Can be used in walling in a variety of ways to construct buildings that are aesthatic, 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/cm^2
Water absorption:	< 15 % by weight
Erosion:	<5% by weight
Surface characterstics:	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 Htz.

Manpower:

- Skilled (Nos.): 1
- Unskilled (Nos.): 8

Tentative Project Cost

Total	**US$ 12,400**
Main equipment	US$ 5,500
Essential Spareparts & tools	US$ 200
Civil Construction	US$ 4,000
Design & installation	US$ 500
Other expenses	US$ 100
Working Capital (one month)	US$ 2,100

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/cm^2
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 Htz.

Manpower:

- Skilled (Nos.): 1
- Unskilled (Nos.): 8

Tentative Project Cost

Total	US$ 14,000
Main equipment	US$ 5,000
Essential Spareparts & tools	US$ 200
Civil Construction	US$ 4,000
Design & installation	US$ 500
Other expenses	US$ 100
Working Capital (one month)	US$ 4,200

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 Htz.

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

Tentative Project Cost

Total	US$ 74,000
Main equipment	US$ 41,000
Essential Spareparts & tools	US$ 2,000
Civil Construction	US$ 8,000
Design & installation	US$ 2,000
Other expenses	US$ 1,000
Working Capital (one month)	US$ 20,000

Compressed Earth Bricks/Blocks

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

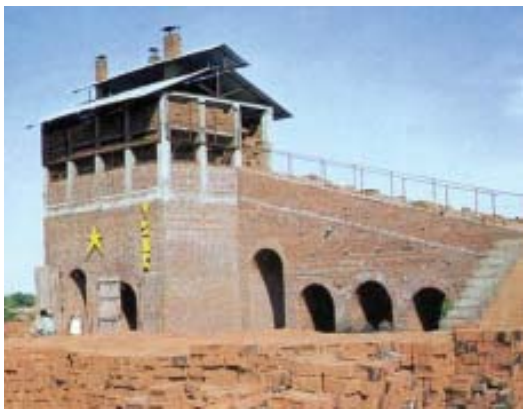
230 x 115 x 75 mm

Properties of product

Compressive strength:	75 - 150 kg/cm^2
Water absoption:	12 - 18%
Unit weight:	2.5 - 3 kgs
Bulk density:	1700 - 1900 kg/cm^2
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 Htz.

Manpower:

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

Tentative Project Cost

	High Drought Kiln	*Verticle Shaft Kiln*
Total	**US$ 300,000**	**US$ 245,000**
Main equipment including kiln	US$ 220,000	US$ 170,000
Essential Spareparts & tools	US$ 10,000	US$ 10,000
Civil Construction	US$ 20,000	US$ 20,000
Design & installation	US$ 5,000	US$ 5,000
Other expenses	US$ 5,000	US$ 5,000
Working Capital (one month)	US$ 40,000	US$ 35,000

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/cm^2
Water absorption: 14%
Volume of brick: 1687.5 cm^3
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 Htz.

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

Tentative Project Cost

Total	**US$ 25,600**
Main equipment	US$ 8,600
Essential Spareparts & tools	US$ 1,000
Civil Construction	US$ 6,000
Design & installation	US$ 2,000
Other expenses	US$ 1,000
Working Capital (one month)	US$ 7,000

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.mt.
- Covered area: 200 sq.mt.

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

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

Tentative Project Cost

Total	**US$ 47,700**
Main equipment	US$ 25,200
Essential Spareparts & tools	US$ 2,000
Civil Construction	US$ 8,000
Design & installation	US$ 2,500
Other expenses	US$ 1,000
Working Capital (one month)	US$ 9,000

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/cm^2
Water absorption:	< 10% by weight

Raw Material:
Cement, Sand, Aggregates

Option I: 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 Htz.

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

Tentative Project Cost

Total	US$ 9,900
Main equipment	US$ 3,000
Essential Spareparts & tools	US$ 200
Civil Construction	US$ 2,000
Design & installation	US$ 200
Other expenses	US$ 100
Working Capital (one month)	US$ 4,400

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 Htz.

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

Tentative Project Cost

Total	US$ 13,350
Main equipment	US$ 4,000
Essential Spareparts & tools	US$ 500
Civil Construction	US$ 4,000
Design & installation	US$ 250
Other expenses	US$ 200
Working Capital (one month)	US$ 4,400

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.mt.
- Covered area: 100 sq.mt.

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

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

Tentative Project Cost

Total	**US$ 17,750**
Main equipment	US$ 4,000
Essential Spareparts & tools	US$ 500
Civil Construction	US$ 4,000
Design & installation	US$ 250
Other expenses	US$ 200
Working Capital (one month)	US$ 8,800

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.mt.
- Covered area: 150 sq.mt.

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

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

Tentative Project Cost

Total	**US$ 36,600**
Main equipment	US$ 8,600
Essential Spareparts & tools	US$ 1,000
Civil Construction	US$ 6,000
Design & installation	US$ 2000
Other expenses	US$ 1000
Working Capital (one month)	US$ 18,000

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 Htz.

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

Tentative Project Cost

Total	**US$ 35,000**
Main equipment	US$ 5,500
Essential Spareparts & tools	US$ 1,000
Civil Construction	US$ 8,000
Design & installation	US$ 2,000
Other expenses	US$ 1,000
Working Capital (one month)	US$ 17,500

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

Production Capacity
2,40,000 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.mt.
- Covered area: 150 sq.mt.

Power

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

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

Tentative Project Cost

Total	**US$ 32,400**
Main equipment	US$ 15,400
Essential Spareparts & tools	US$ 1,000
Civil Construction	US$ 6,000
Design & installation	US$ 2,000
Other expenses	US$ 1,000
Working Capital (one month)	US$ 7,000

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.mt.
- Covered area: 200 sq.mt.

Power

- KW: 12
- Three phase
- Voltage: 440V, 50 Htz.

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

Tentative Project Cost

Total	**US$ 51,400**
Main equipment	US$ 21,400
Essential Spareparts & tools	US$ 1,000
Civil Construction	US$ 8,000
Design & installation	US$ 2,500
Other expenses	US$ 1,000
Working Capital (one month)	US$ 17,500

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,
Conctrete mixer, Pallets

Land requirement

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

Power

- KW: 16
- Three phase
- Voltage: 440V, 50 Htz.

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

Tentative Project Cost

Total	**US$ 76,700**
Main equipment	US$ 29,200
Essential Spareparts & tools	US$ 1,000
Civil Construction	US$ 8,000
Design & installation	US$ 2,500
Other expenses	US$ 1,000
Working Capital (one month)	US$ 35,000

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 m^3
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.mt.
- Covered area: 100 sq.mt.

Raw Material:

Cement, Fly Ash/Volcanic Ash, Fine Sand, Foaming Agent.

Power

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

Manpower:

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

Tentative Project Cost

Total	**US$ 101,500**
Main equipment	US$ 47,500
Essential Spareparts & tools:	US$ 3,000
Civil Construction	US$ 4,000
Design & installation	US$ 5,000
Other expenses	US$ 2,000
Working Capital (one month)	US$ 40,000

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
Compressived strength: 150 kg/cm^2
Water absorption: <5%

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

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

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

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

Manpower:

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

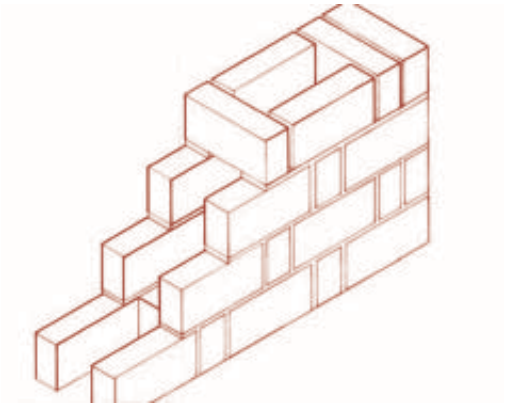
Tentative Project Cost

Total	**US$ 19,500**
Main equipment	US$ 8,000
Essential Spareparts & tools	US$ 500
Civil Construction	US$ 4,000
Design & installation	US$ 1,000
Other expenses	US$ 500
Working Capital (one month)	US$ 5,500

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 stablity 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/cm^2
For 2 storeyed building: 35 kg/cm^2
For 3 storeyed building: 75 kg/cm^2

Production Capacity

0.3 million tiles per Annum (8 hrs shift)

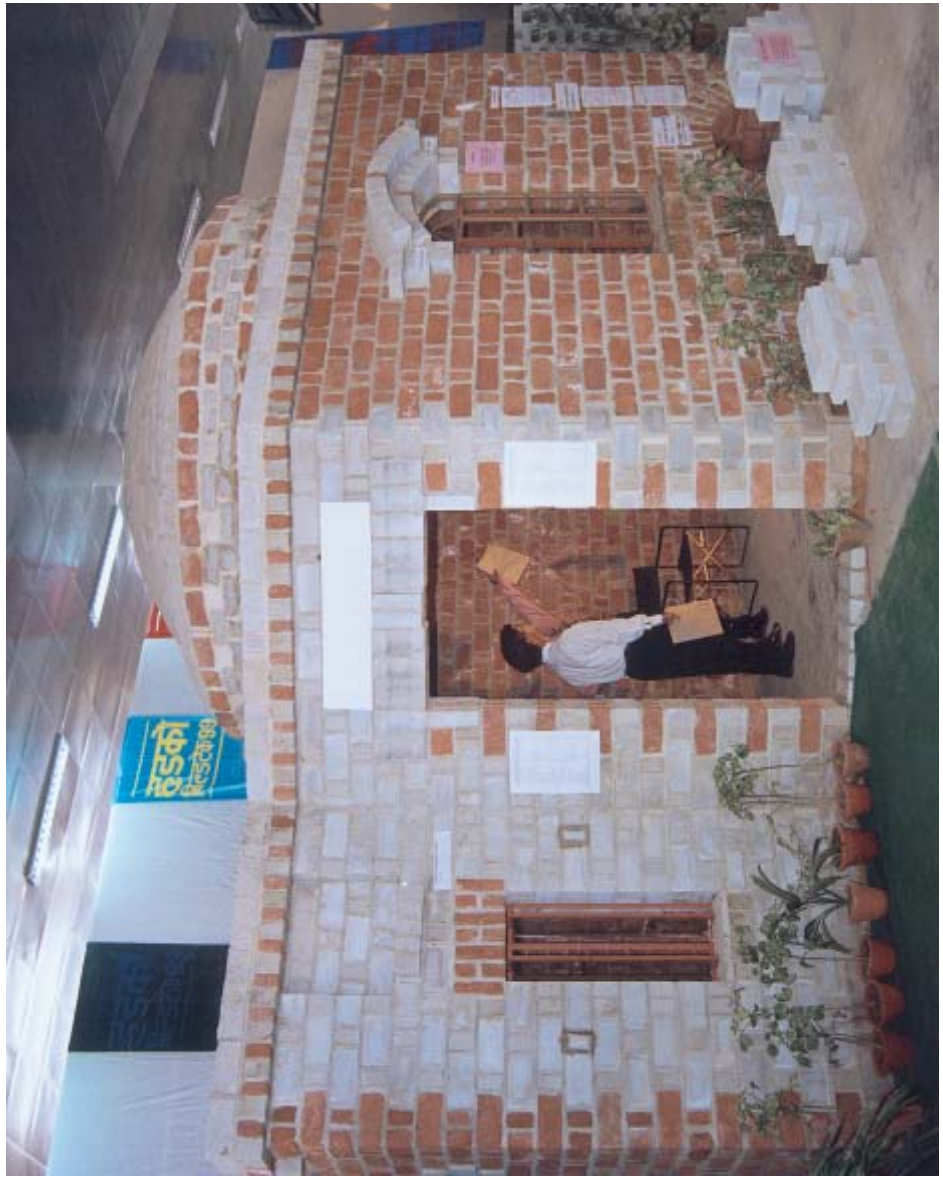
Raw Material (for 1 cu.mt. of masonry)

Bricks:	400 nos.
Cement:	36 kgs.
Sand:	0.15 m^3
Scaffolding:	2.00 m^3

Manpower (for 1 cu.mt. of masonry)

Skilled :	1.60 mandays
Unskilled :	4 mandays
Labour:	0.5 mandays

Rat Trap Bonded Brick Masonry



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
- Managable 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 Htz.

Manpower:

- Skilled (Nos.): 1
- Unskilled (Nos.): 3

Tentative Project Cost

Total	**US$ 10,825**
Main equipment	US$ 4,375
Essential Spareparts & tools	US$ 500
Civil Construction	US$ 4,000
Design & installation	US$ 1,000
Other expenses	US$ 200
Working Capital (one month)	US$ 750

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
- Elegent 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
Botton Nib dimension:	40 x 45 mm
Span:	Upto 6.1 mtrs.

Properties of product

Unit weight:	70 kg/mtr
Density:	2400 kg/m^3
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 Htz.

Manpower:

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

Tentative Project Cost

Total	**US$ 23,600**
Main equipment	US$ 10,800
Essential Spareparts & tools	US$ 1000
Civil Construction	US$ 6,000
Design & installation	US$ 2,000
Other expenses	US$ 1000
Working Capital (one month)	US$ 2,800

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/cm^2
Thermal transmission (U) value:	2.189 kcal/hr/m^2/^{o}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 pully

Land requirement

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

Power

- KW: 9.75
- Three phase
- Voltage: 440V, 50 Htz.

Manpower:

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

Tentative Project Cost

Total	**US$ 26,300**
Main equipment	US$ 14,000
Essential Spareparts & tools	US$ 1,000
Civil Construction	US$ 6,000
Design & installation	US$ 500
Other expenses	US$ 100
Working Capital (one month)	US$ 4,700

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 Htz.

Manpower:

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

Tentative Project Cost

Total	US$ 51,900
Main equipment	US$ 14,800
Essential Spareparts & tools	US$ 1,000
Civil Construction	US$ 8,000
Design & installation	US$ 1000
Other expenses	US$ 500
Working Capital (one month)	US$ 26,600

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.mt.
- Covered area: 200 sq.mt.

Power

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

Manpower:

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

Tentative Project Cost

Total	US$ 56,475
Main equipment	US$ 19,375
Essential Spareparts & tools	US$ 1,000
Civil Construction	US$ 8,000
Design & installation	US$ 1,000
Other expenses	US$ 500
Working Capital (one month)	US$ 26,600

RCC Planks and Joists

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
Compressived strength: 150 kg/cm^2

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

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

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

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

Manpower:
- Skilled (Nos.): 6
- Unskilled (Nos.): 20

Tentative Project Cost

Total	**US$ 51,500**
Main equipment	US$ 8,500
Essential Spareparts & tools	US$ 500
Civil Construction	US$ 6,000
Design & installation	US$ 1,000
Other expenses	US$ 500
Working Capital (one month)	US$ 35,000

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 foundationand 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 fo 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: 150kg/cm^2

Main equipment

- L-Panel casting machine
- Concrete mixer
- Moulds
- Welding machine
- Lifting arrangement with chain & pully

Land requirement

- Open area: 1000 sq.mt.
- Covered area: 100 sq.mt.

Raw Material:

Cement, Sand, Aggregates, Steel, Polyproplyne fibre, Admixtures

Power

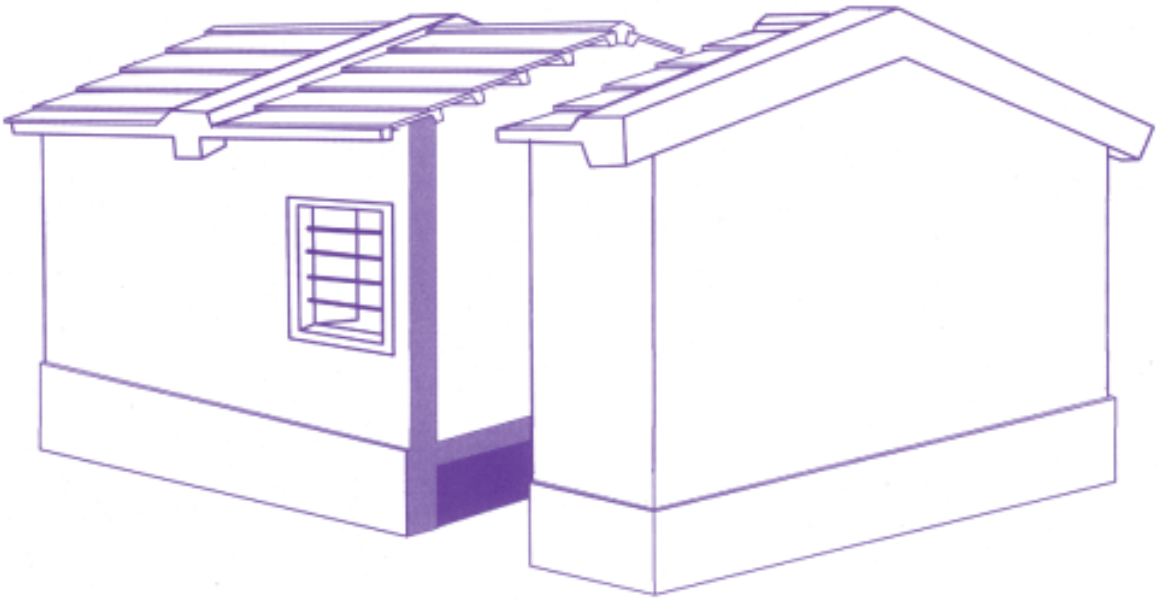
- KW: 8
- Three phase
- Voltage: 440V, 50 Htz.

Manpower:

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

Tentative Project Cost

Total	**US$ 20,700**
Main equipment	US$ 8,500
Essential Spareparts & tools	US$ 1,000
Civil Construction	US$ 4,000
Design & installation	US$ 1,000
Other expenses	US$ 500
Working Capital (one month)	US$ 5,700



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
Compressived strength: 250 kg/cm^2

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

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

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

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

Manpower:

- Skilled (Nos.): 2
- Unskilled (Nos.): 9

Tentative Project Cost

Total	**US$ 21,200**
Main equipment	US$ 8,500
Essential Spareparts & tools	US$ 1,000
Civil Construction	US$ 4,000
Design & installation	US$ 1,000
Other expenses	US$ 500
Working Capital (one month)	US$ 6,200

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 Htz.

Manpower:

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

Tentative Project Cost

Total	**US$ 21,500**
Main equipment	US$ 8,500
Essential Spareparts & tools	US$ 500
Civil Construction	US$ 8,000
Design & installation	US$ 1,000
Other expenses	US$ 1,000
Working Capital (one month)	US$ 2,500

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/cm^2
Flexural strength:	> 35 kg/cm^2
Abrasion resistance	> 35 mm
Water absorption:	< 9%
Desity:	1800 kg/m^3

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.mt.
- Covered area: 150 sq.mt.

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

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

Tentative Project Cost

Total	US$ 24,900
Main equipment	US$ 8,600
Essential Spareparts & tools	US$ 1,000
Civil Construction	US$ 6,000
Design & installation	US$ 2,000
Other expenses	US$ 1,000
Working Capital (one month)	US$ 6,300

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.mt.
- Covered area: 150 sq.mt.

Power

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

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

Tentative Project Cost

Total	US$ 28,000
Main equipment	US$ 8,000
Essential Spareparts & tools	US$ 3,000
Civil Construction	US$ 6,000
Design & installation	US$ 2,000
Other expenses	US$ 1,000
Working Capital (one month)	US$ 8,000

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.mt.
- Covered area: 150 sq.mt.

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

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

Tentative Project Cost

Total	**US$ 29,400**
Main equipment	US$ 15,400
Essential Spareparts & tools	US$ 1,000
Civil Construction	US$ 6,000
Design & installation	US$ 2,000
Other expenses	US$ 1,000
Working Capital (one month)	US$ 4,000

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.mt.
- Covered area: 200 sq.mt.

Power
- KW: 12
- Three phase
- Voltage: 440V, 50 Htz.

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

Tentative Project Cost

Total	**US$ 46,500**
Main equipment	US$ 21,400
Essential Spareparts & tools	US$ 1,000
Civil Construction	US$ 8,000
Design & installation	US$ 2,500
Other expenses	US$ 1,000
Working Capital (one month)	US$ 12,600

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 Htz.

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

Tentative Project Cost

Total	**US$ 67,900**
Main equipment	US$ 29,200
Essential Spareparts & tools	US$ 2,000
Civil Construction	US$ 8,000
Design & installation	US$ 2,500
Other expenses	US$ 1,000
Working Capital (one month)	US$ 25,200

Mosaic & Checkered Flooring Tiles

Use

Mosaic Tiles: For flooring in housing and building construction

Checkered Tiles: For pedestrial pathways, garrage, 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

Compressived strength:	200 kg/cm^2
Weight:	3.5 kgs
Flexural strength:	30 kg/cm^2

Main equipment

Tile press, Concrete mixer, Tile mateial mixing ball mill, Tile grinder, Racks

Land requirement

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

Raw Material:

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

Power

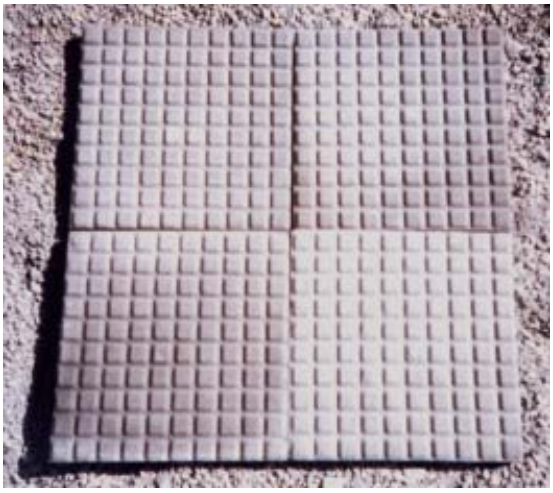
- KW: 15
- Three phase
- Voltage: 440V, 50 Htz.

Manpower:

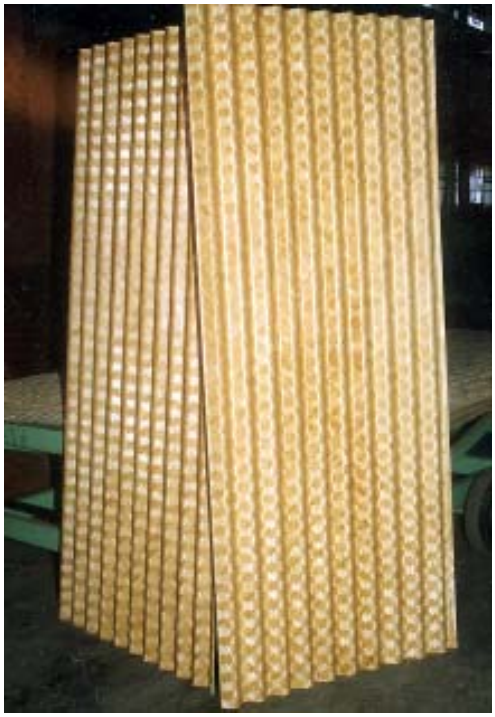
- Skilled (Nos.): 3
- Unskilled (Nos.): 6

Tentative Project Cost

Total	**US$ 28,500**
Main equipment	US$ 12,000
Essential Spareparts & tools	US$ 2,000
Civil Construction	US$ 8,000
Design & installation	US$ 1,500
Other expenses	US$ 1,000
Working Capital (one month)	US$ 4,000



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/mm^2
Deflection at breaking point:	85 mm
Thermal conductity:	0.1928 Kcal/m^{o}c
Modulus of rupture:	40 - 45 N/mm^2
Internal bond strength:	1.3 - 1.4 N/mm^2
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.mt.
- Covered area: 2000 sq.mt.

Raw Material:

Bamboo mats, polymer, preservatives, brush bond coating

Power

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

Manpower:

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

Tentative Project Cost

Total	**US$ 628,000**
Main equipment	US$ 360,000
Essential Spareparts & tools	US$ 50,000
Civil Construction	US$ 140,000
Design & installation	US$ 25,000
Other expenses	US$ 10,000
Working Capital (one month)	US$ 43,000



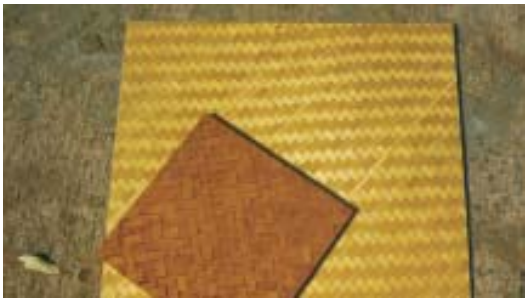




Bamboo Mat Boards

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/mm^2
Compressive strength:	35.3 N/mm^2
Modulus of rupture:	59.4 N/mm^2
Modulus of elasticity:	3144 N/mm^2
Modulus of rigidity:	6066 N/mm^2

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 Htz.

Manpower:

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

Tentative Project Cost

Total	**US$ 535,000**
Main equipmentincluding kiln	US$ 300,000
Essential Spareparts & tools	US$ 20,000
Civil Construction	US$ 140,000
Design & installation	US$ 25,000
Other expenses	US$ 10,000
Working Capital (one month)	US$ 40,000









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 retardent
- 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/m^3
Moisture content:	6.5 %
Glue shear strength:	1720 N/mm^2
Water resistance:	No delamination
Tensile strength:	23.6 N/mm^2
Compression strength:	51.02 N/mm^2
Modulus of elasticity:	6440 N/mm^2
Modulus of rupture:	47.5 N/mm^2
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 Htz.

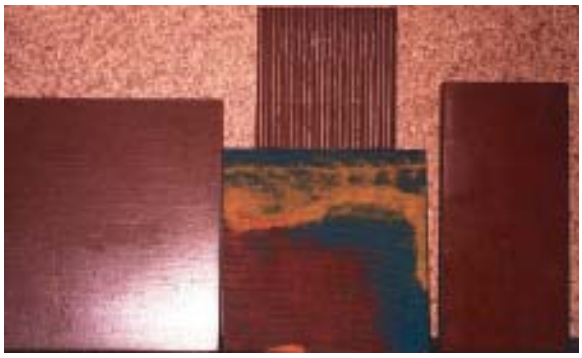
Manpower:

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

Tentative Project Cost

Total	**US$ 6525,000**
Main equipment	US$ 5250,000
Essential Spareparts & tools	US$ 200,000
Civil Construction	US$ 200,000
Design & installation	US$ 100,000
Other expenses	US$ 50,000
Working Capital (one month)	US$ 725,000

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 m^2 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/mm^2
Tensile strength:	22 - 24 N/mm^2
Moisture content:	0.2 - 0.38 %
Compression perpendicular to surface:	78 - 101 N/mm^2
Compression parallel to surface:	44 - 51 N/mm^2
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 retardency:	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 Htz.

Manpower:

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

Tentative Project Cost

Total	**US$ 263,000**
Main equipment	US$ 185,000
Essential Spareparts & tools	US$ 10,000
Civil Construction	US$ 15,000
Design & installation	US$ 5,000
Other expenses	US$ 3,000
Working Capital (one month)	US$ 45,000

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 soud and themal 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 fames

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/mm^2
Tensile strength:	74.40 N/mm^2
Shear modulus:	2970 N/mm^2
Shear strength:	16.40 N/mm^2

Main equipment

Moulds, Moulding tables, Hand/Power operated press, Hand planning machine, Hand shearing machine, Bent vice, Sandering 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 Htz.

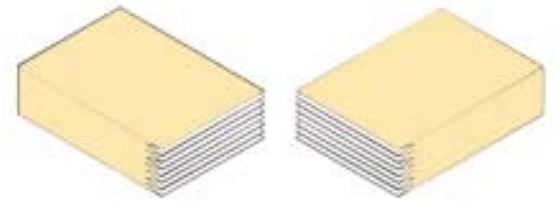
Manpower:

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

Tentative Project Cost

Total	**US$ 73,500**
Main equipmentincluding kiln	US$ 20,000
Essential Spareparts & tools	US$ 2,000
Civil Construction	US$ 21,000
Design & installation	US$ 2,000
Other expenses	US$ 500
Working Capital (one month)	US$ 28,000

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/mm^2
2. Poplar wood:	45 N/mm^2
3. Silver oak:	50 N/mm^2
4. Eucalyptus:	65 N/mm^2

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 Htz.

Manpower:

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

Tentative Project Cost

Total	**US$ 92,000**
Main equipment	US$ 55,000
Essential Spareparts & tools	US$ 5,000
Civil Construction	US$ 15,000
Design & installation	US$ 5,000
Other expenses	US$ 2,000
Working Capital (one month)	US$ 10,000

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 mounteneous terrain) for immediate occupation. Normally such structures are recommended for remote areas where camps for army, refugees/returnees along with other infrastructure like hospital, gymnasia, 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 retreivability 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 feets) 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

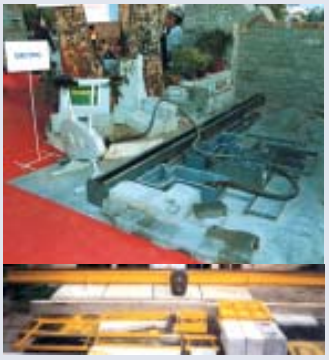
Supervisor : 1, Mason : 1, and local labour : 10-15 depending upon the number of structures to be put at one location

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

TNG Rural Housing Kit



Use:
For Production of building components for a complete house using local materials

Combination Machine

Use:
For Production of Ferrocement C-Section, Lintels and Shelves which replaces similar elements made of steel and timber.

Bar and Pipe Cutting Machine

Use:
For cuting bars and pipes to suit the requirement

Multipurpose Stone Processing Machine

Use:
Versatile stone drilling, cutting and polishing machine for semi-precious stone furniture and decorative items for rural and cottage industries.

Stone/Coal Disintegrator

Use:
For crushing of stone/boulders/ coal at site.

Ferrocement Door Casting Machine

Use:
For Production of ferocement door shutters.

Setting up a Technology Demonstration cum Production Centre for Manufacturing of Prefab Building Components

Production Capacity

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

Size of product

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

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, polyproplyne fibre, chicken mesh, welded mesh, inserts, gullies, bolts, clay.

Power

- KW: 115
- Three phase
- Voltage: 440V, 50 Htz.

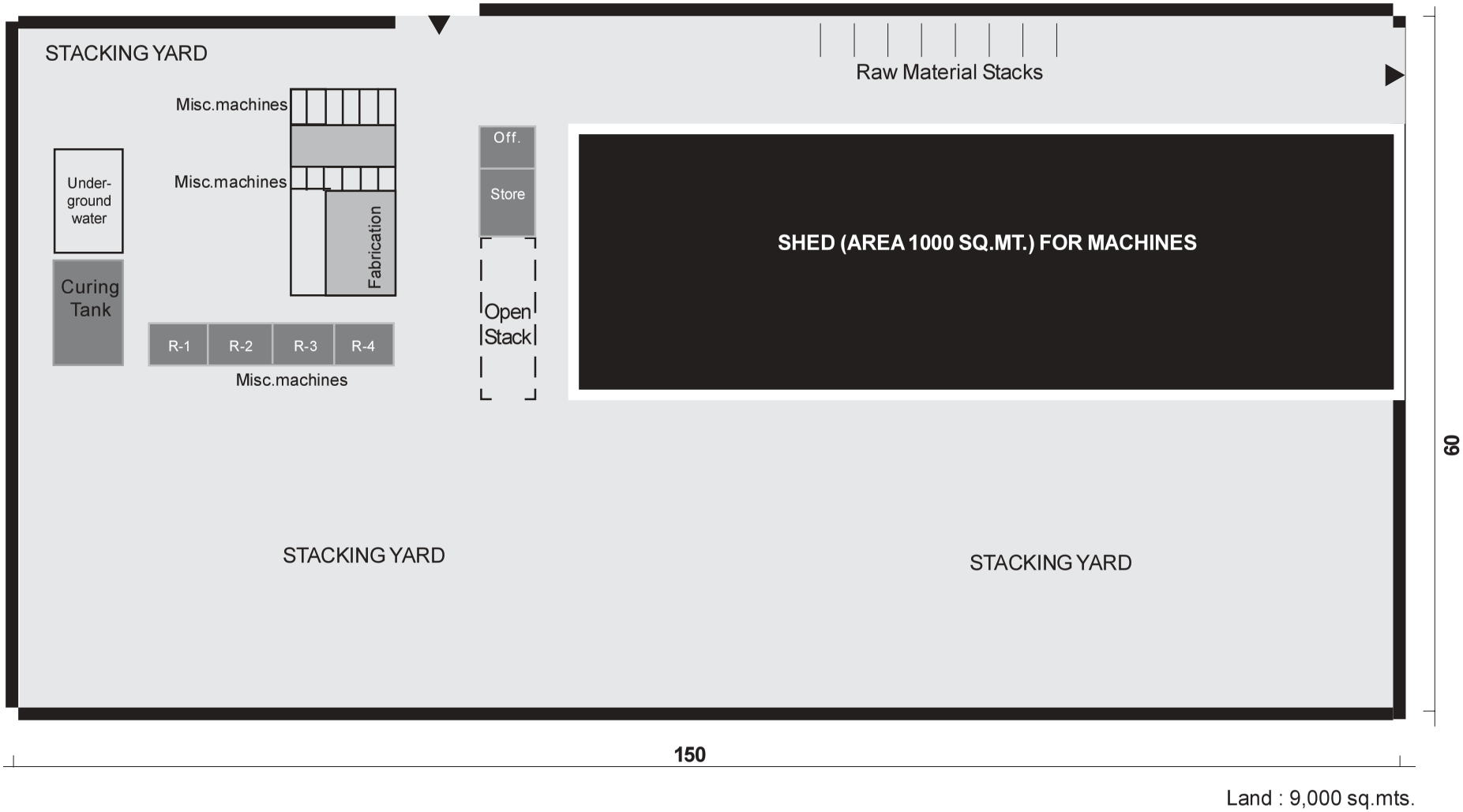
Manpower:

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

Tentative Project Cost

Total	**US$ 325,000**
Main equipment	US$ 160,000
Essential Spareparts & tools	US$ 10,000
Civil Construction	US$ 40,000
Design & installation	US$ 15,000
Training of local technicians	US$ 35,000
Other expenses	US$ 5,000
Working Capital (one month)	US$ 60,000

Setting up a Technology Demonstration cum Production Centre



Land : 9,000 sq.mts.

Layout Plan of a Technology Demonstration cum Production Centre

Production Days for components of a House (60 Sq.mts.)

PRODUCTION DAYS FOR COMPONENTS OF A HOUSE (60 SQMTS) WITH VARIOUS WALLING & ROOFING OPTIONS

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

Note: Components of 84 houses can be produced in a month using different machines.

Industrial, mining, mineral wastes and their applications in building materials as alternate to traditional materials and natural resources

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

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