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Environment Friendly Building Material Technologies for Low Cost Housing

International Centre for Materials Technology Promotion
United Nations Industrial Development Organization
Beijing, P.R.China

Contents

Foreword (by Director CBMA)

The technologies from China presented here are selected by International Center for Materials Technology Promotion (ICM)/China Building Materials Academy (CBMA). These technologies are specially chosen for low-cost housing in the developing countries. Low-cost housing technology is now keenly needed in most of these countries, especially in African, Latin American, Asian regions and post-disaster areas. I am sure that technologies from China, the largest developing countries, are the most suitable for these countries.

ICM is one of the International Technology Centers established by UNIDO with the support of Chinese government, with its premises in CBMA. During the past half century, CBMA has made great contributions to the scientific and technological advancement of Chinese building materials industry. CBMA has also actively involved in most of the key engineering projects in China like the Green Olympic 2008 construction projects, Three Gorges Dam project, etc. I hope this technical catalogue can be of great help for post-disaster rehabilitation and house building in the developing countries.

I would like to acknowledge the contribution of Mr. T. N. Gupta, Former Executive Director of Building Materials & Technology Promotion Council (BMTPC), Ministry of Urban Development & Poverty Alleviation of India, who made his keen efforts to guide the preparation of this catalogue.

Yao Yan
Professor
President of CBMA
Director of ICM
Beijing, China
April, 2005

CBT
01

Cement plant (capacity from 300tpd to 12000tpd)

Cement plant (capacity from 300tpd to 12000tpd)

ICM can undertake the design and technical service for various types of cement production lines, from the most advanced large scale - 12000t/d NSP line to small scale - 300t/d line.

Take 300t/d line as an example.

Use

For production of OPC or special cements

Production Capacity

Clinker output: 300t/day
Output: 12.5t clinker/hour or 14t cement/hour

Size of product

32.5# & 42.5# Portland cement (ISO679: 1989)

Properties of product

Compressive strength (MPa)	3d	32.5OPC: 11.0	42.5 OPC: 17.0
	28d	32.5 OPC: 32.5	42.5 OPC: 42.5
Flexural strength (MPa)	3d	32.5 OPC: 2.5	42.5 OPC: 3.5
	28d	32.5 OPC: 5.5	42.5 OPC: 6.5

Manufacturing process

Dry process for manufacturing cement. One ø3×48m rotary kiln with preheaters.

Land requirement

- Road: 8000m^2
- Covered area: 8000m^2

Raw Material

- Limestone,
- Clay,
- Ironstone,
- Gypsum.

Fuel: Coal or Petroleum.

Power

- Heat energy consumption: 4600kJ/kg clinker (1100 kcal/kg clinker)
- Electricity consumption: 125kW • h/t clinker
- Three phase
- Voltage: 380V

Manpower Skilled (Nos.): 150
Unskilled (Nos.): 80

Main manufacturing workshops

No.	Workshop	hrs/day	days/week	hrs/week
1	Crusher department	8	6	48
2	Drying department	8	6	48
3	Raw mix preparation department	22	6	132
4	Clinker sintering department	24	7	168
5	Cement making department	22	6	132
6	Cement package department	8	6	48

Project cost

PROJECT COST	**US$ 9,181,000**
Main equipment	US$ 3,616,000
Essential Spareparts & tools	US$ 100,000
Civil engineering	US$ 3,532,000
Electricity transmission outside the plant	US$ 223,000
Construction & installation	US$ 1,165,000
Other expenses	US$ 645,000
Working Capital (one month)	US$ 1, 500,000

Cement plant (capacity from 300tpd to 12000tpd)

CBT
02

Lime-Sand Bricks

Lime-Sand Bricks

Use

For load bearing walls of low-rise buildings;
A good substitute for clay brick.

Production Capacity

30 million pieces of brick per year

Size of product

240×115×53mm

Properties of product

Compressive strength (MPa):	10	15	20	25
Flexural strength (MPa):	2.5	3.3	4.0	5.0

Main equipment

- Crushing machine,
- Ball mill, mixer,
- Brick forming machine,
- High pressure steam vessel,
- Boiler.

Land requirement

- Road: 10000m^2
- Covered area: 800m^2

Raw Material: Lime, sand.

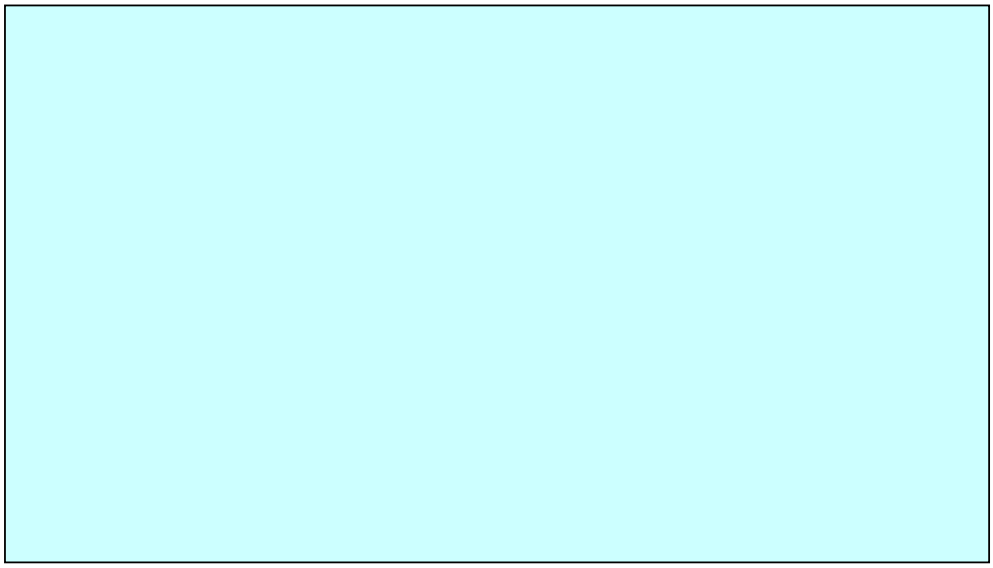
Power

- KW: 40
- Three phase
- Voltage: 380V

Manpower: Skilled (Nos.): 3
Unskilled (Nos.): 30

Project Cost

Total	**US$ 410,000**
Main equipment	US$ 300,000
Essential Spareparts & tools: Metering equipment and conveying equipment, etc.	US$ 10,000
Civil Construction Lime silo, boiler house, lime reaction silo, etc.	US$ 50,000
Design & installation	US$ 5,000
Other expenses	US$ 5,000
Working Capital (one month)	US$ 40,000



Lime-Sand Bricks

CBT
03

Cement-Waste Slag Brick

Cement-waste slag brick

Use
For load bearing walls of low-rise buildings.

Features
A lot of waste slag can be recycled.
Either natural curing or steam curing for bricks.

Production Capacity
15 million pieces/year

Size of product
240×115×53mm

Properties of product
- Compressive strength: 10-30MPa
- Flexural strength: 2.6kg-5.0MPa
- Water absorption: 12.2%-13%

Main equipment
- Mixer,
- Brick forming machine,
- Belt conveyer,
- Metering equipment.

Land requirement
Open: 10000m^2 Workshop: 100 -200m^2
Covered: 200m^2

Raw Material
Waste slag (80%): fly ash, coal gangue, slag, etc.
Aggregate: stone powder or river sand
Bonding agent (20%): cement or gypsum.

Composition of each raw material for the product
Waste slag: fly ash, coal gangue, slag, etc.
Aggregate: stone powder or river sand
Bonding agent: cement.

Power

- KW: 35
- Three phase
- Voltage: 380V

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

Project Cost

Total	**US$ 63,000**
Main equipment	US$ 30,000
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

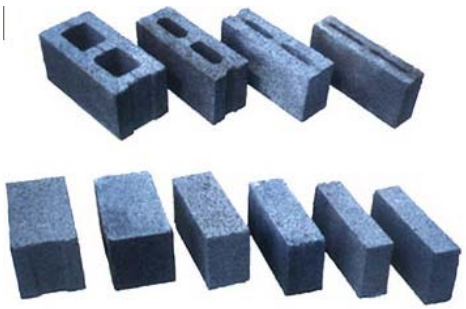
CBT
04

Concrete hollow block

Concrete hollow block

Use

For walls



Features

- Wide source of raw materials
- Simple manufacturing process
- High construction speed
- The same process for Fly ash concrete block
- The same process for Lightweight concrete hollow block

Size of product

390×190×190mm

Properties of product

Compressive strength (MPa): 3.5, 5.0, 7.5, 10.0, 15.0, 20.0;

Raw Material

Concrete Hollow Block: Cement, sand, aggregates
Fly ash concrete block: Cement, fly ash, aggregates
Lightweight concrete hollow block: Cement, lightweight aggregate, such as, fly ash, ceramisite, pumice, furnace slag, cinder, pearlite and other waste slags.

I Simple production line (Movable block forming machine)

Production Capacity

4 pieces/60s, 15000m^3/year (2 shifts, 8 hours per shift)

Main equipment

Mixer, Movable block forming machine (CXJ-A)

Land requirement

Open: 3000m^2
Covered: 100m^2 (shed)

Power KW: 10
Three phase
Voltage: 380V

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

Project Cost

Total	**US$ 37,600**
Main equipment	US$ 5,000
Essential Spareparts & tools	US$ 1,000
Civil Construction	US$ 1,000
Design & installation	US$ 500
Other expenses	US$ 100
Working Capital (one month)	US$ 30,000

II Semi-automatic production line

(Stationary block forming machine)

Production Capacity
4 pieces/25s, 35000m^3/ year
(2 shifts, 8 hours per shift)

Main equipment
Mixer, Stationary block forming machine (QMJ4 – 25), Belt conveyer.

Land requirement
Open: 5000m^2
Covered:100m^2 (shed)

Power KW: 50
Three phase
Voltage: 380 V

Manpower Skilled (Nos.): 1
Unskilled (Nos.): 7

Project Cost

Total	**US$ 113,000**
Main equipment	US$ 35,000
Essential Spareparts & tools	US$ 5,000
Civil Construction	US$ 1,000
Design & installation	US$ 1,000
Other expenses	US$ 1,000
Working Capital (one month)	US$ 70,000

III Fully automatic production line

Production Capacity

9 pieces/15s, 100,000m^3/year (2 shifts, 8 hours per shift)

Main equipment

Whole set of automatic production line, including computer controlled system, metering system, mixing system, conveying system, block forming system and standard moulds, etc.

Land requirement

Open: 10000m^2

Covered: 1000m^2 (shed)

Raw Material

Concrete Hollow Block: Cement, sand, aggregates

Fly ash concrete block: Cement, fly ash, aggregates

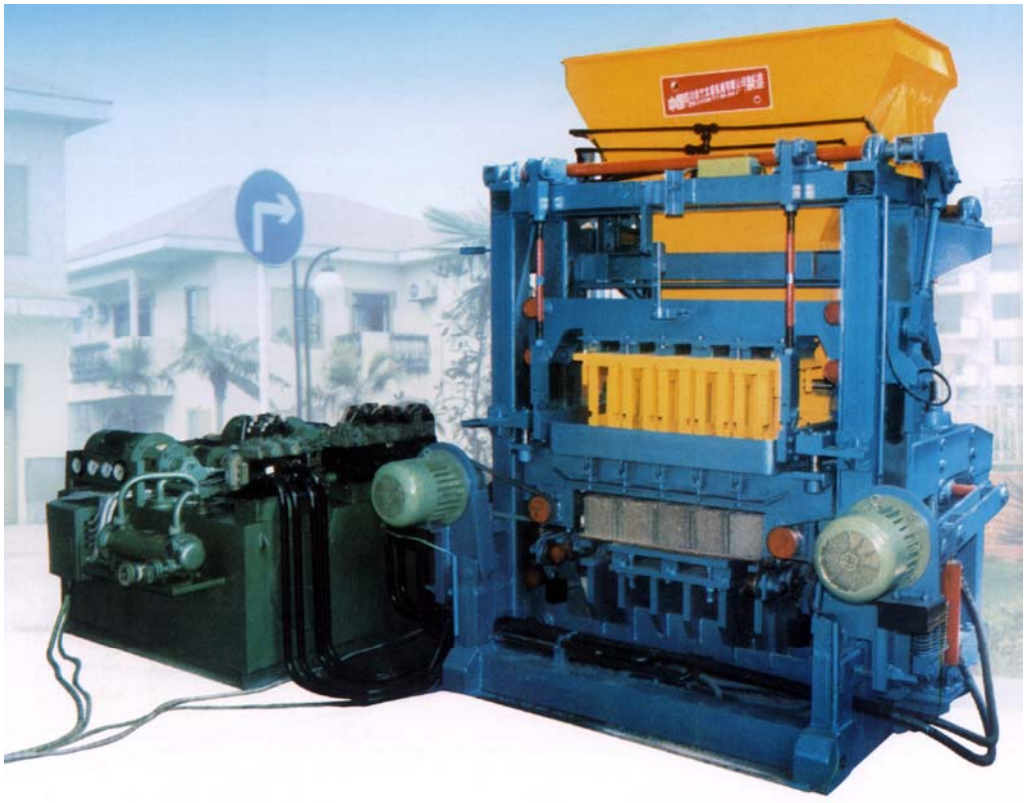
Lightweight concrete hollow block: Cement, lightweight aggregate, such as, fly ash, ceramisite, pumice, furnace slag, cinder, pearlite and other waste slags.

Power KW: 50
Three phase
Voltage: 380

Manpower Skilled (Nos.): 1
Unskilled (Nos.): 11

Project Cost

Total	**US$ 1,015,000**
Main equipment	US$ 600,000
Essential Spareparts & tools Fork truck, loader, boiler, etc.	US$ 50,000
Civil Construction Workshop, Cement silo, fly ash silo, steam curing kiln	US$ 50,000
Design & installation	US$ 10,000
Other expenses	US$ 5,000
Working Capital (one month)	US$ 300,000



Concrete hollow block

CBT
05

Decorative Concrete Block

Decorative Concrete Block

Use
For decoration of exterior walls

Features
Combination of structural function and decorative function;

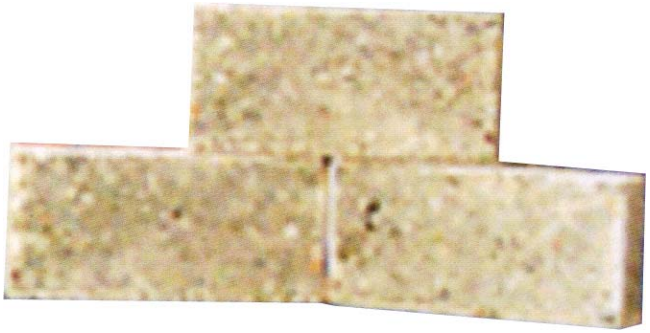
Production Capacity
2 pieces/15s, 1,000,000pieces/year

Size of product
Standard size: 390×190×190mm
Facing block: Maximal surface area 590×290mm (thickness upon demand)

Properties of product
Compressive strength (MPa):
Hollow block: 7.5, 10.0, 15.0, 20.0;
Solid block: 10.0, 15.0, 20.0, 25.0, 30.0;
Flexural strength of Facing block: >4.0

Main equipment

- Mixer,
- Block forming machine,
- Metering system,
- Conveyer,
- Splitting machine.



Land requirement:
Open: 3000m^2
Covered: 600m^2

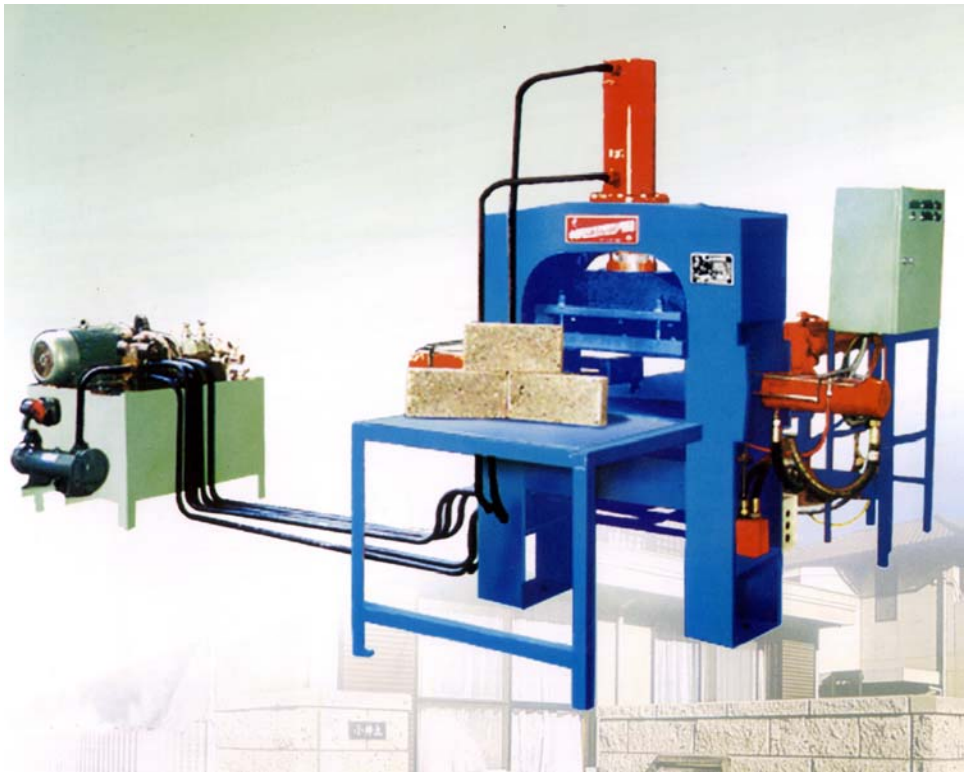
Raw Material
Cement, sand, stone, admixture, pigment

Power KW: 60
Three phase
Voltage: 380 V

Manpower Skilled (Nos.): 1
Unskilled (Nos.): 20

Project cost

Total	**US$ 123,000**
Main equipment	US$ 45,000
Essential Spareparts & tools	US$ 5,000
Civil Construction	US$ 1,000
Design & installation	US$ 1,000
Other expenses	US$ 1,000
Working Capital (one month)	US$ 70,000



Decorative Concrete Block

CBT 06

Lightweight Concrete Hollow (3E) Panel

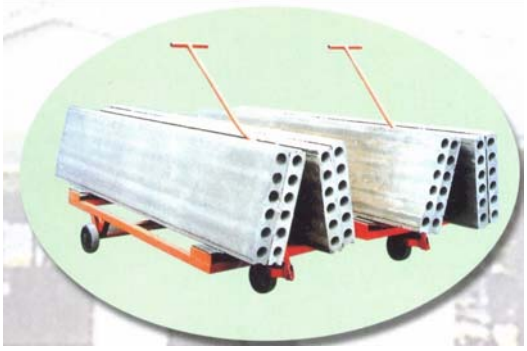
Lightweight Concrete Hollow (3E) Panel

Use

3E panel is for walling system of steel reinforced concrete - lightweight panel system.

Features

- 3E panel (Ecological, Extruding Process, Economical)
- Specially designed for low-cost house.
- 3E house (Easy, Energy-saving, Ensure) can be installed and rapidly constructed with 3E panels.
- Excellent shock resistance: post-casted stem, panel and ring beam form an integrated structure.



Production Capacity

150,000m^2/year (per shift of 8 hours)

Size of product

2500-3000×600×90mm
(thickness is optional upon demand: 60 to 120mm)

Properties of product

- Air-dried density (kg/m^2): 45-58
- Flexural failure load (N): 2500-3000
- Compressive strength (MPa): 6-12

Main equipment

- Panel extruding machine,
- Compulsory mixer,
- Cutting machine,
- Fiber cutting and spraying machine,
- Grinding machine,
- Feeder, etc.

Land requirement

- Open: 5000-7000m^2
- Covered: 100-200m^2 (office and storehouse), 500-800m^2(workshop)

Lightweight Concrete Hollow (3E) Panel

Raw Material

Cement, Fly ash (not necessarily), glass fiber or steel wire, aggregate (optional: sand, stone, blast-furnace slag, pearlite, ceramisite, pumice, and other slags).

Power KW: 20
Three phase
Voltage: 380V

Manpower Skilled (Nos.): 1
Unskilled (Nos.): 8-12

Project Cost

Total	**US$155,000**
Main equipment	US$ 60,000
Essential Spareparts & tools	US$ 5, 000
Civil Construction	US$ 10,000
Design & installation	US$ 10,000
Other expenses	US$ 10,000
Working Capital(one month)	US$ 60,000

CBT
07

Foam Fly Ash - Concrete Panel

Foam fly ash - concrete panel

Use

Foam fly ash - concrete panel for Partition wall, EPS sandwiched external wall panel, Reinforced hollow floor panel, EPS sandwiched roof panel

Features

- Easily worked and rapid on-site assembly
- Light weight
- Fire resistant
- Energy efficient: 80%
- Excellent acoustic performance
- Designed for inner comfort: cooler in summer, warmer in winter

Production Capacity

Annual production of 300,000m^2

Size of product

Product type (all size are available according to requirement):

ASA partition wall panel

Size: 2700～2540×600×60～50mm or 3000～2540×600×90～120mm

ASA EPS sandwiched external wall panel: 2700～2540×600×60～120mm

ASA reinforced hollow floor panel: 4300～2000×600×120mm

ASA EPS sandwiched roof panel: 3000～2000×600×90～120mm

Main equipment

- Raw materials preparing and conveying system
- Foaming and casting system
- Curing system
- Computer-controlled System
- Testing system, etc.

Land requirement:

Open: 2000-5000m^2

Covered: 3200m^2
(Workshop, warehouse, office, laboratory)

Raw Material

Fly ash (50-70%), cement, forming agent, reinforced materials

Power KW: 50
Three phase
Voltage: 380 V

Manpower Skilled (Nos.): 10
Unskilled (Nos.): 50

PROJECT COST	**US$ 1,250,000**
Main equipment	US$ 850, 000
Essential Spareparts & tools	US$ 10,000
Civil Construction Workshop, warehouse, office, laboratory	US$ 100,000
Design & installation	US$ 50,000
Other expenses	US$ 50,000
Working Capital (one month)	US$ 200,000

Foam fly ash - concrete panel

CBT
08

Concrete Hooking panel

Concrete Hooking panel

Use

This panel can be used for wall of low-rise and high-rise buildings

Features

- The wall is assembled by concrete hooking panel and concrete or steel hook.
- No auxiliary materials are needed for assembling. No need for bonding or anchoring for the panel.
- The house built with hooking panel is quake-proof and fireproof
- The machine can produce many kinds of panels
- Low-cost: US$40/m^2 building area

Production Capacity

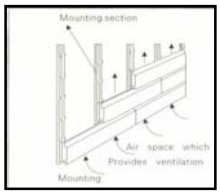
90,000m2 (per shift 7 hours)

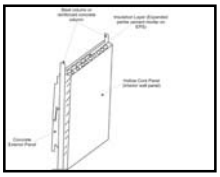
Size of product

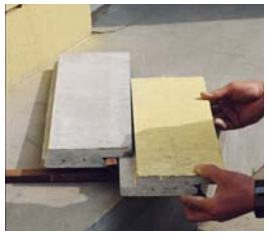
Hooking panel: 1200mm×165mm×30mm
Inside panel: 2700mm×600mm×90mm

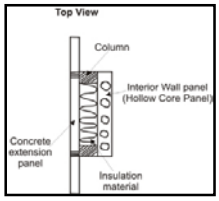
Properties of product

- Weight:≤15kg/m
- Flexural strength: ≥600N
- Good impact resistance
- Water absorption: 15%









Main equipment

- Panel extruding machine,
- Cutting machine,
- Rolling screen,
- Crushing machine,
- Mixer.

Land requirement

- Open: 4000m2
- Covered: 80mt. x 12mt. (shed)

Raw Material

Cement, sand, waste slag, glass fiber (for non-bearing wall) or steel wire (bearing wall)

Power KW: 20KW
Three phase
Voltage: 380

Manpower 10
Skilled (Nos.): 1
Unskilled (Nos.): 9

Project cost:

Total	**US$ 102,000**
Main equipment	US$ 35,000
Essential Spareparts & tools	US$ 10,000
Civil Construction	US$ 5,000
Design & installation	US$ 1,000
Other expenses	US$ 1,000
Working Capital (one month)	US$ 50,000

Example of a 100m^2 house with hooking panel:

a) Manpower: 8 workers
b) Construction period: 15 days
c) Building cost: US$40/m^2
Basement: US$4/m^2
Walling: US$20/m^2
Roofing: US$8/m^2
Door & window: US$8/m^2
d) Total cost: US$4000

Concrete Hooking panel

CBT 09

Glass-fiber Reinforced Concrete (GRC) panel

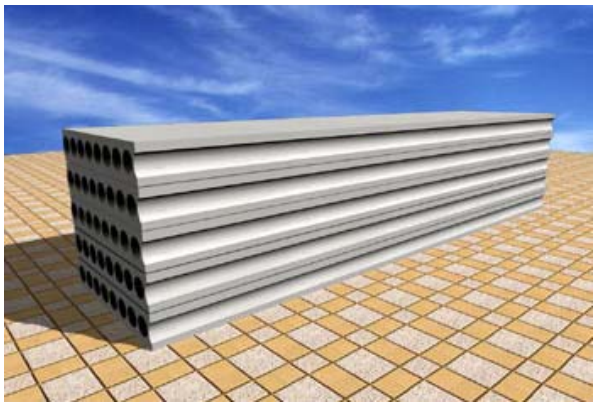
Glass fiber reinforced concrete (GRC) panel

Use

Suitable for load bearing wall of 1 to 2 stories buildings and non-load bearing wall of high-rise buildings.

Features

- Easy and quick construction: all the building materials needed for a 280m^2 house can be transported by a truck; 8 workers can complete the house in 2 weeks;
- Light weight: 35-50kg/m^2;
- High shock resistance;
- Good heat insulation;
- High durability;
- Low-cost house: building cost is only US$60/m^2.



Production Capacity

150,000m^2/year (per shift of 8 hours)

Size of product

2400-3000×900-12000×110-150mm

Properties of product

Weight	0.5kN/m^2
Heat conductivity (thickness 110mm)	≤0.36W/m^2•K
Index of acoustic insulation (thickness 110mm)	≥40db
Axial load limit (length 2400mm)	27.8kN/m^2
Transverse load limit (length 2400mm)	2.0kN/m^2

Main equipment

Panel forming machine, mixer and accessory equipment)

Land requirement

- Open: 4000-6000m^2
- Covered: 100-200m2 (office and storehouse), 500-800m2 (workshop)

Raw Material

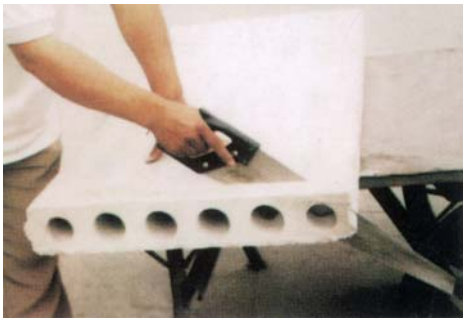
Cement, EPS panel, reinforced materials, sand, blast-furnace slag, pearlite, ceramisite, pumice, and other slags.

Power KW: 25KW
Three phase
Voltage: 380

Manpower Skilled (Nos.): 1
Unskilled (Nos.): 9

Project cost:

Total	**US$155,000**
Main equipment	US$ 60,000
Essential Spareparts & tools	US$ 5, 000
Civil Construction	US$ 10,000
Design & installation	US$ 10,000
Other expenses	US$ 10,000
Working Capital (one month)	US$ 60,000



Glass fiber reinforced concrete

CBT
10

Straw panel

Straw panel

Use

Straw panel is used for wall of low-rise buildings and partition wall of high-rise buildings.

Features

- Green Building Material - 70% straw
- Low-cost: 35%-50% of gypsum product
  10%-20% of wood product
- Lightweight – 33kg/m^2
- Non-radiative
- Waterproof, Fireproof, Crack resistant

Raw Material

Straw (wheat straw, rice straw, maize stalk), sawdust, maize stalk, sawdust, sugarcane pole, husk, etc.
Bonding and anti-burning agent
Reinforced material: mainly glass fiber

Size of product

2400mm×300mm×100mm

Properties of product

- Dry Shrinkage≤0.8mm/m
- Refractory Limit 188 minutes
- Sound Insulation≥40dB
- Water Absorption 22%

I Hand made production line

Production Capacity

20,000m^2

Main equipment

Mixer, 50 sets of forming moulds

Land requirement

Open: 1000m^2
Covered: 100m^2(shed)

Power: KW: 5KW
Three phase
Voltage: 380

Manpower: Skilled (Nos.): 0
Unskilled (Nos.): 10

Project cost:

Total	**US$ 53,000**
Main equipment	US$ 40,000
Essential Spareparts & tools	US$ 1,000
Civil Construction	US$ 5,000
Design & installation	US$ 1,000
Other expenses	US$ 1,000
Working Capital (one month)	US$ 5,000

II Semi-automatic production line

Production Capacity
200,000m^2

Main equipment
Panel forming machine, crushing machine, mixer, moulds.

Land requirement
Open: 3000m^2
Covered: 300m^2(shed)

Power: KW: 5
Three phase
Voltage: 380 V

Manpower: Skilled (Nos.): 2
Unskilled (Nos.): 60

Project cost:

Total	**US$ 270,000**
Main equipment	US$ 200,000
Essential Spareparts & tools	US$ 5,000
Civil Construction	US$ 10,000
Design & installation	US$ 3,000
Other expenses	US$ 2,000
Working Capital (one month)	US$ 50,000

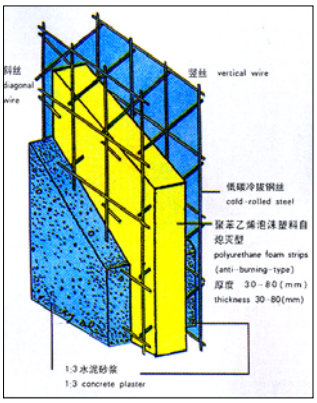
CBT
11

S Panel

(Steel wire-EPS composite panel)

S Panel

Use



S Panel system is a composite construction system. It is used for load bearing walls for low-rise buildings and non-load bearing walls for high-rise buildings, also for floor board and roofing board; It consists of S Panels - three-dimensional welded wire mesh and a built-in expanded polystyrene insulation core. The panels are erected over steel reinforcing bars embedded in a concrete foundation, then fastened to one another with wire - splice mesh. Concrete is sprayed to both sides of the panels to the desired thickness. The result is a homogenous structure with excellent thermal and acoustic properties.

Features

- Fast and simple erection, creating a monolithic structure.
- Cost effective way of creating a quality, plaster finished structure.
- Light weight - only 3.9 kg per m^2, 110 kg with cement mortar of 30 mm thick on both sides, easy to handle and suitable for area with soft foundation.
- High energy efficient system - Efficient thermal barrier, thermal resistance (50 mm in thickness) is 0.825 m^2.k/w.
- Excellent Sound Insulation - STC rating up to 52.6 dBA.
- Superior fire resistance - tested to 2 hours fire rating.
- Earthquake resistance - As a monolithic structural element with superior strength and ductility; it is ideal solution for high seismic areas. Also hurricane and typhoon proof design, even at the highest wind loads.
- Long life, high durability, low maintenance, strong and modern.
- Healthy and secure - Insect, termite, mildew and fungi resistance.
- Greater design flexibility, easily to be adopted to curved/arched application. S Panel System is stronger than rock and more versatile than timber.

Production Capacity

400,000m^2 (per annum)

Manufacturing Equipments and Production Flowchart

Size of products

Can be fabricated in different sizes.

Properties of product

- Light weight - only 3.9 kg per m^2, 110 kg with cement mortar of 30 mm thick on both sides, easy to handle and suitable for area with soft foundation.
- High energy efficient system - Efficient thermal barrier, thermal resistance (50 mm in thickness) is 0.825 m^2.k/w.
- Excellent Sound Insulation - STC rating up to 52.6 dBA.
- Superior fire resistance - tested to 2 hours fire rating.

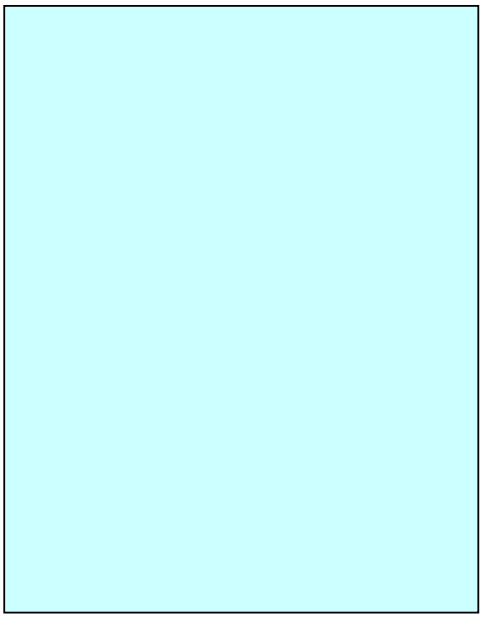
S Panel

Product Standard: China Industrial Standard JC623-1996 Q/LSU001-1998

S Panel

Main equipment

- EPS Foaming System,
- Welding and Forming System,
- Mesh Welding System,
- Checking System,
- Accessory Making System,
- Vapor System,
- Compressed Air System,
- Engineer Electrical System



Land requirement Open: 3000-5000m^2

Covered: 3000m^2

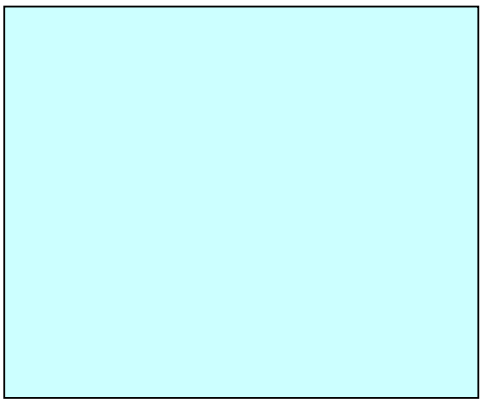
Raw Material

Steel wires: Ø2.0-2.2mm - Annual demand: 1,000tons

EPS resin: density 15-20kg/m^3 - Annual demand: 320tons

Power: KW: 150
Three phase
Voltage: 380 V

Manpower: Skilled (Nos.): 2
Unskilled (Nos.): 36



Project cost

PROJECT COST	**US$ 1,416,000**
Main equipment	US$ 1,186,000
Essential Spareparts & tools	US$ 30,000
Civil Construction	US$ 100,000
Design & installation	US$ 30,000
Other expenses	US$ 20,000
Working Capital (one month)	US$ 50,000

Colored Cement Tile for Roofing

CBT
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Colored Cement Tile for Roofing

Use

Colored cement tile is an ideal roofing materials used for residential and industrial buildings.

Features

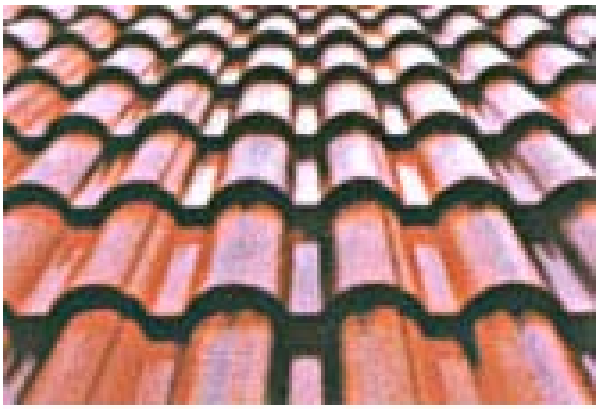
- High flexural strength
- Low water absorption
- Waterproof and good impermeability durable

Production Capacity

4000 pieces per 8 hour shift, 1,000,000 pieces per year

Size of product

420mm×330mm×12mm



Properties of product

- Flexural strength ⩾90kg
- Good impermeability
- Long service life

Main equipment

- Mortar mixer,
- Belt conveyer,
- Bxtruding machine,
- Coloring machine,
- Tile bracket,
- Steel tile mould.

Land requirement:

- Open: 2000m2
- Covered: 200m2

Colored Cement Tile for Roofing

Raw Material

Cement, sand, pigment

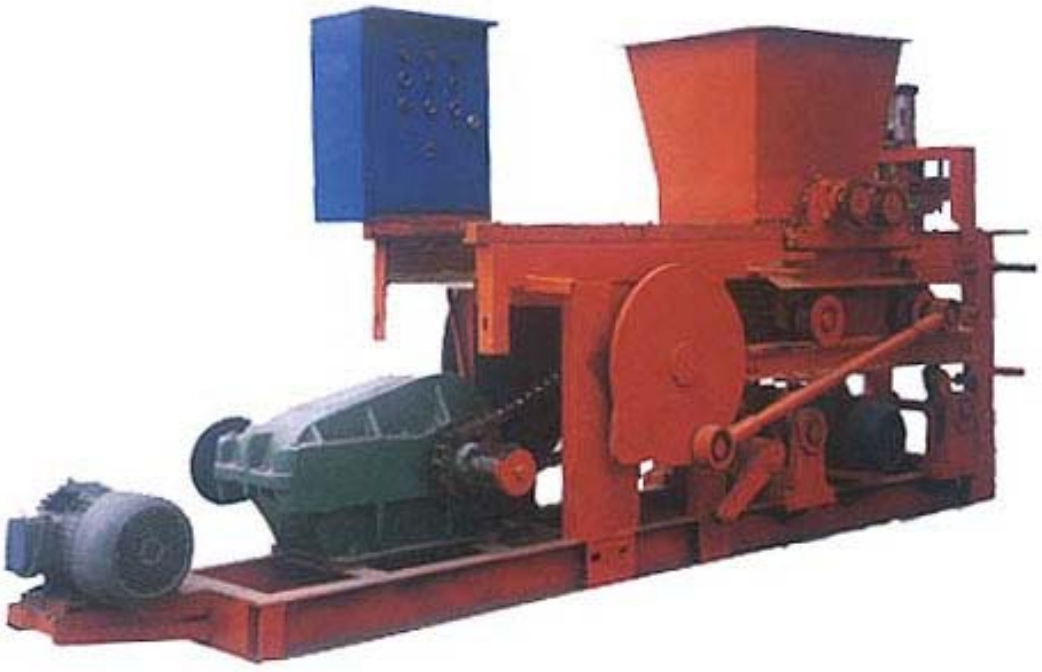
Power

- KW: 22
- Three phase
- Voltage: 380 V

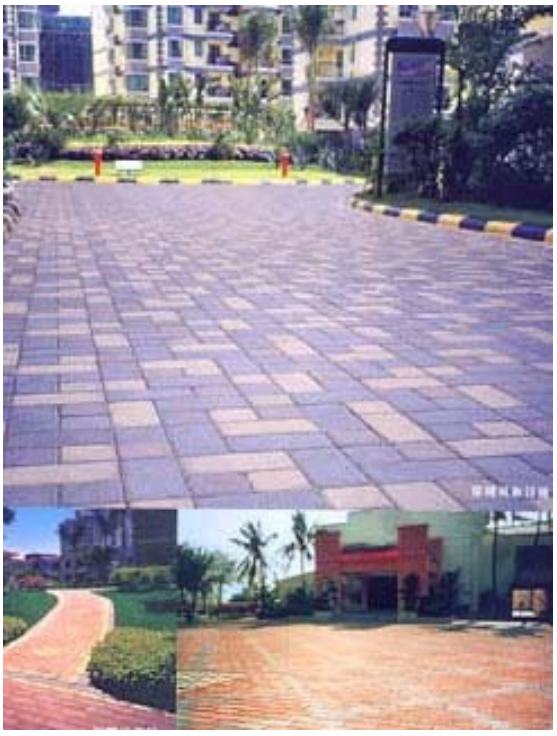
Manpower Skilled (Nos.): 1
Unskilled (Nos.): 10

Project Cost:

Total	**US$ 42,000**
Main equipment	US$ 20,000
Essential Spareparts & tools	US$ 3,000
Civil Construction	US$ 10,000
Design & installation	US$ 3,000
Other expenses	US$ 1,000
Working Capital (one month)	US$ 5,000



Concrete Paving Block



Use
For road paving.

Features
- Flexible design of shape and size;
- Good abrasion resistance
- High compressive strength

Size of product
Size: 250×250×40mm~50mm
300×300×40mm~50mm

Compressive strength≥25.0Mpa

Abrasion resistance≥35.0mm

Properties of product
- Compressive strength: ≥ 25.0MPa
- Flexural strength: ≥3.5MPa
- Abrasive resistance: ≥35.0mm
- Water absorption: 9.0%

Raw Material
Cement, fly ash, sand, stone, etc

I Simple production line

Production Capacity
4 pieces/40-60s, 40,000m^2/year (300 day and one 8 hour shift)

Main equipment
- Mixer,
- Paving block forming machine,
- Crushing machine,
- Moulds

Concrete Paving Block

Land requirement

- Open: 2000m^2
- Covered: 300m^2 (shed)

Power

- KW: 10
- Three phase
- Voltage: 380 V

Manpower 10 (per shift)
Skilled (Nos.): 1
Unskilled (Nos.): 9

Project Cost:

Total	**US$ 38,000**
Main equipment	US$ 15,000
Essential Spareparts & tools	US$ 5,000
Civil Construction	US$ 5,000
Design & installation	US$ 2,000
Other expenses	US$ 1,000
Working Capital (one month)	US$ 10,000

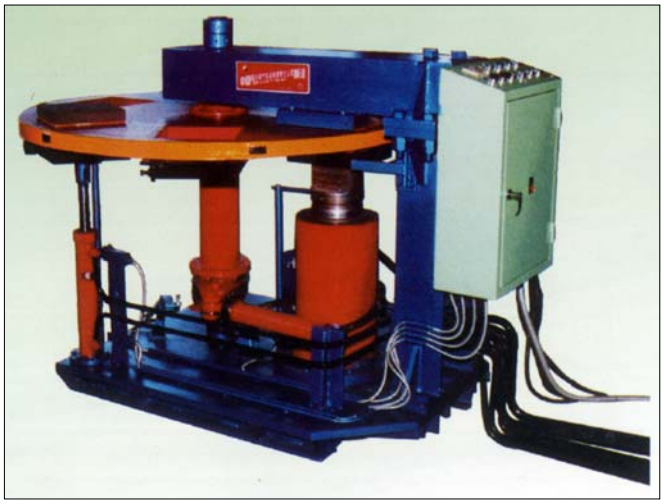
II Semi-automatic production line

Production Capacity

6 pieces/9-12s, 60,000m^2/year (300 day and one 8 hour shift)

Main equipment

- Mixer,
- Paving block automatic forming machine
- Crushing machine
- Moulds



Land requirement

- Open: 3000m^2
- Covered: 300m^2 (shed)

Concrete Paving Block

Power

- KW: 15
- Three phase
- Voltage: 380 V

Manpower 10 (per shift)
Skilled (Nos.): 1
Unskilled (Nos.): 6

Project Cost:

Total	**US$ 48,000**
Main equipment	US$ 20,000
Essential Spareparts & tools	US$ 5,000
Civil Construction	US$ 5,000
Design & installation	US$ 2,000
Other expenses	US$ 1,000
Working Capital(one month)	US$ 15,000

CBT
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Hollow Gypsum Board & Blocks

Hollow gypsum board & blocks

Use
For interior wall.

Features
- Lightweight, fireproof and heat – insulative;
- Easy & quick construction.

Production Capacity
150,000 M^2/year

Size of product
666mm×500mm ×60mm~160mm

Properties of product
Weight < 45Kg/M^2 Bend strength > 500 N

Main equipment
Molding machine, mixer, dry room, transport system

Land requirement
Open: 5000 M^2
Covered: 3000 M^2

Raw Material
Building gypsum, supplementary materials, such as, lightweight aggregate, fly ash, filler, etc.

Power: KW: 500
Three phase
Voltage: 380

Manpower: Skilled (Nos.): 5~8
Unskilled (Nos.): 15~20

Project Cost:

Total	**US$ 730,000**
Main equipment	US$ 100,000
Essential Spareparts & tools	US$ 30,000
Civil Construction	US$ 400,000
Design & installation	US$ 120,000
Other expanses	US$ 60,000
Working Capital (one month)	US$ 20,000

Hollow gypsum board & blocks

CBT
15

Wall plaster

Wall plaster

Use
Plaster for interior wall

Features
- Good workability and micro-expansion;
- Easy & quick construction;
- Good adhesion with basement;
- Lightweight, fireproof and heat - insulative

Production Capacity
30,000～50,000tons per year

Packing sizes
40Kg/bag

Properties of product
Strength > 4.0 MPa, setting time > 60 min

Main equipment
Sintering equipment, grinding equipment, mixing equipment

Land requirement
Covered: 2000 M^2

Raw Material
Building gypsum, supplementary materials, such as, lightweight aggregate, fly ash, filler, etc.

Power: KW: 100 KW
Three phase
Voltage: 380

Manpower Skilled (Nos.): 3~5
Unskilled (Nos.): 10~15

Project Cost:

Total	**US$2,674,000**
Main equipment	US$ 150,000
Essential Spareparts & tools	US$ 24,000
Civil Construction	US$ 2,400,000
Design & installation	US$ 37,000
Other expenses	US$ 13,000
Working Capital (one month)	US$50,000

Wall plaster

CBT
16

Paint for interior & exterior wall

Paint for interior & exterior wall

Use
Decoration for interior and exterior wall.

Features
- Easy construction
- Convenient maintenance
- Wide color option upon demand

Production Capacity
2-10t/d, 600-3000t/y

Packing size
25-100Kg/bucket

Properties of product
GB/T 9756 (for interior), GB/T 9755 (for exterior)

Main equipment
High-speed dispersing machine,
Dispersing kettle,
Grinding equipment.

Land requirement
Covered: 200~1000 M^2

Raw Material
Polymer emulsion, titanium white, filler, additive.

Power KW: 100
Three phase
Voltage: 380

Manpower Skilled (Nos.): 4~6 persons
Unskilled (Nos.): 10~15 persons

Project cost

Total	**US$ 186,000**
Main equipment	US$ 60,000
Essential Spareparts & tools	US$ 10,000
Civil Construction	US$ 24,000
Design & installation	US$ 12,000
Other expenses	US$ 30,000
Working Capital (one month)	US$ 50,000

Paint for interior & exterior wall

About China Building Materials Academy (CBMA)

CBMA is the largest comprehensive research institute in the fields of building materials in China. CBMA has established academic and trade relations with organizations of more than 50 countries. Its technologies and products have been widely recognized and adopted in China and exported to more than 30 countries and regions.

About International Center for Materials Technology Promotion (ICM)

ICM was established by UNIDO with the support of Chinese government, with its headquarters in Beijing. The CBMA is the parenting institution for ICM. The mission of ICM is to facilitate technology transfer and diffusion processes of new materials technologies in the developing countries.

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