

# PROJECT PROFILE

FOR

**CELLULAR LIGHT WEIGHT (CLC)**

**&**

**SAND LIME BRICKS**

PREPARED BY



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## 1.1 INTRODUCTION

### **CLC (Cellular Lightweight Concrete):**

It is a version of lightweight concrete that is produced like normal concrete under ambient conditions. It is produced by initially making a slurry of Cement + Sand + Fly Ash (constituting 26% - 34 % content) + water, which is further mixed with the addition of pre-formed stable foam in an ordinary concrete mixer under ambient conditions. The mixture is either poured or pumped into assembled moulds of blocks or formwork of reinforced structural elements or poured onto flat roofs or voids for thermal insulation or filling. The foam imparts free flowing characteristics to this slurry due to ball bearing effect of foam bubbles enabling it to easily flow into all corners and compact by itself in the moulds/forms without requiring any kind of vibration or compaction.

### **Sand Lime Bricks (SLB):**

Sand lime bricks are manufactured by mixing sand, fly ash and lime in desired proportion that may be followed by chemical accelerator during wet mixing. This mixture is moulded under pressure.

The green bricks can be air cured for 24-48 hours and then steam cured in autoclave at desired pressure and temperature. The green bricks may be steam / hot water cured at atmospheric pressure also.

In presence of moisture, fly ash reacts with lime at ordinary temperature and forms a compound possessing cementitious properties. After reactions between lime and fly ash, calcium silicate hydrates are produced which are responsible for the high strength of the compound. Bricks made by mixing lime and fly ash are, therefore, chemically bonded bricks. These bricks are suitable for use in masonry just like common burnt clay bricks. These bricks have the following advantages over the clay bricks:

1. Possess adequate crushing strength as a load-bearing member.
2. Have cement colour in appearance, are uniform in shape and smooth in finish and require no plastering for building work.

3. They are lighter in weight than ordinary clay bricks.

Generally, dry fly ash available from power plants meets the properties specified in IS: 3812 and is suitable for manufacture of Fly Ash – lime bricks in accordance with the requirements of IS : 12894.

Sand Lime Bricks or Decorative bricks are made of sand and lime mixed with water and then pressed in an atmosphere of steam for hardening.

It is a firebrick made of refractory silica sand with lime as a bonding agent. Brick made with sand and slaked lime rather than with clay; usually a light grey or off-white color.

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1. Possess adequate crushing strength as a load-bearing member
2. Have cement colour in appearance, are uniform in shape and smooth in finish, require no plastering for building work and consume less mortar
3. Are lighter in weight than ordinary clay bricks
4. They can produced in desired colours

## **1.2 MARKET**

Construction industry boom can be seen in almost all the developing countries. The demand for supplies is high; supply of raw material like bricks, cement, sand, iron and steel, builder hardware, paints, manpower and everything else regarding construction.

The construction industry is also very vital because anybody who is concerned with economic development these days highlights the need for infrastructure

development. The infrastructure is in the form of roads, ports, buildings, factories and so on, and all of them involve construction.

Bricks remain one of the most important building materials in the country. Brick making is a traditional industry in India, generally confined to rural areas. Notably, the Indian brick industry, with more than 1 Lakh production units producing about 100 billion tons a brick annually, is the second largest brick producer in the world after that of China. The industry has an annual turnover of more than Rs. 10,000 Crores and, very importantly, it is one of the largest employment generating industries, employing millions of workers. However, brick making is an energy intensive process as fuel costs account for almost 30% of the production cost.

The country consumes about 180 billion tons bricks, exhausting approximately 340 billion tons of clay every year and about 5000 acres of top soil land is made unfertile for a long period. The demand supply gap for bricks is estimated to be 80 billion tons for the year 2006 thus leaving a scope for establishment of more brick units across India.

Despite all initiatives to introduce alternative walling materials like cellular light weight concrete, sand lime bricks, compressed earth blocks, concrete / stonecrete blocks, and fly ash bricks, it is envisaged that sand lime bricks and cellular light weight concrete bricks would still occupy the dominant position in the foreseeable decade.

The excellent mechanical properties and durability of CLC and fly ash brick enlarges its scope for application in building construction and development of infrastructure, construction of pavements, dams, tanks, under water works, canal lining and irrigation work etc. Enormous quantities of CLC and fly ash are available in and around thermal power stations in all the states. The demand of bricks could be met by establishing small units near thermal power stations and to meet the local demand with less transportation costs.

### 1.3 TECHNOLOGY AND PROCESS

#### Production Procedure of CLC

##### **Sand:**

Optimum properties are achieved when selecting the most suitable raw material. The sand is mostly preferred from river, which is washed and should be with minimum 20% fines. Dust in sand increases the demand for water and cement, without adding to the properties. It also increases shrinkage. A certain, small amount of fines contributes towards strength. As in conventional concrete (CC), the sand should be free of organic material or other impurities. Crushed sand, due to sharp edges may destroy the foam mechanically.

##### **Cement:**

Portland cement is preferred over other cements, such as pozzolan. For early stripping and optimum mechanical properties, high-grade (early strength) cement is recommended. Thick walls and when using battery-moulds, excess heat is developing within and might therefore ask for a lesser grade of cement. The slower, the hardening, the better the final quality of concrete. Where economical, fly ash may be added to the mix to substitute some of the cement. Fly ash normally will retard hardening though.

##### **Water:**

When used to produce foam, it has to be potable and for best performance, it should not exceed 25°C. Under no circumstances must the foaming agent be brought in contact with any oil, fat, chemical or other material that might harm its function (Oil has an influence on the surface-tension of water). The oil/wax used in moulds will not harm, since the foam by then will be embedded in mortar. Water to prepare the mix has to conform to general requirements for concrete.

##### **Foaming Agent:**

The containments holding foaming agent must be kept airtight and under temperatures not exceeding 25°C. This way the shelf life is guaranteed for 24 months

from date of Invoice. Once diluted in 40 parts of potable water, the emulsion must be used soonest.

### **Density of Foam:**

The weight of the foam should be minimum 80 g/l the containment should be as close as possible to 10 Liters in volume, to check the weight (density) of the foam.

### **Preparation of moulds:**

For smooth surfaces clean moulds completely of remaining concrete, the steel/or wood surface must be oiled, mostly vegetable oil is preferred. Trials with different materials will have to show best results. Oil will not destroy the mix, once the foam has been mixed in the mortar.

Steel reinforcement will be placed in the moulds as usual. No coating of the steel is necessary. In panels of more than 12-15 cm thickness, the use of double mesh is recommended. The steel connected to the lifting anchors should reach more than half of the width of the panel and should possibly not be connected to the mesh. Ordinary steel is used as in CC when casting densities of 1200 or higher. The high ratio of cement to material in CLC ensures proper protection of the steel against corrosion.

### **Charging, Mixing and Pouring:**

Before charging the mixer with material, it must be rinsed, in particular if the concrete produced before, used any additive, which might have adverse reaction on the foam. Where possible, start the mixer before charging it with material. If the sand contains excessive amount of water, the weight has to be adjusted, adding that much more sand as it contains water by weight, reducing at the same time amount of water to be added to the mix. To obtain optimum performance, sand is first fed into the mixer, first absorbing water left after rinsing of form the previous CLC mix.

Once set correctly, the foam generator will keep the consistency stable, as long as air- and water supply remains constant as well. We still recommend to check the weight of the foam once in a week or if the density/consistency of the mix varies.

Gravity mixers (e.g. Ready Mix) take the foam under almost instantly and distribute it homogenously in the mix. It takes more time to achieve a proper distribution when using pan-mixers or similar. In between pours, the mixer should be kept in motion until it is completely discharged.

CLC always should be poured in the shortest possible time. If buckets are used to fill moulds, they should hold as much CLC as possible, possibly even pouring one complete panel in one step. Extended time between pours of one building member might result in the creation of dry-joints as happening in the case with regular concrete as well.

Although CLC does not require vibration - at least not to density the mix - which is liquid anyhow, vibration of horizontally produced panels will show an even better surface, drawing cement slurry to the mould side. Preference is given to High-Frequency vibrators. Length of vibration 15-20 sec. or until bubbles on the surface appears in large numbers. Use aluminum or other straight and sharp-edged screed slats immediately after pouring the concrete. Delayed screeding might “smear” the surface. If moulds have to be moved after screeding, this might have to be repeated. Any disturbance of the freshly poured CLC during the setting process, might be harmful and cause part of it to collapse, in particular when the concrete is not hard enough yet to carry the weight and the foam has been weakened by loss of water, drawn by the cement already for setting.

The poured building member should be covered, if possible, with a canvass or plastic sheet to keep the evaporating water on the surface. As with CC, hardening may be accelerated either by heating the moulds, steam or chemical (ask for details). Using most standard types of cement, panels may be lifted the day after casting. Due to the reduced strength in CLC, moulds should be tilted before lifting the panels. For the same reason panels of CLC should be handled with utmost care to avoid damage.

### **Curing / Transport / Assembly**

Panels should be positioned upwards on the curing yard, resting on a soft underground - best on a rake or wooden beams. All possible efforts should be taken, in

particular in dry and hot climate or more even when windy, to keep the panels damp for at least three, better for more days. A sprinkler will be helpful or canvas that is kept wet. Curing compound would be the costly alternative. Standards call for a 24 day curing period for cement-based building members.

Due to reduced weight, more volume of CLC building elements can be transported at the same (increased pay-load) than of CC. Panels should be kept upright during transport and also on a soft/wooden underground. Unload only in tilted position.

### ***Assembly***

Assembly of panels in CLC happens usually the same way as with CC. Special care has to be taken not to apply any mechanical force to avoid damage. If necessary, panels of CLC may be sawn (no gravel), definitely nailed (without the use of dowels as in AAC), drilled or profiled. In densities of 1200 kg/m<sup>3</sup> and higher, where reinforcement is used, CLC requires no special coating/plaster on the outside. Water-repellent paint (dispersion-paint) will be suitable.

### ***Vertical casting***

The high fluidity of CLC allows full height walls or complete houses (floor by floor) to be cast in one pour, inclusive the slab. Frames for voids for windows, doors and other opening, or penings therefore are cast in place, together with empty tubes and pipes for power and sanitary. No voids, no sagging (beneath frames). Walls/ partitions may be as slender as 50 mm thick only (!) as no vibration is necessary. With a coarse sand paper stuck to a piece of board, rub the walls immediately after stripping, in circular motion, to eliminate possibly honey-web or “noses” caused by possible irregularities in the mould or by joints. Perhaps a day after stripping it is recommended to saw imitation joints from both sides of the walls on neuralgic positions to allow possible shrinkage to “accumulate” in the joints and not show on the walls, as also done in CC when casting in situ.

As with all lightweight concretes (lesser with CC), hair-cracks might appear but have no adverse effect on the reinforcement, and usually disappear when painted. This

way one complete house is cast each day with every set of vertical mould. Where applicable even the gable can be cast at the same time with appropriate modification to the mould.

#### **Production Procedure of Sand Lime Bricks:**

The process of manufacture of sand lime bricks involves the preparation of the raw material viz., the sand and the quick lime, mixing them in the right proportion with specified quality of water and allowing the mixture to react for a specified period. The reacted material is once again taken and the moisture content suitably readjusted and thoroughly missed again before it is passed on to the press hopper. This properly prepared mixture is compressed under high hydraulic pressure to form the required size of bricks/ blocks. These green bricks are autoclaved for a specified time at specified temperature and pressure to harden the green bricks. This process of hardening gives the required strength to the green brick. After this process of hardening, the brick is ready for use immediately. If coloured bricks are to be manufactured suitable pigments will be added at the time of remixing after reaction.

#### **1.4 INVESTMENT**

The project calls for an investment of Rs. 120.00 Lakhs to set up a unit to manufacture 130 TPD of CLC Bricks and 120 TPD of sand lime bricks with 300 days of operations. The plant and machinery required for the project are indigenously available.

**Table 1: Project Cost** (Rs. Lakhs)

Description	Amount
1. Land & Land Development	6.20
2. Buildings & Civil works	6.00
3. Plant & Machinery	50.00
4. Misc. Fixed Assets	9.00
6. Contingencies	2.80
8. Preliminary & Pre-operative Expenses	17.00
9. Margin Money for Working capital	29.00
<b>Total</b>	<b>120.00</b>

Suggested means of finance is tabulated below.

**Table 2:** Means of finance

(Rs. Lakhs)

Description	Amount
1. Equity from Promoters	40.00
2. Term Loan	80.00
<b>Total</b>	<b>120.00</b>

The debt equity is considered as 2.00 with 15% as interest on term loan.

The product mix and the sales prices are as follows

CLC Bricks 130 TPD	Rs. 6 per Kg
SL Bricks 120 TPD	Rs. 2 per Kg

## 1.5 RETURNS

The returns from the project are adequate enough to repay the term loan in 6 years time from the date of commercial operations. The key financial indicators of the project are tabulated below.

**Table 3: Key Financial Indicators**

Particulars	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8
<b>Total Income</b>	900.00	960.00	960.00	960.00	960.00	960.00	960.00	960.00
<b>Total Variable Costs</b>	796.73	849.12	851.25	853.51	855.89	858.40	861.06	863.88
<b>Total Fixed Costs</b>	50.76	53.81	54.17	54.55	54.94	51.96	52.40	52.86
<b>Total Expenditure</b>	847.49	902.93	905.42	908.05	910.83	910.36	913.46	916.73
<b>PBIDT</b>	52.51	57.07	54.58	51.95	49.17	49.64	46.54	43.27
<b>Profit After Tax (PAT)</b>	20.76	27.32	26.83	26.20	25.42	27.82	25.79	22.52
<b>Cash Accruals</b>	<b>31.52</b>	<b>38.08</b>	<b>37.59</b>	<b>36.96</b>	<b>36.18</b>	<b>38.59</b>	<b>36.55</b>	<b>33.28</b>
<b>Term Loan Repayment</b>	13.33	13.33	13.33	13.33	13.33	13.33	0.00	0.00
<b>Closing Balance</b>	14.50	28.78	48.81	68.20	86.81	104.49	133.39	159.01
<b>BEP (Op Capacity)</b>	67.33%	63.42%	63.13%	62.93%	62.83%	59.30%	60.34%	62.75%
<b>Gross DSCR</b>	1.58	1.92	1.99	2.06	2.14	2.23	-	-
<b>Average Gross DSCR</b>	<b>1.95</b>							
<b>Net DSCR</b>	2.05	2.54	2.51	2.46	2.40	2.33	-	-
<b>Average Net DSCR</b>	<b>2.38</b>							
<b>IRR</b>	<b>32%</b>							