<u>CELLULAR LIGHT-WEIGHT CONCRETE BASED ON “NEOPOR”………</u>

Cellular Light Weight Concrete ***(CLC),*** based on ‘Neopor’ (Germany) technology has been used in over 45 countries of the world over the past 30 years to construct Over a hundred thousand houses, apartments, schools, hospitals, industrial, commercial buildings etc.

The introduction in India of a modified version using over 25% ***fly ash*** has made it an even more *<u>eco-friendly</u>* and *<u>cost effective</u>* version of CLC. The new product is set to revolutionize the manner in which buildings are constructed. In the process, the product brings quality housing closer to the masses at a faster and at a lower cost.

1.0. <u>Uniqueness of CLC in relation to other Light-weight Concretes</u>

Extensive research to develop lightweight concrete has been going-on all over the world for many years. The versions, that have been introduced by companies like *‘Siporex’, ‘Hebel’, Yutong or “H+H”* are ***Aerated Autoclaved Concretes***, requiring *a large Factory set-up, with* heavy Capital Investment *(~$ 10 million)* in plant and equipment and involve elaborate processing. This autoclaved products have naturally to be very expensive.

The Neopor based CLC, is the first of its kind with a ***very simple method of production,*** which can easily be adopted in pre-cast plants or even at the project-site itself ***under ambient conditions***. It requires only ***a nominal investment*** *(<0.5% of AAC plant).* The CLC version with ***fly ash*** as one of its major constituents, is still cheaper and more environment friendly.

It is produced using *Cement, Sand, fly-ash (optional), Water and foaming compound* with the help of normal Concrete/ Transit mixers, simple foaming equipment, ordinary moulds, unskilled labour and is ***water mist/spray cured*** under ambient conditions, just as for ordinary concrete. The foam creates millions of tiny voids or cells in the material, hence the name ***cellular concrete***.

Other unique features of ***CLC*** are that: -

- It can be produced in a wide range of density from 400 – 1,800 kg/cubic meter. The material of density up-to 600 kg/m^3 is normally used for providing thermal insulation. The density of 800 - 1,000kg/m3 is used for non-structural masonry, while the density above 1,200 kg/m3 is used for structural applications, including reinforced elements.

- It may be ***cast in-situ*** into a complete structure or the walling and /or roofing elements of a structure or

- It can be made into ***pre-cast*** elements - whether reinforced or un-reinforced.

Continuation sheet .. - 2 -.

2.0. Cellular Light-weight Concrete - A superior substitute to Bricks:-

Brick is the most extensively used building material all over the World. To most of the people, brick symbolizes the basic unit of construction – one, which seems to have been present since time immemorial. But in spite of its long history the bricks suffer from many shortcomings.

⇒ ***Top soil erosion***:

Bricks are produced with the use of good quality agricultural topsoil. Use of CLC in preference to bricks, will therefore prevent ruining of arable land for establishing brick kilns and help in increasing food production for the growing millions in the World.

⇒ ***Power & Fuel Hungry***:

Manufacturing of 0ne lakh bricks requires 25.77 Mt. of coal, while the energy required for producing CLC is negligible. Added to this is the considerable fuel saving in transportation of CLC as it lighter and can also be produced at the project site itself.

⇒ ***Smallness of size:***

Smaller size of brick warrants higher mortar and labour inputs for masonry and plastering work. A CLC block substitutes 14 bricks for an external/party wall and 7-bricks in case of partition walls. Alternatively, the whole wall could be poured in-situ like ordinary reinforced concrete, thus dispensing with the masonry operation altogether.

⇒ ***Inadequate & Seasonal Supply***:

Supply of bricks is mostly not able to keep pace with the demand. Moreover production is restricted to six months in a year, while a project can continuously produce CLC all through the year at a regular pace to match their requirements.

⇒ ***One size, Different Quality***:

To top it all, even the bricks produced are not of a uniformly good quality. The quality of CLC production can be controlled accurately at the project site, just like Concrete.

The need for an alternative building material was, therefore, being keenly felt in the construction industry. The materials promoted so far are not cost effective. The introduction of ***CLC*** has not only over-come shortfalls of ***bricks***, but it is also ***more versatile,*** apart from being ***eco-friendly and economical.***

3.0. Advantages of Neopor based CLC

3.1. *Reduction of dead load* Unstable ground conditions or desire to add extra floors on to existing structures, often limits application of normal dense concrete. Under utilization of available FAR is one consequence or, the other possibility being the introduction of lightweight concrete. Lightest possible dead load is also highly appreciated for economy in structural design in high earthquake prone areas.

3.2. *Material Savings: CLC* uses no gravel - only sand, cement, water, fly ash and foam. The use of cellular concrete yields substantial savings in locations where gravel is not readily available or hard to obtain or is very costly.

In multi-story constructions, partitions, floor screeds and other non-load bearing building elements are recommended to be made in cellular concrete, thereby substantially reducing the dead-load of the structure (and consequently saving reinforcing steel required for foundations and the main structural elements).

3.3. *Saving in Transportation costs:* Reduced weight of materials and zero transportation of CLC produced at project site imply lesser transportation expenses

3.4 *Ease of Handling* Building elements of CLC can be handled manually in larger dimensions (double sized) in comparison with those of dense concrete.

3.5 *Hilly Area* Construction in hilly areas will become easier with CLC as the problematic transportation of bricks from the plains is dispensed with.

3.6. *Eco-friendly* CLC is remarkably eco-friendly. It saves depletion of the top-soil, while at the same time it can actually use ***fly-ash*** *- an industrial waste-* as one of its major constituents.

The production process of CLC or it's use does not release any harmful effluents to ground, water or air *(unlike smoke of brick kilns and ruining of top soil in production of bricks).*

CLC, due to its low weight is ideal for making partitions. The use of CLC for this purpose will reduce the need for plywood partitions. This consequently will result in reduction in deforestation and will benefit environment.

3.7 *Thermal Insulation*

Air is known to be the best insulation material available. Air voids, if smaller than 2mm each, consequently increase thermal insulation substantially. Normal aggregate concrete has a specific thermal conductivity (Lambda) of 2.1 W/mK, compared to 0.405 only for 1200kg/m^3 cellular concrete. To offer identical thermal insulation as a 100 mm thick CLC wall, the equivalent thickness of dense concrete wall would have to be more than 5 times thicker (i.e. 500 mm) and ten times heavier.

3.8 *Fire Protection:*

Fire rating of cellular concrete is far superior to that of brickwork or dense concrete. Just a 100 mm thick wall of 1200 kg/m^3 CLC, offers a fire endurance (heat transmission) of 3 hours. Moreover, there are no dangerous fumes or spread of fire as experienced with plywood partitions having rigid *(styropore, urethane)* insulation material - often the reason for loss of life of entrapped individuals due to toxic fumes during fires.

3.9 *Speedier Constructions:* The absence of gravel coupled with the ball-bearing effect of the foam lends cellular concrete much higher consistency. No vibration is necessary when pouring cellular concrete into moulds/forms. It distributes evenly and fills all voids completely ensuring uniform density all over the material. This way full-height walls of a complete building (all internal and external walls) can be poured in-situ in one step, thus speeding-up the construction considerably.

Moreover, freedom from dependence on suppliers of walling masonry materials like bricks or hollow blocks and ability to self regulate output of CLC material at site to suit one's pace of progress, can help in achieving speedier outputs.

3.10. *Universal applicability* The wide range in densities and consequently their different thermal and structural properties, make CLC equally suitable for use: -

* As reinforced load-bearing in-situ walls and roofs in Low Rise Buildings.
* Even block-work (made from pre-cast blocks produced at the project site or obtained from a pre-casting plant) can also be used for load-bearing low rise constructions.
* Non load-bearing internal or external walls in High Rise Buildings.
* Thermal Insulation of building roofs and walls & roofs of cold storage.
* Filling of depressions in Toilets, floors etc.

3.11 *Superior to other alternative materials*

CLC is superior in performance, more eco-friendly and cost effective in comparison to other available alternative materials like *Autoclaved Aerated Concrete*, *Ordinary Burnt Clay bricks or Dense concrete Hollow blocks.*

A comparative assessment of available choices has been presented in Enclosure **'A'**

Enclosure "A"

S. No	Parameters	Lightweight concrete: Cellular (CLC)	Lightweight concrete: Aerated Autoclaved (AAC)	Burnt Clay Bricks	Concrete Hollow Blocks
1	***Basic raw materials and other inputs***	Cement, sand, fly ash, water & foaming compound	Cement, lime, sand, Aeration compound & High energy input	Top agricultural soil, Energy	Cement, Sand, Aggregate
2	***Production process and set-up***	Can be produced at project site using ordinary concrete mixer and foaming generator	Produced only in well established plant equipped with steam boiler and high pressure auto-claves	Processed in specially erected or central brick kilns	Mobile/Stationary Plant with BM plant
3	***Technology tie-up***	NEOPOR-*GERMANY*	SIPOREX-*Sweden*, H+H –*U.K.* HEBEL & YUTONG-*Germany*	NONE	Besser /Columbia Shirke
4	***Dry Density Kg/m³***	400-600 / 800-1000 / 1200-1800	650-700 / ~800	1900	1700
	Compressive Strength Kg/cm²	5 - 10 / 25 - 35 / 125 – 250	35 / 40	40-125	30-150 kg/cm²
	Usage	Thermal Insulation / Partitions, Low-rise load- bearing / RC Elements, L-bearing Blks.	Non load bearing blocks / Reinforced panels	Load Bearing & non-load bearing	Non-load bearing Walls
5	***Pre cast block size***	500 x 250 x 100/190mm	625 x 250 x 100/200 mm	229x114x70mm	400x200x200 mm 400x200x100 mm
	Cast-in-place	Any shape & size in density range 400-1800 Kg/m3	Not Feasible	Not Feasible	Not feasible
6	***Compaction during production***	None	None	Yes	Yes
7	***Aging***	Gains strength with age	No	No	Yes
8	***Thermal Conductivity (W/m.k)***	0.098 for 400 Kg/m³ , 0.151 for 700 Kg/m³ 0.238 for 1000 Kg/m³	0.132-0.151 for 650 Kg/m³	0.4	
9	***Sound Insulation***	Superior	Superior	Normal	Better
10	***Ease of Working***	Can be cut, sawn, nailed, drilled	Can be cut, sawn, nailed, drilled	Normal	Difficult
11	***Eco Friendliness***	- Pollution free - Least energy requirement - Can consume fly ash from 25% to 33 %	-Pollution free - high energy requirement	-Process creates smoke - uses high energy and -wastes agricultural land	-Low Energy -No smoke
12	***Cost: of material***	100%...	175% to 215%	78% to 110%	~ 120%
	-Plastered wall/m²				
	- External/Party	100 %	195% - 310 %	106 %	110%
	-Partition	100 %	180 % - 275 %	133 %	115%

Note: The structural savings in the cost of Steel and Concrete due to reduced weight of walls would be an additional advantage.

Comparison between alternative Walling Materials