PRESSED CONCRETE PRODUCTS

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Abstract: *Pressed concrete products are being marketed in Bangladesh for various engineering constructions instead of solid bricks for the last five years. This study compares the two products from environmental and earthquake hazard point of view. The environmental hazard posed by the solid bricks is highlighted, along with their potential vulnerability during strong earthquakes. The pressed concrete products are presented as a suitable alternative in terms of their relative economy, environmental friendliness and potentially better performance during seismic vibrations. Short descriptions of various pressed concrete products have also been added.*

Introduction

Pressed concrete products are used all over the world for all types of buildings-medium and tall. These products are also used for various infrastructure development works and are in use for almost a century now. In Bangladesh however, it was only in 1998 that such products were marketed as commercial venture by a leading construction/engineering group of the country.

Concrete hollow blocks, the major item in the range of products are used in walls in place of conventional bricks. This paper concentrates on the comparison of these two products only from environmental and earthquake hazard point of view. Discussing the whole range of products in the style as detailed below will be voluminous and as such not attempted here. However short descriptions of various products have been added for overall idea.

Environmental Consideration

Concrete hollow blocks are made to ASTM-129 and 90 using sand, stone dust, chips and cement in moulds under high pressure, predetermined vibration and mix ratio in semi-dry mix condition. On the other hand bricks are manufactured using top agricultural soil and then, molded and burnt. The process continuously depletes top agricultural soil. Bangladesh is a land hungry country with 130 million present population, which continues to grow. With 9.25 million hectors of agricultural land we produced 19 millions tons of cereal food grain in the year 1990 and shall have to produce around 30 million tons of food grain in the year 2010 to feed the expected 155 million population. In such a scenario we cannot afford to lose precious top soil (it needs thousands of years for top earth crust to be converted to soil). A 200 sq.m, 4 story building consumes about 0.2 million bricks. Top soil of 150 esq. land is required to produce the same. 70 such buildings destroy 1 hector of land. A survey conducted by the Department of Environment in 1993 revealed that during that year about 2000 million bricks were produced from an odd 1200 brick kilns, 50% of which were located in and around Dhaka. Of this 2000 million, 1375 million bricks were burnt using timber, 400 million by coal and 225 million by gas. Burning of 1375 million bricks consumed 105 million cubic meter of timber, which was 25.5% of total fuel wood used in that year.

Situation of energy availability is grim in rural Bangladesh. About 80.2% of total energy (1986 Energy Survey) is used for domestic cooking, of which fuel wood constitutes about 24.4%. Energy situation is so grim that millions of families cook the bare minimum and often take cold and uncooked food. This part of energy, consumed in Bangladesh may be termed as survival energy and cannot be denied. It is, as such, only fair that fuel wood is saved to the extent possible for millions for use as survival energy.

Brick Kilns emit a huge amount of smoke, dust and ashes. These particulate matter create respiratory track problem amongst people living around and their deposition on tree leaves around thwarts their growth. Real cost of brick making should be viewed as such from the consideration of loss of prime agricultural land, and the use of timber and gas whose long term environmental and economic cost in national accounting.

Our urban centers may now boast to have a large number of medium and tall buildings. The question may be asked as to the adequacy of these buildings in case of a major earthquake. According to Prof. Roger Bilham of the University of Colorado and V. K. Baur of Indian Institute for Astrophysics (Sept'01) “several lines of evidence show that one or more great earthquake may be overdue in a large fraction of the Himalayan, threatening millions of people in that region. Today about 50 million people are at risk from great Himalayan earthquake.……The capital cities of Bangladesh, Bhutan, India, Nepal and Pakistan and several other cities with more than 1 million inhabitants are vulnerable to damage from some of these future earthquakes.”

Are we really prepared for such an onslaught? By and large now a days the general practice is to construct a building by RC frames infilled by brick masonry using sand-cement mortar. When the frames are subjected to seismic force, the behavior of lateral deformation becomes complex and the frame attempts to deform in a flexural mode while the panel attempts to deform in a shear mode. This induces separation

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between the frame and panel at the corners on the tension diagonal, and the development of a diagonal compression strut on the compression diagonal. Shear forces will act at mortar beds resulting in shear sliding. Seismic forces being reversal type, the diagonals will instantly shift from tension to compression and vice versa. Hence tensile splitting, diagonal crushing, shear sliding and separation of in-fill will occur with shedding brick masonry on the streets below.

Posing Great Threats to Human Life

The vulnerability may be minimized, observes Dr. Ali Akbar Mollick, a Japan trained seismologist and structural engineer by 1) not using solid bricks 2) using lighter hollow blocks securing them by rebar and grouting etc. In a seminar at the Institution of Engineers held on 15/9/01 he commented "The use of solid bricks as masonry infill in RC frame should be abandoned. The use of solid bricks makes the weight of each story heavier and so the total weight of the building becomes much higher in comparison to the building, which uses lighter weight hollow blocks. Since the seismic force in horizontal direction is directly proportional to the weight of the building, it will be much higher if solid bricks are used. Lighter hollow block masonry is encouraged to be used as infill materials in RC frames."

Use of concrete hollow blocks as basic building materials appears to be consistent with the present socio-economic reality now available in Bangladesh. We should not ignore the comment by Dr. Kerry E. Sieh of the California Institute of Technology that "the real question is not if but when, where and how big." This being the case all our future buildings should be designed adequately to ensure safety of the inmates within affordable costs. Commenting on the Bhuj earthquake of 26 January'01 Dr. Harsh K. Gupta, world renowned seismologist and Director of National Geological Research Institute in India said, "That earthquakes do not kill people, but seismically deficient constructions do". Do you know that the Californian earthquake of January 1992 measured 8 on the Richter scale and that it destroyed $30 billion worth of property? Yet only 54 people died when the earthquake struck in the early hours of the morning. That was because most of the population there was sleeping indoors in housing that adhered to seismic parameters. In Latur, by contrast, the damage to property was far less, but 10000 people died because they happened to be sleeping in housing that was devoid of any seismic consideration.

New Products

At the present time, it is expected that a huge investment is going to be channeled in areas like infra-structural development to boost market economy and people welfare oriented areas like housing, health and education. To effectively cater for such huge requirements billions of clay burnt bricks will be needed as the principal building block.

Bricks will be needed for the construction of new roads and their maintenance, residential houses, hospitals, clinics and educational institutions. One estimate suggests that a little over 10 million core houses (one room 10′×10′ pucca house) shall house all the families in rural areas at a rate of one house for one family. Lot more hospitals and educational institutions, roads and highways need to be built. Billions of brick will be needed requiring more and more top soil. If these bricks could be replaced by sand-cement and concrete blocks, the serious adverse impact mentioned above could be avoided.

83% of population is estimated to be living in thatched houses. These houses are basically made of agricultural by-products and naturally occurring substances like bamboo, jute stick, hay, dried paddy stem and soil. Rate of obsolescence of these materials has been estimated at 3 years. If this ten million plus thatched houses could be converted to one-room pucca core houses with 50 years life span, from national point of view this would have been a huge savings in terms of time, labor and materials. If these materials could be freed it would have great positive impact on rural energy situation and underfed 22 million bovine population and soil fertility.

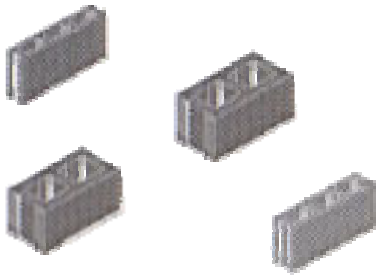
Conclusion

Constructing millions of housing units on the part of government may be an impossible task unless private sector is taken into confidence. With appropriate policy and encouragement private sector may take up this huge task of building hundreds of thousands of housing units including other infrastructure. It is seen that structural cost of a building may be reduced by about 20% and time of construction by about 30% by using pressed concrete products in place of bricks. In national perspective this means about 15,000 million taka a year. From economic environmental and structural point of view, the present practice of using bricks needs to be reviewed and revised.

To address to the above scenario clay burnt bricks may be eliminated by pressed concrete products as indicated above. A little introduction to such products may be of help to the readers.

Concrete Hollow Block

Concrete hollow blocks are produced in compliance with ASTM C-90 and ASTM-129.



These blocks are used in partition wall, interior, exterior and load bearing walls in the high rise as well as low rise buildings.

These blocks are light weight, salt free, fire resistant, heat and sound insulating, absorb less water and are environment friendly. Besides 30~35 story buildings can be made with load bearing block, paint can be applied directly on block wall, shape, size and weight are constantly consistent, horizontal and vertical reinforcement can be placed easily.

Ceiling Block

Concrete ceiling block is a filler material in reticulated waffle flat slab. The idea behind ceiling made of hollow block is similar to that of waffle slabs, but they avoid the high formwork costs and can be completed much faster. The blocks act as permanent filler giving a flat surface suitable for plaster application and impart good thermal insulation and fire resistance to the floor. The ribs framed between the blocks are reinforced to take care of loading of the floor. These are used to construct floors and ceilings.

Advantages of use of these products include good sound and heat insulation, fire resistance, reduction of overall weight and consequent savings in foundations, columns, beams, less labor required in job, easy plaster and flat ceiling.

Uni Block, Rectangular Block and Kerb Stone

Concrete paving blocks consists of small individual high strength concrete units manufactured to accurate dimensional standards. The blocks are one hand sized and are laid without mortar on sand course. The blocks are formed from a “no slump” concrete mix comprised of Portland cement, sand and coarse aggregate which is compressed under extremely high pressure by high frequency vibrator.

These materials are used in pavements, yards, roads and footpaths where heavy or concentrated wheel loads are to be carried and especially where large numbers of turning or slewing movements are expected. These materials are very suitable where traffic intensities are high, where sub grade conditions are poor, where the pavement must withstand severe operational conditions such as widely varying temperatures, frequently fuel, oil or lubricant spillages, where ready access to underground services is needed, where the appearance and aesthetic qualities of the pavement are major design considerations, where planning exigencies may require changes in the pavement layout within the effective service life of the blocks, base or sub-base, such as highway, bus and truck terminal, round about, parking lot, taxiway, footpath and other outdoor spaces.

These materials are durable, easily recyclable, their maintenance cost is low, aesthetics appearance is very good; their color, texture and pattern can be specified.

Roof Tiles

These are traditional and aesthetically pleasing roofing materials. Used in roof, balcony, lobby space, over roof slab for ornamental purposes, over window as a shade etc.

These products are durable, salt free, fire resistant, attractive, heat insulating (reflect 95% of sun heat), easily replaceable and has variation of colors.

Engraved and Plain Files

Engraved cement tiles are a classic product made from a mixture of sand, cement, and pigment and sometimes marble chips.

The product can be used on footpath, car porch, parking space, walkway, and other outdoor areas.

The product is durable, easy to install, easy to replace, attractive, has varieties of pattern and its maintenance cost is very low.

Machine Made Pre-Polished Reconstituted Homogeneous Natural Marble Slab

Machine made pre-polished reconstituted homogeneous natural marble slab flooring are machine made from crushed well graded dust free and properly washed marble chips, white cement and color pigment. The product is used on floors, it is attractive, durable for generations and it has minimum water absorption, tremendous tensile strength, low weight and reduces the dead load of the structure.

Machine Made Pre-Polished Double Layer Marble Tiles

Machine made pre-polished double layer marble tiles flooring are made from machine crushed well graded dust free and properly washed marble chips and a mixture containing white cement and color pigment and placed on 13 to 12 mm thick sand cement semi dry cement mortar base.

The product is used on the floor.

Wall Cladding (Slate Cladding, Split Cladding and Solid Wall Cladding)

These are made from mold pressed cement mortar. They are used to cover facades, exterior and interior walls, for covering against weather and beautification.

The products are aesthetically superb in many colors and shapes, water repellent concrete products. Besides, they are cost wise cheaper compared to products available in the market.