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SUSTAINABLE CONSTRUCTION PRACTICES FOR AFFORDABLE HOUSING

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Affordable housing has become a dream to millions in the world today. Depletion of natural resources together with the increasing price of building materials has aggravated this issue. Sustainable construction is a technological practice that involves the effective utilization of local man power and locally available renewable resources in construction with the help of minimum infrastructure. Alternative technologies which eliminate or rather minimize the utilization energy intensive materials such as concrete, cement and steel form an identity of sustainable construction. Cost Effective and Environment Friendly (CEEF) technological options practicing in the state of Kerala, India is also considered as a sustainable construction practice focusing on affordable housing solutions in the State. This paper presents an overview of CEEF technologies and checks the sustainability of these technological options in the context of Kerala.

Keywords: Cost effective and environment friendly (CEEF) technologies, Kerala, Building process.

1 INTRODUCTION

Shelter is one of the basic needs of human beings next only to food and clothing. It has also a crucial role in the development of human settlements. Affordable housing has become a dream to millions in the world today. Inadequate access to affordable building materials is one of the major limitations of the poor in developing countries to provide adequate housing for them. Out of the total cost of house construction, building materials contribute more than fifty percent in developing countries like India. The gap between the rising demand and the stagnating, and in many cases declining, production levels is widening at an alarming rate, leading to the spiralling of prices of building materials in many developing countries, seriously affecting the affordability of housing for the vast majority of the population (UNCHS 1993). Along with these, the depleting resources and energy consumed during extraction, processing and transportation of raw materials is another serious concern questioning the sustainability of building process. Sustainable construction is a technological practice that involves the effective utilization of local man power and locally available renewable resources in construction with the help of minimum infrastructure. Alternative technologies which eliminate or rather minimize the utilization energy intensive materials such as concrete, cement and steel form an identity of sustainable construction. Cost Effective and Environment Friendly (CEEF) technological options practicing in the state of Kerala, India is also considered as a sustainable construction practise with all these features. This paper

presents an overview of this technology for different stages of building construction. Alternate options practised worldwide are also discussed.

2 EVOLUTION OF PRESENT BUILDING PROCESS: KERALA

Traditional Kerala architecture was based on the principles of Vastu Sasthra (science related habitation) and Tachu Sasthra (the science of carpentry) utilizing local resources. Locally available materials such as rubble, laterite, wood and mud were extensively used in the construction of buildings. Palaces and temples were constructed mainly using rubble and wood. Padmanabhapuram Palace constructed during sixteenth centaury is an excellent example for this. Stone and laterite are mainly used for foundation and basement. Superstructure is made out of timber structures. The roof structure is supported by wooden trusses, covered with thatch or clay tiles.

The social reform movements and the larger process of modernization of Kerala since independence and later the formation of Kerala State had made many changes in the traditional building process. Following the 1973 hike in oil prices, majority of youth from Kerala migrated to the gulf countries during that period in search of better employment opportunities and there was a significant inflow of remittances to the State from the Middle East. A major part of the investment at that time was in the housing sector. Average prices of indigenous building materials (sand, clay) increased by about fifteen to twenty times during this period. The free access to the natural materials were denied and traditional practice of community co-operation in house building became non practicable. At the same period, the factory produced materials (cement, steel) showed an increase of less than 10 fold only (Gopikuttan 2002). The number of new residential buildings has showed a steady increase. This housing boom was the combined effect of economic, social, institutional and cultural changes occurred during those days. Land reforms conferred ownership on land to those who had earlier been landless labourers. These social changes and subsequent investments in housing favored the excessive use of energy intensive building materials like cement, steel and bricks replacing the traditional materials.

The paradigm shift in the housing policy from a Public housing approach to one based on aided self help during the beginning of 1980's facilitated the introduction of cost effective technology in the housing sector of Kerala. Several Non-governmental organizations sprung up in early 1980's with affordable technological options. Mr. Laurie Baker, the well known British born architect, settled in Kerala, took the lead in this effort. Based on his principles, alternative technology initiatives and institutions like Centre of Science and Technology for Rural Development (COSTFORD) and Nirmithi Kendra came up with affordable technological options (Gopikuttan 2004). All the appropriate technology initiatives in Kerala are based on the assumption of abundant supply of labour and availability of indigenous building materials. Their focus was to create maximum employment opportunities and to provide livelihood security to the poor by constructing their own houses. COSTFORD is registered as a non-profit voluntary organization in 1984 under the Chairmanship of Mr. Laurie Baker. It has two main foci of activities, namely, social activities and construction activities using appropriate building technologies. The focus is to empower and enable the weaker sections of the society to improve their living conditions by the application of appropriate and people friendly technologies. Promotion of non-commercial building

practices, which discourage the role of intermediaries from the building process, is also among their priorities.

The devastating flood occurred during the year 1985 and the consecutive rehabilitation works connected with it in the coastal areas of Kollam district opened up a new era of cost effective and environment friendly (CEEF) building technology through Nirmithi Kendras. India's first "Nirmithi Kendra" (Building Centre) was set up in Kollam for bringing out affordable solutions for housing. Arising from the success of Nirmithi movement in Kerala, the ministry of urban development and HUDCO decided to start a national programme of setting up a net work of building centres throughout the country. Later in 1989 Kerala State Nirmithi Kendra (KESNIK) was established as an apex body to all the District Kendras.

3 COST EFFETIVE AND ENVIRONMENT FRIENDLY (CEEF) TECHNOLOGY

CEEF technology is identified as a sustainable construction practise propagated by the Nirmithi Kendras emphasizing cost effectiveness and environmental friendliness in the building process. It is distinctive in the use of locally available materials, minimizing the use of energy intensive materials like cement and steel, ensuring local participation, combining traditional architecture with modern styles and designing the building according to the topography of land.

Figure 1. Corporate office -Kerala State Nirmithikendra.
(Source: http://www.nirmithi.kerala.gov.in/gall.htm)

CEEF technology buildings in Kerala are characterized by brick masonry walls (without plastering) with rat-trap bond or Flemish bond, filler slab roofs and pre cast cement concrete door/window frames. Pre cast lintels and use of brick arches or corbelling is a common feature of CEEF buildings. Natural ventilation in the rooms is facilitated through artistically designed honey comb brick work (brick jalis). Figure1 shows the picture of Kerala State Nirmithikendra’s corporate office located at

Thiruvananthapuram. The office building itself is a very good example showcasing this technology.

The succeeding sections give an overview of CEEF technology features/options for different stages of building process.

3.1 Selection of Site

Site selection has prime importance in the building process in deciding sustainability. Original land has to be considered over made up or reclaimed lands in consideration with economy and environment friendliness. Construction of buildings according to the topography of land is a distinctive feature of CEEF buildings.

3.2 Foundation

Locally available materials such as rubble/ laterite is used for foundation either with dry packing or with mud /lime/lean cement mortar according to the type of soil and load coming over it. Reinforcing the soil in the foundation trench with layers of bamboo can be an alternative foundation in places were stone is not locally available and bamboo is plenty. This technology is widely practiced by COSTFORD. Sand piles, arch foundation and stub foundation are the other alternative options for foundations.

3.3 Superstructure

Technology adopted for walls, openings, doors/windows and lintel are discussed under this section.

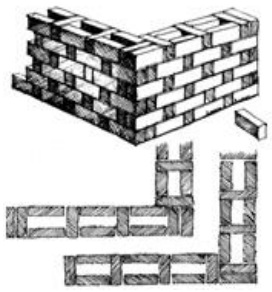

Figure 2. Rat- trap bond masonry.
(Source: Becker, L. 1993c)

Walls - Exposed brick masonry in flemish bond /rat trap bond is a unique feature of CEEF technology. Rat - trap bond masonry is an innovative technological option in brick masonry introduced by Laurie Baker. Bricks are laid on edges to form a cavity in between as shown in figure 2.It is labor intensive technology.

Openings- CEEF buildings are characterized by the provision of honey comb brick work in place of conventional openings. Ventilation inside the rooms are facilitated by the aesthetic arrangement of honey comb brick work.

Doors/Windows – R.C.C door and window frames adopted in urban areas where wood is expensive.

Lintel – R.C.C lintel is replaced by the use of wood/ stone considering the local availability. Brick arches of different types are constructed over the openings to replace the lintels in most of the buildings. Provision of arches is s peculiar and distinctive character of CEEF buildings.

3.4 Roofing

Filler slab construction, shell roofing and other pre cast roofing techniques are the popular CEEF technology options against reinforced cement concrete (R.C.C) slab.

Filler Slab – This roofing technique is very much popular in Kerala than any other technological alternatives due to the economical advantages and comfort with respect to other prevailing roofing options. They are basically solid reinforced concrete slabs with partial replacement of concrete in the tension zone by a filler material. In Kerala, Mangalore pattern (M.P) roofing tiles are used commonly as the filler material.

Pre-cast concrete Funicular shells, pre–cast concrete ribbed slab and pre-cast 'L' panels are other CEEF technology option in roofing.

4 CONCLUSIONS

CEEF technology was promoted in Kerala with the aim of shelter for all through affordable technological options emphasizing the principles of sustainable construction. The overall cost reduction on CEEF buildings are in the range of 25-30 % (Singh *et al.* 2011).These buildings are aesthetically appealing due to the presence of arches, corbelling, artistically designed openings with honey comb brick work and resemblance to traditional style of Kerala architecture. But the people of Kerala are bit reluctant to adopt this technology due to the false perception on cost effectiveness and quality. Hence the sustainability of these options are still doubtful.

Acceptance, awareness and feasibility of technological options are the basic criteria for socio cultural sustainability (Nair 2006). Rat trap bond masonry has several advantages compared to English bond (most popular brick masonry alternative in Kerala) masonry. But the unawareness of technology and the poor acceptance make it less preferable in the State. Same is the case with filler slab. Filler slab roofing is considered to be more material efficient, comfortable and economical. But in practice the poor awareness on this technology and availability of skilled labours make it less affordable to the users. This also gives an indication to the relation between economic factors and socio cultural factors. Both the above mentioned technologies are considered to be more cost effective than their present popular alternatives, but the un–sustainability in socio- cultural factors makes them less affordable in practice.

None of the technological alternatives can be affordable in practice, if it has not enough support and acceptance from the society. Hence dissemination of technological innovations to the masses is a must to make it acceptable, feasible and there by affordable to the users. This can be attributed to the inferior image of CEEF technology against modern or prevailing energy intensive building process.

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