AN INVESTIGATION OF PANEL WALL HOUSING CONSTRUCTION IN KENYA

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Abstract
A wall is the solid structure that defines and delineates a building, supports its super structure and separates space into rooms. The projected annual housing need for Kenya populations exceeds 810,000 units as per the National Development Plan 1997 – 2007 which translates to 162,000 units per year. To solve this acute problem, the country needs to develop a fast mode of erecting houses. 3D Expanded Polystyrene 'EPS Home panels' provides the opportunity to utilize the panel walling system to alleviate the housing crunch. This technology allows for affordable, stronger and faster construction of houses. Similar technologies e.g. the 'Space Frame' system of construction has been used in South Africa since 1980. The EPS home panels are now locally manufactured by National Housing Corporation (NHC). The objective of the study was to investigate the effectiveness of panel wall housing in production of houses in Kenya without compromising the standards. Oral interviews were conducted in various sites. It was observed that a standard size panel weighs only 15kg which allows for easy handling and fast installations process, thus reduces construction time by 50%. A single story 3 bedroom house was completed in 30 days instead of 60 days. The technology was found to lower construction cost by 30% in red soil areas. Off cuts were easily recycled hence drastically reducing the cost. Data obtained from the manufacturers indicate that the material is fire resistant, energy efficient, has lower utility costs, earthquake resistant, versatile, flexible design, sound proof, storms resistant and have superior strength. The use of panel walling system was found to be fast, efficient and effective mode of constructing houses which enables mass production of modular houses. It is therefore recommended that training and creating awareness on the use of local EPS panel walling system be done.

Key words: Walling panels, home construction, flexible construction, welded mesh and polystyrene sheet

1.0 Introduction

The constitution of Kenya recognizes access to housing as a human right. Article 43 (1) b of the constitution specifically provides that every person has the right to accessible and adequate housing, and reasonable standard of sanitation. The International Covenant on Economic, Social and Cultural Rights (ICESCR) to which Kenya is a state party, also recognizes the right to adequate housing (Article 11). Despite the recognition of housing as a fundamental human right, the Kenyan housing centre is characterized by deteriorating housing conditions country wide where adequate housing remain a mirage. The projected annual housing need for Kenya both urban and rural populations exceeds 810,000 units (National Development Plan; 1997 – 2007). This translates to 162,000 units per year, hence the need to develop a fast mode of erecting decent and affordable houses. The country now has the opportunity to move speedily and utilize the 3D Expanded Polystyrene 'EPS Home panels' to alleviate the housing crunch. The aim of this technology is to allow for affordable, stronger and faster construction of houses as well as reducing material wastage. Similar technologies e.g. 'space frame' from South Africa has been used in construction since 1980. This technology has also been certified and implemented in other countries such as Britain, Europe, Central America, China, India, Mexico, Mozambique, Nigeria, Qatar, Sri Lanka, United States of America, etc. using different brand names. The EPS home panels are now locally available and manufactured by National Housing Corporation (NHC). The objective of the study was to investigate the effectiveness of panel wall housing in production of houses in Kenya without compromising the designs and standards of construction.

2.0 Materials and Methods

The components of the 3D EPS expanded polystyrene panels are modified expanded polystyrene core of 50mm to 150mm thick, two outer layer of 50 mm x 50 mm wire mesh on each side connected with galvanized truss wires which pierce the core and are welded to the outer mesh layers to form grids and cross bracing (*see figures 1 and 2).* The panels are manufactured in standard size of 1200mm wide by 3000mm long but the length can be increased to varying lengths to suit construction requirements. The panels are however very easy to trim, fit and transport. Once the wall panels are erected and connected with wire clips/hog rings, they create a monolithic vertical lattice wall with parallel cross wires 50mm spacing. It is then finished with two layers of cement plaster; first coat – between foam layer and outer mesh surface 15mm thick and final

coat – plaster 10mm thick resulting in a 25mm thick coating on each side. This creates a 3-dimensional structurally superior wall. The 3D Welded Wire Panel System allows the architect/engineer to design for various wind loads and seismic conditions. By varying the size of the wire reinforcement, thickness of plaster and incorporating formed-in-place beams and columns, most structural requirements can be met.

Oral interviews were carried out and work study conducted at various sites where the wall panel erection and installation processes were taking place. It was observed that a standard size panel is lightweight and weighs only 15kg which allowed easy handling and faster installation. One cycle of lifting a panel, carrying, placing in position, connecting, trimming and binding with clips/hog rings to other panels was averaged to be six minutes *(see figure 3 and 4)*. Marking out and cutting out to fit in window frames, door frames, services ducts (electrical conduits and plumbing pipes) was easily done within a day for all the above items in a standard three bedroom house (*see figures 5 to 8)*. The off cuts (waste) from panels cut to form window and door openings were recycled (put together) and connected to form internal wall partitions and kitchen work tops. A 100sq. meter of wall was erected and plastered with a gunite machine in only 8 hours to form solid walls *(See plastering operation in figures 9 to 12).*

3.0 Results

A single storey 3 bedroom house was completed in 30 days instead of 60 days thus reducing construction time by 50%. A double storey maisonette was completed in 90 days in lieu of standard six to eight months *(see figure 13 & 14)*. The technology was found to lower construction cost by 30% in red soil areas. Off cuts were easily recycled hence drastically reducing the cost. Data obtained from the manufacturers indicate that the material (polystyrene) is fire resistance, energy efficient, has lower utility costs, earthquake resistant, versatile, flexible design, sound proof, storms resistant and have superior strength. The use of panel walling system was found to be fast (in terms of construction speed), efficient (in terms of material wastage) and effective (in terms of installation of other services) mode of constructing houses. The technology further benefits and enables mass production of modular houses and allows for standardization.

4.0 Discussion

From the above observations, it is found that EPS panel wall housing construction system is a simple module of construction assembled on site, affordable and simple to construct, is completely weather proof, earthquake resistant and soundproof, is lightweight and easily transported and erected on site, has excellent thermal insulating qualities, health & safety inhabitation, and is competitively priced & provides local employment opportunities. Panel wall housing also offers families a platform for economic recovery and is a means of employment generation, requiring intensive unskilled labour and local capital investment.

Design comparisons with traditional architecture shows that the panel homes are highly likely to be accepted by the populations in our country Kenya since the material is now locally available and not imported as has been the case in the past. The panel technology pioneers failed to create an impact since they did not market aggressively to create a wider awareness on the product. The early proponents of the technology were also only seeking to control a niche of the construction market and were unwilling to share their technology, partner with others or seek relationships beyond their limited contracts. The result is that while a few thousand buildings were erected with the panels hundreds of thousands of other buildings were built with traditional construction methods.

Natural disasters like the Tsunami necessitated that the government and NGOs to rush off to affected areas of the world, bringing support, relief and in many cases providing new housings thus the opportunity opened up to showcase new construction methods, introduce new building materials and challenge local traditions. The result is that these developing countries are beginning to build under new jurisdictions – banks which are loaning the money want to see buildings constructed faster, with stronger materials and greater abilities to withstand the next disaster. Expatriates want homes to equal or exceed what they have come to know in more developed countries. Resorts and tourist facilities need to compete with other quality attractions around the world. Developers are not willing to work with traditional construction methods if it means longer construction times and inferior buildings. Finally, the green revolution 'sustainable development' has taken hold in the whole world and Governments are banning the use of timber, materials that create pollutants and are advocating buildings adhere to new requirements to save energy. In other words, the world is now ready for the EPS Panel walling system. It has been used and accepted elsewhere for over the last 25 years and it is

hoped the technology will be accepted as a leading alternative to conventional construction now that local manufacturing by NHC is available and certification by the government is in place.

This technology should be marketed on a global scale for all its virtues as a superior method of construction, one that is better, more cost effective and the most beneficial for our communities and our environment i.e. it has come at the right time to make a difference. The panels can be used in single story facilities, curtain walls, privacy walls, sound barriers, load-bearing, non-load bearing retaining walls and even to make roof slabs. It should be noted that the EPS panel wall building systems is a combination of innovative and conventional construction.

5.0 Conclusions and Recommendation

We therefore recommend training and creating awareness on the use of locally manufactured EPS panels (3D Panel walling systems – EPS technology) not only to help reduce the housing deficit in the country but also in other building applications including schools, offices, farm buildings and county offices. We belief that the use of EPS panels as a faster house production method will go a long way in provision of adequate and affordable housing in the country thus ensuring Kenya is a decently housed nation.

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