The Demonstration Project as a Tool for Introduction of Sustainable Low Cost Housing – Some Experiences from Ethiopia

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ABSTRACT

One of many serious problems in Ethiopia today is the rapid pace of deforestation. This accelerates fire-wood shortage and put a high stress on the natural resources including timber for construction. Based on the assumption that low cost housing based on soil is an economically viable and environmentally sound choice, a research programme at Halmstad University was initiated in 2004. This research, aiming at the Kambaata Region in Southern Ethiopia, has focused on the introduction of adobe technology and cement stabilised soil block technology.

A final stage of this research programme is to erect demonstration buildings. Its objective is to demonstrate new building technologies and to use the demonstration buildings as reference objects in studies regarding building technique and attitudes towards these new technologies.

This paper is focused on the role of demonstration projects at the introduction of sustainable low cost housing. As an introductory background some executed demonstration projects are described and their impact is analysed. Against this back-ground, a currently executed demonstration project is described.

Key-words: sustainability, low cost housing, demonstration project, attitudes, cost effectiveness, environmentally sound, adobe, cement stabilised soil blocks

1. INTRODUCTION

1.1. Background

Ethiopia has a high population growth-rate, at present about 3.2%. Expansion cultivation of the soil to feed the growing population in combination with an extensive high population density, 300 persons/sq. km, Bielie et al (2001), contributes to a rapid pace of deforestation. This results in a rapid soil-erosion, environmental degradation, shortage of fire-wood and scarcity of timber for construction. So far, the deforestation and erosion problems are not that severe in the region of Kambaata. However, it is reasonable to assume that these problems will be accentuated in the years to come.

1.2 Aim and approach

The aim of this paper is to present and discuss the use of demonstration buildings in connection with the introduction of new building technologies in the Kambaata Region. The paper will describe the work with these demonstration buildings, as well as, describe and discuss the need of alternative building technologies. Demonstration projects executed earlier will be described in a more general way to give background information.

1.3 Basis for information – pre-study

This paper is based on the results from different studies executed in the years 2004 – 2010. These studies have mainly consisted of the following:

- Literature survey.
- Structured and spontaneous interviews. These have been held during a number of field studies mainly in Southern and in Western Ethiopia. With some exceptions these interviews were held in the native language of the interviewed person.
- Observations made in connection with the field - studies mentioned above
- Site-investigations and as follow-up studies for these laboratory investigations.

2. THE NEED FOR ALTERNATIVE BUILDING TECHNOLOGIES

2.1 General background

It is obvious that the Ethiopian society is facing a formidable task to meet the needs of a dramatically increasing population. It is a serious challenge to provide this population with decent living houses. In this regard, priority must be given to people with very low income. There is an apparent need of a technology that could be used to construct affordable, cost-effective dwelling-houses which at the same time provide a healthy indoor-climate, are safe to live in and are sustainable.

2.2 Traditional building technology

The traditional way of erecting a dwelling-house in Ethiopia is to use a framework of timber in the walls. Timber-poles with an appropriate length are put into the soil. The timber-specie mainly used, at least in the highlands, has been and still is fast growing Eucalyptus. However, in order to enhance the durability of the walls, with regard to general decay and/or termite attack, some poles of more durable timber species, Thid (*Juniperus Procera Hochst*) and Kosso (*Hagenia Abyssinica*) have been used in the walls with a spacing of approximately 1000 mm. This framework is later on covered with mud mixed with straw. The framework is provided with a roof structure which is covered with corrugated iron sheets. At last a stone masonry may be built around the outer walls as a foundation to protect the lowest part of the walls. The timber core of the walls are in contact with the soil and can thereby be exposed to termite attack and decay caused by high moisture content.

There are two main reasons for not to continue to build in the same way. Firstly, the traditional technology is very "timber-consuming" and the timber scarcity puts a limit. Secondly, the more durable timber species mentioned above, Thid and Kosso, that traditionally have been used in order to obtain durable structures have been almost eradicated from Ethiopia; Bekele et al (1997). The possibility for ordinary people to erect dwelling houses with durable timber is becoming unthinkable; therefore an alternative technology must be used.

2.3 Alternative building technologies

2.3.1 Concrete hollow blocks

The use of concrete hollow blocks for walls in houses is already an important technology in Ethiopia. It is reasonable to anticipate that its importance will be even higher in the future. However, it seems unrealistic to anticipate that it will be of a great importance as regards providing ordinary people with proper housing. To erect a dwelling house with this technology requires special knowledge and special equipment and, above all, the cost will be comparatively high. The fact that cement is a key-material will be a major obstacle. The demand on cement at the Ethiopian market will be high for many years to come causing high price-levels for construction work. Today, 100kg cement cost about 460 Birr (about 28 USD) in Addis Ababa.

2.3.2 Cement stabilized soil-blocks (CSSB)

The CSSB-technology has, during the last 10–15 years, spread in some urban areas, mainly in Addis Ababa. It is reasonable to anticipate that this technology will be further developed in the future and that it will be very important. According to Asplund (1997), Selam Technical & Vocational Centre (STVC) is in the forefront in Ethiopia for cement stabilised soil blocks. STVC has developed and is marketing both cement stabilised soil blocks and ordinary concrete hollow blocks.

2.3.3 Adobe blocks

To use adobe blocks, i.e. to build walls in dwelling houses with sun-dried blocks made of mud, is not a traditional technology in Ethiopia. Forced by reality people in some parts of Ethiopia are developing and improving adobe blocks making technology.

One could observe this development in the vicinity of the towns of Nazreth, Dera, Metehara, Zwai and Meki in the central parts of Great Rift Valley and Alem-Maya (Eastern Ethiopia). All these towns, with the exception to Alem-Maya are situated in areas where there is a shortage of suitable timber for house construction. It is obvious that this technology has been accepted in these areas and that more and more people are using it. During field-studies it has been observed that the material composition for adobe blocks used at these "spontaneous" projects varies within a wide range depending on material available and, probably based on experience.

3. THE IMPACT OF DEMONSTRATION PROJECTS

3.1. Introduction

Some projects related to low-cost building technologies are discussed in the following section. All of the projects were not intended as pure demonstration projects but have in reality functioned as such.

3.2. Adobe blocks – Alem Maya

In the middle of 1950s, Swedish Mission BV constructed an elementary school building with adobe blocks in Alem Maya about 500 km east of Addis Ababa. According to Nilsson (1954) the building was the first of its type in this town to be built entirely with mud blocks and therefore the project aroused big interest among the inhabitants. Some persons tried to adopt the new technology which means, the project had a demonstration value.

However the mission organization did not make any follow up of this technology. Instead, when the school had to be expanded some years later new buildings were erected with the use of concrete hollow blocks. That means that the potential of using this school as a demonstration project for sustainable low-cost building technology was not utilized as it could have been.

Nevertheless, today adobe technology is well known in Alem Maya and used for more simple buildings such as stores and kitchens, Teshome (2010). Even if the building erected in 1954 from adobe blocks is still in use, this technology is not used for more advanced buildings.

3.3 Adobe blocks - Awasa - Rift Valley

Dr Wudenesh Hailu inspired the local people by build a dwelling house with mud blocks in Awassa (in the University compound) in connection to her Ph.D. study regarding integrated rural development, Hailu (2003). She used this technology in order to demonstrate the possibility of using it for erecting a dwelling house with a traditional design adapted to a modern life. The building was designed by taking the gender aspects in to consideration. In this design, efforts were made to give proper place for animals, a proper sitting place for household, shelves, beds and kitchen. In-door environment was seriously considered in her design and construction of this house. Economically, this house could be considered as a "low cost and sustainable". According to Hailu (2003), the intention of the project was demonstration and it had fulfilled its aim.

Inspired by the Awassa demonstration project, individuals had copied the design and constructed similar houses in other areas. Furthermore, Hailu (2003) underlines that the visible impact of mud blocks technology development in the Rift Valley Region to a great extent is a result of this demonstration project.

3.4 CSSB - Jinka

As stated by Asplund (1997), the first building erected with cement stabilised soil blocks (CSSB) in Ethiopia was a school building in Jinka, about 800 km south of Addis Ababa. This building, which was built in 1968, is still in use, and in good condition. Andersson (2003) who was responsible for the project asserted that the

aim was to test a new technology and compare it with the more conventional technology based on concrete hollow blocks. The test reviled the possibility of reducing the use of cement and thereby reducing the high cost of transport.

The Elementary School Building Unit (ESBU), which constructed hundreds of elementary schools in different parts of Ethiopia in the 60s and early 70s, did not continue to use this technology in other parts of the country. Conventional concrete hollow blocks and pre-cast reinforced concrete elements fabricated at the building site were used instead. It is not clear why the idea of building CSSB was abandoned.

We assume that it would have been possible for ESBU to use the CSSB-technology in many places all over Ethiopia. This would have been a tremendous possibility to introduce and demonstrate a more sustainable technology in many parts of the country. It is reasonable to anticipate that if a respected and well know organisation had widely used this technology it should have had a great positive influence on peoples attitudes towards this new technology.

3.5 CSSB - Addis Ababa

In the early 1990s, STVC in Addis Ababa tried to introduce and commercialize sun-dried adobe blocks in the markets in Addis Ababa. But the centre dropped the idea because it could not find a market. As stated by Mokonen (2003), Selam Centre had problem not only in finding market but also in finding workers who were willing to work with mud blocks, which is related to low status.

The centre fall back to using cement and soil to make blocks, i.e. cement stabilized soil blocks. Since then, the Centre has developed and is marketing both cement stabilised soil blocks and ordinary concrete blocks. Office, workshop, and residence buildings at the Mekane Yesus Appropriate Technology Centre and an office building for the Swedish Save the Children in Addis Ababa are two examples that have acted as demonstration projects and where the CSSB blocks manufactured at STVC have been used successfully. However, in the context of this study, these buildings cannot be regarded as low-cost and affordable to low income groups.

4 THE DURAME DEMONSTRATION PROJECT – DESCRIPTION

4.1 Background

At Halmstad University studies concerning low-cost housing with a special focus on the Kambaata Region have been conducted for several years; Hjort and Sendabo (2004). The overall aim has been to introduce low cost housing technologies in this region and at the same time study and analyze the attitudes of ordinary people in connection with demonstration buildings. From the beginning of these studies the importance and necessity of erecting demonstration buildings have been underlined.

4.2 Aim

The aim is to erect four demonstration buildings in the town of Durame with the use of adobe technology and CSSB-technology and thereby get a basis for technical studies as well as studies concerning attitudes. These studies are described later on in the paper.

4.3 Design

The detailed design of the demonstration buildings have been executed by two BS.C students. It is described in Johansson and Wartainen (2008). These two students based their design from findings obtained during a field study in Ethiopia. An essential part of their field study was a visit to Challia in Western Ethiopia, where they studied a successful low cost housing project. Interviews with people living in houses erected by adobe technology was an essential part of their study.

TABLE 1. Design of demonstration project. Johansson & Wartainen (2008).

ITEM	Dwelling House 1	Dwelling House 2	Kitchen 1	Kitchen 2	Toilet-building
Size	5,5 x 5,8 m^2	5,5 x 5,8 m^2	3,4 x 3,4 m^2	3,4 x 3,4 m^2	2,5 x 2,5 m^2
Foundation	Stone masonry				
Walls	Adobe	CSSB	Adobe	CSSB	Adobe
Roofing	Trusses of eucalyptus Corrugated iron sheets				
Flooring	Concrete slab on natural stone				
Doors and windows	Wooden. Locally fabricated				

TABLE 1 shows the main features of the design. However, many important details are discussed and appropriate solutions are proposed in their study. The following can be mentioned:

- Foundations – details
- Roof - overhang
- Securing of roofing against wind-forces
- Fastening of doors and windows
- Protection of outer-walls

4.4 Status of the project

Due to different reasons the project has been strongly delayed. As a result of increasing project costs the project has been reduced. Kitchen building 2, see Table 1, will not be erected.

At present the foundations for the remaining buildings are completed. Preparations are under way for manufacturing of adobe blocks and CSSB blocks on site. According to present plans the demonstration buildings shall be completed at the end of 2011. The production of adobe and CSSB blocks on site will be supervised by two people who within the project have got training at STVC.

4.5 Studies within the project

The studies related to these demonstration buildings can be divided into two groups: studies which focuses on technical issues and studies related to attitudes towards the new technologies. These studies have been and will be executed before, during and after the erection of the demonstration buildings. An overview of these studies is given in TABLE 2.

TABLE 2. Studies within the project – overview.

PART	Studies before erection	Studies during erection	Studies after completion
Technical studies	Laboratory and field tests regarding adobe blocks; reported in Hjort (2009). Laboratory and field tests regarding CSSB, reported in Afkari (2010)	Will focus on methods for weather protection during manufacturing of blocks and masonry work of walls.	Mainly follow-up studies that will focus on durability and function.
Studies regarding attitudes	Interviews executed and inquiry form distributed. Not yet analysed	Interviews executed and inquiry form will be used	Interviews executed and inquiry form will be used

5. CONCLUSION

Demonstration buildings are efficient as tools in connection with the introduction of a new building technology. Especially this seems to be the case when there is some skepticism about the technology as such based on prejudices. Therefore the use of demonstration buildings is very important in connection with the introduction of sustainable low cost housing based on a technology that can be dismissed as “old fashioned” or “low - tech”.

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