

Shelter Development:

Improving Cost Efficient Houses in Qualitative and Quantitative Ways in Addis Ababa



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Introduction

‘Housing’ is universally accepted as the second essential human needs next to food and water. Large scale housing programs create employment, purchasing power and activate the economy. For developing countries, one of the most challenging aspects is housing.

In Addis Ababa, the capital city of Ethiopia, housing problem is one of the major problems. Some of the reasons are the middle and low income groups are unable to buy or build houses due to increased cost of construction material and inaccessibility of land.

In order to alleviate housing problem, currently the government and real state developers (private contractors) have been engaged in large scale construction of houses. However, most of the houses built by the real state companies are not affordable by middle and lower income groups. Therefore, improving of cost efficient houses in qualitative and quantitative ways in Addis Ababa, would contribute a lot for shelter development.

1. Shelter Situation Analysis

Basic General Data

Ethiopia, situated in eastern Africa with 80° North and 380° East, covers an area of 1,104,300 square kilometres. The country has dry and wet seasons, which prevail from October through May and June to September respectively. It has an elevated central plateau varying in height between 2000 and 3000 meters.

Ethiopia has a federal government structure that comprises of 9 regional states and two autonomous city administrations. The Federal Democratic republic of Ethiopia is a multi-ethnic state with a variety of languages spoken (about 80 languages) in the country. Amharic is the working language of the Federal Government.

Total population of Ethiopia as July 2010 estimate is 88,013,491 (CIA-The World Fact book).

Life expectancy of the population is 55.8 years.

Mortality rate at birth per 1000 is 78.99.

Even though the country has a long History of statehood, only 17% of the Total population lives in urban areas (2008). Rate of urbanization is 4.3% Annual rate of change (2005-10 est.)

Like most developing countries, Mararia and HIV/AIDS prevail.



Picture 1: Ethiopia with Regional states

Ethiopia's poverty-stricken economy is based on agriculture, accounting for 45% of GDP, 80% of total employment. Coffee is critical to the Ethiopian economy with exports of some \$350 million in 2006. Flower, hide and skin are emerging into the export market.

Addis Ababa besides being the capital city of the country it is also the head quarter for African Union (AU), the United Nations Economic Commission for Africa and many other international organizations.

Based on figures from the Central Statistical Agency of Ethiopia (CSA) published in 2008, Addis Ababa has an estimated total population of 3,147,000, consisting of 1,511,000 men and 1,636,000 women. The CSA estimated that presently there are no rural parts to the city, so 100% of the inhabitants are considered urban dwellers; Addis Ababa contains 23.8% of all urban dwellers in Ethiopia. With an estimated area of 530.14 square kilometres (204.69 sq mi), this chartered city has an estimated density of 5,936.2 inhabitants per square kilometre (15,375 /sq mi).

1.2 Shelter Related Fact and Figures

As mentioned in the introduction, housing has been one of the major problems in Addis Ababa. Census data indicated (CSA, 1994) the housing stock in Addis Ababa was 374,742 in the year 1994. Between the years 1994-2000, about 84,525 housing were built formally and informally making the total number of housing stock 449,592 (AACA, 2004). Based on the different studies carried on, the total deficits ranging from 350,000 to 450,000. Housing deficit studies do not indicate the exact demand; they only indicate the severity of the situation. The 1994 population and housing census have revealed that 82% of the housing units are made of wood and mud wall. According to various sources in the core of the city where 80% of the total housing stock exists most of the housing units are old, falling down, substandard and overcrowded. According to CSA 2004; 97% of the total housing stock of the city is single storied buildings, 41% of the housing units are overcrowded with an average number of rooms per housing unit being 2.6 and an average of 2.1 people per room, 67% of the units lack toilet facility (CSA, 2001).

The development of affordable housing for the low-income groups in the city is a difficult issue because of lack of land and high cost of building materials. According to PADCO (1996) house prices to annual income ratios ranging from 14:1 for mud houses to 29:1 for masonry units. The price of building materials has

been rising constantly. The construction cost of housing per square meter has been escalating and reached more than double mainly as a consequence of the rise in the price of building materials. The estimated cost of housing with minimum habitable construction materials per square meter of floor area is ranging from 2500ETB (182USD) to 3000ETB (218USD).

Access to and cost of Basic Services/Infrastructure

Mainly, due to poor institutional arrangement and weak financial base of the urban centers of the country, inadequate social and physical infrastructure provision is below the minimum requirement. The 1997 PADCO survey shows only 55.7% of the housing units in Addis Ababa had private or shared water connections. In addition, 30 to 40% of the water produced is lost due to leakage and improper management of the system.

Housing Policy

Ethiopia had no comprehensive national urban housing policy up to 2005. However, the city government of Addis Ababa in 2004 has launched a five-year grand housing development programme. The programme envisaged to build 250,000 housing units within five years time. In spite of some political problems associated with the 2005 election process, the programme has managed to build 66,000 housing units. The Federal Government, having taken the experience as a good opportunity, has replicated the programme as a means to alleviate shelter problems in many parts of the regional towns in the country. Consequently, in the year 2006, the urban development package that addresses the housing sector has been enacted. The package deals with the housing development with the main objective of constructing a cost and land-saving condominium houses for the middle and low income people as a strategy to alleviate the shortage of housing in a meaningful way and create wide employment opportunity to improve the lives of urban poor.

Specific objectives:

- Encouraging saving culture of low and medium income citizens and empowering them through ownership of houses and tenure security.

- Promotion of micro and small enterprises, which can observe more labor force and operate at a lower overhead cost.
- Promotion of cost efficient housing construction technology through capacity building.
- Regenerating the slum areas of the inner city as a process of densification and vertical growth.
- Changing the image of the city.

Long term objective:

Is to improve the standard of living of citizen's especially low income residents of the city, which are the majority through the creation of employment opportunities and the provision of decent and affordable housing.

Actors in Shelter Delivery and their Roles

Housing co-operatives and the Agency for administration of Rental housing (AARH) were the sole actors in the housing provision before the year 1991(the times of the socialist government). Currently, the main actors highly involved in shelter provision are private companies engaged in real estate development, individuals who are entitled to have a legal title deed for their plots or own an informal or 'illegal' plot of land, housing co-operatives and the Federal and Regional governments. The Federal and Regional governments are responsible in the provision of urban land, infrastructure and construction of condominiums.

Shelter Design

Inappropriate design and absence of urban planning regulation are some of the reasons that aggravated housing problem in Addis Ababa.

The problem of standard and its implication in cost and construction time have been dealt with in several works of integrated housing development project. The housing project office prepares a multi-storey building with different house design types that accommodate studio, one bed room, two bed rooms, and three bed rooms to be incorporated in each block.

This paper is trying to stress on improving of cost efficient houses on qualitative and quantitative aspects by using appropriate design technology. Of course, housing requires technology, but technology is a tool and not a solution by itself.

2. Organisation

BERTA Construction P.L.C is one of the largest construction companies in Ethiopia was established in 1969 by two Ethiopian Civil Engineers. Soon after its establishment the company has been engaged in various types of Civil Engineering works including construction of roads and bridges, dams, irrigation schemes, water supply systems as well as building projects such as hotels, office building, factories and residential housing development all over the country. As one of company's goals was to work on the housing problem, BERTA has been engaged in real state development housing project. The total numbers of houses under construction are 258 with total project cost of 239,388 million Birr (17,410 million USD).

The short term objective of the company is to build luxurious but affordable houses by high and middle income population in some of the prime locations in Addis Ababa.

Long term objective of the company is to expand into more economical and low cost housing projects to accommodate the housing shortage of the city.



Picture 2-Real state houses constructed by BERTA



Picture 3 – Designed low cost houses by BERTA

Shelter Problem

There is severe housing shortage in Addis Ababa especially for low income households that accounts for over 80% of the city's population. Some of the main housing related challenges in the city are dilapidated condition of existing housing stock; poorly serviced working and living environment and expansion of informal settlements. Shelter problems in the city manifest itself both in terms of quantity and in quality. It is believed that with a deteriorating housing stock and tremendous housing shortage, ***improving of cost efficient houses in quantity and quality would contribute in the alleviation of the problems.***

The following are some shelter problems in the city:

- ◆ Lack of experience in cost- efficient shelter design and construction. Lack of experience in construction, quality of work is one of the major problems as a result of production of material as well as workmanship. Poor design of houses and the use of substandard construction materials resulted in wastage of materials, time and effort. (See picture 4)
- ◆ Effective use of land for construction
- ◆ Housing affordability as most of the people income is low
- ◆ Lack of integrating the concepts of sustainable development in the design and construction process



Picture 4– Construction material not fulfilling the standard

Proposal for Change and Improvement

The design shall consider the basic design requirement such as cultural and social aspects, physical needs, quality of housing and the likes.

The proposed design technology has three considerations, urban development, cost efficiency and environmental consideration:-

Housing Designs Consideration

The housing design considers land as scarce commodity and the provision of basic infrastructure as relevant cost factor.

The following technologies are introduced by the low cost housing project.

- New hollow block size (L=32 cm x W=16 cm x H=19 cm) - more economical, easier to handle.



Picture 5 - Full hollow block viewed from top

- U-shaped block, same size as hollow block used for prefabrication of lintels and beams.



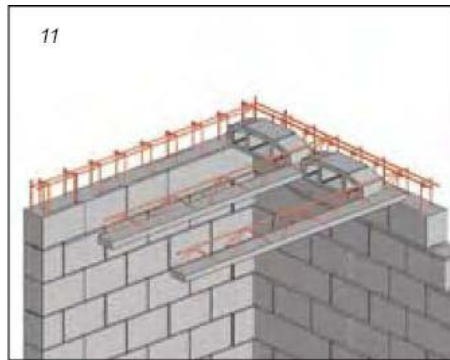
Picture 6 - U-shaped HCB viewed from top

- Reinforcement for columns inside of the hollow blocks – no formwork required for columns.



Picture 7 - Column HCB with reinforcement

- Pre-fabricated slab system (beams and hollow blocks) – no formwork required.



The slab-HCBs are placed between the beams or between beam and ring-beam.



One has to be sure of the proper placement of the slab HCB.

Picture 8 - The slab HCB viewed from top / side

- Modular architectural system adjusted to varying financial capabilities of beneficiaries.
- Designs to be adapted to any kind of soil and earthquake regions.
- Reduction of material wastage of up to 30%.
- Environmentally friendly approach, as no wood is needed for formwork.

Hollow Concret Block (HCB) Production

The machines used to produce HCBs are electrical vibrating machines which have 1.5HP motor. The vibration is strong enough to compact the concrete sufficiently in the moulds and to achieve the required strength. Before starting production the different materials used to produce the HCB will be dry-mixed thoroughly on a clean and dry ground by hand. Then the mixture will be put in the mixer with the appropriate amount of water required (water to cement ratio of 0.49- 0.55). The

mixture is inserted into the mould and vibrated for about 60 seconds before extruded as HCBs. The machines can produce three pieces at a time.

Cost Efficiency Consideration

Using the proposed technology, the project would achieve a cost reduction of up to 40% in comparison to the construction cost per square meter in Ethiopia. (Low Cost Housing Technical Manual, 2003).

As mentioned above saving would be in HCB, formwork, concrete and Labour. For instance if we compare the reduction of cost of one material - HCB, by the new technology, the result would be as follows:

⇒ Using the proposed technology

Material Description	Unit	Qty	Rate (Birr)	Cost Estimate per m² (Birr)
HCB	Pcs	14	4.61	64.54

⇒ Using normally used technology

Material Description	Unit	Qty	Rate (Birr)	Cost Estimate per m² (Birr)
HCB	Pcs	13	8	104

Table 1- Comparison Table

From the above, we can see that by using the proposed technology, there would be a cost reduction of about 38%.

Business Plan

- Rational – meet the increased demand for affordable and decent housing.
- Objective – In cost efficient low cost housing, standardization of building elements would maximize productivity resulting in lower costs per unit.

In line with the rational and objective of the low cost housing, the business plan is prepared as follows.

- Facts – Cost reduction–40% (Low Cost Housing, Technical Manual, 2003)
- Reduction of material wastage–30% (“ “ “ “)
- Usually, wastage of material is expected as 5%, and then there would be a saving of 1.5% of material wastage. The total cost reduction would reach to 41.5% in the proposed technology.

Consideration in the business plan:-

- Material production would be subcontract to micro and small enterprise as a job opportunity scheme and also to have some profit on the materials.
- The cost saving amount due to the proposed technology would be shared to both parties, i.e. the Contractor and the Client. Which would result to:
- Provide affordable house to the Client
- Sell more houses with reasonable profit margin.

Please see hereunder the cost reduction of the proposed design in comparison to the current construction costs per sqm.

No of houses (Units)	Plot Area (m ²)	Construction cost per m ² (Birr)	Total construction cost (Birr)	Cost reduction 41.5% (Birr)	Total construction cost (Birr)
1	90	3,000.00	270,000.00	112,050.00	157,950.00
50	90	3,000.00	13,500,000.00	5,602,500.00	7,897,500.00

Environmental Consideration

In the proposed technology, wood consumption is extremely minimized. The use of wooden formwork has negative effects on the environment. More over it requires skilled manpower and time to mantle and dismantle the formwork.

All in all the purpose of the design is to make a safe and economical structure that meets its intended purpose. The design of the buildings meets the standard code of practice of the country. It is fast economical and very little formwork is required.

Technical people and users shall accept and be able to use, maintain and sustain the technology in their homes as well as in their community.

The proposal for change or improvement in line with the problems shall be as follows:-

- ◆ Technology/knowledge transfer program, as a capacity building program, shall be prepared for the technical workers
As the company has different scattered projects in Addis Ababa, training shall be given batch by batch to all concerned staffs. Then, after the training, model houses shall be constructed for two reasons:
 - i. To test whether the technical staffs have acquired the knowledge and implement it as required.
 - ii. To demonstrate cost efficient houses to the Client.
- ◆ Standardization of building: this would benefit in the reduction of construction time, improve quality, reduce costs and land can be utilized effectively.
- ◆ Regarding affordability, option shall be given to the Client, as to cost efficient houses to be constructed up to minimum habitable stage and finishing work shall be done by the client.
However, if the Client prefers this option, the following points shall be taken into consideration,
 - There should be a minutes of understanding between the Client and the Contractor/designer as an agreement, not to change the original design in any ways during future extension. If there is a need of design modification by the Client, then the client should request approval in writing from the designer.
 - The original contractor shall give technical assistance/advice for future construction.
- ◆ As quality is the major component for shelter development in respect to time and cost, it shall be categorized into two parts:-
 1. Quality of Construction Material – should be checked at the time of production whether it fulfils the minimum requirement of the standard by appropriate testing.

2. Quality of workmanship (the ability of workers) - shall be supervised regularly and periodic training shall be given to the workers on new technology.

In order to analyse the proposal in a SWOT analysis, please see the table hereunder:-

Strength	Weakness
- Encourage saving culture of low and medium income citizen - Promote cost efficient housing construction technology - Empower the people through ownership of house	- May not include very low income groups
Opportunities	Threats
- Create job opportunity for micro and small enterprises, which operate at a lower overhead. - Gives new experience for technical staffs - Higher profit margin for real estate companies.	- Quality of work may not be as good as expected, if adequate training is not given.

Table 2 – SWOT Analysis on the Proposal

Conclusion

As we can see from the SWOT analysis, the strength and opportunities has much higher positive impact on the proposed housing development than the weakness and threat. Therefore, one can conclude that cost efficient technology would contribute greatly to shelter development.

References

GTZ and Low Cost Housing Project

2003 Low-cost Housing Technical Manual, Addis Ababa

AACA (Addis Ababa City Administration)

2004 Housing Sector Development Programme: Addis Ababa

AAHDPO (Office for Addis Housing Development Project)

2006 Report

CSA (Central Statistics Authority)

1998 The 1994 Population and Housing census in Ethiopia: Volume I Statistical Report

IHDP, (Integrated Housing Development Programme)

2004 Integrated Housing Development Programme: Draft II Addis Ababa

PADCO, (Planning and Development Collaborative International)

1997 Ethiopia Housing Sector Study: Final Report, Wass International PLC

CIA (Central Intelligence Agency)

2010 Central Intelligence Agency: The World Fact Book – Ethiopia (on line)

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