

ALTERNATIVE CONSTRUCTION METHODS FOR LOW-COST HOUSING IN SOUTH AFRICA

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Purpose: To compare alternative construction methods for low-cost housing in order to identify the best method regarding cost, time and quality and improve the awareness regarding these methods.

Method: A questionnaire survey on the familiarisation of alternative construction methods and how the different construction methods could be applied to the development and delivery of low-cost housing was conducted among quantity surveying firms and the Eastern Cape Department of Roads and Public Works.

Findings: There are alternative construction methods that take less time and cost for building low-cost housing and that the lack of awareness regarding alternative construction methods is a limitation in its application for low-cost housing.

1. INTRODUCTION

Sixteen years into its democratic existence, the South African government is still struggling to provide adequate low-cost housing as set out in the several housing policies since 1994 (Charlton & Kihato, 2006: 275). Some of the weaknesses of the housing policy is that there is not a clear link between the current focus in government on the contribution of housing to poverty alleviation, and the ability of the policy to deliver on these objectives (Charlton & Kihato, 2006: 259). This resulted in housing backlogs and poor quality low cost houses.

South Africa's minister of human settlements, Mr. Tokyo Sexwale reports that the government housing backlog stands at 2.1 million units, affected over eight million people. He also reports that around 40 000 RDP houses would have to come down because of poor workmanship (South Africa Info, 2010).

In a recent report, *20 Year Review: South Africa 1994 to 2014* the government admits that: "the state capability needs to be increased to support co-production modes of housing delivery and settlement making between ordinary citizens, community organisations, cooperatives, the private construction sector and the banks" (South Africa, 2014: online). Government wants to remove the backlog by 2030 setting a target of building 200,000 housing units a year (Sapa, 2013: online).

According to (South Africa.info, 2013: online) the National Housing Policy specifies that all housing subsidies offered be met with a contribution from the recipient – either in the form of funds or labour - to encourage a culture of responsibility and saving for housing. The government introduced the People's Housing Process and promise to fund households who are willing to participate in building their own house. People can now with assisted help choose alternative construction methods to build dwellings that are of a good quality, of a design that reflects individual needs and taste, and from which they can work (ReadyKit, n.d: online).

In order to address the quality of the structures the Housing Minister Lindiwe Sisulu reports that: "In order to tackle the building material issue, my department is undertaking investigations in respect of the use of alternative building technologies which will meet all the requisite standards for quality, norms and standards" (Ndaba, 2008: online).

The problem of providing low-cost housing of an acceptable quality could possibly be solved by using alternative construction methods and improving the awareness regarding these

methods. This article reports on alternative construction methods as a solution to the search for sustainable low-cost housing.

2. ALTERNATIVE CONSTRUCTION METHODS

The first low cost housing projects were generally a two room brick work structure with corrugated iron roof sheeting. Over the years the design of the house improved a lot. It now consist of a five room brickwork structure with either corrugated iron roof sheeting or clay roof tiles. Lights and electricity are supplied and a geyser for hot water is an option (Greyling, 2009: 3). The problem is that many people can't afford the electricity-driven services of appliances and utilities (GBCSA, 2012: online). Alternative construction methods are necessary as a solution.

2.1 Moladi housing technology

Moladi technology involves easy to use plastic panels that are interconnected to make a plastic structure/form of any length and height for the different walls of a building (Moladi, 2008: online). The reinforcing, pipes, electrical installation, door- and window openings are cast before the concrete is cast into the walls. It takes approximately 4 hours to set up the plastic mould and about two hours to fill it with a special blend of concrete (Mcilhone, 2012 : online). The walls are left to dry overnight (15 hours) and the formwork then removed. The formwork can be used up to 50 times and can then be recycled for other components (De Lange, 2008: 35).

Moladi technology can build house sizes between 52 and 80 square metres and it takes approximately 14 days from the lying of the foundation to revoke. This building method is believed to be stronger and more stable than ordinary brickwork (Moladi, 2008: 6)

As an alternative to traditional building methods Moladi technology is 50% cheaper than ordinary brick wall methods (De Lange, 2008: 35).

2.2 Speedwall building systems

Initially started in 1991, speedwall construction technology provides manufacturing of the systems floor, wall and roof panels on site by a mobile panel manufacturing machine. The panels are constructed from fireproof isolation and steel mass, and then a mixture of concrete sand is sprayed over the wall. A 35m² house will require about 40 panels to be constructed (Speedwall Building Systems, 2013: online).

Construction times are up to 12 times quicker than conventional construction approaches. One onsite panel manufacturing machine is capable of producing 240 panels per day and can be erected *in situ* within minutes. Speedwall structures are cheaper to build, and are known for high energy efficiency which reduces energy costs, a benefit to low-cost houses (Speedwall Building Systems, 2013: online).

2.3 Hydraform interlocking bricks

In 1988 Hydraform developed an interlocking building block machine which hydraulically compress soil (earth), mixed with cement into solid blocks which fit into one another. When cured, the soil cement blocks can be dry-stacked. For building houses, a strip footing foundation build with Hydraform blocks is used eliminating the use of mortar in 70% of the building structure with no need for concrete or steel columns (Hydraform , 2008 : online). The unique dry-stacking building system uses mortar in the first few courses and the top 3-4 courses – the rest of the structure is dry-stacked which make wall construction easy to done by anyone (Promotional Feature, 2012 : online).

The dry-stacking method represents savings (approx 30%) in time and construction costs making Hydraform machines ideal for remote sites where transport, cement and sand costs are high. Hydraform building technology provides a solution for replacing conventional brick and mortar masonry, however basics of the conventional building system remain largely unchanged (Hydraform, 2008: online).

3.4 Modular and timber construction

In South Africa, timber homes were re-introduced as an alternative to conventional brick and mortar homes in the sixties (Cronje, 2013: online). The timber frame wall panels with doors and window frames built into panel openings are manufactured on site or pre-manufactured in panels, and then raised and fitted onto the floor platform of the building. Builders Trade Depot supply quality standard modular timber homes of 41m² or 53m², as a complete unit, including wall and ceiling lining, cornice and skirting, wall and floor tiling, plumbing and electrical fittings, windows, doors and kitchen and bedroom units. The houses are delivered in stages to suit the contractor/clients progress

In terms of environmental and cost aspects, manufactured timber components contain approx 14% per cent embodied energy, in comparison to bricks, blocks and concrete with 80% and steel at 95%. Better insulation, means a smaller heating system and lower heating bills (Builders trade depot, n.d.: online).

Frames are quickly and accurately manufactured, increasing the predictability and pace of building programmes, and offering a fixed-price / fixedterm solution for the supply and erection of the structure. This method supports skills development, improves both productivity and quality, and provides higher standards for homeowners (Builders trade depot, n.d.: online).

2.5 Straw bale construction

Revived since 2000 straw bale construction structures as a low cost alternative for building highly insulating walls are built by creating a frame (out of wood, usually) and stacking bales of straw as if they were cement bricks in order to create walls. These straw bales are then plastered over on both the inside and outside of the bale to create walls that are strong and insulated (Chapo, n.d.: online ; Strale bale construction, n.d.: online).

Using straw as wall material can save up to 50 percent off of the cost of traditional wall materials. The primary attractiveness of the process is 50 percent less energy use required to heat homes, saving on energy bills (Jones, 2002: 16).

Straw bale structures with walls made out of these bales are also great at providing sound and thermal insulation Jones (2002: 15, 85) and Magwood & Mack (2000: 8), is easy to construct (Steen, Bainbridge & Eisenberg, 1994: 22), is sustainable (Jones, 2002: 14) and is durable and structurally sound (Lacinski & Bergeron, 2000: 13). Straw is readily available (Prinsloo, 2004: 32) and can counteract climate change because straw turns carbon dioxide into oxygen. Straw bale buildings can then actually cause a net decrease in carbon dioxide emissions (Jones, 2002: 15).

3. METHODOLOGY

A questionnaire survey strategy was used whereby a questionnaire was distributed to quantity surveying firms and the Eastern Cape Department of Roads and Public Works. The survey was designed mostly with open-ended questions and one closed-ended grouped into two sections. Section A requested the biographic profile of respondents. Section B tested

familiarisation of alternative construction methods and how the different construction methods could be applied to the development and delivery of low-cost housing.

Fifteen questionnaires were sent out and five were received back, resulting in a response percentage of 33.33%.

4. RESULTS AND DISCUSSION

4.1 Profile of respondents

Table 1 shows the years of experience and position in company of the participating respondents.

Table 1: Profile of respondents

Respondent	Company/Firm	Position	Experience
1	VBV in association	Candidate Quantity Surveyor	4 years
2	Eastern Cape Department of Roads and Public Works	Candidate Quantity Surveyor	4 years
3	University of the Free State	Lecturer in quantity surveying	8 years
4	Eastern Cape Department of Roads and Public Works	Candidate Quantity Surveyor	3 years
5	Eastern Cape Department of Roads and Public Works	Candidate Quantity Surveyor	2 years

4.2 Low cost housing construction methods

Question 1: Which construction methods are currently being used in Low cost housing?

60% respondents answered that the methods currently used in low-cost housing includes cement brick walls, with a metal roof and minor finishes inside and outside, it normally only has one door and little windows. 40% of the respondents said that Moladi Housing Technology were used for low-cost housing.

Question 2: How costly are these methods?

All respondents agreed that low-cost housing is normally not expensive, due to materials being used not being expensive. The cement bricks' being much cheaper than the conventional clay bricks, with minor finishes inside, with no floor covering, ceiling etc. Cement bricks are not of a good quality like conventional clay bricks.

Question 3: Why are these construction methods particularly being used?

40% of the respondents answered that the current methods are familiar, whilst 60% of the answered that it is cost effective and takes a shorter time to deliver.

Question 4: What are the advantages and disadvantages of these construction methods?

Respondents reported the following:

Advantages	Disadvantages
It is a strong structure (normally) if build correctly and will last longer than shacks and timber structures.	The structure normally takes a while be erected.
It is a more insulated structure, than shacks.	Bad workmanship begins to show in a few months with walls cracking etc.
Safer and more secure structure.	Bad/low/cheap quality finishes normally.

Question 5: What are the constraints in delivering low cost housing?

80% of the respondents answered that the constraint in the delivery of low-cost housing was due to poor workmanship and corruption, whilst 20% answered that it is due to the limited budget compared to the great demand.

Question 6: Do you know of alternative construction methods?

All the respondents knew about alternative construction methods with 20% referring to timber frames and lightweight steel structures, 10% only had theoretical knowledge and 60% knew precast concrete structures such as The Speedwall System.

Question 7: Where have they been used?

20% of the respondents answered that timber construction is being used more often in South Africa, especially in coastal areas while the lightweight steel structures are used in the central areas of the country. 60% reported that precast concrete structures were being erected in the Eastern Cape and Free State Provinces. 20% of the respondents did not reply.

Question 8: What are the advantages and disadvantages of alternative construction methods compared with to current construction methods?

Advantages	Disadvantages
take less time and carry less costs	unfamiliarity

4.3 Alternative low cost housing construction methods

Question 9: Are you familiar with the following alternative construction methods?

Moladi Housing Technology	YES - 80%	NO - 20%
Speedwall Building Systems	YES - 80%	NO - 20%
Hydraform Interlocking Bricks	YES - 60%	NO - 40%

4.3.1 Moladi Housing Technology

Question 10: Have you ever worked on a project where Moladi Housing Technology was used.

Only 20% of the respondents has worked on a project where Moladi Housing Technology was used whilst 80% has never worked on a project where Moladi was used.

Question 11: What do you think about Moladi Housing technology as a construction method?

80% of the respondents believed that it is a superb method that allows for construction of wall elements in a day. The system also is permanent, durable, waterproof and possesses excellent thermal sound insulation properties. The best advantage is that the system eliminates time constraints, shortage of skilled labour and materials as well as waste. It also seems to be 30% less expensive to similar structures built using the traditional brick and mortar structures.

20% respondents did not approve by saying: "Cracks as soon as 1 month after completion" meaning that the Moladi construction method has not proved to be resilient over time.

4.3.2 Speedwall Building Systems

Question 12: Have you ever worked on a project where the Speedwall building system was used?

Only 20% of the respondents have worked on a project where the Speedwall Building System was used, while 80% has never worked with this construction method before.

Question 13: What do you think about the Speedwall building system as a construction method?

80% respondents reported that it is a good construction method, which is less time consuming, strong and durable. 20% of the study did not reply.

4.3.3 Hydraform Interlocking Bricks

Question 14: Have you ever worked on a project where Hydraform Interlocking Bricks where used.

40% respondents have worked with this system whilst a majority of 60% have never worked with this system before.

Question 15: What do you think about Hydraform interlocking bricks as a construction method?

All respondents reported that it is a system where interlocking bricks are manufactured by a machine. The interlocking bricks are then used/stacked to build all sorts of structures. It allows for minimal use of mortar and has a "facebrick" finish both sides, resulting in cost savings. It is also a much faster type of construction method and can be used for community upliftment.

4.4 General questions

Question 16: What do you think are the main constraints hindering low cost housing delivery?

From a variety of answers the study concluded that the following are the main constraints hindering low-cost housing:

Corruption and tender fraud from the various role-players.

Lack of skills.

Bad management of projects and budgets.

Lack of awareness.

Non- delivery.

Government constraints.

Government policies.

Question 17: How could building methods for low-cost housing be improved?

The respondents answered that professionals should improve on their planning and management skills. They also answered that new construction methods should be researched and utilised resulting in these methods being used and improving the awareness regarding these construction methods. They believed that more individuals should be trained regarding the physical construction of the construction process as a lack of skill is a great constraint in the delivery of low-cost housing.

Question 18: What in your opinion is the most suitable construction method taking in consideration time, quality and cost for low-cost housing?

60% respondents answered that they believe that the Hydraform Interlocking Brick System would be the most suitable construction method, while 20% answered Speedwall and 20% Moladi.

All respondents indicated that there are alternative construction methods that take less time and carry less cost than the construction methods currently being used in low-cost housing.

All respondents indicated that there are alternative construction methods but they are unfamiliar to them.

These findings indeed support the hypothesis that the use of alternative construction methods may be limited due to a lack of awareness, and could possibly be the key to a more time efficient and cost effective construction method in the delivery of low-cost housing.

5. CONCLUSION

Conventional construction methods are currently being used in low-cost housing and consist of concrete walls, a steel roof, a door and few little windows. Construction cost is low as the materials used are not of the highest quality. Poor workmanship, corruption, tender fraud, lack of awareness, government policies and bad management are the reasons for the backlog in the delivery of low-cost housing.

Alternative construction methods such as Moladi, Speedwall and Hydraform interlocking bricks will be suitable for sustainable low-cost housing in terms of cost, time and quality but it is difficult to determine the ultimate construction method as each has positive and negative attributes.

6. RECOMMENDATIONS

In the search for an alternative construction method for sustainable low cost housing important aspects such as environment, cost, time and quality should be considered.

If attention is predominantly given on how to construct and deliver low-cost housing as quick as possible, Moladi is the best option. It has a short construction period, the plastic panels can be reused and the method of construction is very easy. Houses can be erected in as short as 14 days to provide housing for the people in communities who are in desperate need of shelter. Communities can also get involved in the construction process which will develop their skills. Although Moladi is a cheap building method it is not an environmental friendly method.

Hydraform interlocking bricks is an easy method to construct a house but is rather time consuming and costly in comparison to Modali.

Modular and Timber Construction is a very modern construction method to deliver low-cost housing but it does carry a higher construction cost and proves to be too expensive for low-cost housing. This construction method is more fitting to low-cost housing for communities in towns and cities which form part of the middle class.

The government should support and introduce more non-profit organisations like 'The Homeless and Poor Peoples Initiative' which provides advice, workshops to train people of the community and those less fortunate how to provide housing for themselves by increase their understanding and the use of sustainable and natural building materials.

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