

CHAPTER EIGHT: ALTERNATIVE HOUSING DESIGN AND CONSTRUCTION PROPOSALS

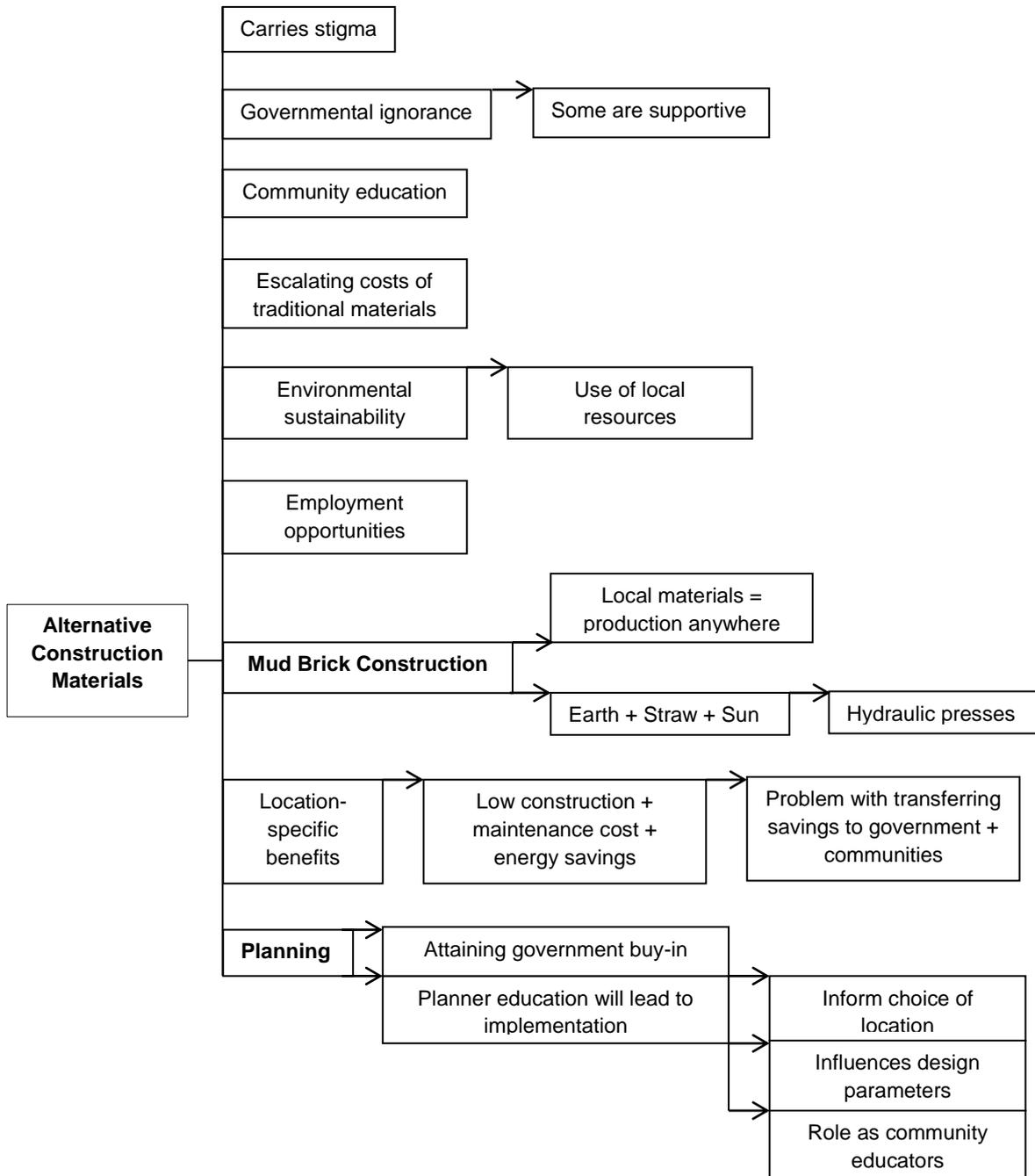


Figure 21: Summary Chapter 8: Alternative housing design and construction proposals

Source: Own construction (2012)

Chapter 8 will discuss the relevance of alternative building approaches in support of sustainable low-cost residential development. In light of the escalating costs of traditional building materials and the high expectations of those demanding free housing, alternative more economically effective building materials and construction methods should be sought. This chapter will not entail detailed discussions on the countless existing alternatives, but will aim to investigate the aptness of alternatives in low-cost residential development.

8.1 An introduction into alternative construction materials

According to Burger et al. (2012:101) there has been little implementation of alternative materials and technologies in the low-income, mixed income and subsidised housing sectors. According to the Human Settlements Review (2010:266) 2.9 million housing units were delivered for South African low-income earners between 1994 and 2009. Studies conducted during this period indicated that only 17 000 of these units were constructed using alternative building materials or innovative systems. This constitutes only 0.06%. Low-income residential development can be significantly improved by considering alternative building material options (Balleriono, 2002:6). Up to 60% of total housing delivery costs can be attributed to engineering design and construction materials, clearly justifying the investigation and implementation of more effective alternatives for the sake of improving the use of financial resources (Balleriono 2002:3).

The use of alternative building materials could excel the building process substantially. A 40m² house may be built in four to seven days, using alternative materials, compared to the average thirty day period required to build a unit of the same size using conventional brick and mortar construction (Human Settlements Review, 2010:268). Given the backlogs experienced in South African housing development and the urgency related to supplying homes for the disadvantaged, time savings can be of substantial benefit.

However many problems regarding the use of alternative materials as substitutes for more traditional approaches hinder the implementation of these options. These difficulties are summarised in Table 10.

Table 10: Difficulties with the use of alternative construction materials in SA

Problem	Explanation
Perceptions of Beneficiaries	<ul style="list-style-type: none"> -Alternative materials do not always carry acceptance from beneficiaries. -Beneficiaries are not always familiar with products and their benefits. -Beneficiaries often believe they are receiving a devaluated product. -Suppliers of alternative systems do not market their products sufficiently to the public.
Quality of structures	<ul style="list-style-type: none"> -Structural defects are often found a few months after completion. -In some cases units need to be demolished due to substandard workmanship. -Quality troubles contribute to the existing negative perceptions surrounding alternatives.
Developmental issues	<ul style="list-style-type: none"> -Minimal manufacturing capacity and a focus on importing: <ul style="list-style-type: none"> >Most alternative material suppliers import materials, limiting SA's manufacturing capacity and local economic development. >Extending starter units may prove difficult given the scarcity of new and alternative materials. -Job Creation and local economic development: <ul style="list-style-type: none"> >Building with alternative materials has to date not proven to provide more employment opportunities in local areas where prefabricated materials are used. >New technologies often require extensive training. -Business sustainability and consumer protection: <ul style="list-style-type: none"> >There are currently too many unknowns in alternative technologies to merit extensive investment. -The price of alternative building materials <ul style="list-style-type: none"> >Any cost savings to be encountered are often transferred to material suppliers and contractors and not to government or beneficiaries.

Institutional support	<ul style="list-style-type: none"> -Procurement and tender processes <ul style="list-style-type: none"> >A lack of procurement policies for alternative materials constrain usage. -Inspections <ul style="list-style-type: none"> >The inspection of units might be carried out by qualified engineers, but are not always undertaken by officials who understand the comprehensive certification conditions which the material or system carries. >In-house provincial inspectors are not experienced in the quality assurance of alternative building materials.
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Source: Constructed based on Human Settlements Review (2010:268-270)

In conjunction with the search for more cost effective options, more eco-friendly materials need priority. The provision of environmentally sensitive low-cost housing should be seen as a prominent tool in creating greener and more sustainable cities. Alternative technologies which are based on the use of renewable energy and materials can be simple and can function in harmony with the environment (Odhiambo & Wekesa, 2010: 66).

Sullivan (2009) states that achieving environmental sustainability is one of the United Nation's eight Millennium Development Goals, as adopted in 2000. The United Nation's main target for achieving environmental sustainability requires countries to integrate principles for sustainable development into their policies and programmes in order to reverse the loss of resources. Various South African policies and legislature have promoted innovative approaches.

The most prominent being the New Housing Policy and Strategy for South Africa: White Paper of 1994 which states: 'it is only by mobilising and harnessing the full diversity of resources, innovation, energy and initiative of individuals, communities, the State and the broader private sector, that the (housing) challenge can be met effectively'. In this regard there is no question that sustainable building alternatives can provide a means to meet the growing needs of our country's inhabitants whilst conserving our valuable natural systems and resources.

According to Balleriono (2002:1) the selection of building materials should take location-specific conditions into account and should meet the needs of low-income inhabitants by building new structures or improving existing units. India (2000) states that it is being increasingly recognised that one strong option to strengthen efforts on housing is to promote the use of innovative composite materials based on local resources from forestry, agriculture, natural fibres, plant materials, and other local resources like agricultural and industrial wastes available within small geographical regions.

It is thus important to localise the materials used to promote cost savings and minimise ecological footprints. According to UN-Habitat (2011:2) the provision of sustainable low-cost options will only be made possible by following an approach which is sensitive to local and regional variations in climate, governance structures, building and design expertise, and the availability of local materials. Materials which are locally available and thus minimise transport costs need to receive preference (UN-Habitat, 2011:55). Schmidt & Leader (2005:14) states that true sustainability may depend entirely on the use of locally available materials as a substitute for conventional supplies. Traditional, locally inherent building techniques which are adapted to weather conditions and cultures may provide feasible solutions given the limited resources often related to low-cost residential development.

Regionally appropriate design is of the utmost importance, but the significance of local stakeholders should never be underestimated. Local stakeholders should be given the opportunity to influence the design and planning of the housing systems which will impact them. (UN-Habitat, 2011:75) Alternatives have to be chosen which are both accepted and of benefit to the community in terms of ecological and socio-economic approaches.

Schmidt & Leader (2005: 6) states that many low-cost housing projects have the effect of 'branding their occupants as poor or outcasts'. Environmentally friendly alternatives can often induce this perception because they may look slightly different than the units delivered conventionally. Instead of creating incentives for long-term investment, these units can breed alienation and resentment. As previously stated educating communities about the advantages of alternative materials will prove vital in the implementation process. The fact that beneficiaries are generally not familiar with alternative approaches in housing construction, leads to a number of challenges. Communities often associate anything which is not traditional as substandard and unpleasant, resulting in rejection and resistance to proposals which incorporate alternative building systems and technologies (National Department of Human Settlements, SA, 2010: 273). Supplying homes built from alternative materials which will lead to protests and neglected developments due to unsatisfied users, would prove disastrous given the resources invested. Education is key.

Sullivan (2009) states: 'Communities may finally begin to recognize how much local wealth is being transferred away with the purchase of energy and other goods and services from elsewhere.' Beneficiaries must therefore be made aware of the development constraints in their area and how alternative approaches may alleviate these stresses whilst directly providing them with new opportunities and benefits. Part of educating communities must entail the promise of skills development and employment creation.

The Breaking New Ground Initiative (SA, 2004:25) states that on-site housing material production should be promoted to encourage labour absorption and employment creation. According to Odhiambo & Wekesa (2010: 66) the use of alternative materials and technologies responds to the plight of the urban poor and their environment by relying on labour-intensive methods which allows community members to participate in the delivery of affordable housing.

Community participation and involvement in construction should however be carefully managed and administered. Build quality should enjoy priority. UN-Habitat (2011:28) states that it is important to grasp that when units are poorly built the focus on creating sustainable and efficient communities, is missed. Ensuring a high build standard will entail builder training and education in order to deliver the required standard. In developing countries, such as South Africa, training can prove challenging, but the process can be simplified by the use of local materials and methods which are familiar to the local labour force. According to the National Department of Human Settlements (SA, 2010: 274) construction contracts should only be awarded to contractors who have experience in housing construction which makes use of alternative technologies. Companies which show a broad understanding, but lack implementation experience should not be considered.

The implementation of alternatives should start at a national and provincial level. Training should extend beyond the education of builders and contractors, to training the officials who are to instigate and apply the use of alternatives. According to the National Department of Human Settlements (SA, 2010: 272) South African provinces have proven to be attracted to the use of alternative building technologies due to the inherent time-savings associated with these methods when compared to conventional brick and mortar construction. However, the Human Settlements Review (2010:267) states that most provincial officials who would be responsible for implementation, are often uncertain of how projects utilising alternative technologies and materials are to be managed from the procurement stage to construction.

The limited understanding of alternatives clearly limits large scale implementation. According to UN-Habitat (2011:2) housing guidelines which are regionally standardised will encourage and improve the provision of sustainable low-cost residential options, especially when these guidelines integrate local knowledge.

Besides meeting the needs of the housing sector, the industrial production of composite materials from local resources would greatly help in environmental protection, the conservation of energy and employment generation in low-income urban and rural settlements. Appropriate building material choices can impact the economic development of both the formal and informal sectors (Balleriono, 2002:6). In this regard South Africa could start an entirely new production industry specialising in alternative and recycled materials, leading to employment creation and skills development.

The following section will discuss mud brick construction as an example of an alternative construction material and technique which could apply in the South African context.

8.2 Mud brick construction

According to Richards (2010) mud brick has been historically used throughout the world, especially in the Middle East, India and North Africa. Mud bricks are traditionally made of mud or clay that is mixed with straw and hardened by baking in the sun or a kiln. Modern variations on this method have led to faster and stronger bricks which can be produced on site. Figure 21 illustrates hardened bricks ready for construction. De Villiers (2010) states that more people in the world live in mud brick houses than all other mediums combined. These bricks are used to build houses and various other structures.



Figure 22: Mud brick construction

Source: Ingaza (2009)

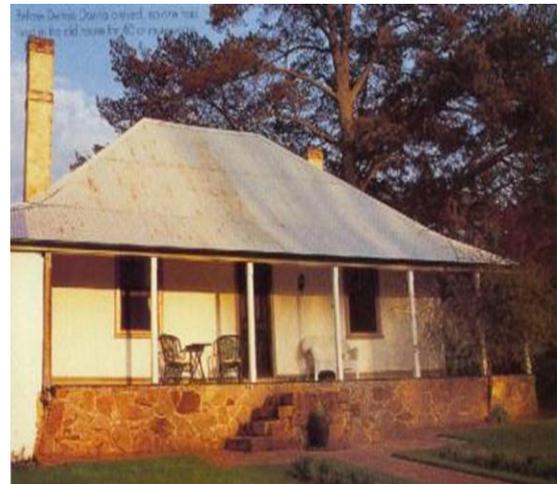


Figure 23: A completed mud brick unit

Source: University of Technology of Sydney (2002)

According to UN-Habitat (2011:56) earth based construction methods are best suited to arid and semiarid climates where clay rich soils are present. De Villiers (2010) has found that most areas have enough rock to build a foundation for a house of between 40 and 45 square metres. A house of this size typically uses between five and seven bags of cement to complete with a range of other extra materials and additives, like lime.

Materials like local soil, clay and silt are mainly used to form each brick, usually with a binding agent such as cement. With the speed of brick production one can quickly gain enough bricks to form a simple structure (Harrison, 2011).

Harrison (2011) states that the use of local materials to produce bricks points to the fact that production can take place anywhere, including on site. As production uses natural sustainable sources, a minimal detrimental effect to the environment is incurred, making it a good option for eco-construction. According to UN-Habitat (2011:55) materials should be chosen which are minimally processed as is the case with most earth based materials.

Harrison (2011) states an example of innovation in the field of mud brick production as the invention of hydraulic press machines. The hydraulic press can create a solid compact brick from mud in around 30 seconds. Each brick from the compressor is formed with a series of indentations and bulges, making them easily stackable to speed up the building process. According to Balleriono (2008:8) rammed earth walling systems involve the use of compacted earth in temporary or permanent forms. Rammed earth has been used extensively in countries such as Australia, the USA, Peru and Ecuador.

As some disadvantages to rammed earth techniques, Bolleriono (2008:8) states the following:

- Low acceptability amongst communities
- Most suitable in arid and semiarid areas
- Low tensile strength, increasing vulnerability to earthquakes.
- Commonly lack of references for building performance and standards.
- Non-stabilised soils show excessive absorption of water

According to Harrison (2011) the use of mud bricks for building homes can have several more benefits. Mud bricks provide substantial insulation, keeping heat in and cold out when needed, saving money on heating and cooling bills. De Villiers (2010) states that where people have experienced both cement and mud brick homes, they continuously prefer mud brick houses due to their comfortable insulation properties. A lack of insulating materials in the cement houses of the poor due to high costs, leads to uncomfortable shelters and not well insulated homes.

According to Steyn & Bosman (2010:197) earth architecture has been identified as an ideal medium for supporting sustainable local economic development. Building with these bricks does not require skilled labourers and one professional bricklayer supervising the construction of each house will be sufficient. De Villiers (2010) says that women are commonly more open to the idea of mud brick building as they realise the benefits it holds. Men still cling to the stigma that mud houses are the destiny of the poor.

De Villiers (2010) states that the South African government clings to the idea that poor people must have the same dwellings as rich people. Activists endure immense frustration at government and local authorities' refusal to discuss and learn about the advantages of mud brick construction and techniques of durable construction. This not always the case, but even where authorities are more susceptible to the use of alternative, generalisations and ignorance is still rife. A lack of good leadership, management, vision and bureaucratic restrictions, lead to mud brick housing not being more widely accepted and implemented in South Africa (De Villiers, 2010).

Earth construction justifies investment and implementation due to the benefits sighted in Table 11:

Table 11: The benefits of earthen building and its value in the South African context

Benefit	Value in SA
Almost one third of the world's population live in houses made of raw earth	The opportunity exists to learn from international construction and implementation methods.
Earthen bricks in any form are cheaper to produce than burnt bricks and are more ecologically sensitive.	This promotes economic and environmental sustainability.
The material (soil) can be found almost everywhere	Making material production on location possible.
Production can provide employment	Lining up with SA policies which promote employment through low-cost housing delivery.
Creates employment for small entrepreneurs.	Encouraging skills transfer, employment creation and sustainable economic growth.
Creates thermally comfortable spaces.	Reducing heating and cooling costs, promoting affordability for beneficiaries.
The material is different in every part of the country contributing to the unique characters.	Given SA's diverse cultural landscape, individuality is key.

Source: Constructed and adapted from Steyn & Bosman (2010:198)

8.3 Alternative materials and urban planning

According to Low (2010:1) the policy evolution of recent years has shifted the approach to housing from a quantitative to a qualitative concern. It is left to built environment professionals, including urban planners, to interpret these policies in ways which establish new approaches to design and delivery. This extends to reconfigurations and arrangements which inform new spatial conditions which link qualitative and quantitative dimensions.

Sustainable development has become increasingly central in urban planning and development. The focus on sustainability in urban planning relates to the functional, technical, environmental and financial considerations given to the choice of building materials (Odhiambo & Wekesa, 2010: 68). The use and implementation of alternative construction materials may be seen as an issue best left to architects and builders, but urban planners need an understanding of the benefits and requirements connected with these options in order to plan accordingly.

Certain locations may for example be better suited to the implementation of mud brick construction given the geotechnical and climatic characteristics present. Planners will need a basic knowledge of the requirements posed by these construction materials and methods to ensure that the ultimate development potential of an area/site is utilised.

The financial savings often implied by the implementation of alternative construction materials can influence many planning decisions. The availability of more funding could merit the introduction of larger stand sizes, improved levels of infrastructure and an increased number of better quality public facilities. Where the production of mud bricks is to be conducted on site, the planner may need to facilitate space for production and storage during the construction phase of development.

According to Low (2010:9) design interpretations should maximise the latent potential of the site, enhanced by the configuration of space. Participatory practice can be engaged by design. Design can breach the gap between policy, community needs, spatial transformation, local economic and sustainable development (Low, 2010:1)

Planners can furthermore play an important part in enlightening and educating communities regarding the benefits of alternative materials. According to the National Department of Human Settlements (SA, 2010: 274) the most prominent measure to ensure the implementation of alternatives is an investment in consumer education. Beneficiaries need to comprehend the materials, their strengths and weaknesses and maintenance. In order to secure the successful realisation of alternatives, community satisfactions must be secured prior to housing construction. Urban planners are often the link between communities and authorities and may in this capacity play an important role in the acceptance and implementation of alternative construction materials. Planners may in the same capacity be responsible for attaining government buy-in and endorsement for the use of alternatives by validating and motivating the need for alternative construction materials.

8.4 Conclusions with regard to alternative building materials and construction techniques in in the South African context

Alternative construction materials can prove vital in the quest to provide better quality housing within the restrictive environment in which low-cost housing is to be delivered in South Africa. The most important factor when considering these alternatives is a commitment from government to actively research and implement these alternatives. Where possible planners should advocate the benefits of these substitutions in conjunction with architects and urban designers. Only when planners understand the concepts involved in alternative construction, can informed design decisions be made. Community Participation is a vital step in the introduction of alternative construction materials, as the community has to understand and accept the homes they are to spend their lives in, with social and environmental benefits. In this regard the importance of community participation and stakeholder engagement is discussed in Chapter 9 of this study.