THE ACCEPTABILITY OF EARTH CONSTRUCTED HOUSES IN CENTRAL AREAS OF SOUTH AFRICA

by

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The financial assistance of the National Research Foundation (NRF) towards this research is hereby acknowledged. Opinions expressed and conclusions arrived at, are those of the author and are not necessarily to be attributed to the NRF.

DEDICATION

To my parents Casper and Eden for their nurtured love
for building and beautiful spaces.

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This thesis is the result of a life-long fascination with natural building materials that started in childhood, continued during my early architectural studies and will continue throughout my career.

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LIST OF ACRONYMS AND DEFINITIONS

Adobe	An international traditional sundried earth or mud brick or block
CAP	Process of Context-driven Actualisation of Potential
CRAterre-ENSAG	International Centre for Earth Architecture at the National Superior School of Architecture in Grenoble, France
DoHS	Department of Human Settlements
ECS	Escola Calleicia Superior in Villa Nova De Ceveira, Portugal
EU	Earth Unit at the Department of architecture at the University of the Free State (the new name for the UEC after 2012)
FFC	Financial and Fiscal Commission of South Africa
Pise de Terre	Traditional un-stabilised rammed earth wall
RDP	Reconstruction and Development Programme
SANPAD	The South Africa-Netherlands Research Programme on Alternatives in Development
SMME	Small, medium and micro-enterprises
TOC	Theory of Change
UEC	Unit for Earth Construction at the Department of architecture at the University of the Free State (1996 – 2012)
UNESCO	Chair for Earthen Architecture, Construction, Cultures and Sustainable Development based in Grenoble in France.
USM	Upward Social Mobility
Wattle and daub	Traditional timber structure with infill timber lattice word covered with clay and natural fibre layers of plaster and finished in clay plaster

ABSTRACT

THE ACCEPTABILITY OF EARTH CONSTRUCTED HOUSES IN CENTRAL AREAS OF SOUTH AFRICA

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The traditional earth building techniques of South Africans are well documented, but little research reflects the current perceptions of these building materials and techniques. The thesis explores the factors (independent variables) that can be addressed in order to make earth constructed houses in general more acceptable in central areas of South Africa. The thesis draws on data obtained from the SANPAD project (South Africa-Netherlands Research Programme on Alternatives in Development) with a household survey (n=1790) from respondents regarding their perceptions and attitudes towards earth construction. Multiple qualitative and quantitative responses were recorded both for and against the use of sun dried earth blocks (adobe). Correlation and regression analyses were used to test for the characteristics (significant variables) that influence the acceptability of earth constructed houses.

The findings show that respondents regard traditional earth building materials as inferior. Negative attitudes were found to be linked to the structural performance of unbaked earth materials regarding stability in wet conditions and maintenance. Limited other studies confirmed the low acceptability of traditional earth constructed walls.

Regression analysis could not confirm that personal and household characteristics are associated with the housing, context and acceptability characteristics. Correlation analyses confirmed that certain housing characteristics (basic services

such as water born toilets connected to sewerage systems, running water and electricity) influence the acceptability of traditional earth constructed houses. Correlation analyses confirmed that context characteristics (location and area types) influence the acceptability of traditional earth constructed houses. Furthermore, the data and literature confirm that the building culture (available material and buildings skills) and upward social mobility together with Reconstruction and Development Programme (RDP) houses (with basic services) influence the acceptability of traditional earth constructed housing.

The findings concluded that attitudes toward traditional earth construction are more positive in 1) informal urban areas where informal houses do not have access to basic services and 2) rural households where the building culture dictates the norm even without basic services. The effects of conformity, imitation and upward social mobility were confirmed, as stated by the literature and the data. Together with upgraded earth construction techniques (such as cement stabilised compressed earth blocks or bricks) wall components for earth buildings in parts of central South Africa may be more acceptable.

The hypothesis is that if the influencing factors on the acceptability of traditional earth constructed housing are known, it can be used in the promotion of contemporary earth construction.

The thesis aims to promote contemporary earth construction techniques. This thesis states that the public should be equipped and educated about the importance of preserving existing forms and methods of earth construction, in order to support useful applications within contemporary architecture.

Keywords: traditional earth constructed houses, acceptability, upward social mobility, compressed earth blocks

Figure 0.1 Traditional earth constructed house in Magolokweng, Free State

OPSOMMING

DIE AANVAARBAARHEID VAN GRONDKONSTRUKSIEHUISE IN SENTRALE GEBIEDE VAN SUID AFRIKA

deur

Gerhard Bosman

Die tradisionele Suid Afrikaanse grondkonstruksietegnieke is goed gedokumenteer, maar daar is min verwysings na navorsing van huidige sienings oor hierdie boumaterial en -vaardighede. Die proefskrif ondersoek die faktore (onafhanklike veranderlikes) wat aangespreek kan word om grondkonstruksiehuise meer aanvaarbaar in die sentrale gebiede van Suid Afrika te maak. Die proefskrif gebruik die data van die SANPAD-projek (*South Africa-Netherlands Research Programme on Alternatives in Development*) as ’n huishoudelike opname (n=1790), wat respondente se waarnemings en sienings oor grondkonstruksie versamel het. Verskeie kwalitatiewe en kwantitatiewe reaksies is aangeteken, vir en teen songedroogde stene (adobe). Korrelasie en regressie analises is gebruik om die eienskappe (beduidende veranderlikes) wat die aanvaarbaarheid van grondkonstruksiehuise beinvloed, te toets.

Die bevindinge toon dat respondente tradsionele grondkonstruksiemateriale as ondergeskik beskou. Negatiewe houdings hou verband met die strukturele vermoë van ongebakte grondboumateriaal ten opsigte van stabiliteit en onderhoud in nat weersomstandighede. Enkele studies bevestig die lae aanvaarbaarheid van tradisionele grondkonstruksiemure.

Regressie analises kon nie die verband tussen persoonlike en huishoudelike eienskappe rakende behuisingkonteks en aanvaarbaarheidseienskappe bevestig nie. Korrelasie analises het bevestig dat behuisingseienskappe (basiese dienste

soos toilette verbind aan ’n rioolstelsel, lopende water en elektrisiteit) die aanvaarbaarheid van tradisionele grondkonstruksiehuise beïnvloed. Korrelasie analises het bevestig dat sekere kontekseienskappe (ligging en area tipes) ook die aanvaarbaarheid van tradisionele grondkonstruksiehuise beïnvloed. Verder het die literatuur en data bevestig dat die boukultuur (beskikbare boumateriale en -vaardighede), opwaardse sosiale mobiliteit, tesame met Heropbou-en-ontwikkelingsprogram (HOP)-huise (met basiese dienste), die aanvaarbaarheid van tradisionele grondkonstruksiehuise beïnvloed.

Die gevolgtrekking na aanleiding van die bevindinge is dat sienings meer positief teenoor tradisionele grondkonstruksiehuise is in 1) informele stedelike gebiede waar informele huise geen basiese diense het en 2) landelike huishoudings waar die boukultuur (sonder basiese dienste) as die norm beskou word. Die invloed van gelykvormigheid, nabootsing en opwaardse sosiale mobiliteit, word deur die literatuur en die data bevestig. Saam met opgegradeerde grondkonstruksiemetodes (soos sement gestabiliseerde gekompakeerde grondblokke en –stene) mag muurelemente van grondhuise in sentrale streke van Suid Afrika, meer aanvaarbaar wees.

Die hipotese is dat, indien die faktore wat die aanvaarbaarheid van tradisionele grondkonstruksiehuise beïnvloed bekend is, dit aangewend kan word in die bevordering van hedendaagse grondkonstruksie.

Die proefskrif poog om hedendaagse grondkonstruksiemetodes te bevorder. Die proefskrif bevestig dat die gemeenskap toegerus en ingelig moet word rakende die bewaringsbelang van bestaande grondkonstruksiemetodes, ten einde die nuttige toepassings binne hedendaagse argitektuur te ondersteun.

Sleutelwoorde: tradisionele grondkonstruksiehuise, aanvaarbaarheid, opwaardse sosiale mobiliteit, gekompakteerde grondstene

CHAPTER 1
INTRODUCTION

1.1 Background to the study

> *Our domicile is the refuge of our body, memory and identity.*
> *(Holl, Pallasmaa, & Peres-Gomes. 2006: 34).*

The author has been involved in training architecture students and small builders in the contemporary use and production of cement stabilised compressed earth blocks and stabilised adobe techniques, since 1996. The author experienced negative attitudes towards traditional earth constructed houses during this period.

This thesis uses data obtained from a South Africa-Netherlands Research Programme on Alternatives in Development (SANPAD) project that was conceptualised by the author in 2003, to investigate the perceptions of South Africans living in earth constructed houses. The objectives of SANPAD are to stimulate and promote quality research and co-operation between institutions. An important project aim was to produce Master's and PhD students. This study draws from the outcome of the project entitled: *A South African Building Renaissance – Acceptability of high quality, earth constructed, public and private buildings to support sustainable local economic development*. The aim of the project was to change perceptions of earth constructed buildings.

1.2 Challenges for architects to have an impact in social housing

Architecture, as discipline, should be more involved in low-income housing in South Africa, but Rapoport (1969: 1) believes that the physical environment of man, namely the built environment, is not controlled by the designer. This environment is the result of vernacular (folk or popular) architecture and is largely ignored in architectural history and theory. On the other hand, Murray (2007: 56) states that the fascination with the vernacular has ironically "never been questioned or critiqued" to date. Architecture, as discipline, is not leading the way in the reality of sustainable

specification, but often retreats “into the spectacle of visual and spatial innovation with materials” (Stevenson, 2006: 258). The architect can make a major contribution by solving technical issues in appropriate aesthetic and affordable ways (Fathy, 1973: xii). The problem, however, is not only technical, but connected to community involvement and perceptions (Hamdi, 1985: 45–50). This thesis considers the complex socio-psychological contexts in low-cost housing of South African low density urban and rural built environments.

Attempts to make unconventional building materials and building systems like interlocking blocks, vertical concrete wall panels and lightweight steel structures more user friendly and more acceptable, are difficult tasks in the South African built environment. The “detachment of construction from the realities of matter and craft [also] turns architecture into stage sets for the eye, devoid of the authenticity of material and tectonic logic” (Holl, *et al.,* 2006: 29). RDP housing in South Africa have been stripped of all that is known to be architecture. Many architects perceive this as the act of building (housing) that do not have a place for architects, where the making of place (in a cultural context) and a home for known people (clients) will be important.

The successful efforts of architects to get involved in large-scale housing projects funded by the state are limited. These attempts often fail, since low-income housing and urban planning (ideologically charged) are driven by planners, policymakers, city managers and activists (SALGRC, 2013a; 2013b; 2013c) who engage with urban development in relation to politically charged questions of race, ethnicity, citizenship and governance (Robins, 2007). These social questions are important, but cultural, technical and financial issues should be addressed as well. Architects are guilty of not challenging the status quo.

1.3 Significance of research in traditional earth construction

Earth construction, as technology within vernacular heritage, should be celebrated. Rudolfsky (1964: 1) believes that the art of building is a wide concept because little is known of architecture without architects. The application of earth as building material

worldwide is well documented (Oliver, 1969; Fathy, 1973; Seth & Seth, 1988; Houben & Guilaud, 1994), but in many communities across the globe, traditional earth construction is regarded as inferior (Houben & Guilaud, 1994). Furthermore are the southern African and European origins and adaptations to suit the local situation in South Africa, well documented (Fransen & Cook, 1965; Greig, 1971; Frescura, 1981, 1985, 1989).

Studies conducted by Americo and Aragones (1997: 47) offer a theoretical and methodological approach to residential satisfaction in order to give a general view of the relationship established between people and their residential environments. According to Buttel (1987: 471–472), literature on environmental orientation can be divided into three main categories:

- studies with sample survey methodology that explore a social-structural problem between environmental attitudes and beliefs of different segments of the public, for example, according to social class, gender, or age group;
- categories of studies involving experimental or quasi-experimental survey methodology where hypotheses are tested;
- applied studies that attempt to determine the social factors related to behaviour associated with the environment, for example littering, recycling or household energy conservation.

Due to the general negative attitudes towards traditional earth construction, it is often difficult to change the attitudes of home owners or dwellers regarding traditional earth construction techniques.

Several international institutions, such as the International Centre for Earth Construction at the National Superior School of Architecture in Grenoble, France (CRAterre-ENSAG), the Auroville Earth Institute (India), the Escola Superior Galacia (Portugal), and the Earth Unit (South Africa) are all partners of the UNESCO Chair in Earthen Architecture, Construction, Cultures and Sustainable Development (based in Paris, France) that disseminate knowledge of using earth and associated construction techniques. Other partners are located in Italy, Spain, Morocco, Mali, Mexico, Peru, Argentina and Brazil. These partners have often reported generally

negative attitudes towards traditional earth construction in different parts of the world, since conventional building is the norm globally (Bosman, 2006; Hadjri *et al*., 2007; Guilaud, 2010). “Earth as building material undoubtedly presents certain outstanding shortcomings. However, it also has important assets which compensate any disadvantages which could be corrected” (Siyan Siwe,1983: 43).

1.4 Present earth construction experiences

The author found the localised sourcing of material by people in rural areas of South Africa, using traditional un-stabilised earth construction, for examples, in farm workers’ homesteads, a fascinating phenomenon, even in early childhood. It later became evident that these techniques, together with recycled materials, were used as a temporary housing solution by people migrating to informal urban areas. This led to an earlier investigation in earth architecture using local earth construction techniques.

The general state of rural earth buildings and the temporary application of traditional earth building techniques in urban areas in and around towns and rural settlements in the Free State Province draw the attention to the acceptability of earth constructed houses. This interest continued throughout a professional career of eighteen years in teaching students in architecture, and training small builders in using stabilised adobe and compressed earth blocks (CEB) in the constructing of small-scale public buildings in the Free State and Northern Cape provinces.

Being involved in the training and teaching activities at the Earth Unit in the Department of Architecture at the University of the Free State since 1996, equipped the author with practical experience. Working with small community groups in Mangaung, Gariepdam and Kuruman, which were trained in contemporary earth construction techniques, provided practical experience on how to address concerns about compressive strength, erosion and abrasion. Building these small-scale public building projects (a prototype farm worker’s house, two day-care centres, four ablutions blocks, a workshop complex, a visitor’s centre and two school assembly halls) provided good building practice for detailing problem areas in earth buildings.

But, addressing technical issues were only half of the problems solved. The problem regarding social acceptability was addressed by the SANPAD project.

1.5 Purpose and methodology of study

The SANPAD-project confirmed that the acceptability of traditional earth constructed houses is low, with the most important significant dislikes cited as: 1) structural problems, for example, the houses collapse, are not strong and stable, and 2) water problems from rainwater (erosion) and penetrating moisture (capillary rise) (Steÿn, 2009: 120-130).

A new hypothesis and research questions were formulated for this thesis. This thesis investigates factors that influence the acceptability of traditional earth constructed housing, in order to promote contemporary earth constructed housing. The argument is that a better understanding of the influencing factors (characteristics) of traditional earth constructed walls may be useful in the promotion of contemporary earth construction. This depends on more than just the technical performance of the building material. The problems are not only technical in nature. The influence of personal and social issues within different cultural contexts should be considered.

After the conclusions were drawn from the project, the first data set was re-analysed around new research questions and aimed at promoting contemporary earth construction. The proper skills for building with adobe blocks are waning or absent in some of the nine surveyed locations in central parts of South Africa. These locations are mainly limited to a highveld landscape with a predominant semi-arid climate with extreme temperatures and low summer rainfall patterns, experienced as thunder showers. The respondents, who were interviewed in a household survey, lived in the nine locations and lived in, or near, traditional earth constructed dwellings in urban informal and formal areas, as well as rural areas where earth construction was used in permanent or temporary dwellings. This thesis is limited to the social perceptions on traditional building materials for walls of houses in the central areas of South Africa.

1.6 Gaps in research on acceptability of earth construction

Social mobility patterns, driven by the overall structure of the economy (Iannelli & Paterson, 2006: 540) and consumer behaviour (Hamdi & Goethert, 1997), influence personal and community perceptions. It is important to consider contemporary representations of health, status, social ethics and mobility when interpreting social change (Carocci, 2011: 370). The influence of upward social mobility should be considered if the negative perceptions of traditional building material are investigated.

During the apartheid years there was a lack of social mobility and inequality of opportunities in South Africa. These social patterns influenced personal and normative beliefs about which building materials are more acceptable than others. Urban communities perceive traditional building materials as being backward and not contemporary (Guillaud, 2010). Although the urban perceptions of traditional earth construction and the acceptability thereof in the vernacular sense have been reported, limited studies have confirmed this notion (Guillaud, 2010; Wessels & Bosman, 2014) and few have been documented in the past (Hadjri *et al*., 2007).

The current literature has not sufficiently addressed the characteristics that influence traditional earth construction as unacceptable for inhabitants of dwellings. This thesis attempts to fill the existing gap by presenting findings that future studies can either support or reject.

1.7 Role of the architect in sustainability

Architects can contribute to promote sustainable development programmes. Without the architect's participation, buildings can become ugly, inappropriate or expensive (Fathy, 1973: xii). Buildings can also contribute to the waste of natural resources such as sunlight, water and energy if they are poorly designed. Ngowi (1997: 289) remind us of the traditional European societies where the master mason or master carpenter headed the construction team as architect and contractor. Architects should also consider the agency (inclusion and exclusion) their profession holds. During the Middle Ages, craftsmen passed down their craft and all connected to it, as

an inheritance, to be defended and safeguarded. This limited access to the status of the master resulted in the modes of exclusion and closure because of increasing cohesion of families, the definition of more rigid systems of succession, and “a vast range of behaviours, along with values and manners that were assimilated in childhood from one’s own milieu” (Carocci, 2011: 389). This is not the case in Africa where the vernacular built heritage is shared and practiced by all. According to Ngowi (1997: 289), this contrasts with the holistic approach of non-Western societies, where the construction was an activity for all members in the community group. Building skills were passed down from one generation to the next. Contemporary societies evolved the construction industry in specialised roles – architect, engineer, builder, supplier, inspector, broker, buyer, insurer and, sometimes, tenant – often in isolation from one another.

The former deputy editor of *Architecture Review*, critic and writer Peter Buchanan, states that architects have lost ground and respect in society because of “their lack of stable values” (Cooke, 2013: 14). There is more to architecture than just living up to the expectations of sophisticated clients with an elaborate budget and an unrealistic programme. South African architects are reluctant to get involved in social housing issues and they tend to leave this domain to engineers and planners. In South Africa, architects collectively comment very little on society, while they should take up a core position in creating the country’s future because of their knowledge and ability to make, extend or change spatial environment (Cooke, 2013: 14).

This thesis argues that South African architects should be more concerned about the embodied energy and material sourcing that minimizes environmental impact. The embodied energy of non-local building materials is expensive because of long-distance transport. Using sustainable systems for heating and cooling, which only address energy issues, are insufficient to claim green credits for the building project. Architects can provide much more profound assistance to their clients regarding real environmental issues (Cooke, 2013: 14).

Architects should not only marginally improve sustainability through the current practice of solar heating or grey-water systems (Cooke, 2013: 14). They need to

have a clear vision, and change their views and practices radically. Sustainability in a deeper sense depends on social equity and economic opportunity, as well as a lifestyle that offers a sense of meaning and deep satisfaction, a sense of connectedness, intimate engagement with community and nature, and with people's "deeper psychological and spiritual selves" (Buchanan, 2005: 7).

The social contribution of many contemporary buildings in different earth construction techniques used worldwide (Bosman, 2006; Guillaud, 2010; Fontaine & Anger, 2009; Steÿn, 2009) suggests that, from a technical and a building systems typological point of view, individuals, groups and communities may be convinced by the advantages of contemporary earth construction. The literature on the methods and different building system typologies of contemporary earth construction in South Africa is limited. Thus far, it has been based on case studies of contemporary earth constructed public buildings in central South Africa, constructed under the supervision of the Earth Unit (EU) at the University of the Free State between 1996 and 2004. The literature is, furthermore, limited to other case studies of several public and private buildings constructed in earth in southern Africa since the 1990s. Several individuals and public and private organisations in South Africa are committed to the promotion of earth construction.

The literature on the acceptability of earth construction in the South African context is limited, since it fails to offer in-depth descriptions of the specific architectural and material qualities of building materials that people desire for housing. The literature does not provide the factors (basic services, such as running water, electricity and a municipal sewerage system) that influence the attitude of people towards buildings in a holistic, social, and scientific sense.

The thesis, therefore, provides factors that influence the attitude and expectations of people living in earth constructed buildings in central South Africa. These factors can suggest a conceptual theory in the form of criteria or guidelines to be used to improve the acceptability of earth construction in central South Africa. The findings from this research could, firstly, be useful to home-owners, trainers and self-help builders, who want to improve the qualities of earth constructed wall elements and

construct better earth buildings. Secondly, architects, structural engineers, soil engineers, building contractors and professionals in the building industry can improve their knowledge by understanding the attitudes in order to influence the acceptability of earth constructed buildings. Thirdly, the national and regional policymakers who are dedicated to innovative, environmentally friendly solutions will find these issues useful when considering alternative for conventional building practices. Turner (1976) believes that if home-builders are free to control and contribute to the design, construction or management of their own houses, it can have a positive influence on their social well-being and "a self-build house could be constructed gradually, using cheap labour, cheap resources and spare time in order to reduce cost" (Mehlomakulu & Marais, 1999: 93).

1.8 Limitations of the research

The SANPAD project hoped to change the acceptability of earth constructed housing. The conclusion was that other ways to influence attitudes should be followed. This thesis is limited to the perceptions of earth constructed wall building material in central parts of South Africa. The respondents in the household survey lived in, or near, traditional earth constructed dwellings in urban informal and formal areas, as well as rural areas, where earth construction was used in permanent or temporary dwellings.

This thesis investigated the factors affecting the acceptability of earth constructed housing. An understanding of these factors will allow researchers, professionals in the building industry and government organisations to include these factors in strategies, if the acceptability of earth constructed housing is considered. This study, however, has some limitations to consider:

- **Technical performance:** This thesis did not aim to compare the technical performance of traditional earth construction to other conventional building materials.
- **Different earth construction techniques and typologies:** This thesis did not make a geographic survey of the distribution of the different earth construction techniques or the development thereof in the central parts of

South Africa. Furthermore, the history and development of indigenous vernacular construction methods is well documented (Fransen & Cook, 1965; Frescura, 1981, 1985, 1989; Greig, 1971).

- **Sustainable building methods**: This thesis did not investigate or show a comprehensive comparison of the sustainable benefits that traditional or contemporary earth construction has compared to other building techniques. Several case studies in southern Africa have documented sustainable and acceptable contemporary earth constructed buildings (Steÿn, 2009: 96). Furthermore, this study did not aim to promote contemporary earth construction as the ultimate 'green' building material to consider; however, the reduced amount of cement or lime in stabilised compressed earth blocks (CEB) is a viable option to be promoted in central parts of South Africa. This technique have proven itself as a sustainable building material (if not a true 'green' building material) since only 6-8% of the dry weight of the soil mix is stabilised with cement or lime, and locally available gravels, sands and clays sourced from building sites or commercially controlled quarries (Bosman, 2003, 2009, 2012).
- **Environmental impact**: Construction and buildings contribute to environmental crises through resource depletion, energy consumption, air pollution and creation of waste (Ngowi, 2001: 292). This study did not compare the differences between, and impact of 1) existing burnt clay brick yards, 2) existing cement concrete block/brick yards, or 3) existing CEB yards (Bankhara Bodulong) on the environment in the surveyed areas. This is possibly a theme to be investigated or considered in order to promote the use of contemporary earth construction techniques such as compressed earth blocks (CEB).
- **Housing delivery**: The thesis did not indicate that the state provided housing programmes will resolve housing delivery problems by including earth construction projects. Earth construction should be included in the bigger pallet of building material options, supported by training programmes and general good practice, according to the National Building Regulations and SANS 10400-XA (South African National Standard SANS 10400-XA, 2011 [online]). Past efforts of the Department of Public Works have included the

"approval of innovative construction products and systems" through Agrément South Africa. Compressed Earth Blocks Building Systems, "Use-it" (South Africa, 2013a) and Eco-Build Sandbag Building System. "Ecobeam Technologies cc", (South Africa, 2013b) are acknowledged as limited inclusion.

- **Appropriate technology**: This thesis did not attempt to illustrate that earth constructed walls will be the most appropriate material in all cases. Earth construction has more advantages than disadvantages for contemporary application in all possible climates and South African weather conditions. In some projects/cases it might not be the best possible material option, for instance where no direct link between the building culture (local construction technique and available resources) and the surrounding context can be made. This, however, can be achieved over a longer period by proper training programmes, developing brick yards, business skills aimed at development, and sustaining communities. Appropriate technology is the appropriate application of scientific knowledge for development by providing the best engineering solution while making best use of available resources (Ngowi, 1997b: 146-147).
- **Quality of the built environment**: Another factor that may play a role in the acceptability of wall building material, such as the overall quality of the built environment, is a possible theme to be investigated by other studies.

1.9 Structure of the thesis

Chapter 1 provides the background to earth construction as emerging discipline and the importance of research in earth construction. The challenges of unconventional construction are highlighted.

Chapter 2 shows the limited research on the acceptability of earth constructed walls from an environmental sociological viewpoint and holds the socio-psychological sciences' view as a possible explanation for the low acceptability of earth constructed walls.

Chapter 3 discusses the social sciences models, to have a better understanding of personal and social influences. The influence of the individual's status and role within the group and community affects changing behaviour, since people are reluctant to use traditional earth construction. Exposing individuals and the group to new information may change perceptions and intentions. The changes can be experienced and applied to the wall building materials for housing.

Chapter 4 highlights the first paradigm shift that resulted in a general movement away from earth construction. Earth construction, as discipline, has to face global and local problems regarding contemporary housing.

Chapter 5 highlights the second paradigm shift towards the use of earth construction.

Chapter 6 explains the methodology for using the SANPAD data in this thesis. New research questions were formulated and a re-analysis of the first of two data sets resulted in new findings.

Chapters 7 and 8 present the results and findings. The research suggests the need for a basis for developing stronger guidelines in order to understand the factors that influence the individual choices regarding building materials and the perception and attitudes within the built environment. Finally, the work presents a better understanding of factors that influence the acceptability of earth construction in urban and rural areas of central South Africa, in order to promote the use of contemporary earth construction for housing applications.

> *… if we consider the order (the idea) to be the outer perception and phenomena (the experience) to be the inner perception, then in a physical construction, the outer perception and inner perception are intertwined* (Holl, *et al.* 2006: 1).

The research questions below guided the investigation.

Research question 1: *Are housing characteristics associated with the acceptability of earth constructed buildings?*

Research question 2: *Are contextual characteristics of the built environment associated with the acceptability of earth constructed houses?*

Research question 3: *Are personal and household characteristics associated with the housing and the contextual characteristics, and the acceptability of earth constructed houses?*

> *The timeless task of architecture is to create embodied existential metaphors that concretize and structure man's being in the world … architecture materializes our image of ideal life* (Holl, *et al*., 2006: 37).

CHAPTER 2
CURRENT RESEACH IN TRADITIONAL EARTH CONSTRUCTION

2.1 Introduction

This chapter provides the background to the question why an investigation of the acceptability of earth construction is important for research in vernacular architecture. The expectation was that environmental sociology, as discipline, might hold more answers to explain the characteristics of earth constructed buildings, but limited connections could be made to other studies in this field. The influence of migration, social capital and upward social mobility explain the low acceptability of traditional earth construction more fully. Limited qualitative and quantitative studies provide information on people's attitudes and associations of materiality of houses.

2.2 Environmental sociology studies

Qualitative and quantitative research in architecture is not a popular field and limited comparative objectives regarding the attitudes or the acceptability of building materials could be found. No other study in environmental sociology could offer insight regarding the factors that influence the acceptability of earth constructed buildings. From an environmental sociology perspective, this research did not hold comparative links and answers to the research questions of this thesis. Environmental sociology has become more diverse and fragmented, while innovative theoretical works tend to have a limited audience and quantitative research tends to be confined to problems that lend themselves to large data sets and statistical precision (Buttel, 1987: 484). The research of Hinds and Sparks (2008), however, show that attitudes are linked to behaviour, where the behaviour of people interacting with land and landscape, reflects direct engagement in land management and indirect usage through recreation.

Some studies in environmental sociology, covering issues of environmental protection, have been conducted in the past (Buttel & Flinn, 1974; Van Liere &

Dunlap, 1980; Honnold, 1981). Research on social bases of environmental concern often focuses on the socio-economic variables that explain the conditions for environmental protection. Early studies reported well-educated urbanites to be most concerned with environmental protection (Buttel & Flinn, 1974). Later studies (Honnold, 1981) elaborated that education and age turned out to be the only socio-economic variable consistent and significant to environmental concern. According to Van Liere and Dunlap (1980), many studies found "income and occupation prestige to be, at most, only weakly related to environmental concern." The environmental education of both rural and urban communities and effective modes of communication are important. These are also linked to the social capital of these communities.

2.3 Migration, social capital and social mobility of low-income households

The concept of social capital (social networks) provides the basis of how the urban labour market functions in developing countries. The survival of low-income households has been a regular and serious concern mentioned in literature on development economics. These households are often affected by migration and social mobility, where the households' financial status is connected to a "life strategy" (Sandu, 2000).

Inequality, which accompanies greater social differentiation, is a growing field of research in South Africa (Krige, 2015: 104). The research holds the continued debate around the conceptions of class (Crankshaw, 2005; Schlemmer, 2005; Alexander *et al.*, 2013; Melber, 2013) that are contrasted by neo-Marxist and neo-Weberian class stances. The Marxian approach is based on production that results in ownership and different classes, while the Weberian approach is based on consumption and class (Nijman, 2006: 759). In South Africa, these approaches have shaped research on how black middle-class members legitimise newfound wealth and social mobility (Seekings, 2009; Southhall, 2004). Migration, as a "total social fact" (Rotariu & Mezei, 1999: 5; Sandu, 2010: 35), changes and shapes rural communities and social mobility trajectories (Alexandru, 2012) of communities. Parson (1949: 435) refers to these communities as "rurban" villages, where living

standards and lifestyles have changed so much that these previous rural socio-geographic spaces resemble those in urban areas. These changes are possible through the accumulation of wealth, exposure to Western ideas, ideals and lifestyles (Alexandru, 2012: 141). These changes then build new mind sets.

Contact and bonds through relatives, friends and co-villagers in low-income rural households allow people to pursue urban jobs. Several studies pointed out the high incidence of migration among low-income urban households with contact-based migration in the job-search context (Mitra, 2008: 261; Zhu, 2011: 17; Chan *et al.,* 2003; Song *et al.,* 2008; Chung, 2010). Rural migrants are in general successful with their desired urban employment, which is considered to be the final destination. But these changes in social space (Sandu, 1984: 22-23) do not secure wealth easily (Sorokin, 1959: 133). The jobs of the contact persons and newcomers tend to be similar, which results in overcrowding and low wages.

Social mobility is often prevalent among younger age groups. Social and health-related studies from the USA, Scotland and Sweden suggest that poor health-related behaviours (smoking and too much alcohol), material and economic deprivation, the psychosocial environment, ethnic background levels of education and language barriers (first generation immigrants) are relevant characteristics that influence social mobility (Novak, *et al.,* 2012; Blane, Smith & Hart, 1999; Power).

The negative side of social capital is the negative impact on upward social mobility. Both the contact person (who helped to secure the new job) and the new entrant experience a slower improvement in living standards over time (Mitra, 2008: 261-262). Architects should consider the “life-worlds” (Schutz, 1982) of migrants, and investigate the way people understand and live in the social world (Alexandru, 2012; Schuts & Luckman, 1989) if they want to address social or low-income housing in South-Africa. South African cities are influenced by migration, since the built environment paves the way for political changes. From the earliest history, urbanisation led to political change (Steÿn & Viviers, 2000: 271) and the scope of the work of architects are, therefore, influenced by migration and urbanisation.

2.4 Limited research in materiality and acceptability of building materials

A study by Stevenson (2006: 257), conducted in Scotland, adopted an approach to people's attitudes, associations and understanding of key construction materials. This study was based on a qualitative case-study analysis. The findings grouped natural materials (for example stone and timber) against composite building materials (for example concrete, plastic and others). Earth building materials were not specifically investigated. The findings suggested that people have a deep tacit knowledge of materiality, which draws on the ecological "affordances" offered by material indicators. Respondents in this study were very clear about what material they want, where and why. Gibson's theory (Gibson, 1979) of ecological perception identified these affordances that transcend the usual subject/object divide and challenge designers to do the same. People's occupation and childhood context are related to their tacit knowledge on building material. This supports the notion that a bioregional approach should be adopted for material and product specification, which empowers users to take more responsibility for the materiality of the buildings they live and work in (Stevenson, 2006: 257).

In southern Africa, Hadjri *et al.* (2007: 147) report that urban residents in Zambia associate earth constructed buildings with poverty and low socio-cultural status. Poor developing countries have governments that cannot afford to house their people (Turner, 1988). These people should be allowed and encouraged to build their own communities. Ngowi (1997a, 1997b, 1997c, 2001) conducted some important studies on efforts to upgrade the use of traditional earth construction techniques in rural areas of Botswana. The decline in vernacular building practices is not new.

According to Oliver (2003: 236), the desire to participate in a global economy often leads to some people in developing countries feeling embarrassed about their vernacular traditions. Smaller communities, for example, the Masai and San in Africa, and peoples from Oceania and Indonesia, cash in on tourists' needs to stay in a simulated dwelling (Oliver, 2003: 241), which helps to overcome local embarrassment. This contributes in an anthropological and cultural way to support and conserve the identities of smaller groups in bigger communities (Wessels &

Bosman, 2014). The support of tourism is essential for economic growth, but this cultural experience is often romanticised.

Previous research contributions on the advantages of earth construction in general were not always valued by officials and policymakers. During the middle of the 1970s, the energy crisis resulted in new research and writing on passive solar heating, sustainable resource use and alternative energy systems as a strategic issue in the building industry (Ngowi, 2001: 291). Gerneke (1992a, 1992b, 1992c) states that earth construction was reduced to mainly rural areas but re-emerged in South African cities and towns after the Second World War. Much of earth construction knowledge was discarded through many government policies and public apathy during the 1980s (Kennedy, Smith & Wanek, 2002).

The formation of CRAterre-ENSAG in the late 1970s and the formation of the UNESCO Chair in Earthen Architecture in 2001 were far-reaching achievements. CRAterre-ENSAG is the centre of excellence of the UNESCO Chair and made valuable contributions to heritage conservation, new scientific knowledge and the contemporary application of sustainable earth construction in architecture worldwide (Steÿn, 2009).

2.5 Earth construction and sustainability

The two new pillars of culture and governance are welcome additions to the already considered social, economic and environmental pillars of sustainability development, according to Hubert Guillaud and Hugo Houben (Guillaud, 2010: 7), two of the founding members of CRAterre. CRAterre-ENSAG has been pre-occupied by more than just the different techniques of earth as a building material since the 1970s. Their vision and bigger picture holds other possibilities for society. John F. C. Turner stated that “a material is not interesting for what it is but for what it can do for the society” (Guillaud, 2010: 29). The social usefulness highlights “meaning” and “utility” for human and social development.

Furthermore, earth construction, as discipline, questions the scientific scope of earth construction in the physical chemistry of matter and materials (Fontaine & Anger, 2009). Earth construction promotes eco-housing as the anthropology of habitat, the conservation and management of built heritage. Earth construction, furthermore, presents the opportunity for the contemporary application of technological and architectural innovations in construction. There is also an increasing need to undertake research on the cultural values of earth construction (Guillaud, 2010: 17).

2.6 Future research on earth construction

Hadjri, *et al.* (2007: 148) support the need for additional research and practical implementation of earth construction projects to address limiting factors of aesthetic performance and maintenance. Information should be shared to convince all parties of the advantages of earth construction as a viable building material. The main causes of the deterioration of earth building are shrinkage, cracking, erosion or the effect of water and mechanical damage due to structural failure. This can be addressed through design and detailing in combination with hybrid materials (Houben & Guillard, 1994; Ngowi, 1997c; Fontaine & Anger, 2009; Steÿn, 2009).

The many advantages of earth as building material are well known: 1) availability in large quantities, low price and ease of use by all, 2) good fire resistance, and 3) thermal and acoustic insulation properties contributing to interior comfort of dwellings. The shortcomings are mainly low mechanical characteristics, unsatisfactory resistance to weathering and liability to volume changes. Clayey soils can be corrected by physically changing its texture (grain-size distribution), and its chemical and mechanical action (Siyan Siwe, 1983: 43).

According to Guillaud (2010: 34 - 35), research on both tangible aspects (materials and construction) and intangible phenomena (society and culture) should be developed. This multi and trans-disciplinary approach responds to changes in sustainable development. Furthermore, research serves society if field activities – to better meet the needs and expectations of society – join forces with the construction industry, businesses, local authorities and education. This stronger connection would

contribute to growth and consolidation of a greater demand for earth construction projects in the built environment. Earth materials could then earn a place on par with other materials. Fathy (1973: xii) believes that a great deal can be done with labour and earth.

Guillaud (2010: 36) values research on building cultures and traditional vernacular earth buildings, both in cognitive (knowledge) and practical (skill) domains. This should be descriptive, but should be able to improve the skills of cultures and the *genius loci* (spirit of place) as explained by Norberg-Shulz (1980, 1993). The concern is not just with how people embrace concepts of building material interpretation and phenomenology; it is also about the visual of the whole experience of people being in, and interacting with, their built environment.

This thesis aims to promote the use of contemporary earth construction by filling the gap regarding the social perceptions of earth construction in South Africa. This thesis is not a technical or typological (building systems) contribution to the existing knowledge on South African vernacular architecture.

2.7 Conclusion

Architects seldom use qualitative and quantitative research in architecture as comparative methodology to establish end-users' attitudes of acceptability of building materials. The low acceptability of earth constructed walls is well known, but there are few answers to the factors that influence these attitudes. In order to have a better understanding of these factors, it is necessary to investigate basic principles and models from a social sciences viewpoint.

CHAPTER 3
SOME THEORIES ON COGNITION, NORMATIVE BELIEFS, ATTITUDE AND BEHAVIOUR

3.1 Introduction

This chapter explores the reasons why people are reluctant to use earth construction as a housing option in central parts of South Africa. A review of the literature is used to illustrate the connection between the individual's:

- cognition of the built environment;
- normative beliefs presented as perceptions (influenced by personality and role models);
- attitudes expressed as preference of building materials (affected by role and status) within the community; and
- how these result in the behaviour (evident in limitations and conformity) affected by upward social mobility.

Figure 3.1 shows the interaction of these connections with influences such as the desire for upward social mobility (USM) that affects people's behaviour. This chapter is necessary as most studies investigate experiencing architecture or urban form, but few focus on attitudes towards a specific phenomenon, such as earth construction and people's attitude towards it.

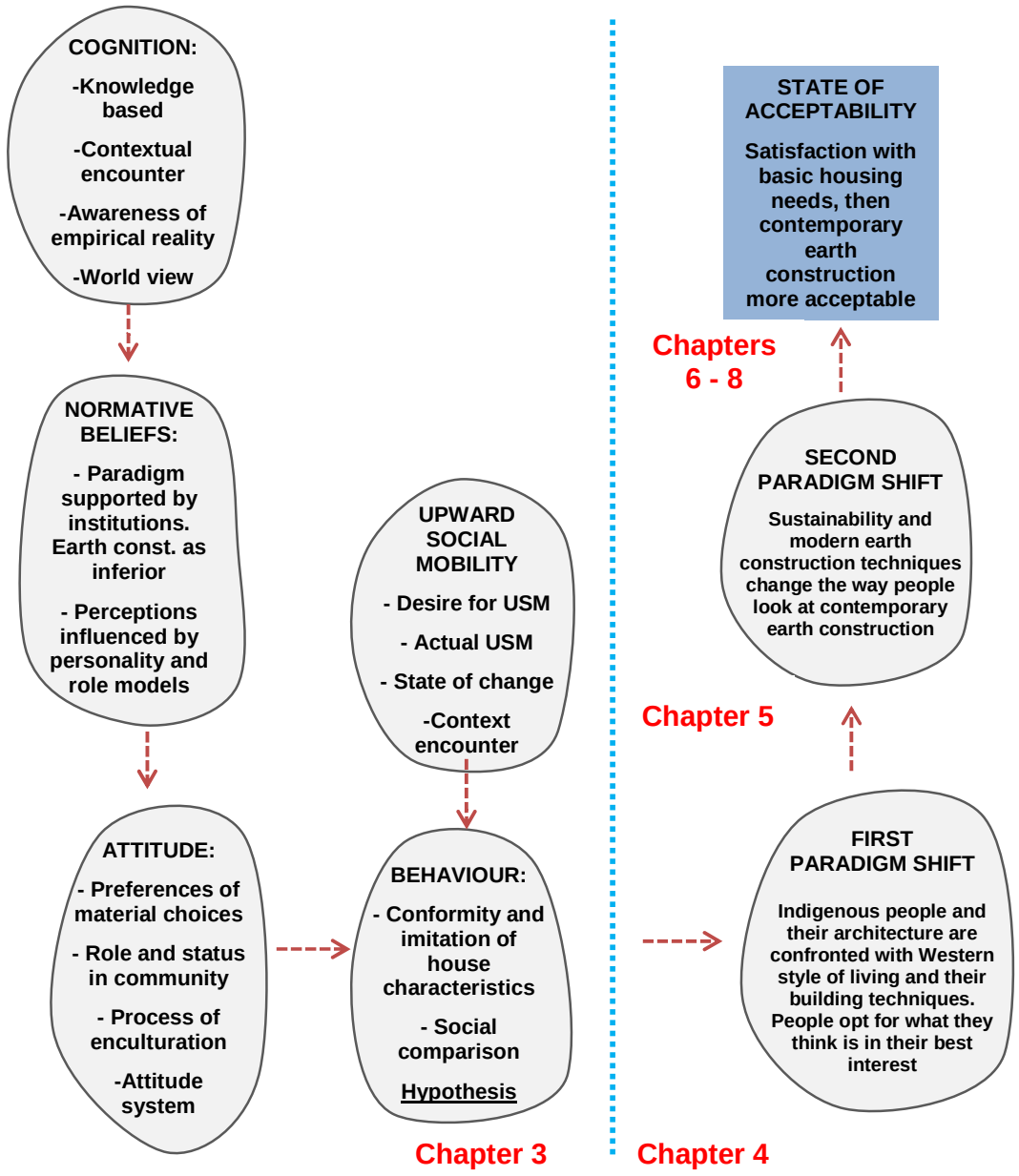

Figure 3.1 **The thesis model (and structure for following chapters) explains the influence of upward social mobility on behaviour and how this have supported the first paradigm shift and may support the second paradigm shift to influence the state of acceptability of contemporary earth construction.**

Figure 3.1 explains what will be done in terms of the literature review (Chapters 3 and 4). Only one part of this model is dealt with in this chapter, while the rest is

discussed in the following chapters. This study relies heavily on the work of Ajzen and Fishbein (1980) and Ajzen (1991, 1998), although other sources were also used.

3.2 Cognition

'Cognition' can be defined as 1) the "act or process of knowing (perception)", 2) the "product of such a process (someone thus 'knows or perceives')", or 3) "knowledge" (Random House Dictionary, 2014: online). The cognition and awareness of location and culture are influenced by a world view. Modern individuals live within changing contexts (globalisation, urbanisation and consumer culture) that do not always support the indigenous knowledge of ethnic groups and their customs.

According to Swanwick (2009: 6), cognitive studies investigate how people process information in their surroundings to give meaning to what they see. Cognitive theorists focus on individuals' essential readiness to contemplate change in their own situation (Bandura, 1982; Fishbein & Ajzen, 1975). Walinga (2008: 319) states that readiness models highlight the fact that (some) people may think that they can change their situation.

3.2.1 Cognition and cultural awareness

Gabora and Aerts (2005: 69) propose an "integrative framework for characterising how entities evolve". This framework views evolution as a process of *context-driven actualisation of potential* (CAP). This process can organise phenomena across disciplines into a broad conceptual framework.

According to Gabora and Aerts (2005: 81), a person experiences CAP in different ways, depending on the context. This process is potentially present every time the person has a 'contextual encounter' (cultural experience within a built environment). Earth construction techniques evolve (incremental adaptation) through such encounters and could change as a result of the particular changes of the context (cultural built environments) in which they are used. For example, individuals are confronted by complex situations and they have to choose how to react. The CAP framework provides techniques which may be replicated where culture is "an

integrated network of knowledge, attitudes and ideas". Individuals own internal models of the world of ideas and artefacts that are revealed in a particular context (Gabora & Aerts, 2005: 83).

The brain provides the infrastructure of individual change, and also provides the mechanism that internalises (to create, update and re-sculpt) the world outside. The extent to which people are aware of this, and actively direct the process within themselves, is called consciousness (Nunn, 2006: 184). One effect of cognitive ability is illustrated by Paterson (2008: 428), who found that upwardly mobile people of above-average ability were much more influenced by the class of destination than people of below-average ability. Carocci (2011: 387), furthermore, believes that not only rational and conscious plans, but also people's unconscious, habitual or incorporated motivations, should be examined.

Cognition and awareness of location and culture are influenced by a worldview or value system. This is supported by individuals' personal experiences of the world outside their own groups and communities. It can also be reflected in the built environment as an empirical reality through examples of good building construction in an environment which can be improved with upgraded technical and scientific knowledge. This awareness may reverse the growing ignorance of local vernacular construction. It is possible, therefore, that local residents may experience a context of earth constructed buildings positively, thereby influencing their choices regarding future construction methods. This is discussed in more detail in Chapter 4. Cognition develops into and affects people's normative beliefs.

3.2.2 Role of values in thinking

Rapoport (1977: 40) states that all thinking is influenced by the normative *value filters* people use to look at life (Figure 3.2). People's world views are, thus, influenced by their parents, their upbringing and their culture.

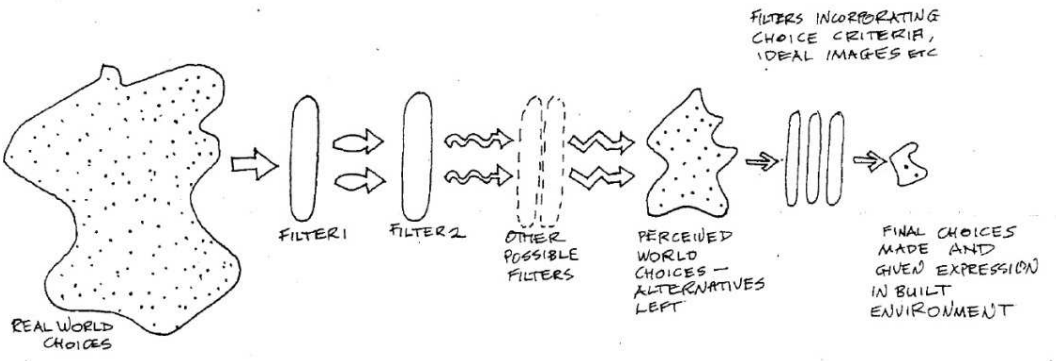

Figure 3.2 The world as seen through filters (Rapoport, 1977: 40)

According to Packard (1957, 1960), modern man, to a large extent, is materialistically driven and individualistically orientated. Individuals live by the choices they make, as Sorokin puts it:

> *If the individuals of a group are in conflict; if they urge him to contradictory actions, duties, thoughts, convictions; if, for instance, the state demands what is disapproved by the church or the family, then the respective egos will be mutually antagonistic. The individual will be a house divided against himself, split by the inner conflicts. There will be no peace of mind, no unclouded conscience, no real happiness, no consistency in such an individual. He will be like a ball pushed in opposite directions by several forces* (Van den Berg, 1963: 9).

As a means to solve the extent of choice available to the individual, Goudappel (1985: 179) developed the urbanistics concept as "a systematic inventory and classification of the elements that rule our active interventions through physical planning and as a vehicle for understanding the patterns in man's relationship with his environment". In essence, urbanistics aims to merge the framework of reflection (thought) with that of action by providing an understanding that the various interactions that exist, could take place in any given situation (Steÿn, 1989: 10-25). Regarding the urbanistics concept, Goudappel (1985: 180) differentiates between three levels of reflection (thinking), which might help to understand the connection between values, theory and practice, namely:

- the ideo-structure, dealing with the ideals and values which directs human activities;
- the superstructure, dealing with theoretical and organisational thinking; and
- the infra-structure, dealing with the physical appearance of things and phenomena.

Every philosophy or world view will deal with the meaning of life, with the nature of man and society, and with people's relationships with their environment. For this study, only parts of the "theory of reasoned action" (Ajzen & Fishbein, 1980) and the "theory of planned behaviour" (Ajzen 1991, 1998) are used. These theories endeavour to explain the link between beliefs and behaviour, but for this study, normative beliefs are emphasised.

3.3 Behavioural and normative beliefs

According to Ajzen and Fishbein (1980: 3-6), in their "theory of reasoned action", a person's intention is a function of two basic determinants: one that is personal in nature and the other reflecting social influence. According to the theory, attitudes are functions of beliefs. Generally speaking, a person who believes that performing a given behaviour will lead to mostly positive outcomes will hold a favourable attitude towards performing the behaviour, while a person who believes that performing the behaviour will lead to mostly negative outcomes will hold an unfavourable attitude.

The beliefs that underline a person's attitude towards the behaviour are termed *behavioural beliefs*. Subjective social norms are also a function of beliefs, but of a different kind. These beliefs are termed *normative beliefs,* according to Ajzen and Fishbein (1980: 7-8). Normative beliefs will tend to put pressure on people to adjust their behaviour to comply with social norms. In forming a subjective norm, an individual takes into account the normative expectations of others in his or her environment.

> *By taking perception as a model for architectural thought, a student of architecture (which I strive to be) struggles to become a seer. The art of seeing brings a certain joy in engaging the revealing of the world. Yet it remains in our 'perspective' from which we form our own visions* (Holl, *et al*. 2006: 29).

Normative beliefs, according to Ajzen and Fishbein (1980: 8), will cause the social pressure put on a person's behaviour to comply or not comply with social norms. In forming a subjective norm, an individual takes into account the normative expectations of others in his or her environment. Social pressure has a significant influence on individuals' own normative beliefs.

To explain individuals' behaviour, we need to understand, in each case, the relative importance of a person's own attitudes and the normative factors which influence their intentions. In this analysis, 'attitudes' refer primarily to individuals' own subjective perspectives, while 'norms' refer to social values to which an individual may be exposed. For some intentions, attitudinal considerations may be more important than normative considerations, while for other intentions, normative considerations may predominate. Often, both factors are important determinants of the intentions. In addition, the relative weights of the attitudinal and normative factors may vary from one person to another (Ajzen & Fishbein, 1980: 6).

3.4 Attitudes

> *We restrict the term attitude to a person's evaluation of any psychological object and we draw a clear distinction between beliefs, attitudes, intentions and behaviours* (Ajzen & Fishbein, 1980: 25).

Otto Klineberg (1961: 507-508) defines attitudes as "individuals' states of readiness to undertake certain kinds of responses". Oppenheim (1996: 175) states that attitude "is a state of readiness, a tendency to respond in a certain manner when confronted with certain stimuli". This can happen by imitating others or because of various

personal experiences. It is often expressed in the form of a stereotype or ‘picture in our head’ which influences perception and behaviour.

By the early 1970s the unreliable causal relationship between attitudes and behaviour could no longer be neglected. In 1972, Abelson, (cited in Schuman & Johnson, 1976), concluded that attitudes cannot predict behaviour, while others suggested that certain behaviours are so context-dependent as to be virtually unpredictable from measures of attitudes (Ajzen & Fishbein, 1980: 25). In contrast to the view that there is no close link between attitude and behaviour, Ajzen and Fishbein (1980: 27) suggest that measures of attitudes are strongly related to action. They argue that attitudes towards an object can predict only broad types of behaviour. Attitudes are of little value in predicting and understanding particular actions.

The *role* of an individual, therefore, includes the attitudes, values, and behaviour ascribed by the society and all persons occupying a certain status. Newcomb, (cited in Klineberg, 1961: 363), states that a society’s existence is dependent on the willingness of individuals within that society to “take on the role behaviours expected of them”. Attitudes and behaviours are influenced by *role* and *status* which are related to other demographic variables such as age, sex, class and various other factors (Klineberg, 1961: 374).

Figure 3.3 illustrates Linton’s explanation of *status* as the place of an individual in a particular system occupied at a particular time and *role* as the designated sum total of the cultural patterns “associated with a particular *status”* (Klineberg, 1961: 363). This includes the attitudes, values, and behaviour ascribed by the society to all persons occupying this status.

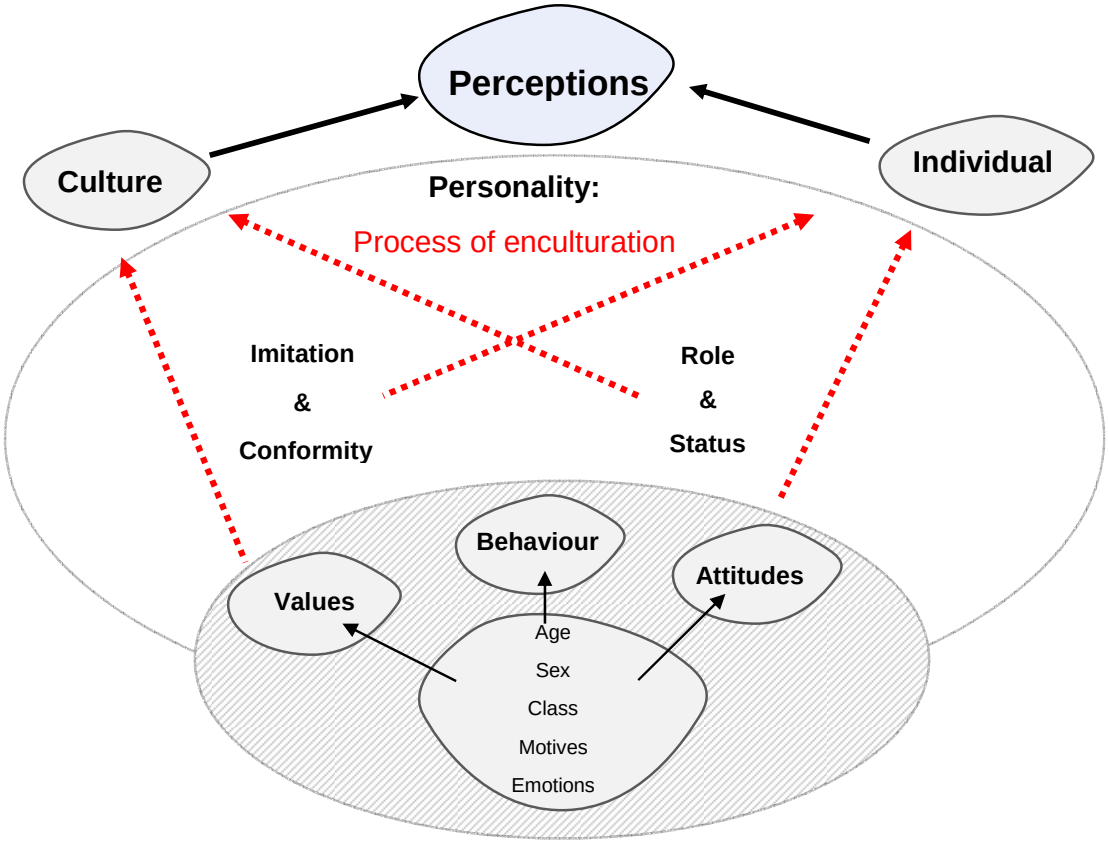

Figure 3.3 Analytical diagram to explain Linton's process of enculturation between culture and personality that influence perceptions

Klineberg (1961: 363) confirms that a "society keeps itself going by a process in which individuals come to take on the role behaviours expected of them". In addition, at an individual level, attitudes and behaviours influenced by *role* and *status* are related to age, sex, class and other factors, for example, motives and emotions. Motives and emotions are influenced by social interaction. According to Klineberg (1961: 374-437), motives and emotions are also influenced by "the relation between culture and the individual (personality) and the performance of the various roles which a community assigns to its members" (Klineberg, 1961: 437). Members in a group situation tend to conform. It is possible that even non-conformists conform most of the time to different and unconventional norms. In this thesis, the propensity of individuals to accept the customary behaviour of their communities in an uncritical way is an important feature of social reality (Klineberg, 1961: 457). Modern communities exist within a changing context, such as globalisation, urbanisation and

consumer culture, that tends to undermine the indigenous knowledge of ethnic groups. Traditional customs are, therefore, losing ground.

3.4.1 Understanding human attitudes for predicting individual behaviour

According to Katz, (cited in Silverman, 1979: 6-12), attitudes are well-established mental states that predispose a person to evaluate something as favourable or unfavourable. This automatic evaluation of everything we encounter almost invariably includes judgement about its merits as good or bad, an individual like or dislike an object, situation or person (Zimbardo & Leippe, 1991: 33-34).

Understanding human attitudes is useful in predicting individual behaviour, particularly when designing policies. If the prevalence and intensity of an attitude is not known, we cannot predict its influence. A study by Almitage, *et al.* (2004), aimed at predicting eating habits, presented the limitations of the theory of planned behaviour (Ajzen, 1991, 1998). Almitage, *et al.* (2004) used the theory of planned behaviour and the construct of perceived behavioural control. This understanding of mental states and cognitive elements is a confirmation of Zimbardo and Leippe's (1991: 33-34) view, who define attitude as an evaluative disposition based on *cognition*. Furthermore, they highlight 1) affective reaction, 2) behavioural intentions, and 3) past behaviours as aspects that can influence cognition, affective responses, and future behaviour and intentions. These components are highly interrelated and not isolated. They represent an attitude system within each individual. To form attitudes (the tendency to evaluate) is basic to being human.

3.5 Behaviour

The Cambridge Advanced Learners Dictionary (Walter, 2009) defines behaviour as "to act in a particular way". Behaviour can also be "to act or conduct oneself, especially towards others" (Oxford University Press, 2014: online). Ajzen and Fishbein (1980: 7) state that it is necessary to explain peoples' attitudes and subjective norms to improve our understanding of intentions. For example, when a person has a positive belief that an action of behaviour will be to his/her benefit or for the good of society, the person will hold a favourable attitude towards the behaviour.

Zimbardo and Leippe (1991: 32) formulate five categories of reactions to a social object:

a) *The behaviour* itself (to buy a product, to vote for a political party, etc.).
b) *Behaviour intentions* (expectations or plans to act in specific ways prior to doing so although these intentions are sometimes not carried out).
c) *Cognitions* (ideas that inform actions and beliefs such as knowledge of the availability and price of a product, or knowledge of a particular political party).
d) *Affective responses* (emotions or 'gut feelings' that reflect one's attitude at the level of physical arousal [sensations of pleasure, sadness, such as sentiments about the value of a particular product, or beliefs about the moral stature of a political party]).
e) *Attitude* (the overall summary evaluation that includes the other components).

In this analytical scheme, the concept 'attitude' is, therefore, an umbrella term; it combines a complex set of phenomena, from cognition, values and sentiments to intended behaviours and eventually carrying out a specific action. Significantly, 'attitude' includes the behaviour itself, since almost all behaviours (other than completely mindless ones) include a strong element of attitude – even if it is only enjoying a cup of tea!

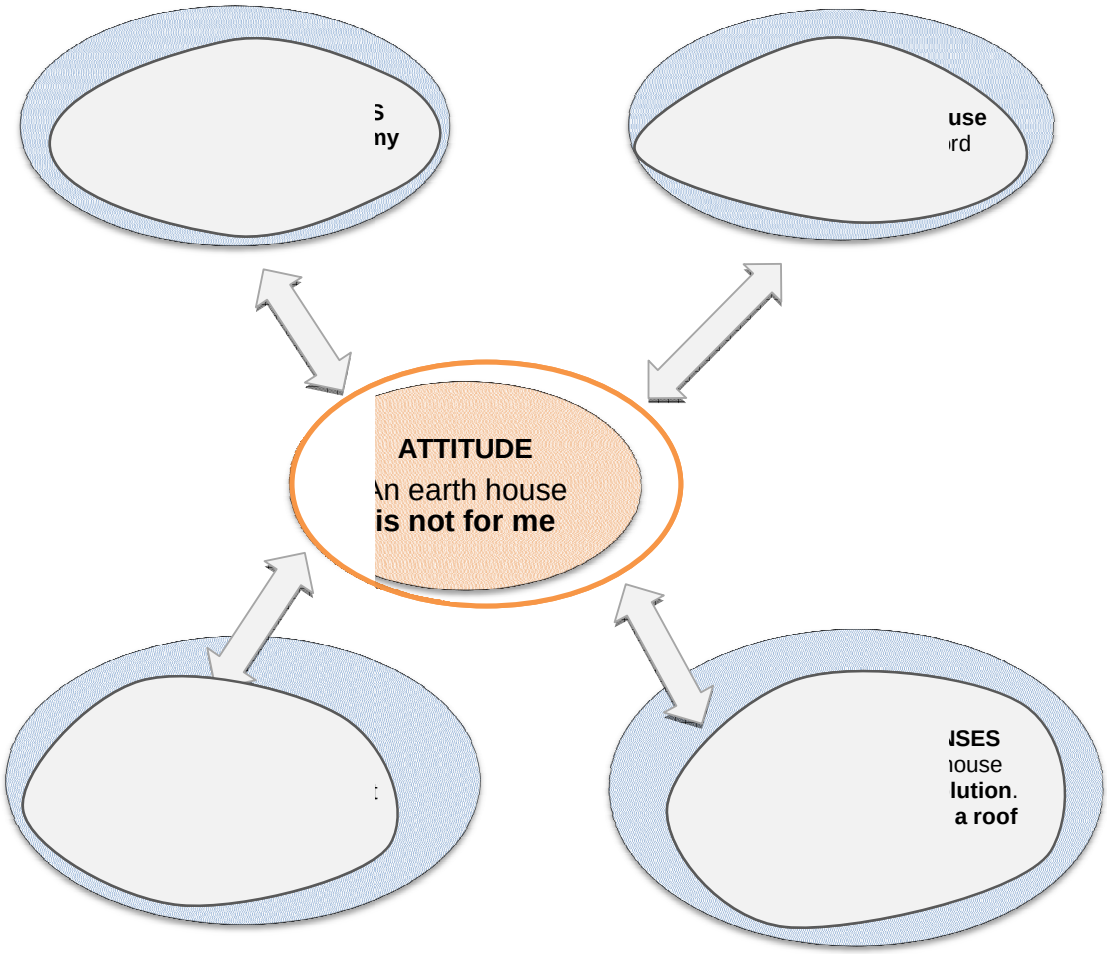

Figure 3.4 Attitude system adapted for earth constructed houses (Zimbardo & Leippe, 1991: 33)

Figure 3.4 presents different attitudes towards earth constructed houses. The 'behaviour intention' can be that the person wishes to use earth to build a house, but does not do so because it is regarded as old fashioned and will look like a poor man's house. The 'actual behaviour' can be that, over time, the person will use earth to build a house because a bigger space is needed or the person is not prepared to wait any longer for better building material, and settles for the idea that it is the only affordable building material. The 'cognition' can be that the person knows from experience, that the quality of the earth constructed walls compare badly to other conventional materials, while the 'affective response' is that living in an earth house is a temporary solution.

It is necessary to know the relative importance of the attitudinal (individual) and normative (social) factors as determinants of intentions. Figure 3.5 shows the factors that influence behaviour, according to Ajzen and Fishbein (1980: 6). For some intentions, attitude (individual considerations) may be more important than the normative (social) considerations, while for other intentions, normative considerations may predominate. Often, both factors are important determinants of the intentions. In addition, the relative weights of the attitudinal and normative factors may vary from one person to another (Ajzen & Fishbein, 1980: 6).

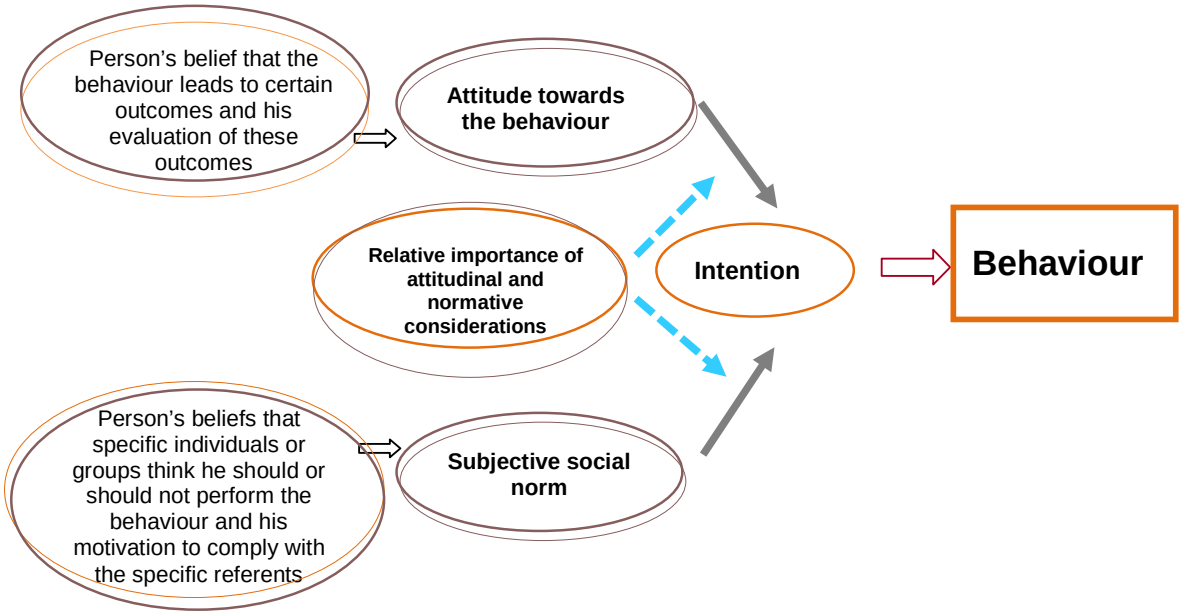

Figure 3.5 Factors determining a person's behaviour (Ajzen & Fishbein, 1980: 5)

According to Ajzen and Fishbein (1980: 62-64), beliefs are viewed as underlying a person's attitudes and subjective norms and help to determine intentions and behaviour (see Figure 3.5). Beliefs about an object are formed by its association with various qualities, characteristics and attributes. Although a person may hold a large number of beliefs about any given object, it appears he or she can attend only to a small part of beliefs at any given time. Salient beliefs (uppermost in people's minds) may change, or be weakened, strengthened or replaced by new beliefs.

3.5.1 Models of environmental behaviour

People react to their reading and understanding of environmental cues; therefore, the 'language' of the built environment should be understood. Design of the environment is a process of encoding information, and the users can share in the decoding of it. If the code is shared, appropriate and understood, the environment will communicate to the users (Rapoport, 1977: 3). It is also the basis on which the whole idea of defensible space is built (Newman,1972) where visibility, knowing your neighbours and having shared public space that control access, make social spaces safer and more user friendly.

The crucial point is that people respond to their built environment in a complex combination of cognition, beliefs, norms and attitudes. This, in turn, affects their choices about future construction methods and styles of the houses in which they live – whether these are earth constructed buildings, clinker-brick houses or prefabricated houses. These people would continue using these building styles. But there are also other people who develop their own individual attitudes and beliefs, somewhat detached from prevailing norms in their communities, and they turn into innovators or rebels.

For the topic of earth construction, there are several categories of people who are of interest. Firstly, there are those who live in earth houses, in communities where such houses predominate, and they are very happy with the vernacular construction style and method. An important question is whether they will continue to be happy in future, or will new values lead to different construction choices, such as clinker-brick houses? Secondly, there are those who live in modern houses, such as the Reconstruction and Development Programme (RDP) houses, who may yearn for traditional houses, but have lost the knowledge (cognition) of how to build such houses. And thirdly, there are those in modern houses who simply would not consider returning to the vernacular architecture or methods.

A key variable (although not the only one) in explaining such choices is the concept of 'upward social mobility' (USM), which refers to people's changing values about

their social status and proper roles. This is often based on cognitive factors (how people understand social dynamics), norms (which status is considered to be more desirable), beliefs (how one could or should attain such status), and individual attitudes (whether people want to enjoy USM). It should be noted that USM is not the only variable – others, such as sentimentality, aesthetic views, religious views, and ecological beliefs are not considered here, and could be studied in more detail in future. Furthermore, behaviour is how and what an individual chooses to react to. If USM is satisfied by other factors, it is possible to influence the acceptability of specific objects, materials and matter. Earth construction may be more acceptable if USM has been satisfied by some basic housing needs.

3.6 Upward social mobility

Social mobility is defined as individuals' movement from one class to another over time. This can be upward or downward and can be either intergenerational (occurring between generations, such as when a child rises above the class of his or her parents) or intra-generational (occurring within a generation, such as when an individual changes class because of financial success). In a caste system, for example, mobility is strictly limited by the circumstances of one's birth. At the other extreme are open class systems in which class system placement is based on individual achievement rather than ascription (Crossman, 2014: online).

Pitirim Sorokin, a Russian-American sociologist, is considered to be the originator of social mobility as separate scholarly subject. He stated that any individual's place in social space is determined by the position he or she occupies in the economic, political and professional hierarchy (or dimensions of social stratification). These different types are related to each other (Carocci, 2011: 367).

USM is a specific set of social values and norms that emphasises the importance of improving our own social standing and material benefits over time – either in our own lives or those of our children. It is a future-orientated belief system in which the past tends to be regarded as inferior or inappropriate. It is, therefore, an important spur to action, as people set about improving their own material and social conditions.

The influence of USM is considered as an important variable that can affect the social acceptability of earth construction. Paterson (2008: 413) suggests that political attitudes and social participation within welfare state democracies need a substantial degree of USM. This is very visible in South Africa, as interventionist and welfare state, “where all the wrongs of the past” are addressed by the state and non-governmental organisations in terms of social stratification since the 1990s. The policies of black economic empowerment (BEE) and affirmative action under a post-apartheid government led to rapid social change in the USM of those in the emerging African elite and middle class. They experienced rapid upward mobility, including substantial occupational leaps, within a short period (Schlemmer, 2005). By 2000, nearly half of the middle class was black, compared to 29% in 1994 (García-Rivero, 2006: 660). Burger and Van der Berg (2013: 25) found that “black affluent exhibit distinctive spending patterns”. Compared to the affluent from other population groups, the black affluent was spending more on appliances and furniture and less on personal computers, telecommunications and domestic workers. This could be attributed to their relatively new status among the affluent. These new aspirations of a new middle class will also influence the poorer classes, as this development results in a shift of their terms of reference.

Nieuwbeerta, De Graaf and Ultee (2000) offer evidence that mobility does not explain the effect of classes. Furthermore, they believe in ‘acculturation’, where people are more likely to show typical class behaviour the longer they are in a class. Paterson (2008: 428) supports the ‘acculturation’ hypothesis of Niewbeerta, De Graaf and Ultee (2000), and adds that all individuals have a specific place (status and role) in a group, which should be considered. According to Rapoport (1977: 3), the environment directly affects the behaviour, mood, satisfaction and performance of people with each other as well as with their environment.

It can be argued that, if a home owner selects building materials for an extension to his or her house, he or she will be motivated to comply with what he or she perceives to be the wishes of his or her wife or husband, children and even neighbours and close friends. If he or she believes that these referents think he or she should buy cement bricks, his or her subjective norm of satisfying his or her family and peers

can exert pressure to perform this behaviour. If, on the other hand, the home owner believes that his or her social peers think he or she should buy burnt bricks, while he or she wants to buy cement bricks, he or she will experience social pressure in the opposite direction. The subjective norm may exert pressure to perform or not perform a given behaviour, independent of a person's own attitude towards the type of building material in question.

The crucial issue is the person's attitude. Will he or she resist these social pressures? If so, then why? Is it to remain more traditional or conventional? Or, alternatively, to achieve upward social status? There is clearly a crucial interaction between a person's own preferences and those of his or her family and peers, and as explained above, there is no direct causal relationship between these factors.

Generally, however, in a context in which USM has become the norm, and USM tends to be associated with burnt brick construction (as opposed to earth, wood, iron or prefabricated materials), the social pressure is likely to be great, and it is also likely that each individual will internalise the values of USM. This could create an almost unstoppable preference for 'modern' materials, which, in turn, will cause the loss of the knowledge of working with earth and other traditional materials or vernacular styles. But even in this context, it is not a foregone conclusion that everyone will prefer 'modern' materials. There may well be people who hark back to traditional times and ways, and would like some assistance in reviving traditional customs. In fact, there may also be young people who grow up in a modern context, and take an individualist pride in being 'retro', and would like to explore traditional methods.

3.7 How change takes place in society

Context-driven actualisation of potential (CAP) entities described in section 3.2.1 have the potential to change in different ways under different contexts: 1) some aspect of this potential are actualised when the entity undergoes a change of state as a result of context encounter; and 2) the entity undergoes another change of state, and so on, recursively (Gabora & Aerts, 2005: 81). Earth construction

techniques evolve as entities (incremental adaptation) and should change as a result of the particular changes of the context (cultural built environments) in which it exists. The CAP framework within culture is “an integrated network of knowledge, attitudes, ideas and so forth – that is, an internal model of the world, or worldview – and that ideas and artefacts are how a worldview reveals itself under a particular context” (Gabora & Aerts, 2005: 83).

According to Nunn (2006: 183), the theory of change should consider time, and the experience of time, where sameness is persistence in time, and change is differences over time. Nunn (2006: 189) believes that two of the most important needs of humans are: 1) change; and 2) maintaining sameness. The brain is central to this process to construct and envisage the future and provide the critical faculty for adaptation to a changing environment. Nunn (2006: 189) refers to this as “neurofuturity”. The importance of cognition was highlighted in section 3.2.

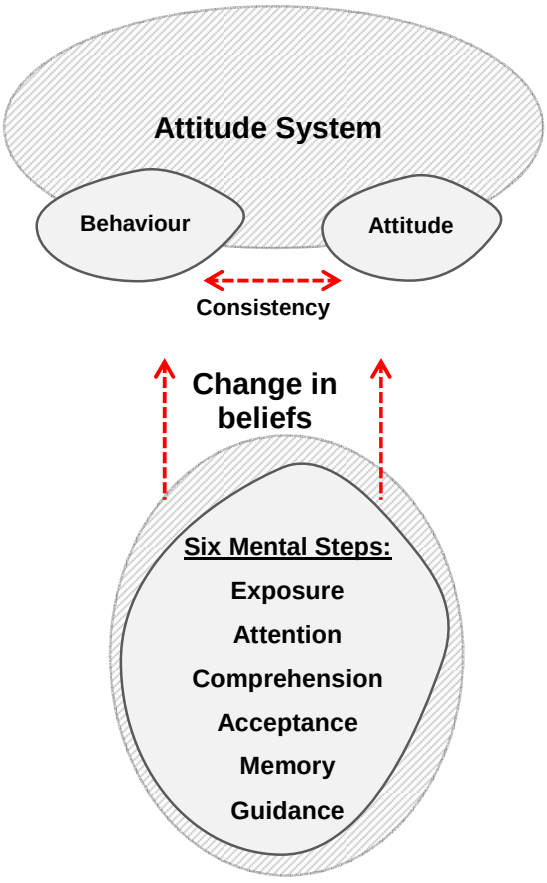

Figure 3.6 Analytical diagram of the social comparison theory (Zimbardo & Leippe, 1991: 166).

According to Zimbardo and Leippe (1991: 166), the social comparison theory is the process by which people actively collect persuasive information from others and assess validity of our opinions by comparing them with those of others. The six mental steps that must occur before a message can change behaviour are the following: the subject should 1) be exposed to a message, 2) pay attention to it, 3) understand it, 4) accept its conclusion as the new attitude, 5) remember the attitude and, 6) use it to guide the behaviour (see Figure 3.6).

Attitudes are difficult to change and not necessarily permanent, but can be modified, discarded or replaced, usually in response to new information. Many factors may result in change of attitude due to information (a message) that is communicated and received from others. When the individual (an audience) regards the communicator as credible, a greater immediate change is possible. As time passes, the message source is even less important that the message (Silverman, 1979: 502).

Furthermore, under the influence of anthropological sociology, the idea has taken root that, in social interplay, individuals are defined by different sets of attributes. Carocci (2011: 370) refers to Pierre Bourdieu's theory of economic capital, cultural capital (schooling and technical knowledge to internalised behaviour), social capital (the sum of influential relationships of individuals) and symbolic capital, whose real importance we only realise when we are deprived of it (Carocci, 2011: 370). Attitudes can be changed due to a message (new information) or inconsistency between attitudes, behaviour and the environment.

According to Stevenson (2006: 263), Gibson's theory of affordance suggests that the ability to survive is related to the evolutionary perception of what an environment physically offers. People relate to construction materials in terms of how they can meet personal needs. Kasteren, (cited in Stevenson, 2006: 263), states the possibility that a loved building may require less maintenance since the users become attached to it and "treat it with more respect". Architects should draw on the free care people provide for buildings constructed in local materials. The idea of harnessing the emotional meaning of materials to sustain resources used is new for many architects. Stevenson (2006: 263) argues that sustainable construction is

ensured by referring to the users themselves, their needs, and the specific and local manner in which they believe their needs are satisfied. She proposes the reframing of architecture as “the emotional design of resources use in place” rather than design of space using construction resources.

3.8 Conclusion

This chapter aimed at an understanding of the social and psychological aspects that influence people’s perceptions of their built environment. This chapter showed that attitudes are a complex construct of thinking (cognition) and cultural awareness of the world around individuals against the bigger world view. The chapter also showed how values (influenced by personal and cultural background) are the filters that form and hold values. These values influence the state of readiness to react or not react (responses) to change. A person’s status and role in society affect their responses that result in their behaviour. Thus, behaviour is an action with or without society’s approval. Human beings are sensitive to social norms and, therefore, will consider society’s reaction to personal actions even in the choice of building material to use for their houses. The need for USM affects people’s behaviour since most people will react to their physical built environment in a way that live up to a sense of well-being and social status. These needs to live up to other people’s expectations are common phenomena formed by the conscious and sub-conscious. All entities and individuals have the potential to enter into a state of change as a result of the context. This state holds the possibility to change negative attitudes positively. **From this, the hypothesis can be concluded as: understanding the factors that influence the acceptability of earth construction will help to promote earth construction.**

These attitudes are discussed in more detail in Chapter 4, where the aspects that influence the acceptability of building material and housing delivery are highlighted. Furthermore, Chapter 5 explores new values that may encourage individuals to regard earth construction as acceptable and desirable. In Chapters 6 and 7, Renis Likert’s method of summated ratings is used to test the degree to which respondents respond favourably or unfavourably to traditional earth constructed houses.

CHAPTER 4
LITERATURE REVIEW OF EARTH CONSTRUCTED WALLS IN SOUTH AFRICA

4.1 Introduction

This chapter discusses the first paradigm shift as referred to in Chapter 3. The second paradigm shift is discussed in Chapter 5. The thesis model illustrates and sets the stage for Chapters 6 and 7 (method and the empirical findings) that support the state of acceptability of contemporary earth construction. This study focuses on the walls of buildings as this is where the use of earth construction can be promoted.

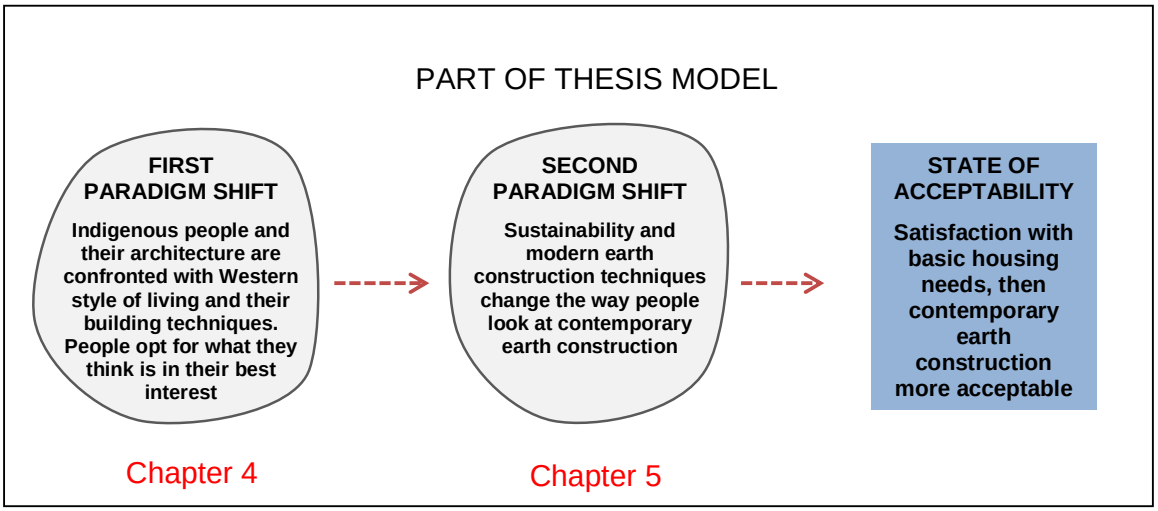

Figure 4.1 The thesis model (and structure for Chapters 4 and 5) explains the first and second paradigm shifts to influence the state of acceptability of earth construction.

The first paradigm shift encapsulates the pressure of Western influences on traditional earth constructed walls (see Figure 4.1). This change consists of factors contributing to a general movement away from traditional earth construction. The attitudes regarding traditional earth construction of people who live in, and next to, earth constructed houses, are pointed out in this chapter. The influence on indigenous South African building typologies is a combination of:

- contact with the Western style of living and values;
- the colonial building typologies and their influence on the indigenous heritage;
- the influence of modern construction techniques on traditional earth construction; and
- houses provided by the South African government.

What ensued was a typically negative attitude towards traditional use of earth constructed walls for dwellings. At the same time, people's lifestyles and their preferences for house forms changed.

The second paradigm shift consists of trends that can contribute to the movement towards using contemporary earth construction. These influences are a combination of three major trends. Firstly, environmental sustainability has become a major priority throughout the world, and it is also increasingly influencing the policies of the South African Government with regards to future sustainable development. Secondly, the development of earth construction as an emerging discipline made the use of modern earth walls feasible. Thirdly, South Africans are increasingly becoming concerned about the cost of conventional housing methods, which, in turn, leads to the construction of houses that are far too small for African families. This second paradigm shift supports the argument that people have a more positive attitude regarding modern earth walls.

4.2 First paradigm shift

This section discusses how people are changing their building patterns, from using earth construction in traditional houses to shanty towns that sprang up around the cities of South Africa. This change involved moving away from using earth to using other materials.

Since the 1600s, numerous international new building types had evolved, each with its own sphere of social influence (Seth & Seth, 1988: 60). The influence of corrugated iron on western American building styles is an indication of the influence of the territorial-style adobe house. The two traditional types of buildings were: 1) the

“flat-roofed building of one or two stories with brick coping at the top of the wall”, and 2) the pitched roof mountain style, in colder regions where “snow accumulation made flat-roofed structures impractical”. The length and proportions of roofing timbers in western America dictated the pitch of the roof that served as the traditional guideline for vernacular building globally (Seth & Seth, 1988: 60). The same roofing limitations were evident at the seventeenth century Cape of Good Hope.

4.2.1 Influence on choice of material

Frescura (1989) studied the development of the traditional house among the different ethnic groups in South Africa and indicates how it was transformed. In his book, *Rural shelter in southern Africa* (1981), Frescura shows that using earth for constructing walls was mainly done in the drier areas of South Africa. The environment or the availability of materials typically determined the type of material used for wall construction in different areas. Moore *et al.* (71-73) use climate as a determining factor in the development of American colonial housing with thick earthen walls in the Southwest. Rapoport (1969: 18-45) shows that, despite different theories on the choice of materials, ranging among others from climate and available materials to available technology, culture and the form of the house determine the final choice of materials that will be used.

4.2.2 Cultural changes and influence on building technologies

In South Africa, grass building technologies were mainly used by the Swazi, Zulu and Xhosa groups living in the grass rich coastal lands east of the Drakensberg. Wattle and daub technologies, on the other hand, were favoured by the Tswana, Venda and Sotho groups in the drier Highveld regions. Pictorial records of the early days are sketchy and open to interpretation (see Figure 4.2), but on both the Highveld and lowveld, home builders used the conical dome shape until the early 1800s (Frescura, 1981: 11).

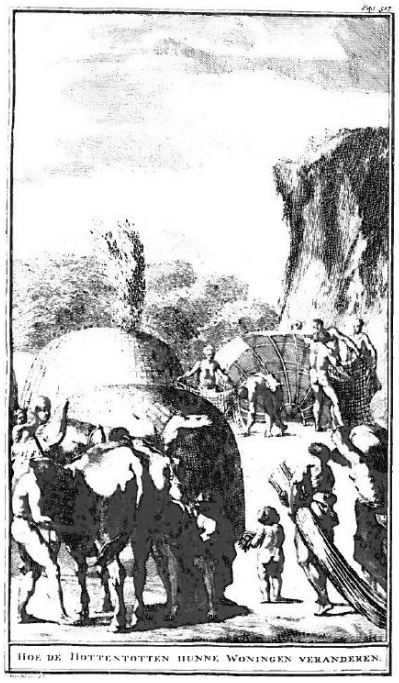

Figure 4.2 A nomadic Khoi beehive dome under reconstruction. Illustrated by Peter Kolbe in 1727 (Frescura, 1981: 191)

During the *Difaqane* or the 'scattering of the people' in the early 1820s as a result of Zulu aggression during King Chaka's reign, many people fled to areas where the various grasses needed for building homes were no longer freely available. Consequently, they adapted their building methods (see Figure 4.7). By 1812, well before the *Difaqane*-period, the Tswana had already adapted the conical dome successfully to a cone on a cylinder. Wattle and daub technology advanced into a type of wall construction element because different materials were available in their new environment. In later examples, the wattle- and daub in-fill wall "disappears and the wall becomes fully load-bearing" (Frescura, 1981: 13).

4.2.3 Western influence on construction methods in the Cape Colony

With the arrival of the Dutch at the Cape in the mid-seventeenth century, new forms of building styles evolved in response to local conditions. The Fort (later replaced by the Castle) was the first building, but within a few years houses and other types of buildings were constructed. In size, form and durability, these houses were different from the traditional round huts of the indigenous people.

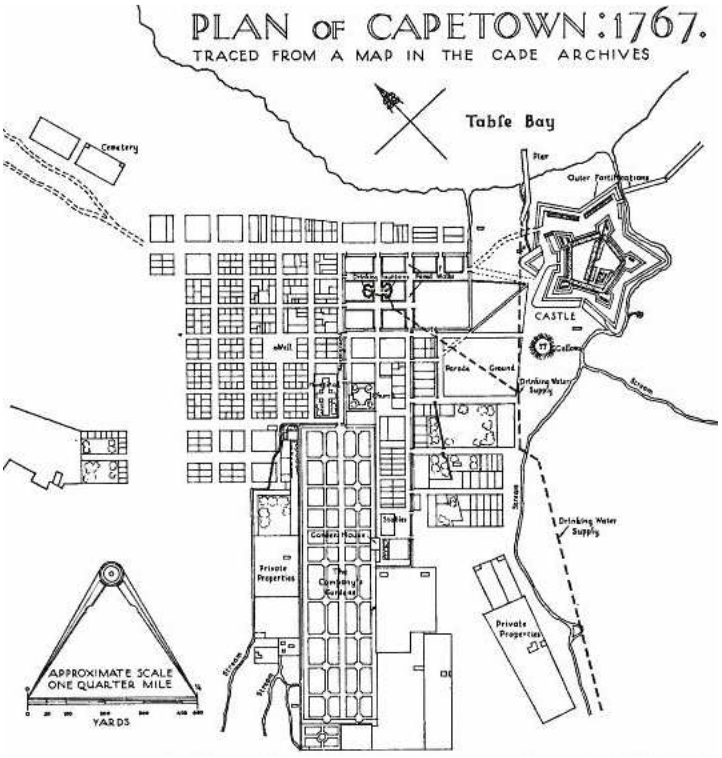

Figure 4.3 Plan of Cape Town in 1767, traced plan from the Cape Archives (Pearse, 1968: 3)

Jan van Riebeeck's arrival, and the availability of European commodities, soon influenced the preferences of the indigenous people. On 22 November 1652 Van Riebeeck noted in his diary that the price of a sheep was a copper wire (of the sheep's length), while tobacco and pipes were distributed as gifts (Schoeman, 2002: 26). New needs were established in the traditional cultures of the indigenous people.

Not only did the European arrivals have an impact on the indigenous people, they had to adjust their own building standards in the new environment. The Fort was built with sod walls (Potgieter, 1970: 506) which gradually disintegrated with each succeeding rainy winter. The half-baked or sun baked bricks were easily affected by moisture, so it had to be plastered and whitewashed with lime (Kench, Goldblatt & Courtney-Clarke, 1990: 11).

The walls of the houses often had no foundations and were built directly onto the ground, with a thicker base that tapered towards the roof. Roof beams of local wood supported the reed *brandsolder*, a ceiling made of Spanish reeds bound together and covered with a layer of clay as fire insulator. The roof was finished with a thick layer of the abundant local *dekriet (Dovea tectorum)* (Kench, Goldblatt & Courtney-Clarke, 1990: 11).

Outside Cape Town, house-walls were generally built of undressed stones, or sometimes of sun-baked bricks, with clay mortar. Lime mortar was rarely used:

> *…this mixture was sometimes faced [plastered] with three inches' thickness of ant-heap earth. The wall was made 20 ins. – exceptionally, over 3 ft – thick, to enable it to stand up: it had, of course, no damp course, and required and annual lime-wash – white, more rarely yellow – to prevent it disintegrating in the rains* (De Bosdari, 1971: 20).

After searching for clay, Van Riebeeck established his first brickyard. He described the first bricks manufactured as "fine red bricks like Leyden bricks". They proved to be of poor quality, with a "limited life of about nine years" (Potgieter, 1970: 506). The bricks were porous and did not weather well (De Bosdari, 1971: 20). The gateway and the residential buildings within the fort (later replaced by the Castle – see Figure 4.3) were built with bricks imported from the Netherlands.

> *Ten years after the foundation of the Cape settlement, the infant town has taken on the appearance of a village in the Netherlands. The red-brick, gabled houses had gold-colored tile roofs, and the cottages were built with sod, wattle and daub' or weather-boarded walls; their thick thatched roofs swept close to the ground* (Potgieter, 1970: 507).

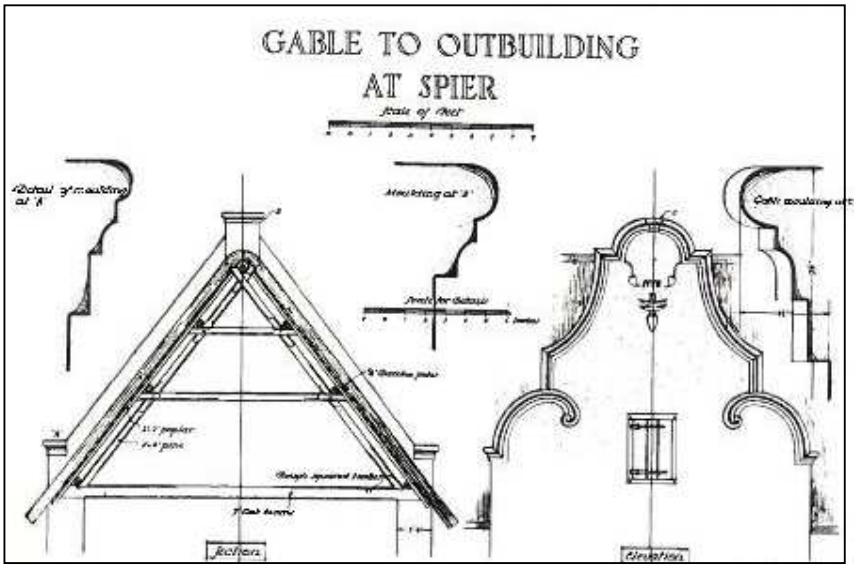

Figure 4.4 Details of a gable and timber roof structure of Spier outbuilding (Pearse, 1968: 19).

In the case of climate and technical performance, a combination of fire and driving winds proved a forceful argument against the use of thatched roofs in seventeenth century Cape Town (Frescura, 1989: 39). The earth-covered flat roofed technology (*brakdak*) which replaced it was not entirely water-proof, and needed constant maintenance. By 1660, the fear of fire led to the use of burned roofing tiles (Potgieter, 1970: 506).

The climate was harsher than that of Holland. The driving rain, together with the sudden change in temperature, affected the bricks and tiles. By the end of 1663, most of the buildings were covered with plaster. They were also whitewashed with lime burned from sea shells, while thatch was reintroduced (Potgieter, 1970: 507). The typical Cape buildings were established (see Figure 4.5).

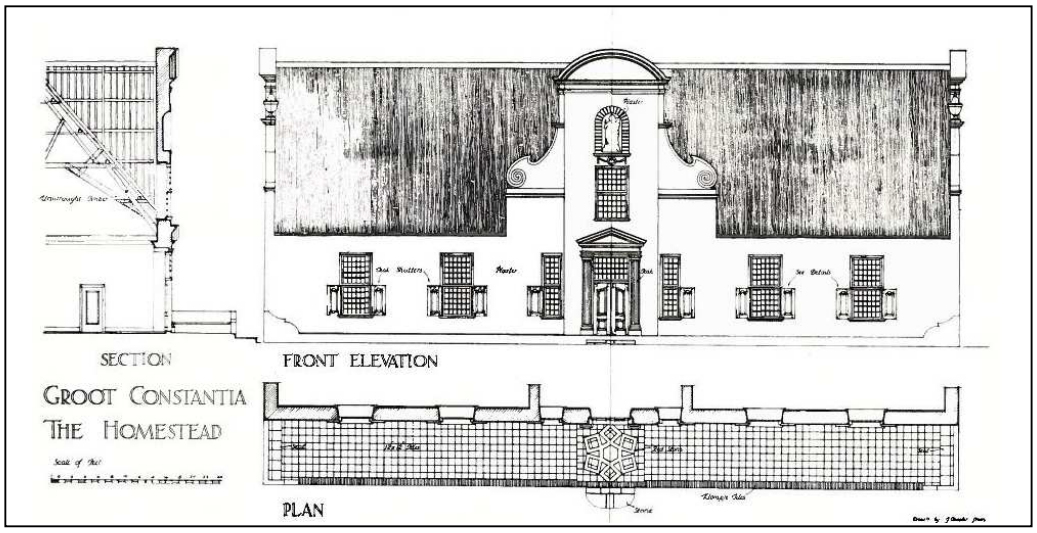

Figure 4.5 Typical Cape homestead building constructed in earth construction.
(Pearse, 1968: 39)

Further inland from the Cape, sun-dried or superimposed layers of mud, mixed with sand or grit, was used to build walls. The latter type of wall was stronger and more durable than those made from sun-dried bricks (Potgieter, 1970: 514). The arid climate of the Karoo made the use of *brakdakke* also more feasible. Consequently, there were two alternatives: a pitched thatched roof (see Figure 4.4 and Figure 4.5), or timber for an easily-constructed *brakdak*. Eventually, these types were replaced with the introduction of corrugated iron that "at once cancelled both variables of climate and technical performance but also added a factor of cost and affordability to the housing equation" (Frescura, 1989: 39-40).

With the arrival of the English in 1806, new forms of housing and building techniques were introduced in South Africa. The industrial revolution led to new forms of material such as corrugated galvanized iron, which had already been imported to the Cape from the early 1850s (Potgieter, 1970: 526). It was originally used for both roofing and walling. Corrugated iron (safer and easier to maintain) was increasingly used in Cape Dutch homesteads to replace thatch.

The use of “corrugated iron revolutionized the Victorian outlook; still more so the use of cast-iron as a functional but decorative medium” (Picton-Seymour, 1977: 11). According to Rudd (2006: 8), many wood and corrugated iron houses were brought from Brittan and Europe in ‘kit’ form, ordered from a catalogue, shipped to the nearest port and further transported to its destination by ox wagons. The designs were limited to a few basic architectural designs (see Figure 4.6).

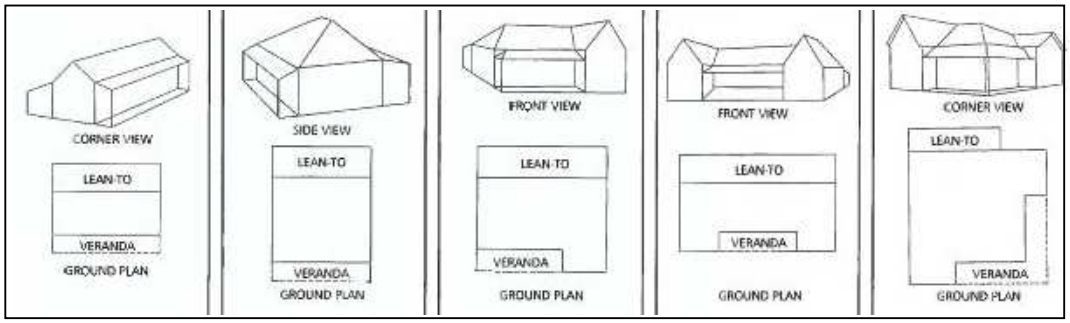

Figure 4.6 A diagram of some of the different catalogue styles of wood and corrugated iron houses (Rudd, 2006: 9)

4.2.4 Western influence on housing of ethnical groups in eighteenth century South Africa

The first change in the development of the traditional hut was away from the cylinder and cone form to a more square form, but still with a coned thatch roof, stretched to cover the new form (Frescura, 1981: 18). Using trusses made erecting the roof much easier, as a gable could now be used together with the trusses. The gables added to prominent houses presented the opportunity for clay plaster decoration. Hips and valleys in thatched roofs tend to leak. Using galvanized corrugated iron made the roof’s construction simpler. Due to costs, the roof overhang was abandoned, while the pitch became much lower, resulting in the distinctive roofs of the well-known Highveld house.

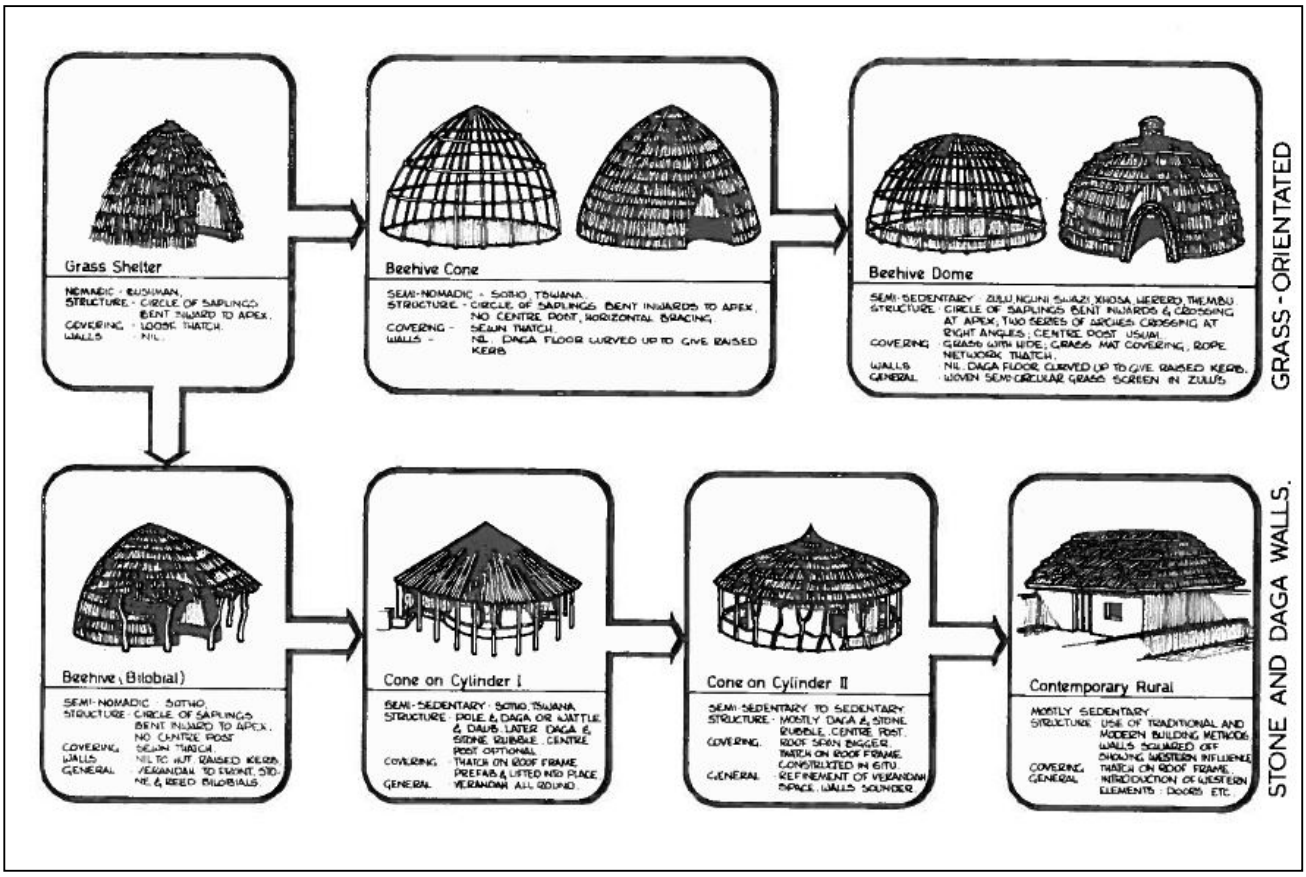

Figure 4.7 The three stages of development from primitive shelters to the contemporary rural house (Frescura, 1981: 12)

Frescura (1981: 13) traced four major stages of development (see Figure 4.7). Stage one is the primitive shelter, beehive dome and dome raised on drums of different heights. Only later on were walls built entirely of earth, sods, or rubble. If the walls were strong enough, the roof frames were built onto the walls (Potgieter, 1970: 539).

Stage 2 included all variations of the cone-on-cylinder and cone-on-cube house forms, including the “veranda” house. “This stage is typified by the emergence of the roof and the wall as separate and identifiable structural elements” (Frescura, 1981: 15). Traditionally, these types of walls largely depended on the available material. The earliest examples were wattle-and-daub, also known as *pole-and-daga*. For example, the Tswana hut had a cylindrical wall, which was not load bearing as the

roof rested on a circle of upright posts (see Figure 4.7). The walls usually had a space between the top of the wall and the roof. Traditionally, the walls were plastered/smeared with a mixture of earth and cow dung for waterproofing. At the same time, decorative patterns were created on the walls (Potgieter, 1970: 539).

Stage 3 consisted of the triangular roof truss over a square or rectangular floor plan. This typology allowed the plan to dictate the shape of the roof. The fourth stage described the Highveld house, popular in the rural areas of provinces now known as the Free State Province, North West Province and Gauteng Province and surrounding Highveld areas. The later house development consisted of load-bearing sundried earth (adobe) walls with a lean-to corrugated iron roof that fell to the back of the structure. Parapet walls became more dominant. Failure of the walls was a result of the lack of waterproofing of the parapets. The roof structure had no or inadequate anchoring and the openings had no lintels (Frescura, 1981: 18).

The multi-roomed dwellings probably became more popular as a result of 1) the economic one-roof form; 2) the spread of Christianity and monogamy (no need to accommodate different wives with different statuses); 3) urbanisation and resettlement, which resulted in smaller family units; and 4) the increasing importance of White society that promoted the aesthetic of the multi-roomed dwelling (Frescura, 1981: 89).

Furthermore, new commercial patterns followed the development of new needs and wants. This contact with the West had a profound influence on the traditional cultures. New commodities even influenced the housing form; a rectangular bed did not fit a round hut, which encouraged changes in the form of houses. Coming into contact with new technology resulted in these changes to traditional housing.

4.2.5 Influence of aesthetics, style and status

The Dutch and British influences regarding building materials were connected to the ideas and styles of Britain and Europe. These aesthetic ideas and styles were overlaid onto the local context which created new types of social status in a colonial

order. Increasingly, fired bricks and other ceramics were locally produced. There was steady investment in government buildings, botanical gardens, landscaped parks, monuments and memorials, church schools, mission institutions, and archival and bibliographic collections in the Orange Free State and Transvaal Republics.

More than two and a half centuries later, the 'avant-garde' of modernism arrived in southern Africa (Murray *et al.,* 2007: 3). In 1925, a small group of followers of the 'international style' began designing modern buildings in South Africa (Murray, 2007: 43). Since then, South African architects have followed international trends and styles. Contemporary architecture in South Africa, consisting of various postmodern styles, trends and influences, are juxtaposed. These coexist in increasingly hybrid African cities (Wessels & Bosman, 2014).

There was an influx of modern and postmodern styles into South Africa despite the poor climate and technical performance of the stylistic elements or the lack of practical climatic elements such as verandas and louvers. It has also been influenced by issues of aesthetics, style and status. Consequently, Frescura (1989: 38) argues, those architectural styles are often not a matter of individual style, but are strongly related to the values of dominant groups. He questions the role that climate and technical performance played in predetermining man's choice of his own built habitat. It should be asked at what stage these choices cease to be guided by pragmatic factors and are "overtaken by consideration of aesthetics, style and status". It should be considered that architecture stopped being a matter of individual choice and are strongly connected with the values of a larger group. This supports the argument that upward social mobility (USM) is a possible influencing factor to be considered in the acceptability of earth construction. From the literature review it is suggested that imitation and conformity, together with USM, can influence the choices home-owners have regarding wall building materials.

4.2.6 Government influence on housing

The first time governments really started to get involved in housing was after the riots in 1886 in England and the government's fear of the spread of communism (Hall, 1988: 24-28). A commission, led by Charles Booth, was established to look into

poverty issues. This commission undertook a survey of the poorer classes in London. The recommendations of this commission led to government provision of housing for the poor, for the first time in history.

Poverty is the most important issue to be addressed in South Africa. In 2013, South Africa's Gini coefficient was one of the highest in the world at 63.1 (Donnelly, 2013). The Gini coefficient is a measurement of the income distribution of a country's residents. South Africa's level of income inequality is much higher than countries such as Brazil at 54.7, China 47.4, Russia at 40.1 and India at 33.4 (Donnelly, 2013).

In 1994, the South African Government introduced the Reconstruction and Development Programme (RDP), which argued for housing for the poor as well as rapid creation of jobs. There was indeed a major housing shortage, due to decades of influx control and rapid urbanisation. These policy priorities were implemented by constructing small houses for nuclear families. These houses, known as RDP houses, were handed over to the poor. It is something tangible that voters could see, and it was easy to show that the government had done something for the poor. Clawson (1973: 3) opposed this notion that housing will solve the problems of the poor. He believes that people do not need houses but rather need jobs because they can then provide their own housing.

The provision of the RDP houses altered the face of housing for the poor in South Africa. For many poor families, a free RDP house was indeed a blessing. However, the policy of rapid roll-out of contractor-built housing had unintended consequences. Firstly, the houses were often extremely small, because of cost constraints. Secondly, it disempowered the occupants of these houses, because they were not involved in the construction process. Thirdly, it may well have created a 'dependency syndrome' in poor communities, where local residents regard the state as the only agency to solve their problems.

Hall (1988: 242-246) found that one of the solutions to solve poverty was through sweat equity, whereby families who would otherwise be unable to purchase a house, can contribute their labour and be involved in the construction of their own house.

Some poor communities have become reluctant to solve their own housing problems, as they have a sense of entitlement regarding government-funded housing (SALGRC, 2013b: 4-5). They will use the easiest possible solution to provide their own shanty in urban areas and pressurise the government to provide housing for them. The minimum standard for a house is now an RDP house and anything less than this is regarded as inferior. This might have a large influence on the use of earth constructed houses. Current mass housing programmes in South Africa have been severely criticised. This literature review discusses issues which may well lay the groundwork for a new appreciation of earth constructed houses.

4.3 Self-organization housing approach of Turner

An architect by profession, Turner was actively involved in research and consultancy work in Latin America during die 1960s and 1970s. He criticised large-scale government-built rental housing (Mehlomakulu & Marais, 1999: 93). Turner (1976) states that using standardised products and procedures do not accommodate individual needs and variety. He believed that individuals should be able to make decisions about planning, construction and management in order to address housing problems effectively. He supported the shift from ‘self-build’ to ‘self-organisation’ that involves people organising themselves in the building environment.

Turner saw the shack as a house-in-process which could be built according to the occupants’ needs (Mehlomakulu & Marais, 1999: 93). He used concepts such as “dweller satisfaction”, “use value”, “housing as a process” and “housing as a verb” in his work. Turner (1976) argued the importance of the meaning and functional value of housing.

The research and work of Turner influenced the World Bank policy on housing (Mehlomakulu & Marais, 1999: 93). The World Bank (1993) proposed that housing subsidies should be used for infrastructure only, and not for housing structures. The state should focus on providing as much infrastructure as possible and leave the construction of housing units to low-income households (Maishoane, Marais, & Barker, 2003: 55).

Skinner (1983: 130-136) states that community participation programmes seldom involve local control in site-and-services projects and upgrading programmes. The advantages of community participation can be linked to a better understanding of community needs. This can result in better planning, cost recovery, skills transfer, use of resources and affordability. Furthermore, the circumstances to stimulate "self-organisation" should be considered, but the South African government of 1994 had a different approach.

4.4 South African government's ideals of proper housing

In the South African context the idea of a proper community and proper housing informed the state initiated, physical projects of house-building in the form of RDP houses. The policy documents of the South African government holds the idea of a proper community, where the state will provide the poor with formal housing structures in planned and serviced areas. In many areas, informal structures are interpreted to be unacceptable temporary housing. According to Watson (2007: 68-71) these ideals shaped government actions in westernised utopian societies in order to administer, control and incorporate municipal finance systems. Part of this ideal is the notion that occupants in informal settlements will accept long-term, binding, legal and financial obligations as part of home ownership; the payment of rates and services; and being committed to a particular piece of land or territory. The developing world ties the issue of shelter upgrading to poverty reduction and sustainable urbanisation. The demand is on municipalities to become local developmental agencies and to work with citizens as well as groups within communities to find sustainable ways and address social and material needs. Creating communities depend on community participation and to build social capital to find local solutions. This involves looking beyond the technical and managerial tasks and seeing the moral and political tasks of issues. According to Turner (1988) the objective is to support the potential of people to reclaiming and discovering their forgotten need and capacity for community-building.

4.5 Change from welfare to development approach

Turner (1976) refers to favourable development circumstances as appropriate tenure, basic services, access to employment, and housing finance. The World Bank adopted and economised the views of Turner by promoting self-organisation to reduce the financial burden on governments. This economisation focused largely on infrastructure development and subsidisation (Ntema & Marais, 2013: 391). Other analyses support the views of the World Bank in arguing that infrastructure provision should be prioritised. According to Maishoane *et al.* (2003: 75), the South African government can increase the reach of the South African housing policy by providing only the infrastructure to assist more people. Marais and Botes (2006: 379) confirm that the "welfare paradigm has shifted from one of welfare to development" in South Africa.

"The South African housing policy directly favours the poor" (Marais & Wessels, 2005: 19), but continued efforts for home-owners to do their own home improvements should be supported. The security of tenure helps to stimulate housing improvements (Harrison, 1992; Laquian, 1983: 112). This could also be accelerated by other factors, such as improved infrastructure, availability of building materials and loans. But the lack of finance is the most important reason for not extending houses (Tipple, 1998). Maishoane *et al.* (2003: 75) confirms that household size is an influencing factor in expanding houses, while household income influences the improvement of houses. The Breaking New Ground: Informal Settlement Upgrading Programme effectively attempted to reduce vulnerability and promote social inclusion only since 2004 (Huchzermeyer, 2006).

Maishoane *et al.* (2003: 55) concur that low-income households do upgrade their informal houses to formal houses. This is influenced by the size of the household in the area and the period of residency. Informal settlements are proof of the ability of the poor to find solutions for their built environment problems (Betancur, 1995).

Laquian (1983: 114) states that choosing building materials to use in housing consolidation (strengthening and developing the house over time) is influenced by 1)

construction considerations, 2) availability of materials, 3) building skills needed, and 4) people's attitudes toward the status or prestige of types of materials. According to Ntema and Marais (2013: 391), political and economic theories have narrowed the housing studies and detached them from more general social sciences theories (Ntema & Marais, 2013: 395).

In South Africa, the process of policy development did not reflect and accommodate sociological theories (Ntema & Marais, 2013: 395). The fact that we need to consider the status or prestige of types of material is an important aspect to support the thesis argument. This investigation (understanding the basic social sciences theories, discussed in Chapter 3 guided the research regarding the acceptability of traditional earth construction in order to promote contemporary earth construction.

4.6 Earth construction standards not acknowledged in South Africa

South Africa, as developing country, enforces strict national building regulations that do not provide minimum standards for traditional building materials (Gerneke, 1992a, 1992b, 1992c). This notion supports the view of traditional and vernacular earth construction as being weak and inferior. The South African government, as welfare state, holds Reconstruction and Development Programme (RDP) housing as the minimum acceptable form of housing. This supports negative perceptions that traditional earth construction is unacceptable. These perceptions are further influenced by a combination of social normative beliefs, individual personalities, and role models in communities, as discussed in Chapter 3.

The public belief (normative) system is supported by government institutions and government actions. Because the state does not include the minimum standards of earth construction within the national building regulations or provide social and low-cost housing in acceptable building materials, it creates the impression that earth construction is inferior. This paradigm should be addressed by the South African government as it is currently addressed by many international organisations.

South Africans have a high desire for upward social mobility, especially since 1994. The expansion of full citizenship to Black people, should accommodate contemporary earth construction methods, drawn from various ethnic groups. The South African national building regulations do not make provision to upgrade earth building techniques, however, the Department of Public Works do acknowledge some contemporary earth building techniques (South Africa, 2013a, 2013b).

4.7 Acceptability of earth construction in developing countries

Few studies have reported on the negative perceptions of traditional earth construction methods. Public acceptance calls for programmed action over a long period, as shown by the research by Abraham Quattara and Jacques Simonnet in the Ivory Coast in 1983. These researchers concluded that, for any new technique to become popular, the material should be based on: 1) ensuring real saving; 2) taking the cultural, historical, social, economic climatic and technological context into consideration; 3) drafting an official standardising document; and 4) training the work force, in order to increase stakeholders' awareness of new building materials or technologies (Siyan Siwe, 1983: 40-41).

Experience elsewhere in the world suggests that 80% of rural dwellings in Zambia have adobe and wattle, and daub walls. They assessed attitudes towards traditional earth building among end-users, designers, contractors and government regulators using quantitative and qualitative research methods. Most urban dwellers associated traditional earth constructed houses with poverty and low socio-cultural status, and construction professionals were reluctant to use earth as a construction material, due to technical and performance limitations. The study concluded that earth building materials offer viable alternatives to reduce urban housing shortages in Zambia, but several barriers needed to be overcome before the construction industry, regulators and end-users would buy into the technology (Hadjri *et al.,* 2007: 141-144).

Earth construction offers new housing options, although it received limited public debate in many countries. Furthermore, architects, engineers and building contractors should play a role in influencing a change in culture, and producing earth

constructed housing by leading the debate, designing and constructing desirable earth dwellings and offering confidence to developers and the public. The concepts of sustainable construction and local economic development are closely connected and aimed at improving the lifestyles and quality of life of local communities (Jooste-Smit, 1998). Sustainability implies long-term viability that "involve a new respect for and learning from the past" but "can only be achieved by also moving forward" (Buchanan, 2005: 8). "The purpose of collaboration is to create a shared vision and joint strategies" (Chrislip & Larson, 1994: 5). Turner (1988) states that people can win their right to use resources for housing and use the freedom to act for themselves.

The lessons learnt from vernacular building practices should not be underestimated. According to Siyan Siwe (1983: 40), research institutes and governments should take parallel lines of action if housing problems are to be solved. The first is to find ways of using abundant and cheap local materials by tapping into the local building culture that do not depend on high investments or qualified labour. The second aspect to be addressed simultaneously is to make the techniques acceptable for the concerned population, since earth as building material should be addressed.

4.8 Conclusion

The first paradigm shift encapsulated how traditional earth construction came under pressure in South Africa. The climatic conditions, technical performance of material, the availability and the different cultures influenced the way houses were built. Colonialism and the modern movement introduced a variety of architectural styles to South Africa. Over time these styles where associated with the building materials. These materials were accepted; however, traditional earth construction was negatively regarded.

The South African Government's role as housing provider to the poor sets the benchmark for minimum standards for acceptable housing. The government struggles to deliver housing and keeps on expanding the housing delivery policy in South Africa. These efforts open up the way to get government support for the

promotion of earth construction as part of sustainable development. It is necessary to continue addressing the issue of negative perceptions and attitudes towards earth construction and the lack of technical knowledge and building codes in developing countries. The South African governments' role is important in developing policies, codes of practice and training programmes to encourage building designers and contractors to use earth construction. This should be addressed by a second paradigm shift or the growing movement which encourages using earth as a building option again.

CHAPTER 5
LITERATURE REVIEW OF CHANGES BACK TO THE USE OF EARTH CONSTRUCTED WALLS IN SOUTH AFRICA

5.1 Introduction

This chapter explains that significant efforts have been made to make contemporary earth constructed walls acceptable for housing. It started with the world realising that an environmental crisis is on hand and that sustainability is a possible solution to this crisis. Concerned with the global energy crisis, the building environment also investigated earth constructed walls as an alternative to provide a greener option.

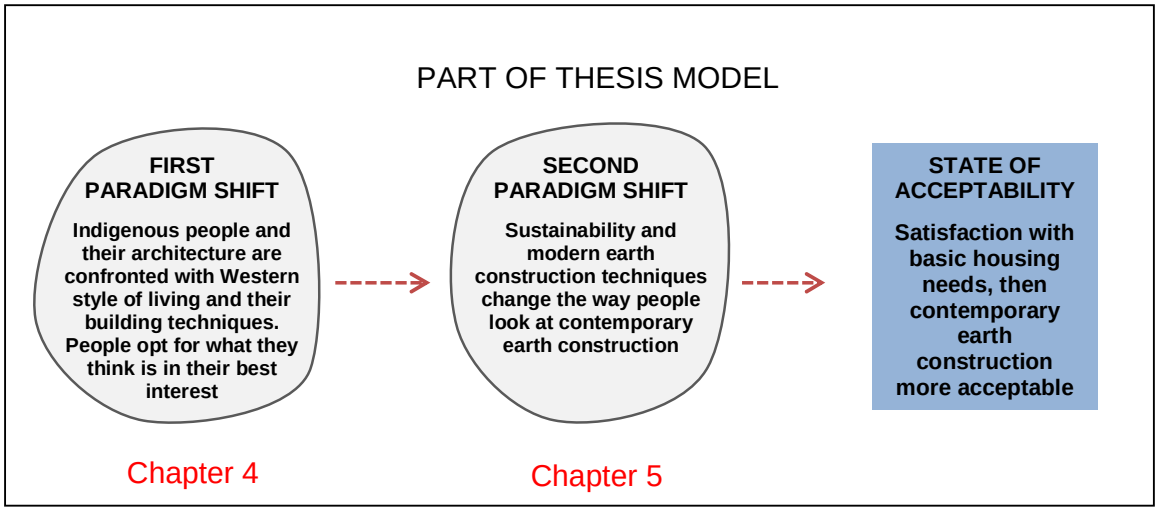

Figure 5.18 The thesis model (and structure for Chapters 4 and 5) explains the first and second paradigm shifts to influence the state of acceptability of contemporary earth construction.

5.2 Second paradigm shift

The changes in the second paradigm shift encompass recent changes and proposed future actions. The major role players in this shift are local and national government departments and their building policies, researchers and academics. These changes and actions set the stage for a state of acceptability that will promote using contemporary earth construction techniques.

5.2.1 Green movement and sustainability

Maltus (2004) introduced the idea of natural resources that cannot sustain indefinite population growth in *An Essay on the Principle of Population a*s early as 1798*.* Steÿn (2006: 234) describes the history leading to sustainability as follows:

> *However, the development of science, technology and organization made it possible in the 20th century for mankind to survive despite the ongoing population explosion since mass production of penicillin began in the 1940's. In the first half of the previous century even per capita food production increased due to the green revolution in agriculture through the use of modern fertilizers and pest control.*

However, Carson (1962) changed the course of history with her book *Silent Spring*. Her early warnings focused on the degradation of quality of life as a result of the chemical poisoning of the earth. Ian McHarg (1969) brought hope to the built environment with his book *Design with Nature* in which he illustrates that man-made structures can be accommodated within the ecological order. This developed into the environmental movement that supported environmental impact assessments for new developments worldwide. But, by the late 1960s the concerns of resource depletion became more earnest. The contribution of Meadows (1972) with his book *The Limits to Growth* highlighted the issue again. Steÿn confirms this:

> *The oil crisis that started the next year strengthened this perspective. Schumacher (1972) in his popular book Small is Beautiful shows people in the West with their impersonal views on man, life and the world at large that they could learn some lessons from the cultures of the East by concentrating on a small-scale approach to development* (Steÿn, 2006: 234).

Nijkamp (1980: 31), however, reacted to Shumacher's Oriental approach to Western problems. By 1983 the secretary-general of the United Nations appointed the World Commission on Environment and Development that published a report entitled *Our Common Future* (1987). The commission's proposal formulated approaches to support human progress and development without harming the rights of future generations*.* The environmental movement expanded to encompass all branches of science; even the building environment. Unfortunately, according to Buchanan

(2005: 7), politicians and corporations often claim to be acting sustainably based on irrelevant cynical reasons that achieve only seductive advertising resulting in scepticism.

5.2.2 Contribution of contemporary earth construction

According to Ngowi (1997c:1), the Egyptian architect, Hassan Fathy, supported and practiced sustainable development in several projects and buildings in North Africa and the Middle East in the late 1980s. Fathy (1973) reiterated that success in earth construction have been achieved through experimentation and the experience of builders (Steÿn, 2009), and not only through deliberate scientific reasoning. The oil crisis of 1973 led to an emphasis on environmental issues, including the built environment. This crisis brought vernacular building methods like earth construction to the forefront. Today, earth construction is a developing subject (Guillaud, 2010: 12) taught in higher education institutions, universities and professional building training centres. A vast field of scientific and technical knowledge were created since the 1970s, with earth construction as an emerging new discipline (Fontaine & Anger, 2009). This is also the case in South Africa (Steÿn, 2009: 26-34; Guillaud, 2010: 12; Wessels & Bosman, 2014: 227-228).

Earth construction has been established internationally as a discipline in developing and developed countries by non-governmental organisations and some governmental departments that contribute to the environmental, building, social and educational sciences since the 1980s (Nel & Bosman, 2014: 767-769). People in communities today are often more connected (Fathy, 1973) through community developing projects and social capital to sustain human settlements than previously.

According to Guillaud (2010: 7-17), earth construction, as discipline, questions many aspects, for example, the physical and chemical composition of matter and materials, the anthropology of habitat, the conservation and management of built heritage, social economics, as well as the technological and architectural innovations in construction (Fontaine & Anger, 2009). The TERRAEducation seminar held in 2010 confirms the existence of an active community of teachers and researchers in the scientific community. This second earth education seminar was held at the

National Superior School of Architecture of Grenoble (ENSAG) from 24 to 29 May 2010 and was organised by the International Centre for Earth Architecture (CRATerre-ENSAG). This brought together 41 participants from 4 continents – Africa, America, Asia and Europe – and 22 countries. CRATerre-ENSAG is the centre of excellence for the UNESCO Chair Earthen Architecture, Construction, Cultures and Sustainable Development. CRATerre-ENSAG was established in the Grenoble School of Architecture in France in the early 1980s, after the French government showed renewed interest in the building industry and academics who were considering more environmentally friendly building techniques.

The global green-movement, together with growing local awareness of green issues, has helped to sensitise the public towards looking for more sustainable answers. Guillaud (2010: 15) emphasises support from developed countries and implementation in developing countries. Furthermore, Africa is not viewed as a case of failed development, according to Chabal and Deloz (Watson, 2007: 75). It can rather be seen as embracing modernity focusing on the economy and culture of the context. Robins refers to “indigenous modernities” as the way that development packages are resisted, embraced, reshaped or accommodated regarding content and context (Watson, 2007: 75).

> *However, due to the resistance from consumers and the companies providing the service, it is very difficult to imagine that the demand for sustainable housing and better services can be satisfied with alternative clean technologies. The self-help tradition of poor families does not guarantee the use of these technologies, because they tend to copy medium and high-class construction concepts with a misunderstood concept of progress and modernity* (Du Plessis, 2002: 30).

Local experience has proved the allure to modern, environmentally unfriendly building materials. Furthermore, the relationship between landscape and place (Swanwick, 2009: 1) is much debated and results in a wide range of research in multiple disciplines on ‘place’ theory. This relationship is complex, since it goes beyond landscape and is also concerned with social and cultural dimensions (Wessels & Bosman, 2014). These cultural dimensions are stressed by the cultural

meaning of place(s). Dagmar Weston reminds us that significant architecture is the deep expression of a physical and cultural context that can sustain human activities in a living setting with a durable embodiment (Emmons *et al*., 2012: 5).

5.2.3 Early experimentation in earth construction

The thermal properties of earth construction that supports the use of earth and building material in southern Africa have been well documented (Fathy, 1973; Houben, & Guillaud, 1994; Kennedy *et al.,* 2002; McHenry, 1984; Seth & Seth, 1988; Ngowi, 2001). Besides the long vernacular traditions and heritage of earth, experimentation supports the usefulness of earth as building material in southern Africa.

In 1993 the thesis of Christian Roberg (1993), entitled *The use of soil-cement as a construction material* contributed to national research in earth construction, when he chose different soils from around Johannesburg and characterised their properties using soil science techniques (Morris & Booysen, 2000: 2). In 1996 the Unit for Earth Construction (UEC) was established under the guidance of CRATerre-ENSAG within the Department of Architecture at the University Free State.

The UEC was supported by the French Embassy in Pretoria to build capacity in the form of short courses for young architects and other building professionals. The activities of the UEC developed from small-scale community buildings with manual and semi-mechanized operational brickyards where small builders and students from the building sciences of the University of the Free State were trained in using earth construction techniques. These activities opened up the research field of the social aspects of acceptability that the UEC had addressed through training and promoting earth construction in southern Africa since 1990. Although the technical data supports the sensible use of earth as building material, prejudice continues today as reflected in the general low acceptability of earth construction techniques reflected by the SANPAD project (Steÿn, 2009).

5.2.4 Traditional view of a house and a home within a cultural landscape

According to Swanwick (2009: 1) it is useful to consider the interaction between land and landscape. Within this landscape we build houses to support living. Rapoport (1969: 46) describes the *house* as an institution and not just a structure that is created for a complex set of purposes. Housing projects in developing countries are often unsuccessful for many reasons. According to Holm (2005: 20) the home owners cannot afford to pay the high service cost, heating and cooling, maintenance and commuting. Furthermore, South African housing delivery models do not accommodate input from the end-users before and after construction, resulting in no new information to guide improvements in future applications (Holm, 2005: 21). The cultural mismatch of the purpose of a *home* can be added to this. “Building a house is a cultural phenomenon; its form and organization are greatly influenced by the cultural milieu to which it belongs” (Rapoport, 1969: 46). This phenomenon is confirmed by other studies.

Stevenson’s (2006: 261) qualitative study explores the notion of wall construction materials with particular tacit rules that are shared by a community in the same context in Scotland. The findings suggest that geographic locations play a key role in people’s attitudes to materials. Stone was generally the choice of building material for the Scottish groups (reflecting prevalence in their locality) but not the case for the control group. For the study, significant gender differences were noted: men related more to the strength qualities of material, while women were more concerned with the social aspects of material (homeliness, warmth and comfort). It was concluded that an understanding of local knowledge (use of material) of context and local climate and topology must be handed down from person to person over time as it provides a sense of orientation through repetition, familiarity, experience and attachment (Stevenson, 2006: 262).

5.2.5 Challenges for social and low-cost housing

Chris Wickham hypothesises a peasant mode of production, where social and economic life is characterised by the absence or marginal presence of the state and/or aristocracies. For this type of peasant society, represented in large parts of

northern Europe and the Mediterranean regions, the accumulation of wealth and power was difficult for many centuries. Social relations and individual status depended on the reciprocity and support of other inhabitants, where surpluses were redistributed to relatives, friends and neighbours (Carocci, 2011: 388). The South African rural modes of production can seldom sustain contemporary life-styles.

Buttel (1987: 475) states that the major component of environmental attitudes and behaviour literature has been devoted to improving or evaluating policy programmes aimed at influencing environmentally related behaviours. The main conclusions were that economic motivations and incentives have less impact than "nonfinancial motives, effective communication and information, and the trustworthiness of information and sponsoring organizations" (Black *et al*., 1985; Herberlein & Warriner, 1983; Stern, 1986).

5.2.6 Difficulties for the government to perform

Fathy (1973: xii) reminds the architect, planner, sociologist and anthropologist, and local, national and international officials concerned with housing, that they all have the welfare of the poor in trust. In South Africa, the housing backlog escalates and the rural poor is still worse off that the urban poor.

The South African Members of Parliament are concerned about the country's 2012/13 housing budget, with Limpopo and the Eastern Cape as the worst performers. In March 2013 parliament's Human Settlements Portfolio Committee was told that R886 million (or 4% of the total budget of R25 billion for human settlement) would remain unspent by the end of the 2012/13 financial year (SALGRC, 2013a: 27). This creates a growing concern about housing delivery.

The expectations and experiences of upward social mobility as a result of socio-economic development can contribute to social and political stability (Zhiming, 2013: 36). South Africa has experienced political stability since 1994, and the majority of the growing poor population have continued to support the ANC ruling government that hold relatively high political trust. The South African welfare state continues to

support the poorer rural areas, but struggles to deliver on their promises and infrastructure allocations.

Under-spending of the Rural Household Infrastructure Grant (RHIG) was created to provide toilets for the estimated 2.2 million rural and semi-urban households without access to basic sanitation. In 2012, the Human Settlement Minister, Tokyo Sexwale, blamed contracted service providers for the failure (SALGRC, 2013a: 28) while the South African White Paper on Local Government recognises the importance of good household infrastructure and services as an essential component of social and economic development (Marais, 2000: 5). The state tried to correct this by investigating the Housing Finance Policy. The Financial and Fiscal Commission (FFC) of South Africa recently reported an alternative housing finance policy that calls for a review of the current unsustainable system of providing a complete and free housing product. This document – *Exploring Alternative Finance and Policy Options for Effective and Sustainable Delivery of Housing in South Africa* – is based on two rounds of public hearings held by the Financial and Fiscal Commission. Their concerns include the rising housing backlogs, poor programme delivery and rising expenditure, reliance on state assistance for housing, inadequate influence of non-state housing interventions and perceptions of a lack of financial sustainability in housing delivery (SALGRC, 2013c: 24).

5.2.7 Loss of self-help building in South Africa

The architect should guide an essentially self-reliant or self-help project (Fathy, 1973; Steÿn, 2009). According to Guillaud (2010: 21) the building industry teaching and research units should transfer more technical assistance activities between public and private organisations, NGOs and local communities through working agreements with municipalities and local authorities. UNESCO's earth chair partners in Latin America (Argentina, Mexico, Colombia, Brazil, and Uruguay) and Africa (Nigeria, South Africa, Angola) have incorporated professional programmes for students in conjunction with local communities (South Africa, Angola, Mali, Burkina Faso and others) that lead to the achievement of innovative social housing prototypes. These partnerships and concrete results have a strong positive

educational impact on students and the technical teams of partner organisations, and the inhabitants themselves. These activities stimulate the development of various types of participatory self-building practices (Guillaud, 2010: 21).

According to Turner (1988) it is possible for people with access to available resources and who are allowed to use it, to build, together with community based organisations, up to five times more than their government with the same funds and to a similar or better standard. Guillaud (2010: 15) claims that there is a widening gap between professional industry and the self-help construction process. Often, the formal sector does not take the technical and economic potential of local materials, including earth, into account. In South Africa, self-help housing is seen as something of the past and not a process supported by the state.

According to Noero (2002: 1) there is a perception that the idea of self-help housing was co-opted by the Apartheid government and reconfigured as sweat equity work programmes as it occurred in many developing countries. Communities resisted this perceived exploitation. In addition, support from the government is viewed as mandatory as part of the process of income re-distribution promised to redress past inequalities.

Housing allocation in South Africa does not have much to do with individual housing needs. It is more associated with access to power and resources. The housing delivery programme is perceived as corrupt. Research shows that these perceptions are related to real corruption, and a lack of information and explanation of technical processes and systems. Politicians and officials created the impression of a rational process of housing allocation, and prioritise those in greatest need to be accommodated first (SALGRC, 2013b: 4). Noero (2002: 3) views the mismatch between intentions to give support and results of community development as alarmingly high. But to dismiss the contribution of professionals would create an equally unworkable situation. If the presented professional knowledge was owned by local communities, concerned matters can be controlled by themselves. The fact that this does not happen demonstrates a need for external assistance.

Furthermore, intended housing beneficiaries in South Africa are frustrated due to a lack of transparency that creates an impression of corruption. This leads to public protest and unlawful occupation of public-funded constructed houses (SALGRC, 2013b: 4). If a "growing sense of anomie pervades" (Chrislip & Larson, 1994: 3) citizens lose interest in public life or purpose. To have a civic duty or desire to be involved in public matters is not the case in South Africa, where citizens are angry and frustrated by politics. The government struggles to respond to the concerns and needs of individuals, neighbourhoods, and communities. According to Chrislip and Larson (1994: 3), citizens want to be engaged in public life, where their views can be heard and considered and where their involvement defines the public interest.

The welfare state is based on accommodating extensive upward social mobility by securing opportunities while reconciling the continuing power of the middle classes through patronage or indirectly via education (Iannelli & Paterson, 2006: 540). Alternatively, the tri-dimensionality of every social structure, defined by Walter Garrison Runcimann as 1) economic power, 2) ideological power (or social prestige) and 3) coercive power, should be considered (Carocci, 2011: 370).

5.2.8 Self-help housing, job creation and earth construction

> *Strengths (of sustainable settlements) are labor intensive construction methods, locally sourced materials and highly structured, internally networked and mutually supportive communities* (Du Plessis, 2002: 29).

The need for employment is greater than the need for proper housing. "In poor communities … most people's available energy is spent on survival – this is fact!" (Noero, 2002: 2). Using earth construction for housing projects creates more job opportunities than in the case of using conventional building materials (Bosman, 2003, 2006; Steÿn, 2009). Earth construction could offer great opportunities for improved social housing. This becomes even clearer when the costs of earth construction are compared to the costs involved in the transportation of raw materials, such as cement blocks and fired bricks (Jooste-Smit, 1998; Steÿn, 2009).

> *In the developing countries, construction in earth appears to be an effective means of building homes in the short term so*

> *that the greatest number of people can be housed, while at the same time encouraging the use of local resources for building materials, the training of building technicians and craftsmen, and the creation of jobs* (Houben & Guillaud, 1994: 7).

Since the 1980s, economic development supported upward social mobility, mainly in South African urban areas. The historically delayed social mobility resulted in a very strong upward mobile and progressive Black urban middle class. But this is still not the case in the poverty-stricken rural areas of South Africa. Already four decades ago, Fathy (1973: xv) appealed for a new attitude to rural rehabilitation. There are social and cultural questions of great complexity and delicacy and there is the economic question. There is the question of the project's relation with the government and so on. Each has a bearing on the other and the total picture would be distorted by any omission.

According to Marais (2000: 5), improving social housing will be ineffective in changing the quality of life if the infrastructure, services and local circumstances are not addressed. These aspects are regarded as indicators of local economic development. Basic services, such as running water, sanitation, local roads, storm water drainage, refuse collection and electricity are essential to enable people to support family life, find employment, develop their skills or establish their own small business (RSA, 1998).

The Agenda 21 for Sustainable Construction in Developing Countries (Du Plessis, 2002: 28) states that informal housing represents the biggest producer of housing stock in most developing countries. The majority is illegal and built through self-help construction processes.

The potential of the construction industry, small, medium micro-enterprises (SMME) and small brickyards for creating jobs, could play an important role in local economic development – and even more so if earth construction techniques, such as the use of stabilised adobe and compressed earth blocks (CEB), were employed more often

(Jooste-Smit, 1998; Steÿn, 2009). The production of earth-building components such as CEBs is a labour-intensive process (Houben & Guillaud, 1994; Fontaine & Anger, 2009; Guillaud, 2010). Small and medium-sized brickyard plants could be established all over South Africa, providing work to thousands of people. In South Africa, many small groups of entrepreneurs in poor communities have started to produce earth blocks in accordance with traditional skills, with material that has been upgraded. In Kuruman in the Northern Cape, many local privately owned small brickyards produce cement stabilised adobe blocks and make a living from selling these to local home builders. With proper training programmes, these entrepreneurs could produce a bigger variety of blocks of a high quality, which would be more acceptable to buyers. With minimal means at their disposal, and hard work, many brickyards have managed to run small businesses successfully (Bosman, 2003: 22-23, Bosman, 2006: 300-305; Jooste-Smit, 1998: 73).

Diedericks (2001: 50) highlights support for local experience that has proved itself. He believes that a person cannot simply be trained to become an entrepreneur or businessman or -woman by means of training or financial support, if no interest or initiative has been shown by that person in the past. Existing small businesses that have been running successfully for a time should be supported, either financially or through training. It is argued that local brick-makers, as a potential source of further local economic development, should be supported (Steÿn, 2009).

5.3 Process of change

Van den Berg (1974) defines his understanding of the theory of change as “metabletica”. He describes change as a process that people will first reject, then wonder about and later accept. New ideas will only bloom if the time for it is ripe, since it needs philosophical acceptance and appropriate technology to support its development. Concepts such as development and sustainability had to go through the same process.

Rapoport (1977: 40) refers to the value filters (illustrated in Chapter 4) that people look through at life. These filters can be parents and upbringing, culture and religion

that have a worldview. These filters are sensitive and are influenced by the media. The modern man's vision is manipulated and formed from the cradle to the grave by the media (especially television) and can eventually erode his judgment (Nijkamp, 1980; Kelemen, 2006). However, Zimbardo and Leippe (1991: 369) state that the media can contribute. A combined effort from media, government and educational systems must synchronize a more effective persuasion. Raising consciousness must begin in childhood, while the media should, for example, not only focus on 'green' events but on daily environmental problems and solutions (Zimbardo & Leippe, 1991: 369). Silverman (1979: 506) concludes that people can restore consistency when their attitude, behaviour and environment are inconsistent.

Goudappel (1985: 180), furthermore, supports that all thinking is influenced by values, as supported by his urbanisation concepts. He differentiates between three levels of reflection. This can help to explain the connection between values, theory and practice. Thought should be given to connections at the:

- ideo-structure level, dealing with human activities (directed by values and ideals);
- super-structure level, dealing with theory and organisational thinking; and
- infra-structure level, dealing with the physical appearance of phenomena and things.

Klineberg (1961: 457) reminds us that dealing with these connections are difficult for the individual to break through. He defines four main reasons for customary conformity. The first phenomenon is the power and importance of the group whose ideas tend to be accepted. The second reason is the fact that the individual often knows no other customs than those of his/her own community (relative small isolated groups) and is unfamiliar with any alternative.

The third aspect is that the individual, who does not practice the customary behaviour related to the social and economic life (Steÿn, 2009) of the group, will soon be regarded as outside the system of duties upon which life in the community may depend. Finally, there may be punishment for transgression. In small communities it takes the form of ridicule.

> *These four factors together make it possible to understand why individuals conform, without the necessity of assuming that custom in itself has power and authority… even the leader or the genius must in a sense 'follow' the group* (Klineberg, 1961: 458).

5.4 Conclusion

The second paradigm shift explained the global environmental concerns and the efforts made by the built environment to reduce its negative environmental impact. The contributions that contemporary earth construction could make was realised by the late 1970s. This chapter presented the acceptability problems that earth construction, as discipline, faces in developing countries. The South African contributions in experimentation with contemporary earth construction from a scientific perspective were discussed. The combined efforts of local and international organisations continue to support earth construction as a developing discipline. Despite the low status of earth construction, it has a place in social housing delivery in South African.

Earth construction, as sustainable development, can create job opportunities, while accommodating individual housing needs. The methodology followed for obtaining the influencing factors associated with the acceptability of traditional earth construction, is presented in Chapter 6. These factors should be considered if earth construction is to be promoted for contemporary housing application in central arid parts of South Africa.

CHAPTER 6
RESEARCH METHODOLOGY

6.1 Introduction

This chapter reintroduces the main research questions and presents the background to the SANPAD-project that produced the data for this study. The research method for the SANPAD project as well as the emphasis placed in this study is explained. The aim of the SANPAD project was to change the perceptions of earth construction with interventions. This study draws on the data of one of three phases of the original study.

The research questions in this study explain the empirical evidence of the factors that affect or influence the acceptability of traditional un-stabilised earth construction. The research questions investigate the influence of place (location and area) and the lack of basic services (running water, electricity and toilet with sewerage system) on the acceptability of the local earth constructed techniques. Research question 3 investigates if personal characteristics influence the acceptability of earth construction.

The following research questions guided the investigation:

Research question 1: *Are housing characteristics associated with the acceptability of earth constructed buildings?*

Research question 2: *Are contextual characteristics of the built environment associated with the acceptability of earth constructed houses?*

Research question 3: *Are personal and household characteristics associated with the housing and the contextual characteristics, and the acceptability of earth constructed houses?*

6.2 Background of the SANPAD study

This study is based on the outcome of a research project entitled: *A South African Building Renaissance - Acceptability of high quality, earth constructed, public and private buildings to support sustainable local economic development*. The purpose of the South Africa-Netherlands Research Programme on Alternatives in Development (SANPAD) is to build research capacity and disseminate PhD students. The project leader was Prof. J.J Steÿn and the two senior researchers enrolled for their PhD studies during the implementation of the fieldwork, which was part of the dissemination of the project. This study was conducted from 2004 to 2009 at the University of the Free State (UFS) in South Africa in collaboration with The Technische Universiteit Eindhoven (TU/e) in The Netherlands. The TUe team consisted of Wolf Schijns, Kees Dovendans, and Annelies van Bronswijk as senior researchers and Master students Michiel van der Velde (field work assistant) and Tamara Dercksen (data analysis) who each visited South Africa for three months. Both teams visited different areas in the Free State Province, Northern Cape Province and the North West Province, in order to identify possible areas to survey. Part of the completion of this project was that Petria Smit and Gerhard Bosman would be assisted to complete PhD theses from the data collected.

6.3 Research design of the broader SANPAD Project

The first phase comprised a literature review on the themes of the current perceptions regarding the acceptability of earth construction; measuring the extent to which earth construction is used globally at present; and ways in which earth construction could help to sustain local economic development. The research proposal was drawn up by the UFS team who involved the TUe team. This resulted in a workshop for the finalisation of the proposal at the TUe in November 2003, after which the grant was officially awarded to the two teams.

The second phase comprised the mobilisation and inception phase, during which the study was outlined and developed. During this phase, the possibility of an initial survey in different areas in two provinces was explored. An attempt was made to

determine the target areas where the survey and in-depth research could take place. Ideal target areas would comprise those inhabited by communities in which earth-building skills are still applied, and where earth is valued as a permanent building material. In collaboration with the Dutch partners, 20 towns in the Free State and Northern Cape were visited, from Philippolis in the southern Free State to Harrismith in the north, and as far west as Kuruman in the Northern Cape. Nine target locations were selected for surveys (see Table 6.1 and Figure 6.1):

Table 6.1 Towns and settlements visited and selected (Steÿn, 2009: 61)

Towns and settlements visited.	Towns and settlements selected for surveys.
• Philippolis in the southern Free State • Trompsburg • Edenburg • Botshabelo, near Bloemfontein • Thaba Nchu, near Bloemfontein • Bulfontein, near Thaba Nchu • Pampierstad, near Taung • Manokwane, near Taung • Jan Kempdorp • Christiana • Hertzogville • Dealesville • Bankhara Budulong, near Kuruman • Mapoteng, near Kuruman • Barkley West • Fouriesburg • Ficksburg • Bethlehem • Magolokweng, near Harrismith • Tsiame A and B, near Harrismith	• Botshabelo • Thaba Nchu • Bulfontein • Pampierstad • Manokwane • Bankhara Budulong • Mapoteng • Magolokweng • Tsiame B

After these visits, a set of criteria was drawn up, in order to identify the survey areas (Steÿn, 2009: 61). The towns and settlements selected met the following criteria:

- Earth construction was widely used as a building material in the area.
- The locations included a mix of both urban and rural areas.
- The locations included a mix of both formal and informal areas.
- The locations were within a four-hour drive from Bloemfontein.

These areas were classified into formal and informal areas, as well as urban and rural areas. Formal urban areas are townships that were planned before settlement took place. These areas may or may not have all the necessary essential services such as water, electricity and a sewerage system. An informal urban area is established when settlement occurred before any planning was implemented. These areas may, or may not have any or all services. The difference between urban and rural areas is that in rural areas, the land belongs to the tribe and is subject to the allocation of land by the chief.

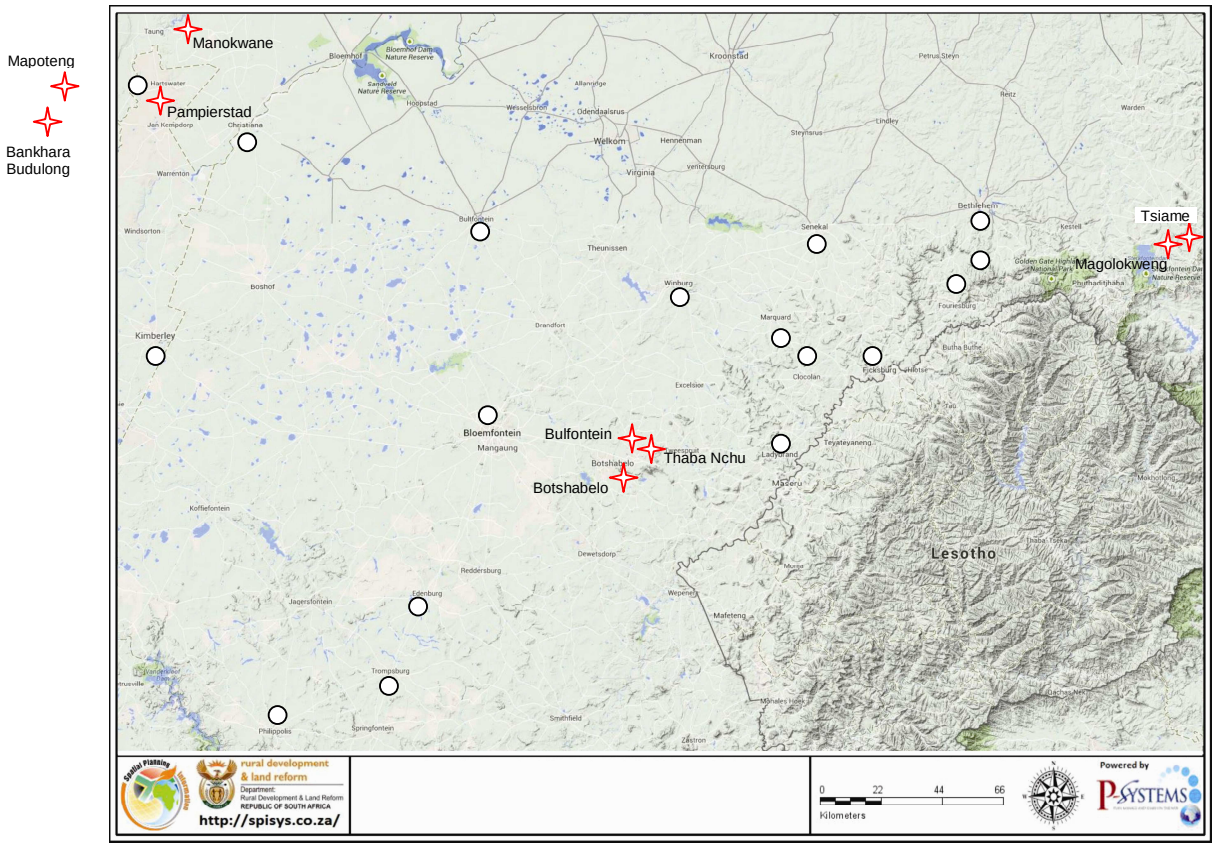

Figure 6.1 Towns and settlement visited (circles) and selected (stars) for the survey (Rural Development and Land Reform, 2014)

The term ‘adobe’ is a cultural hybrid, believed to be Egyptian for brick, but is the Arabic word ‘at-tob’ or ‘al-tob’ meaning sun-dried brick (Seth & Seth, 1988: 11). The term ‘adobar’, meaning ‘daub’, ‘plaster’ or ‘knead’ was introduced to Spain by the Moors. Today, the term ‘adobe’ is used to describe the buildings, bricks and mud-clay (Seth & Seth, 1988: 11). Different earth building techniques in the different

areas that were included in this study – globally well-known and used – are defined under the term *earth construction*, and include the following different construction typologies:

- load-bearing *adobe* (sundried mud or earth or clay mix blocks or bricks) stabilised with animal dung or other natural fibres (see Figure 6.2) or un-stabilised;
- tectonic in-fill *wattle and daub* consisting of a timber frame that carries the roof load with a lattice weave with laths or reeds with infill of un-stabilised earth (see Figure 6.3) or clay mix with or without animal dung or other natural fibres to stabilise the clay; and
- load-bearing sod walls that consist of a plastic clay soil dug out on site (see Figure 6.4), not moulded and include organic material (grasses and roots).

Figure 6.2 Adobe (traditional un-stablised sun-dried mud bricks) in Botshabelo

Figure 6.3 Wattle and daub (timber and straw clay) in Makgolokweng

Figure 6.4 Sods in Tshiame

The research methods of the thesis are based on qualitative ratings in the form of a household survey. In 1932, Renis Likert proposed a method of summated ratings which was subsequently widely adopted. Typically, subjects are asked to respond to each item in terms of a five-point scale, defined by the labels “strongly agree, agree, neutral, disagree and strongly disagree”. The Likert scaling is a useful scale that represents the degree to which a person is favourable or unfavourable with respect to the attitude object. In architectural synthesis, these categories naturally overlap while investigating the dominant characteristics of perception and the architectural experiential consequences (Holl, *et al.* 2006: 43).

6.4 Data collection and sampling strategies

The third phase involved the design and planning of the survey. The questionnaire was formulated in three languages: Afrikaans, English and Sesotho. Questions in the survey referred to demographics, income, present housing conditions and services available. Open-ended questions relating to preferences in respect of building materials and earth construction were also included. The questionnaire was tested in the field before it was finalised.

The fourth phase involved the survey that was conducted from 12 June to 1 July 2004 with the help of 12 master's students, the study leader, the two senior researchers and the visiting Dutch assistant.

As most of the locations were internally and individually homogeneous (in terms of the variables or comparative characteristics being studied), it was decided that certain neighbourhoods were selected through a spatial cluster sampling method in the different townships or settlements in the nine study locations (Steÿn, 2009: 61-62). The selection certain areas were based on their comparative characteristics and representation. In each of these locations, the houses were counted and identified on a map (in cases where maps were available; for some of the rural areas, no maps or aerial photographs were available).

The sample size for each of the areas was calculated according to Stoker's (1981: 13) method, as follows:

$$\sqrt{(N \div 20)} \times 20$$

With N as the stratum size, it therefore gave the number of houses for the selected areas that were calculated to give as sample size.

Table 6.2 The sample size of houses surveyed in different areas.

Location	Area Type	Sample size
Botshabelo	Informal urban (Block W) & formal urban (Block K)	390 houses
Thaba Nchu	Informal urban	221 houses
Bulfontein:	Formal urban	186 houses
Bankhara Bodolong	Formal and informal urban	231 houses
Tshiame B.	Formal urban	72 houses
Makgolokweng	Informal rural	130 houses
Manokwane	Informal rural	91 houses
Pampierstad	Formal urban	313 houses
Mapoteng	Informal rural	165 houses

A distinction was drawn in all areas between urban formal areas (those with water, sewerage, electricity and site number), urban informal areas (those without services and site number) and rural informal areas (bigger sites with site numbers in areas

governed by traditional chiefs (see Table 6.2). These areas were homogeneous; therefore, every fourth house was selected for the purpose of the survey. The students were each given a map of their specific part of the survey area if available. The informal area types tended not to have maps. If nobody was present in a particular house that was to be surveyed, the student had to go to the previous house or the next house on the map; but the next house to be visited thereafter, had to be determined according to the original house. Completed questionnaires were periodically collected by the research team, who then proceeded with the verifying process. One student from the group was identified to check or control information in completed questionnaires. Questionnaires were collected from each member of the surveying team, in order to be checked.

As the areas were approximately the same in respect of their socio-economic characteristics, it was decided that a systematic sample would be used, rather than a stratified random sample, as maps for some of the areas were not available.

Subsequently, the collection of data from the different sampling areas in terms of the different households was done (see Appendix 1 – Questionnaire A). Students speaking all three of the stated languages were trained to complete the questionnaire and the survey was then conducted under the supervision of the project leaders. For quality control, 10% of all questionnaires were checked, and the coding and data-processing were conducted twice. The processed data results were compared and checked in respect of each questionnaire, and adjusted where necessary.

During the fifth phase the questionnaires were codified by the research team and computerised by the Information and Communication Services department of the UFS. The data set was compiled under the supervision of Kate Smit. As a control measure, the questionnaires were codified a second time.

During phases six to eight, two interventions and a follow-up survey were conducted in the research areas. These phases do not have a direct link to the thesis and are, therefore, not discussed in detail. Only the results obtained from the first

questionnaire were used as a re-analysis for this thesis. The thesis formulated a new set of research questions, a new literature review and re-analysis and discussion of the first of two data sets collected for the SANPAD project.

6.5 Research ethics

The SANPAD project was conducted before any ethical protocol conditions were set for social survey studies formally established at the UFS. The protocol was not formally approved by any committee at the UFS. The project, however, made provision for many ethical good practice conditions. The TUe team controlled the research ethics of the project methodology.

During the project planning phase, the research team contacted and established an agreement with the ward councillor in the urban areas and the paramount chiefs in the rural areas. These contact persons informed the public of the household survey to be conducted in the up-coming months and that the purpose of the project was to gather information about house building materials in these areas. No expectations were created for any change to the respondent's current housing situation or that service provision was to be improved or upgraded. During the survey, the plot or stand numbers of the houses were recorded on the survey forms in order to improve the accuracy of the information.

The questionnaires were coded by the same group of students trained for the survey interviews. The data was processed in a way that the identities of respondents could not be traced and the profile of the respondents who provided the information was limited to their position in the household and their gender.

6.6 Main results of the SANPAD study

The variables within the questionnaire were grouped according to the independent variables, the dependent variables and the control variables. Synonyms for control variables are ‘mediating’ or ‘intermediary’ variables. For example, the statistical association between income and longevity can be explained as such: money will not help to make one live longer; therefore, other variables control or mediate the relationship between money and a long life. However, it is possible for people with a high income to have better medical care than those with a lower income, therefore, medical care can be an intervening variable that mediates the relationship between income and longevity. The relationship between income and medical care can be measured as well as the relationship between income and longevity.

The independent variables are discussed. These explain the relationship or provide the inferential link between other variables. This is followed by a discussion of the dependent variables. The control variable measures (see Research question 3) if there are any other relationships that influence the relationship between the dependent and the independent variables (acceptability parameters).

Correlation methods can be used to measure or investigate events or relationships that cannot be manipulated. The measurement of the relationship between two variables is their correlation, which can be either positive or negative. The relationship can be plotted on the x and y scales that represent two sets of characteristics expressed as a decimal number called r. An r of +1.00 indicates a perfectly positive correlation and an r of -1.00 indicates a perfectly negative correlation. If r is 0.00, there is no relationship between the variables. Correlation coefficients near 0.80 are considered very high and indicate a high degree of relationship (Silverman, 1979: 6-12).

Table 6.3 Different variables used in the analysis.

Independent variables	Dependent variables	Control variables
Housing characteristics (Research question 1) ▪ Tenure ▪ House size ▪ Services ▪ House wall type ▪ House roof type ▪ House age ▪ Previous house ▪ Proposed price/material (open ended) ▪ Housing responsibility ▪ Housing priority ▪ RDP housing opinion (open ended) **Contextual characteristics (Research question 2)** ▪ Location ▪ Area type of settlements	**Preference characteristics (Research question 1)** ▪ Wall type one preference (open ended) ▪ Wall type two preferences (open ended) ▪ Material properties (open ended) **Acceptability Characteristics (Research questions 1, 2 and 3)** ▪ Adobe quality ▪ Adobe problems (open ended) ▪ Adobe usefulness (open ended)	**Personal characteristics (Research question 3)** ▪ Respondents' background and gender ▪ Home language **Household characteristics (Research question 3)** ▪ Household size ▪ Income

The next sections of this chapter are structured around the following variable types: independent, dependent and control. Table 6.3 provides a summary of the different variables, their characteristics and the questions related to each. Only the result, which might give a better understanding if the characteristics of the research location, is shown.

6.6.1 Independent variables

6.6.1.1 Architectural characteristics

6.6.1.1.1 Tenure

The houses occupied by the respondents are owned by the family; in some cases these houses were built by the owners themselves, and some houses were built by the government as part of the RDP programme.

Table 6.4 The ownership of the house in all areas

		Frequency	Percentage
Valid	Owned by family	1 731	97.3
	Rented	30	1.7
	Other	18	1.0
	No answer	11	
	Total	1 790	100

6.6.1.1.2 Services

The services surveyed were water provision, electricity and sewerage facilities. Some houses have flushing toilets and running water. Running water was provided in 8.9% of the houses (Table 6.5), electricity in 65.6% of the houses (Table 6.6) and 6.7% of the houses had a water born flush toilet connected to a sewerage system (Table 6.7).

Table 6.5 Availability of running water

Availability of running water		Frequency	Percentage
Valid	Running water in the house	157	8.9
	Tap on lot	490	27.7
	Tap in the street	660	37.4
	None	460	26
	No answer	23	
	Total	1 790	100

Table 6.6 Availability of electricity

Availability of electricity		Frequency	Percentage
Valid	Electrical connection	1 125	63.6
	Other	40	2.3
	None	605	34.2
	No answer	20	
	Total	1 770	100

Table 6.7 Availability of toilet facilities

Availability of toilet facilities		Frequency	Percentage
Valid	Flushing toilet connected to drain	120	6.7
	Flushing toilet with tank	31	1.7
	Pit-latrine	897	50.3
	Other	157	8.8
	None	547	30.7
	Bucket	30	1.7
	No answer	8	
	Total	1 782	100

6.6.1.1.3 House wall type

Several different questions were asked about the wall type of the respondent's house (see Table 6.8); if it was made of earth, where did it come from; if they built it themselves, who taught them how to build it; what type of earth techniques was used and who made it. The 62.8% of respondents who lived in earth houses, built it themselves (Table 6.9). It shows that these communities still have basic earth constructed skills.

Table 6.8 Current wall type of house

Wall type		Frequency	Percent
Valid	earth walls	425	23.7
	brick walls	280	15.6
	cement block walls	330	18.4
	zinc walls	600	33.5
	stabised abode	63	3.5
	zinc and earth walls	49	2.7
	sinc and brick walls	28	1.6
	earth and cement block walls	2	.1
	Total	1777	99.3
	No answer	13	.7
Total		1790	100.0

Table 6.9 Builder of the current earth constructed house

Current earth constructed house		Frequency	Percentage
Valid	self	263	62.8
	family/friends	71	16.9
	hired someone	63	15.0
	previous owners	22	5.3
	Total	419	100

6.6.1.1.4 Past exposure to earth constructed houses

Previous exposure to living in an earth house was established by asking if the respondents had lived in an adobe house before living in their current house (see Table 6.10).

Table 6.10 Past exposure to earth constructed houses

Ever lived in an earth house before		Frequency	Percentage
	yes	1 044	58.5
	no	725	40.6
	don't know	15	.8
	No answer	6	
	Total	1 784	100

6.6.1.1.5 Housing responsibility

Respondents were asked who they think should be responsible for building houses (Table 6.11). The majority of respondents build it themselves (82.8%). This indicates that people still take a lot of responsibility for building their own houses.

Table 6.11 Housing responsibility

Housing responsibility		Frequency	Percentage
	Government (RDP houses)	117	6.8
	Self-built	1 426	82.8
	Bought	71	4.1
	Inherited	49	2.8
	Other	58	3.4
	Don't know	1	.1
	No answer	68	
	Total	1 722	100

6.6.1.1.6 Housing priority

Respondents were asked to choose what they think are more important to have: a house, running water, lights and sewerage, a job or other (see Table 6.12).

Table 6.12 Housing priority

Housing priority		Frequency	Percent
	a house	436	24.4
	water, lights, sewerage	178	9.9
	a job	717	40.1
	other	453	25.3
	No answer	6	99.7
Total		1790	100.0

6.6.1.1.7 RDP housing opinion

The last question was open-ended and aimed to establish the respondents' opinion on RDP houses (see Table 6.13).

Table 6.13 RDP housing opinion

RDP housing opinion		Frequency	Percent
	helpfull for poor	320	17.9
	to small	189	10.6
	good/satisfied	822	45.9
	not satisfied	152	8.5
	should be built better	142	7.9
	it cracks	7	.4
	not safe	4	.2
	never seen	78	4.4
	other	7.6	4.2
	No answer	76	
	Total	1714	95.8

6.6.1.1.8 Contextual characteristics

The communities were categorised into three area types of settlements (see Table 6.14), in which nine different locations (individually homogenous) could be identified:

Area A consists of formal urban areas, such as townships, that were planned before settlement took place. These townships may, or may not, have all the services, such as water, electricity and/or a sewerage system.

Area B consists of informal urban areas, where settlement took place before any planning had been implemented. Such areas may have services in some cases, or they may not have any services at all.

Area C consists of rural areas, where the land belongs to the tribe and the local chief is in charge of the distribution thereof. These areas, too, may or may not have all the basic municipal services.

Table 6.14 Frequency by areas type investigated

Area type of settlement		Frequency	Percentage
	Formal Urban – A	1 075	60.1
	Informal Urban – B	329	18.4
	Rural - C	386	21.6
	Total	1 790	100

6.6.2 Dependent variables

6.6.2.1 Preference characteristics

6.6.2.1.1 Wall type one preference

The respondents were asked about their preference of wall material of their own house (see Table 6.15) and to state the reasons why (see Table 6.17). The question was: "*What building material would you prefer for the walls of your house?"* The majority of respondents (69.9%) preferred burnt bricks, but after photos of three building materials were show to them (see Table 6.16), the majority that preferred burn bricks, reduced to 59.5%.

Table 6.15 Preferred building material for construction of walls

Preferred building material		Frequency	Percentage
Valid	Burnt bricks	1 233	69.9
	Cement stabilised blocks/bricks	502	28.4
	Earth	29	1.6
	No answer	26	
	Total	1 790	100

6.6.2.1.2 Wall type preference for a possible new house

In a follow-up question the respondents were asked to choose a type of material they prefer most for building their own house walls. The question was: "*Choose the two materials you prefer most for building your walls".* Photos of cement stabilised compressed earth blocks (that look like cement blocks) and stabilised earth blocks were shown to respondents, together with sample blocks, for them to consider. The majority (59.8%) preferred burnt brick walls.

Table 6.16 Choice of wall material

Wall material	choice	
	[-]	[%]
Corrugated iron	118	6.6
Burnt bricks	**1 059**	**59.8**
Cement blocks	548	30.6
Adobe bocks	59	3.0
Wood	6	0.0
Wood and earth	-	-
Total	1790	100

According to Stevenson (2006: 260), people's perception of materials is an evaluation indicator. Gibson's theory of "affordance" has been developed by ecological psychologists that claim that "the value and meaning of things in the environment" are captured through the body's environmental interaction. If a surface is horizontal, it "affords" support and can be stood upon. Stone offers strength; wool offers comfort, softness and warmth. These affordances are neither purely objective

nor subjective; “they are both, and cut across the usual subject/object divide in evaluation” (Stevenson, 2006: 260).

The preferred material choices and perceived properties of respondents are important and will be linked to their current house wall material. This is discussed in the in Chapter 7 (see Table 7.28).

6.6.2.1.3 Material properties

An open-ended question was asked to establish what properties the respondents find important for three building materials for walls. The question was: “*What properties do you find important for a building material for walls?”* The random responses were then coded and grouped according to the most frequent perception of properties: 1) aesthetics, 2) strong and safe, 3) less problems, 4) better in the climate, 5) a quick building process, and 6) financial reasons (see Table 6.17).

Table 6.17 Perception of properties for wall materials

Perception	**Burnt bricks n=1446**		**Cement stabilised blocks/ bricks n=572**		**Earth n=31**	
	[-]	[%]	[-]	[%]	[-]	[%]
Aesthetics	475	32.9	**257**	**44.9**	**13**	**41.9**
Strong & safe	**730**	**50.6**	209	36.5	8	25.8
Fewer problems	61	4.2	12	2.2	-	-
Better in climate	84	5.8	11	1.8	5	16.1
Quick building process	8	0.5	18	3.2	1	3.3
Financial reasons	17	1.1	46	8.0	4	12.9
Other	71	4.9	19	3.3	-	-

The tacit knowledge of construction materials are formed over a lifetime from various sources, for example, bodily experiences, cultural normalisation and social experience according to need. These understandings of construction materials are often shared with the community of a particular place (Stevenson, 2006: 260). These

measured intentions can be in an open-ended or closed-ended format that indicates the available alternatives' range. This behavioural performance was applied to the different qualities respondents perceived building material should have. These qualities are again perceived as affordances of building materials.

According to Stevenson (2006: 260) the affordances of Gibson's theory of building materials are always there, waiting to be perceived, and do not change as the need of the observer changes. In order to draw on a wide variety of inherent affordances according to our needs, the 'warmth' of wood for intimacy of a home's interior can be contracted with the relative 'solidity' of protection from a door. The theory is that objects should look the way they are to provide the appropriate information for perception (Stevenson, 2006: 260).

6.6.2.2 Acceptability characteristics

The acceptability characteristics of earth construction were established by asking three questions.

6.6.2.2.1 Adobe quality

Respondents were questioned on the average quality of traditional adobe blocks (Table 6.18) on a five-point Likert scale (very poor, poor, neutral, good and very good). The question was: "*What do you think the average quality of walls made from adobe blocks is ?"*

Table 6.18 Perceived quality of adobe

Quality of adobe		Frequency	Percentage
Valid	very poor	612	34.2
	poor	844	47.2
	neutral	155	8.7
	good	120	6.7
	very good	55	3.1
	Total	1 786	99.8
	No answer	4	.2
Total		1 790	100

The most frequent answer was ‘poor’ (47.2%; n=844), followed by ‘very poor’ (34.2%; n=612).

6.6.2.2.2 Adobe problems

Respondents were asked if they see any problems with the use of traditional adobe blocks (Table 6.19) and had to name the problems which were then grouped and coded. Regarding if they felt that the use of adobe was problematic, 86.6% (n=1546) of respondents agreed.

Table 6.19 Problems with adobe

Problems with adobe		Frequency	Percentage
Valid	no	239	13.4
	yes	1546	86.4
	Total	1 785	99.7
	No answer	5	.3
Total		1 790	100

6.6.2.2.3 Adobe usefulness

A follow-up question was asked to establish if the respondents think that using adobe is useful (see Table 6.20), of which 84.6% (n=1377) of respondents answered in the negative.

Table 6.20 Adobe usefulness

Adobe usefulness		Frequency	Percentage
Valid	no	1 377	76.9
	yes	251	14.0
	Total	1 628	90.9
	No answer	162	9.1
Total		1 790	100

6.6.3 Control variables

6.6.3.1 Personal characteristics

Individual level control variables were obtained regarding the respondents' profile background: head of the household, husband or wife, tenant, adult child, or other. The respondents' age and language spoken were established. The ethnical background of the respondents was established. The respondents consisted of 53.2% Setswana, 36.3% Sesotho, 4.3% isiXhosa and 6.1% who spoke other languages.

6.6.3.2 Household characteristics

On the household level the number of people that lived in the house (Table 6.21), were reported on.

Table 6.21 Household size

Household size (persons)		Frequency	Percentage
Valid	1	104	5.8
	2	206	11.5
	3	310	17.3
	4	329	18.4
	5	294	16.4
	6	229	12.8
	7	135	7.5
	8	84	4.7
	9	46	2.6
	10	21	1.2
	11	13	.7
	12	7	.4
	13	3	.2
	14	4	.2
	15	3	.2
	16	2	.1
	Total	1 790	100

The majority of households in these areas comprised between two and six people, accounting for 81.4% of the households interviewed.

6.6.3.2.1 Employment status

In 66.5% of the households the respondents had a permanent job, while in 28.9% of the cases one person in the household had a job. The monthly income of the household was stated (see Table 6.22).

Table 6.22 Monthly household income

Monthly household income		Frequency	Percentage
Valid	0 - 250 R	479	29.2
	251 - 500 R	152	9.3
	501 - 750 R	360	22.0
	751 - 1000 R	259	15.8
	1001 - 1250 R	124	7.6
	1251 - 1500 R	134	8.2
	1501 - 1750 R	50	3.1
	1751 - 2000 R	30	1.8
	2501 - 3000 R	17	1.0
	3001 - 5000 R	25	1.5
	> 5000 R	8	.5
	No answer	152	
	Total	1 638	100

In 76.3% of the households, the income generated per household amounts to between R0.00 and R1 000.00 per month (equal to €0–150, or $0–$100 per month); another 15.8% receives an income of R1 001.00–R1 500.00 per month. A total of 83.1% of the households live on an income of below R1 500.00 per month.

The house size regarding the number of rooms in each household were reported on. This varied from one to twenty rooms that consisted of single standing structures or more than three structures in some cases. The actual sizes of the houses were not surveyed.

6.7 Formulating variable into research questions

Analytical diagrams are used to show the hypothesised relationships between variables that can influence peoples' perceptions of earth constructed houses. In

Chapter 3 the influence of the unconscious, culture and personality, on attitude patterns was discussed (Silverman, 1979: 342-495). To understand the influence of society on the individual's behaviour, norms or standards set by the group (culture) in that social context, should be consider. The social norms are the results of the social relations shared within the group examined. These norms establish the ideal or expected behaviour, for example by building your house with the same available material as the neighbours do. Furthermore, Klineberg (1961: 356-357) states that together with the individual's behaviour, the individual's personal characteristics should be considered. He notes the expression of culture in behaviour on the one hand and the attitudes of the individual on the other hand, while he urged "personality as the process of enculturation and the result of a surrounding culture". This resulted in the principle meeting-ground of culture-and-personality.

Ajzen and Fishbein (1980: 97) state that to provide complete account of the relationship specified in the theory of reasoned action, it would be necessary to measure 1) outcome evaluations (normative beliefs) and motivations; 2) the attitude towards the behaviour; 3) the intention to perform the behaviour; and 4) the behaviour itself.

Firstly, the outcome evaluation (normative beliefs) and motivation in the locations are reflected in the predominant building material and skills available in the cultural context (see building culture discussion in Table 7.28 in Chapter 7). Secondly, the attitude towards the use of earth construction (the behaviour) are reflected in the data collected about the respondents' perceptions of earth constructed walls (see Table 6.17) and the perceptions of properties for three wall materials. Thirdly, the intention to perform the behaviour (use of earth construction for own new house) is reflected by the preferred building materials (see Table 6.15). Fourthly, the behaviour itself is reflected by the current wall building materials that the respondents live in (Table 6.8).

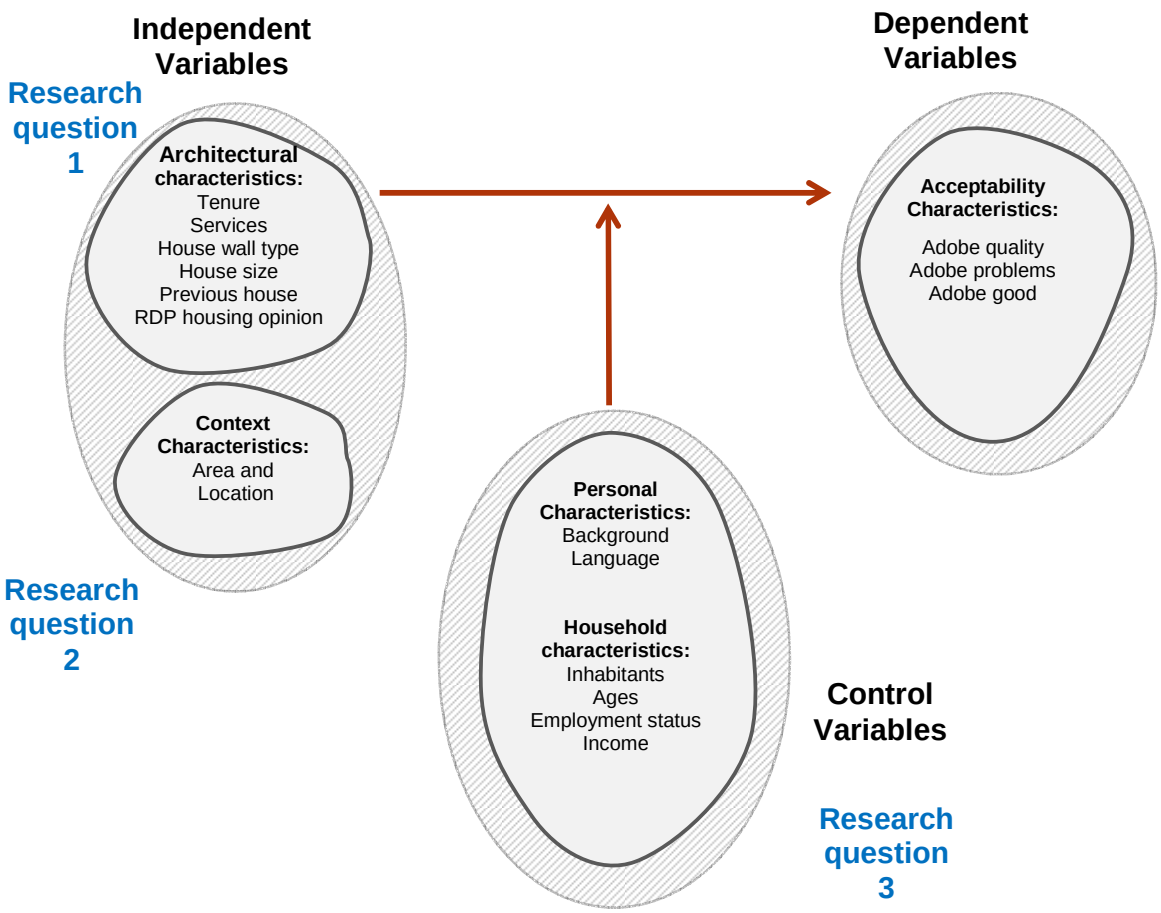

Figure 6.5 **Analytical diagram showing the hypothesized association between the architectural and contextual characteristics of the built environment with the personal and household characteristics on earth construction perceptions.**

Correlation analyses tested the associations between different factors that may affect the attitudes towards traditional earth constructed houses (Figure 6.5). **The main hypothesis states that if the influencing factors are understood then the negative attitudes towards earth constructed housing can be controlled with the advantages of earth construction.**

Research question 1 asks: *Are housing characteristics of housing associated with the acceptability of earth constructed buildings?*

The first and main research question suggests that there are influencing factors between the nature of housing and the acceptability of earth constructed buildings. These factors should be understood according to the first part of the main hypothesis if any change in the attitudes towards earth construction can be controlled. The building materials of existing houses and the preferred housing material were analysed, to establish if it influences the acceptability of traditional earth construction. Building materials of respondents' existing houses were classified into formal and informal building material and then tested for associations with the acceptability of earth constructed buildings. The presence of basic services in the form of running water, electricity and municipal sewerage systems connected to water flushing toilets were analysed to establish if these services can be associated with the acceptability of traditional earth constructed houses.

Research question 2 asks: *Are contextual characteristics of the built environment associated with the acceptability of earth constructed houses?*

The different locations are all in semi-arid parts of central South Africa (see Figure 6.1) that include a mix of both urban formal, urban informal and rural informal areas. This were analysed to understand to what extent geographic location (proximity of brick yards and hardware stores) and cultural context (building culture) are influencing factors to the acceptability of traditional earth construction.

A general observation regarding available hardware stores for building material and local brick yards (Figure 6.6) were done in five of the nine areas (visited by the author). The thesis study examined a smaller sample (n=1086) with specific reference to the building culture and wall building material in the residential context in the areas of:

- Botshabelo (n=383),
- Bulfontein (n=185),
- Bankhara Bodulong (n=228),
- Magolokweng (n=129) and
- Mapoteng (n=161).

Botshabelo and Bulfontein are characterised as formal and informal urban areas. Some hardware stores are located within a 5-10 km radius. There are also many local small-scale brick yards where burnt bricks can be purchased.

Bankhara Bodulong is a combination of formal and informal urban area types. Some hardware stores within a 15-25km radius and many local small-scale cement block yards were observed during the survey.

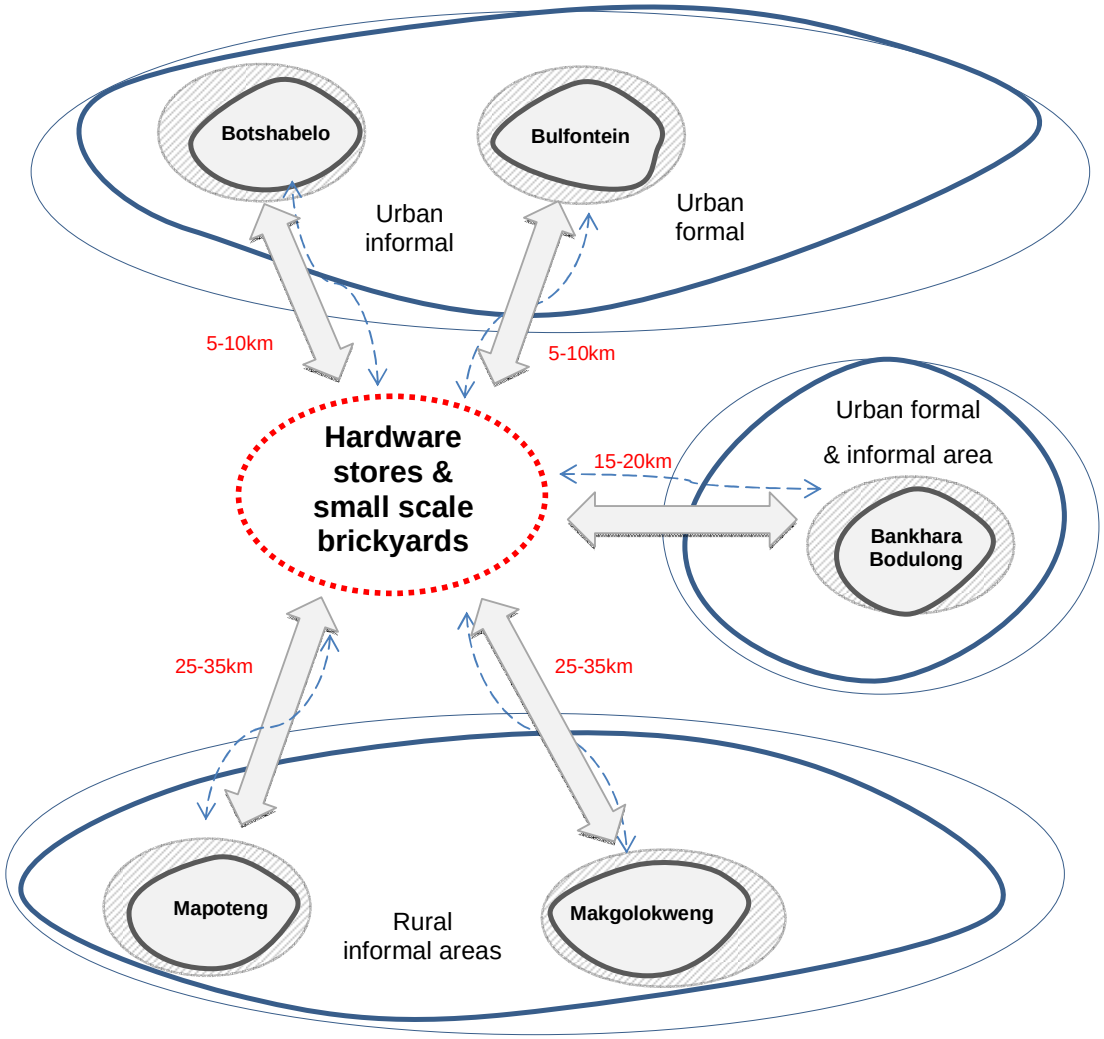

Figure 6.6 **Analytical diagram showing the hypothesized relationship of building culture that are influenced by proximity of available material from hardware stores and local brickyards.**

Makgolokweng is located in a rural area. There were no hardware stores within a 25-35 km radius and very few small-scale concrete block yards where wall building materials can be bought were observed during the survey.

Mapoteng is located in a rural area. It has some hardware stores within a 25-35 km radius and several small-scale concrete block yards where wall building materials can be purchased were observed during the survey.

The varying distances to brick yards, and hardware and building material stores have a meaningful relationship with the wall building choices of the residents.

Research question 3 asks**:** *Are personal and household characteristics associated with the housing and the contextual characteristics, and the acceptability of earth constructed buildings?*

The analysis investigated personal and domestic household characteristics together with the housing and contextual characteristics to predict (through regression analyses) the acceptability of earth constructed houses.

6.8 Statistical methods and significance

The means to describe the strength of the relationship among variables described by Ajzen and Fishbein (1980: 98) is known as the correlation coefficient, or simply correlation, represented by the letter r. This coefficient can take on values that range from -1 through 0 to +1. The more the correlation between two measures departs from 0 and approaches either -1 or +1, the stronger the relationship will be between the two measures in question. Where r=0, there is absolutely no relation between the two variables. Correlations greater than zero indicate that as the value of one variable increases, so too, does the value of the other. The negative correlation, in contrast, indicates that, as the value of one variable decreases, the value of the other decreases. A positive correlation would, for example, support the assumption that a person’s intention to visit Europe increases as his or her attitude toward this behaviour becomes more positive. The higher the correlation (the closer to +1) the

stronger is the relationship and the better a person's intention from his/her attitude can be predicted. Again the closer the correlation is to -1, the better the ability to predict (Schall, 2014).

The correlation would often indicate whether or not it is statistically significant. A correlation is significant when the observed relation between two variables is unlikely to be due to chance alone. A finding is considered statistically significant if its probability (possibility, or likelihood) (p) of occurrence by chance alone is less than 5 in 100 ($p<0.05$). The statistical significance (meaning or connotation) of a correlation coefficient depends not on its magnitude (the extent to which it deviates from zero in either a positive or negative direction) but also on the size of the sample on which it is based. For example, where a correlation of 0.20 or greater is statistically significant ($p<0.05$) in a sample of 100 respondents, for a sample of 30 the correlation would have to be at least 0.36 before it could be concluded that it was unlikely to be due to chance alone (Ajzen & Fishbein, 1980: 98-99). Schall (2014) agrees that the statistical significance also depends on the sample size and not only on the magnitude of the correlation coefficient.

Statistical significance does not necessarily imply a strong relationship. Although it is an arbitrary indication to term a correlation 'strong' or 'weak', Ajzen and Fishbein (1980: 97) suggest general guidelines: if a correlation around 0.30 is satisfactory and consistent with this practice, it would suggest that correlations below this level are usually of little practical value even if they are statistically significant. Correlations in the range of 0.30 to 0.50 may be considered of moderate magnitude, while correlations exceeding 0.50 indicate relative strong relationships between two variables.

6.9 Univariate assessment of association

All variables investigated are either categorical variables, or counts (numeric). The following statistical methods were used to investigate the association between a pair of variables.

In all cases, the households in the sample were cross-classified by the two variables in question, and the relevant two-way frequency table is presented. If both variables are ordinal (or numeric), the Kendall-tau coefficient was calculated to assess the correlation between the two variables in question. Furthermore, a test of the null-hypothesis of zero correlation was performed. The value of the relevant P-value in question is reported (Schall, 2014).

If the first variable was nominal, and the second variable ordinal (or numeric), a Mantel-Haenzel chi-square test (null-hypothesis of no difference in mean scores) was performed to assess the association between the two variables in question. The value of the relevant chi-square statistic, its degrees of freedom (df), and the P-value are reported (Schall, 2014).

If both variables are nominal, a Mantel-Haenzel chi-square test (null-hypothesis of no general association) was performed to assess the association between the two variables in question. The value of the chi-square statistic, its degrees of freedom (df), and the P-value are reported. Frequency tabulations for all variables (number of households and percentages of household per response category) are presented (Schall, 2014).

6.10 Conclusion

The potential importance of factors or *external variables* like personality characteristics, demographic variables, sex, age and social class are recognised but do not constitute an integral part of the *theory of reasoned action*. The external factors (variables) as an influence on behaviour are not necessarily related to any behaviour. Some external variables may bear a relation to the behaviour under investigation, while others may not, and even if a relationship is identified, it can change over time and change from one group to another.

CHAPTER 7
ACCEPTIBLITY OF EARTH CONSTRUCTED WALLS FOR HOUSES

7.1 Introduction

The influence of various variables or factors on the acceptability of earth construction was investigated. More specifically, in statistical terms, the association of various variables with the acceptability of earth construction was tested. Relevant correlations were calculated (univariate analysis) and regressions analyses performed (multi-variate analyses) and variables that were significantly associated with the acceptability of earth constructed walls for houses are discussed.

Some aspects of the findings were used for further statistical analysis by means of the Mantel-Haenzel chi-square statistic test to report on the statistical significant associations, degrees of freedom (df), and the P-values (see Chapter 6). The Kendall-tau coefficient was also used to assess the correlation between the variables defined in Research question 1 and Research question 2.

In all analyses the variables expressing preference qualities and acceptability of earth constructed houses were considered the dependent variables, while the set of contextual and housing characteristics was considered to comprise the independent variables. Various personal and household characteristics served as control variables to check for other associations that can predict acceptability in multi-variate analyses addressing Research question 3.

7.1.1 Objective of statistical analysis

In the first analysis, the association of a subset of the housing characteristics with the acceptability of earth constructed houses was investigated. This analysis indicates associated characteristics of houses (availability of services, formal and informal perceived qualities of the house) that are associated with the acceptability of earth constructed houses as discussed under Research question 1.

In a secondary analysis, the association of a subset of the above characteristics with some contextual characteristics (formal and informal urban and rural areas within different geographic locations) was assessed. Observations about the proximity of brickyards, available building materials and hardware stores (suppliers of basic building materials) in five of the nine locations (the only locations that were used for observations) are discussed as part of the analysis of current and preferred wall building materials, under Research question 2.

The next objective of the statistical analysis was to investigate the association between a set of personal and household characteristics (demographic type questions from respondents) and the perceived quality and the acceptability of earth constructed houses. This analysis indicates if the personal and household characteristics, together with the housing and contextual characteristics influence the acceptability of earth constructed houses as discussed under Research question 3.

7.2 Relationship of housing characteristics and acceptability

Research question 1: *Are housing characteristics associated with the acceptability of earth constructed buildings?*

7.2.1 Ownership

Question 10 of Survey 1 contained subsidiary questions, to gather information about different aspects of the respondents' houses. These aspects included the type of house building, the type of ownership and the size of the house. In 97.3% of cases, the houses occupied by the respondents are owned by the family. In 82.8% of the cases, these houses were built by the owners themselves. Only 6.8% of the houses surveyed were government built RDP houses. The RDP houses can be identified on the basis of a specific wall type and typology of design (Steÿn, 2009: 95).

Table 7.1 Association between housing characteristics and perceived quality and acceptability of earth constructed houses

Housing Characteristic	Quality/acceptability characteristic	Chi-square statistic	df	P-value
Ownership	Perceived quality	0.3604	2	0.8351
	Problems adobe	0.3636	2	0.8338
	Adobe good	2.3245	2	0.3128

Ownership had no significant association with the perceived quality or expectations of adobe (all p-values in Table 7.1 are higher than 0.05) Therefore, respondents in houses with different types of ownership do not differ significantly regarding their views on acceptability of earth constructed walls.

7.2.2 Services

The services surveyed were water provision, electricity and toilets with sewerage facilities. There were 6.7% of the houses surveyed that had flushing toilets. These houses may be RDP houses, along with the 8.9% of houses that have running water in the house.

Table 7.2 Association between available services characteristics with location of earth constructed houses

Context characteristic	Characteristic	Chi-square statistic	df	P-value
Location	Water available	391.9037	8	<0.0001
	Electrical available	568.3044	8	<0.0001
	Toilet with sewerage	247.9450	8	<0.0001
	All services	380.5586	8	<0.0001

All the locations are individually homogenous. These analyses indicate strong statistically significant relationships (see Table 7.2) between location and all types of services, since all the p-values are <0.05. Therefore, respondents in the same locations had a higher likelihood to have the same type of basic services available.

Table 7.3 Association between available services characteristics with area of earth constructed houses

Context characteristic	Characteristic	Kendall-tau	P-value
Area types	Water available	0.4709	<0.0001
	Electricity available	0.2942	<0.0001
	Toilet with sewerage	0.1732	<0.0001
	All services	0.3470	<0.0001

All the area types (urban formal, urban informal rural) are individually homogenous The analyses indicate weak to strong correlations and statistically significant relationships (see Table 7.3) between area types and all services. As could be expected, the availability of services in urban formal area was significantly better than in either urban informal or rural areas.

The values of the relevant Kendall-tau and the P-value suggest that the perceived quality (“perceived quality”, “adobe good”) of earth constructed houses was significantly negatively associated with the availability of services (negative values of the Kendall-tau coefficient), while, consistent with this trend, perceived problems with earth constructed houses (“problems adobe”) were generally positively correlated with the availability of services (negative of the Kendall-tau coefficient). Generally, the correlation coefficients are small (less than 0.1), but in some cases statistically significantly (see Table 7.4). The implications are that respondents living in houses with better services tend to be more negative about the acceptability of earth construction, since houses provided with good services are less likely to be adobe houses.

Table 7.4 Association between available services characteristics and perceived quality and acceptability of earth constructed houses

Services characteristic	Quality/acceptability characteristic	Kendall-tau	P-value
Water available	Perceived quality	-0.0554	0.0063
	Problems Adobe	0.0325	0.1434
	Adobe good	-0.0456	0.0394
Electricity available	Perceived quality	-0.0690	0.0022
	Problems Adobe	0.0647	0.0086
	Adobe good	-0.0327	0.1773
Toilet with sewerage	Perceived quality	-0.1103	<0.0001
	Problems Adobe	0.0124	0.5573
	Adobe good	-0.0556	0.0100
All services available	Perceived quality	-0.0859	<0.0001
	Problems Adobe	0.0364	0.0700
	Adobe good	-0.0506	0.0106

The values of the relevant Kendall-tau and the P-value suggest that perceived "problems with adobe" are in all cases positively associated with availability of services, but not significantly, except in the case of electricity services. The implications are that if the respondents' level of services improves, they become less content with adobe.

These analyses suggest that negative correlations that are associated with the availability of all services influence the acceptability of earth constructed houses negatively.

The data on the types of materials used for respondents' houses, and on the occupants' perceptions of their living environment, show that the occupants' socio-economic status ranges from poor to extremely poor. It is not surprising that basic services, such as running water, electricity and a flushing toilet inside the dwelling, could represent acceptable living standards. Most of the houses (63.6%) had electrical connections, 8.9% had running water and 6.7% had a flushing toilet inside the house. Services are considered as proxies for socio-economic level. Therefore,

the more services respondents have, the more they were negative towards traditional earth construction.

Table 7.5 Association between demographic characteristics and perceived quality and acceptability of earth constructed houses

Demographic characteristic	Quality/acceptability characteristic	Kendall-tau	P-value
Time in house	Perceived quality	0.0567	0.0023
	Problems Adobe	-0.0510	0.0112
	Adobe good	0.0643	0.0013
Past exposure to earth	Perceived quality	0.0197	0.3782
	Problems Adobe	0.0025	0.9165
	Adobe good	-0.0076	0.7502

There was a statistically significant association between the time persons lived in their houses and the perceived quality of adobe (Table 7.5). In particular, the positive Kendall-tau correlation coefficients for “perceived quality: and “adobe good” imply that the longer a person lived in their house, the more negative the perceived quality of above (since perceived quality was scored from high to low). Consistently with that, the longer a person lived in their house, the higher the perceived problems with adobe (since those were scores from “yes” to “no”). In contrast, past exposure to earth constructed houses was not significantly associated with perceived quality of adobe.

Table 7.6 Association between demographic characteristics and perceived quality and acceptability of earth constructed houses

Demographic characteristic	Quality/acceptability characteristic	Kendall-tau	P-value
RDP opinion	Perceived quality	0.1004	<.0001
	Problems Adobe	-0.0239	0.3441
	Adobe good	-0.0145	0.5555

The responses on “Opinion on RDP houses” were initially categorised into five groups, namely (1) Not satisfied; (2) Should be built better; (3) Too small; (4) Acceptable; (5) Good/satisfied. These options were aggregated into the binary categories (a) Not satisfied (1; 2; 3); (b) Satisfied (4; 5). Thus, a positive Kendall-tau

coefficient for the association between RDP opinion and perceived quality (perceived quality being scored from high to low) implies that higher satisfaction with RDP houses is associated with lower perceived quality of earth constructed houses. Table 7.6 shows that this association between RDP opinion and perceived quality was statistically significant; in contrast, the associations between RDP opinion and the responses to “problems adobe” and “adobe good” were not significant.

7.2.3 House wall type

Different survey questions were asked to establish aspects of the respondents’ earth constructed houses. Of the respondents (n = 419) who currently live in an earth constructed house, 62.8% built their own earth houses (see Table 6.9).

Table 7.7 Association between housing characteristics and perceived quality and acceptability of earth constructed houses

Characteristic	Quality/acceptability characteristic	Kendall-tau	P-value
Walls type	Perceived quality	0.0687	0.0021
Earth wall vs “other”	Problems Adobe	-0.0192	0.4305
	Adobe good	0.0394	0.1135

Wall type was categorised as “earth wall” versus “other type”. Thus a positive Kendall-tau coefficient for the association between wall type and perceived quality (being scored from high to low) implies that living in a house with earth walls is associated with higher perceived quality of earth constructed houses. Table 7.7 shows that the association between wall type and “perceived quality” was statistically significantly; in contrast, the associations between wall type and the responses to “problems adobe” and “adobe good” were not statistically significant.

In order to have a better understanding of homeowners’ perceptions of informal and formal housing wall materials, an analysis was done with 1) adobe, 2) corrugated iron and other wall materials categorized as informal wall material, and 4) burnt bricks and 5) cement bricks categorized as “formal” wall material. There are 65.7% homes with informal walls and 34.3% with formal walls.

Given the categorisation of wall type into informal versus formal, a positive Kendall-tau coefficient for the association between wall type and perceived quality being scored from high to low, implies that living in a house with informal walls is associated with higher perceived quality of earth constructed houses. Table 7.8 shows that the association between wall type and "perceived quality" was statistically significant, as were the associations between wall type and the responses to "problems adobe" and "adobe good".

The correlation coefficients show a somewhat stronger association of wall type categorised as informal with perceived quality of earth houses, than in the previous analysis when wall type was categorised as earth walls versus other. The correlation between wall type and perceived quality is evident from the fact that there were 11.76% of respondents living in informal houses who perceived the quality of earth constructed houses as "very good" to "good" against the 6.08% of respondents living in formal houses who perceived the quality of earth constructed houses as "very good" to "good". The implication is that people living in houses with informal walls are more positive about earth constructed walls, than people living in houses with formal walls.

Table 7.8 Association between housing characteristics (formal and informal wall types) and perceived quality and acceptability of earth constructed houses

Architectural Characteristic	Quality/acceptability characteristic	Kendall-tau	P-value
Wall type (Informal vs formal)	Perceived quality	0.0730	0.0007
	Problems Adobe	-0.0579	0.0108
	Adobe good	0.0729	0.0013

There were 14.85% of respondents living in informal houses who did not have problems with adobe and only 10.69% of respondents living in formal houses who did not have problems with adobe. This shows that people living in informal housing are relatively more positive about the quality of earth constructed houses. This was found to be consistent with the follow-up question, if the respondents think that the use of adobe was a good thing. The correlation coefficients show a positive strong

significance between the two housing wall types (Table 7.8 shows the Kendall-tau of 0.0729 and the P-value of 0.0013). There were 17.58% of respondents living in informal houses that responded with adobe good and only 9.18% of respondents living in formal houses responded with adobe good.

It was investigated 1) who made the home, and 2) who taught about earth building techniques, is associated with the acceptability of earth constructed walls. The analysis tested whether the participation of the respondent in the construction of the house is associated with the acceptability of earth construction in order to identify participation as an influencing factor.

Table 7.9 Association between house/ building characteristics and perceived quality and acceptability of earth constructed houses

Characteristic	Quality/acceptability characteristic	Chi-square statistic	df	P-value
Who made	Perceived quality	0.4585	3	0.9279
	Problems adobe	1.3352	3	0.7208
	Adobe good	3.5997	3	0.3081
Who taught	Perceived quality	0.3518	2	0.8387
	Problems adobe	1.5692	2	0.4563
	Adobe good	4.5840	2	0.1011

The chi-square suggested that the perceived quality and whether respondents expect problems with earth are not influenced significantly by (i) who made the respondents' earth houses, and (ii) who taught the respondents' to make or work with adobe (see Table 7.9).

When the relationships between the three different questions that address the acceptability of adobe blocks are considered, significant correlations can, as expected, be observed. The correlations show that the higher the perceived quality of adobe blocks became more positive, respondents would be 1) less likely to consider the use of adobe blocks, 1) the less likely respondent are to consider the use of adobe blocks to be problematic, and 2) more likely respondents are to regard the use of adobe as a good idea (see Table 7.10).

Table 7.10 Correlation between three characteristics for the perceived quality and acceptability of earth constructed houses

Pair of characteristics	Kendall-tau	P-value
Perceived quality vs. Problems Adobe	-0.3442	<0.0001
Perceived quality vs. Adobe good	0.3153	<0.0001
Problems Adobe vs. Adobe good	-0.4655	<0.0001

The respondents were asked to specify the problems which, in their view, were related to the use of adobe blocks. The responses were divided into the following categories: (a) Collapses; (b) Cracks; (c) Maintenance; (d) Climate/rain; (e) Insects; (f) Not safe/ not strong and (g) Other. More than one of these categories could be selected as arguments regarding the use of adobe as problematic.

Respondents were also asked to indicate why they did, or did not, consider the use of adobe blocks to be a good idea. Arguments both for and against the use of adobe blocks were recorded. Multiple responses were allowed. The answers to this question were divided into the following categories: (a) Collapses and cracks; (b) Aesthetics; (c) Maintenance; (d) Climate/rain; (e) Dangerous; (f) Finances; (g) Strong/good/satisfied; (h) No good/don't like; (i) Other.

Table 7.11 Grouped problems with the use of adobe blocks for walls

Reasons: NO	Frequency [n]	Percentage [%]
Collapses & cracks	511	37.1
Aesthetics	36	2.6
Maintenance	121	8.8
Climate/rain	216	15.7
Dangerous	128	9.3
Finances	70	5.1
Strong/good/satisfied	56	4.1
No good/don't like	161	11.7
Other	271	19.7

Table 7.12 Grouped reasons for thinking adobe blocks for walls is not a good thing

Reasons: YES	Frequency [n]	Percentage [%]
Collapses & cracks	95	37.8
aesthetics	13	5.2
Maintenance	22	8.8
Climate/rain	46	18.3
Dangerous	26	10.4
Finances	13	5.2
Strong/good/satisfied	10	4.0
No good/don't like	31	12.4
Other	49	19.5

The results, grouped in two categories, correspond with one another (see Table 7.11 and Table 7.12).

The perceived acceptability of adobe blocks as building material is low. In 33.8% of the cases, the house in which the respondents currently reside is made of corrugated iron; in 23.9% of the cases, it is made of earth; 18.6% of the houses are made of cement; 15.8% are made of burnt bricks; while the houses of another group of respondents are built of a combination of materials. The high percentage of respondents who reside in houses made of earth suggests that the material of which their houses are made is not their preferred building material.

7.2.4 House size

The number of rooms in the surveyed households varies from one to twenty. However, it may be assumed that households with more than one room have more than one house or building on the site, which is customary, especially on bigger rural plots. In 91.45% of the cases, the houses have between one and five rooms.

Table 7.13 Association between housing characteristics and perceived quality and acceptability of earth constructed houses

Housing Characteristic	Quality/acceptability characteristic	Kendall-tau	P-value
House size	Perceived quality	0.0334	0.0931
	Problems Adobe	-0.0100	0.6430
	Adobe good	0.0103	0.6314
Roof material	Perceived quality	0.0032	0.8817
	Problems Adobe	0.0020	0.9334
	Adobe good	-0.0027	0.9133

The number of rooms and the roof material were found to have no statistically significance association with perceived quality of adobe, since different sized houses with different roofing material were found in the three area types (Table 7.13).

Table 7.14 Association between architectural characteristics with area of earth constructed houses

Housing Characteristic	Area/location characteristic	Kendall-tau	P-value
Roof material	Area	0.0106	0.6702

The roof material, furthermore, had no statistically significance association with the area (see Table 7.14). The roof material, however, had statistically significant association (P-value <0.0001) with the location (see Table 7.15), since the locations were individually homogenous.

Table 7.15 Association between housing characteristics with location of earth constructed houses

Housing Characteristic	Area/location characteristic	Chi-square statistic	df	P-value
Roof material	location	38.7739	8	<0.0001

In a multi-variate analysis there was a strong statistically significant association between the housing characteristics as a group (tenure, amount of rooms, services, wall types, ever lived in earth house and RDP opinion) and perceived quality and

acceptability characteristics, but a somewhat weaker significant association between the different housing characteristics and problems with adobe.

Table 7.16 Association between different architectural characteristics and perceived quality and acceptability of earth constructed houses

Group of characteristics	Quality/acceptability characteristic	Chi-square statistic	df	P-value
Housing characteristics	Perceived quality	89.5295	15	<0.0001
	Problems adobe	26.4828	15	0.0332
	Adobe good	40.7403	15	0.0004

This gave rise to the second research question to be discussed from the analysis. How would the geographic location (formal or informal urban and rural qualities) influence acceptability of earth construction? A further analysis of the different areas and locations was done.

In section 6.8 it was noted that the statistical significance of a correlation coefficient does not only depend on its magnitude, but also on the size of the sample on which it is based (Ajzen & Fishbein, 1980: 98-99; Schall, 2014). **The small or weak correlations found in the data can be considered as a weakness of the results but the large sample size (n=1790) is a strength.**

7.3 Contextual characteristics and acceptability

Research question 2: *Are contextual characteristics of the built environment associated with the acceptability of earth constructed houses?*

7.3.1 Areas

The nine different locations can be categorised into three (3) main areas:

Area A comprised the formal urban areas type, such as townships planned before settlement took place. These townships may, or may not, have all the services, such as water, electricity and/or a sewerage system. The individual plots have numbers.

Table 7.17 Area associated with perceived quality of adobe.

Area		Perceived quality of adobe					Total
		Very poor	Poor	Neutral	Good	Very good	
Urban formal	Count	385	522	85	57	23	1.072
	%	35.9	48.7	7.9	5.3	2.1	100
Urban informal	Count	110	118	39	35	26	328
	%	33.5	36.0	11.9	**10.7**	**7.9**	100
Rural	Count	117	204	31	28	6	386
	%	30.3	52.8	8.0	7.3	1.6	100
Total	Count	612	844	155	120	55	1.786
	%	34.3	47.3	8.7	6.7	3.1	100

Area B comprised the informal urban areas, where settlement took place before any planning had been implemented. Such areas may have electrical services in some cases or a shared water tap in the street, or they may not have any services at all. The individual plots may not have numbers.

Area C consists of rural areas, where the land belongs to the tribe and the local chief is in charge of the distribution thereof. These areas, too, may or may not have all the relevant services. The individual plots may not have numbers.

Table 7.18 Area vs. acceptability of earth constructed walls).

Area	N Obs	N	Mean	Std Dev	Min	Median	Max
Urban formal	1075	1072	4.11	0.91	1.00	4.00	5.00
Urban informal	329	328	3.77	1.24	1.00	4.00	5.00
Rural	386	386	4.03	0.90	1.00	4.00	5.00

Urban informal area respondents are more positive (mean score – 3.77) about the perceived quality of earth constructed houses. In contrast, urban formal (mean score – 4.11) and rural area (mean score – 4.03) respondents are more negative about the perceived quality of earth constructed houses (Table 7.18). Note that perceived quality was scored from 1=high to 5=low.

Table 7.19 Area vs problems with adobe (frequency)

Area	Yes %	No %	Total
Urban formal	89.64	10.36	1 071
Urban informal	76.83	23.17	328
Rural	86.53	13.47	386

The frequency distribution of the follow-up question confirms that urban informal area respondents are more positive about the use of adobe for houses (23.17%). Fewer respondents in urban formal (10.36%) and rural areas (13.47%) do not have problems with adobe (see Table 7.19).

Table 7.20 Area vs. problems with adobe (mean score)

Area	N Obs	N	Mean	Std Dev	Min	Median	Max
Urban formal	1075	1033	1,87	0.32	1.00	2.00	2.00
Urban informal	329	316	1.72	0.44	1.00	2.00	2.00
Rural	386	365	1.82	0.37	1.00	2.00	2.00

Urban informal area respondents are more positive about problems with adobe, with a lower mean score (1.72) than respondents in urban formal (1.87) and rural areas (1.82) who have more problems with adobe (see Table 7.20).

7.3.2 Locations

Urban informal area type respondents are more positive (see Table 7.21) about the use of adobe for houses and urban formal and rural area respondents are more negative about the perceived quality of earth constructed houses. It is interesting to note that the Free State Province locations (Bothshabelo, Thaba Nchu, Bulfontein, Tsiame B and Makgolokweng), together with the Northern Cape Province locations (Bankhara Bodulong and Mapoteng), are more positive than the North West Province locations (Manokwane and Pampierstad).

Table 7.21 Location associated with perceived quality of adobe.

Location			Perceived quality of adobe					Total
			Very poor	Poor	Neutral	Good	Very good	
	Botshabelo Informal & formal urban	Count	152	162	31	27	16	390
		%	39.2%	41.8%	8.0%	7.0%	4.1%	100%
	Thaba Nchu Informal urban	Count	51	96	30	20	15	212
		%	24.1%	45.3%	14.2%	**9.4%**	**7.1%**	100%
	Bulfontein Formal urban	Count	73	82	14	13	4	186
		%	39.2%	44.1%	7.5%	7.0%	2.2%	100%
	Bankhara Bodulong Formal & informal urban	Count	75	103	23	18	12	231
		%	32.5%	44.6%	10.0%	7.8%	5.2%	100%
	Tshiame B Formal urban	Count	25	33	9	5	0	72
		%	34.7%	45.8%	12.5%	6.9%	0.0%	100%
	Makgolokweng Rural	Count	36	63	14	15	2	130
		%	27.7%	48.5%	10.8%	11.5%	1.5%	100%
	Manokwane Rural	Count	31	53	3	3	1	91
		%	34.1%	58.2%	3.3%	3.3%	1.1%	100%
	Pampierstad Formal urban	Count	119	164	17	9	2	313
		%	38.3%	52.7%	5.5%	**2.9%**	**0.6%**	100%
	Mapoteng Rural	Count	50	88	14	10	3	165
		%	30.3%	53.3%	8.5%	6.1%	1.8%	100%
Total		Count	612	844	155	120	55	1.790
		%	34.3%	47.3%	8.7%	6.7%	3.1%	100%

Thaba Nchu respondents are most positive about the perceived quality of earth constructed-houses and Pampierstad respondents are most negative about the perceived quality of earth constructed houses.

Table 7.22 Location vs. acceptability

Location	N Obs	N	Mean	Std Dev	Min	Median	Max
Botshabelo	390	388	4.05	1.06	1.00	4.00	5.00
Thaba Nchu	212	212	3.70	1.15	1.00	4.00	5.00
Bulfontein	186	186	4.11	0.97	1.00	4.00	5.00
Bankhara Bodulong	231	231	3.91	1.10	1.00	4.00	5.00
Tshiame B	72	72	4.08	0.87	2.00	4.00	5.00
Makgolokweng	130	130	3.89	0.99	1.00	4.00	5.00
Manokwane	91	91	4.21	0.75	1.00	4.00	5.00
Pampierstad	313	311	4.25	0.74	1.00	4.00	5.00
Mapoteng	165	165	4.04	0.89	1.00	4.00	5.00

Table 7.22 confirms that Thaba Nchu respondents (mean score – 3.70) are most positive about the use of adobe and Pampierstad respondents (mean score – 4.25) most negative about the use of adobe.

Table 7.23 Location vs. problems with adobe

Location	Yes %	No %	Total
Botshabelo	85.31	14.69	388
Thaba Nchu	72.51	27.49	211
Bulfontein	89.19	10.81	185
Bankhara Bodulong	86.09	13.91	230
Tshiame B	90.28	9.72	72
Makgolokweng	83.85	16.15	130
Manokwane	85.71	14.29	91
Pampierstad	95.85	4.15	313
Mapoteng	89.09	10.91	165

Thaba Nchu respondents are more positive (27.49%) about the use of adobe and Pampierstad respondents are more negative (4.15%) about the use of adobe. The mean scores in Table 7.24 confirm the difference between respondents from Thaba Nchu (1.74) and Pampierstad (1.95).

Table 7.24 Location vs. adobe good

Location	N Obs	N	Mean	Std Dev	Min	Median	Max
Botshabelo	390	388	1.81	0.36	1.00	2.00	2.00
Thaba Nchu	212	210	1.74	0.42	1.00	2.00	2.00
Bulfontein	186	176	1.83	0.35	1.00	200	2.00
Bankhara Bodulong	231	231	1.79	0.40	1.00	2.00	2.00
Tshiame B	72	61	1.84	0.37	1.00	2.00	2.00
Makgolokweng	130	123	1.83	0.35	1.00	2.00	2.00
Manokwane	91	86	1.84	0.20	1.00	2.00	2.00
Pampierstad	313	296	1.95	0.20	1.00	2.00	2.00
Mapoteng	165	156	1.80	0.39	1.00	2.00	2.00

Table 7.25 shows the significant association (Chi-square statistic) between area and location, with the perceived quality of earth constructed houses.

Table 7.25 Association between geographic characteristics and perceived quality and acceptability of earth constructed houses

Geographic Characteristic	Quality/acceptability characteristic	Chi-square statistic	df	P-value
Area	Perceived quality	30.4646	2	<0.0001
	Problems adobe	35.4955	2	<0.0001
	Adobe good	41.4798	2	<0.0001
Location	Perceived quality	49.9190	8	<0.0001
	Problems adobe	63.4674	8	<0.0001
	Adobe good	54.7617	8	<0.0001

Area was found to have no statistically significant association with the ownership of houses (Table 7.26). However, since the three area types were individually homogenous, several associations were expected.

Table 7.26 Association between area and housing characteristics

Context Characteristic	Housing Characteristic	Chi-square statistic	df	P-value
Area	Ownership	8.5646	4	0.0730
	Water service	498.8697	2	<0.0001
	Toilet service	87.2009	2	<0.0001
	Electrical service	499.5101	2	<0.0001
	Wall type	114.3379	2	<0.0001
	Who made earth house	22.3233	6	0.0011
	Who taught	18.6172	4	0.0009
	Number of rooms	112.0183	2	<0.0001
	Ever lived in earth	63.7104	2	<0.0001
	Opinion on RDP houses	14.9151	2	0.0006

There were statistically significant associations (see Table 7.26) between area and the availability of basic services, as well as between area and the variables ever lived in an earth house; wall types used, and who made and who taught earth constructed walls. It was also expected (and confirmed by the findings) that there are statistically significant associations between area and the variables number of rooms and opinion on RDP houses.

Table 7.27 Associations between location and housing characteristics.

Context Characteristic	Housing Characteristic	Chi-square statistic	df	P-value
Location	Ownership	41.1371	16	0.0005
	Water service	391.9037	8	<0.0001
	Toilet service	247.945	8	<0.0001
	Electrical service	568.3044	8	<0.0001
	Wall type	194.4632	8	<0.0001
	Who made earth house	93.4831	24	<0.0001
	Who taught	39.9494	16	0.0008
	Number of rooms	180.4558	8	<0.0001
	Ever lived in earth	144.5603	8	<0.0001
	Opinion on RDP houses	23.7561	8	0.0025

The nine locations were homogenous and several associations were expected. In fact, there were statistically significant associations between location and all housing characteristics listed in Tables 7.26 and 7.27. Area is a proxy for location; it is, therefore, not surprising that the results for area and location are similar.

The characteristics of the locally available material and dominant material (most commonly used) in the location and the cultural surrounding area (different provinces) played a role in the acceptability of earth constructed housing.

Question 13 of the survey asked respondents about the current wall building material of the house in which they resided. In 33.8% of the houses surveyed, the walls were made of corrugated iron, 23.9% with earth, 18.6% of cement stabilised blocks or bricks, 15.8% of burnt bricks, and 7.9% of a combination of materials.

Question 17a asked respondents which wall building material they would prefer in a house that they would like to live in. The majority (69.9%) preferred a burnt brick house, 28.4% preferred cement or compressed earth blocks or bricks and only 1.6% preferred traditional adobe or sundried blocks.

A follow-up question explored why particular materials were preferred. Respondents were allowed to provide multiple answers, which were then grouped into the following categories: (a) Aesthetics; (b) Strong and safe; (c) Fewer problems; (d)

Climate; (e) Quick building process; (f) Finances; and (g) Other. Table 6.17 shows the scores in each category, grouped according to wall material preference.

Respondents were asked to choose the two materials that they preferred most for building walls. The interviewers showed the respondents photos of 1) stabilised adobe (similar to cement blocks but with half the cement stabilisation), 2) cement stabilised compressed earth blocks (CEB) and 3) brunt bricks (see Figure 7.1).

It was anticipated that there would be a socio-economic progression from living in a corrugated iron shack or traditional earth constructed house (the traditional vernacular) to a cement-stabilised block or brick house, and even later in a burnt brick (plastered or face brick) house. A comparison between the current wall building material of the respondents and their preferred wall building material (Table 7.28) in five of the locations were made where the proximity of brick yards and hardware stores were observed. The five most different of the nine locations are compared.

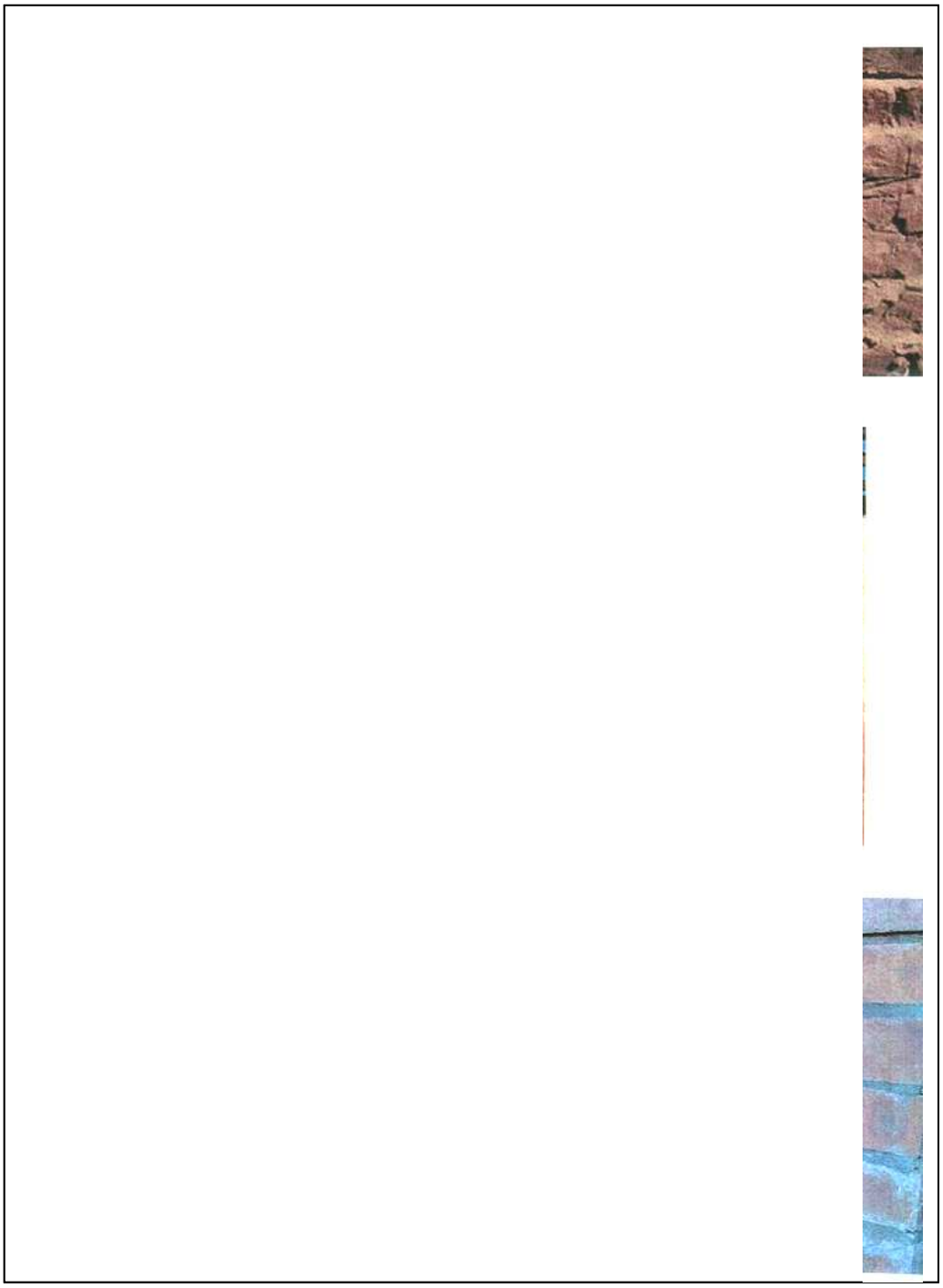

Figure 7.1 Page of photos with three material choices: 1) stabilised adobe, 2) cement stabilised compressed earth blocks, 3) burnt bricks shown to respondents

There are more burnt brick yards in Botshabelo and Bulfontein (informal and formal areas) in the Free State Province, where clay soils are in abundance for burnt brick

production than Bankhara Bodulong (Northern Cape Province) and Mapotheng (North West Province) where clay soils are less readily available. Magolokweng in the Free State Province does have clay soils available, but are in more remote rural areas and the closest hardware store is more than 20km away.

Table 7.28 Current and preferred wall building materials in the five locations

Wall material of houses	Botshabelo		Bulfontein		Bankhara Bodulong		Magolokweng		Mapoteng	
	(n=383)		(n=185)		(n=228)		(n=129)		(n=161)	
	Current material	Preferred material	Current material	Preferred material	Current material	Preferred material	Current material	Preferred material	Current material	Preferred material
earth walls	12.8	**1.3**	21.0	0	13.4	**1.7**	**62.3**	**3.1**	**41.8**	**3.6**
brick walls	19.5	**75.6**	**41.9**	**77.4**	5.6	**64.9**	1.5	**63.8**	15.8	**61.2**
cement block walls	15.9	**21.3**	**26.9**	**22.0**	9.5	**32.0**	5.4	**32.3**	26.7	**32.7**
corrugated iron walls	**49.2**	0	**8.6**	0	**66.2**	0	**28.5**	0	**7.9**	0
other	2.1	0	0.5	0	4.8	0	2.3	0	7.9	0
Total	99.5	98.2	98.9	99.4	99.5	98.6	100.0	99.2	100.1	97.5
Missing	0.5	1.8	1.1	0.6	0.5	1.4		0.8		2.5
Total	100.0	100.0	100.0	100.0	100.0	100.0		100.0		100.0

In Botshabelo (formal and informal area types), almost half of the respondents (49.2%) live in informal shacks with corrugated iron walls. Most of them (75.6%) preferred burnt bricks walls and 21.3% preferred to live within cement stabilised walls. Only a small percentage of respondents (1.3%) preferred to live within earth walls. During the survey it was observed that respondents live next to an area which included burnt brick dwellings and where multiple local burnt brick yards sell directly to the public. The residents of Botshabelo, therefore, aspire towards a local building culture that is burnt brick dominant. The mean score of respondents in Botshabelo is 4.05 (out of 5) for acceptability of earth (see Table 7.22).

In Bulfontein (formal area type), few respondents (8.6%) live in informal shacks with corrugated iron walls, some respondents (26.9%) live within cement stabilised block walls and a relatively high percentage (41.9%) of respondents live within burnt bricks

wall. Most respondents (77.4%) preferred burnt brick walls, while 22% preferred cement stabilised walls. No respondents preferred earth walls. Similar to Botshabelo, the survey location was near an area with many burnt brick dwellings, and the local burnt brick yards also sell directly to the public. Bulfontein respondents may, thus, also be described as aspiring towards a local building culture dominated by burnt bricks. The mean score of respondents in Bulfontein is 4.11 (out of 5) for acceptability of earth (see Table 7.22).

In Bankhara Bodulong (formal and informal area types), the majority of the respondents (66.2%) live in informal shacks with corrugated iron walls. Most of them preferred burnt brick walls (64.9%), while 32.0% preferred to live within cement stabilised walls. Only a small percentage of respondents (1.7%) preferred to live within earth walls. This semi-rural informal location has no burnt brick yard but has several local businesses that sell stabilised cement blocks and compressed earth blocks to the public. The local building culture of Bankhara Bodulong is, therefore, perhaps influenced by the lucrative manual cement block industry, but residents still aspire towards houses built with burnt bricks. The mean score of respondents in Bankhara Bodulong is 3.91 for acceptability of earth (see Table 7.22).

In Magolokweng (rural area type), the majority of the respondents (62.3%) live in traditional earth dwellings, while 28.5% live in shacks with corrugated iron walls. Similar to the other areas, most respondents preferred burnt brick walls (63.8%), with 32.3% preferring to live within cement stabilised walls. A bigger percentage of respondents (3.1%) stated a preference for living within earth walls (the dominant building material) than in the previous three areas discussed. This rural location has no burnt brick yards and very few cement stabilised brick yards that sell to the public. The local building culture of Magolokweng can be described as earth brick dominant with the potential for a manual cement block or burnt brick industry. The mean score of respondents in Magolokweng is 3.89 (out of 5) for acceptability of earth (see Table 7.22).

In Mapoteng (rural area type), the highest number of respondents (41.8%) live in traditional earth constructed dwellings, while only 7.9% live in shacks with corrugated

iron walls. Most preferred burnt brick walls (61.2%), while 32.7% preferred to live within cement stabilised walls. Compared to the other areas, Mapoteng had the largest percentage of respondents (3.6%) who preferred to live within earth walls (the dominant building material). This semi-rural location has no burnt brick yards and very few cement stabilised brick yards that sell to the public. The local building culture of Mapoteng can thus be described as earth brick dominant with the potential for a manual cement block or burnt brick industry. The mean score of respondents in Mapoteng is 4.04 for acceptability of earth (see Table 7.22).

It is interesting and worth mentioning that both Mapoteng and Magolokweng have brick yards that sell cement blocks, and these two locations have a higher percentage of respondents who stated a preference for cement block walls. Not a single respondent in any of the five survey locations wanted to live within corrugated iron walls. The vast majority of respondents (from 61.2% to 77.4%) aspired to live in dwellings with brick walls.

The general observed quality of the built environment of the houses of the respondents could suggest possible explanations for the way people build and negates what will be considered as the established norm of building in that specific context. In the rural areas, residents regard building in traditional earth construction with example adobe or wattle and daub as the way to build in that area. This may reflect the normative belief that it is acceptable to use earth as building material in rural areas. The implication is that people's choices regarding construction methods are associated (do not vary) with existing trends in those areas or location.

The conclusion is that if more people in the community live in burnt brick houses, then more people in that area will aspire to also live in burnt brick houses. This conclusion depends on the assumption that people tend to follow the styles and fashions which surround them. In both Magolokweng (62.3%) and Mapoteng (41.8%) the majority of the respondents live in traditional earth constructed houses. It is interesting that 3.1% of the respondents in Magolokweng, and 3.6% of the respondents in Mapoteng, still prefer to live in traditional earth constructed houses. Although these percentages are low, it is more than the 1.3% of respondents (Table

7.28) in Botshabelo (urban formal and informal area types); the 0% of respondents in Bulfontein (formal area types); and the 1.7% of respondents in Bankhara Bodulong (urban formal and informal area types).

Table 7.29 Association between context characteristics and perceived quality and acceptability of earth constructed houses

Group of characteristics	Quality/acceptability characteristic	Chi-square statistic	df	P-value
Context characteristics	Perceived quality	51.8123	9	<0.0001
	Problems adobe	77.4397	9	<0.0001
	Adobe good	91.8751	9	<0.0001

In a multi-variate analysis there is a significant association between the different context characteristics as a group (area and location), and perceived quality of earth constructed houses.

This gave rise to the third research question to be discussed from the second analysis regarding the contextual characteristics that correlate to perceived quality and problems with adobe. Are there relationships between the personal and household characteristics associated with the housing and contextual characteristics of housing, and are there sentiments about the acceptability of earth constructed houses?

7.4 Personal and household characteristics and acceptability

Research question 3: *Are personal and household characteristics associated with the housing and the contextual characteristics, and the acceptability of earth constructed buildings?*

This analysis assesses the possible association of demographic, personal and household characteristics with the housing and contextual characteristics, and the acceptability of earth constructed houses.

7.4.1 Personal characteristics

7.4.1.1 Respondents' background and home language

The Free State Province is mainly the home of Sesotho speaking respondents and the Northern Cape and North West provinces are the home of Setswana speaking respondents. Personal characteristics that were analysed for associations were gender and home language.

Table 7.30 Association between gender and architectural characteristics

Personal Characteristic	Housing Characteristic	Chi-square statistic	df	P-value
Gender	Wall type	4.0864	1	0.0432
	Size of house	5.1823	1	0.0228
	Opinion on RDP houses	0.9979	1	0.3178
	Ownership	0.8019	2	0.6697
	Water service	5.2476	1	0.0220
	Electrical service	0.8767	1	0.3491
	Toilet service	0.3648	1	0.5458
	Ever lived in earth	0.1139	1	0.7358

Gender was found to have a statistically significant (<0.05) association with wall type, the size of the house, and the water services (see Table 7.30). Women are traditionally more involved in the making of earth walls, and men are more involved in building trades associated with carpentry, and cement related bricklaying. If women are more comfortable with making earth walls, then they trust the method of building. Also, it would mean that they are proud of their handiwork. Furthermore, it would give them a sense of autonomy and importance. If they lived in brick houses they would be totally dependent on their menfolk, or other male contractors, for the money and skills to construct such houses.

The association between gender and water services can be explained. In most traditional households the collection of water is the responsibility of all women. Women have to use water for cooking, cleaning and laundry. The proximity of the tap in the street, tap on the plot or running water inside the house can, therefore, be associated with gender, since running water will directly improve the living conditions of women in the household.

Table 7.31 Association between gender and context characteristics.

Personal Characteristic	Context Characteristic	Chi-square statistic	df	P-value
Gender	Area	3.6468	2	0.1615
	Location	13.6651	8	0.0909

There were no statistically significant associations between gender and area or location (see Table 7.31). Family households are often split up between locations; some are located near job opportunities, others near schools for children, and other reasons that influence these phenomena. Typically, for example, a father may leave the mother and children in the one location and seek work in another area.

Table 7.32 Association between home language and housing characteristics.

Personal Characteristic	Housing Characteristic	Chi-square statistic	df	P-value
Home language	Wall type	72.5204	5	<0.0001
	House size	3.7677	5	0.5833
	Opinion on RDP houses	4.8647	5	0.4326
	Ownership	40.6812	10	<0.0001
	Water service	72.3836	5	<0.0001
	Electrical service	189.5738	5	<0.0001
	Toilet service	31.6999	5	<0.0001
	Ever lived in earth	42.8035	5	<0.0001

Home language was found to have a strong statistically significant association with wall type; ownership of the house; the three services and if ever lived in an earth house before (see Table 7.32). People of a certain language, such as Setswana, tend to have the same preferences regarding wall type. They tended to have the same level of home ownership, the same levels of service, and the same histories regarding previous types of housing, since the area types and locations were the same.

There are no statistically significant associations between home language and the size of the house and opinion on RDP houses.

Home language was found to have a strong relationship with area and location. This was to be expected since the North West Province and Northern Cape Province

have mainly Setswana speaking respondents, and the central and eastern Free State, have Sesotho speaking respondents (see Table 7.33).

Table 7.33 Association between home language and area/location of respondents

Personal Characteristic	Area/location characteristic	Chi-square statistic	df	P-value
Home language	Area	82.9751	2	<0.0001
	Location	416.6397	8	<0.0001

Gender was not significantly associated with the perceived quality and acceptability of earth constructed houses (see Table 7.34).

Table 7.34 Association between demographic characteristics and perceived quality and acceptability of earth constructed houses

Personal Characteristic	Quality/acceptability characteristic	Kendall-tau	P-value
Gender	Perceived quality	0.0230	0.3025
	Problems Adobe	-0.0299	0.2160
	Adobe good	0.0015	0.9516

Similarly, home language, however, not significantly association with perceived quality and positive expectations of adobe walls (see Table 7.35).

Table 7.35 Association between home language and perceived quality and acceptability of earth constructed houses

Personal Characteristic	Quality/acceptability characteristic	Chi-square statistic	df	P-value
Home language	Perceived quality	5.0887	5	0.4051
	Problems adobe	8.0645	5	0.1527
	Adobe good	4.2692	5	0.5113

In a multi-variate analysis (regression analysis) no statistically significant association (see Table 7.34 and Table 7.35) was found between the different personal characteristics (gender and home language) and the characteristics of the quality and acceptability of earth constructed houses (see Table 7.36). The use of the term ‘prediction’ is central to regression analyses. The analyses examine whether one variable can predict (explains or affect) another variable.

Table 7.36 Association between personal characteristics and perceived quality and acceptability of earth constructed houses

Group of characteristics	Quality/acceptability characteristic	Chi-square statistic	df	P-value
Personal characteristics	Perceived quality	3.4699	6	0.7480
	Problems adobe	10.3884	6	0.1092
	Adobe good	5.0001	6	0.5438

7.4.2 Household level

Household size was found to have no statistically significant association with the wall type, RDP opinion or ownership (see Table 7.37).

Table 7.37 Association between household size and architectural characteristics

Household characteristic	Housing characteristic	Chi-square statistic	df	P-value
Household size	Wall type	2.3787	1	0.1230
	Size of house	137.8720	1	<0.0001
	Opinion on RDP houses	0.0849	1	0.7708
	Ownership	1.5462	2	0.4616
	Water service	12.1147	1	0.0005
	Electrical service	54.3833	1	<0.0001
	Toilet service	13.2445	1	0.0003
	Ever lived in earth	29.5774	1	<0.0001

Household size, however, had a statistically significant association with the size of the house, if ever lived in earth and the three basic services (electrical, water and toilet with sewerage). Larger households tended to have more rooms. Bigger households differed regarding area types. Area type is associated and is a proxy for if ever lived in earth, and the three basic services. Therefore, household size is statistically significant with size of the house, if ever lived in an earth house, and the three basic services.

Table 7.38 Association between household size and context characteristics

Household characteristic	Context characteristic	Chi-square statistic	df	P-value
Household size	Area	58.9731	2	<0.0001
	Location	99.6954	8	<0.0001

Household income was found to have no statistically significant association (only if P<0.05) with opinion on RDP houses, ownership and if ever lived in earth houses (see Table 7.39).

Table 7.39 Association between household income and housing characteristics

Household characteristic	Housing characteristic	Chi-square statistic	df	P-value
Household income	Wall type	6.9182	1	0.0085
	Number of rooms	125.0185	1	<0.0001
	Opinion on RDP houses	2.3194	1	0.1278
	Ownership	0.4550	2	0.7965
	Water service	35,9369	1	<0.0001
	Electrical service	49.1570	1	<0.0001
	Toilet service	37.7892	1	<0.0001
	Ever lived in earth	0.7969	1	0.3720

It was expected (and confirmed by the findings), that household income would have a statistically significant association with wall type used, the number of rooms, and the three basic services. If there are more working people in the household, the household income will be higher. More wage earning people can lead to more informal rooms being added to the main formal/informal house. The basic services are connected to urban formal area types with more job opportunities available.

Table 7.40 Association between household income and context characteristics

Household characteristic	Context characteristic	Chi-square statistic	df	P-value
Household income	Area	19.8141	2	<0.0001
	Location	63.8209	8	<0.0001

Household size had a strong statistically significant association with perceived problems of adobe (P=0.0016), with larger households tending to have a higher perception of problems (see Table 7.41). However, income was found to have no statistically significant association with the acceptability characteristics. Brick houses have a strong aspirational significance, because both poor and rich people prefer brick houses. Household size was weakly correlated with perceived quality (the larger the household, the lower the perceived quality), although the association was not statistically significant (P=0.0844).

Table 7.41 Association between household characteristics and perceived quality and acceptability of earth constructed houses

Household Characteristic	Quality/acceptability characteristic	Kendall-tau	P-value
Household size	Perceived quality	0.0329	0.0844
	Problems Adobe	-0.0626	0.0016
	Adobe good	0.0080	0.6954
Income	Perceived quality	0.0299	0.1392
	Problems Adobe	-0.0181	0.3979
	Adobe good	0.0197	0.3731

In a multi-variate analysis (regression analysis) no significant association was found between household characteristics as a group (how many people, how many people with a permanent job, people with grants, household income) could predict the acceptability of earth constructed houses (see Table 7.42). However, there was a statistically significant association between the group of household characteristics and the perceived problems with adobe walls (P=0.0497).

Table 7.42 Association between household characteristics and perceived quality and acceptability of earth constructed houses

Group of characteristics	Quality/acceptability characteristic	Chi-square statistic	df	P-value
Household characteristics	Perceived quality	4.8020	4	0.3082
	Problems adobe	9.5001	4	0.0497
	Adobe good	1.5343	4	0.8205

7.5 Conclusion

Chapter 7 analysed the factors which could potentially influence people's views on the construction materials investigated. These factors were presented as correlations, regressions and statistical significant associations. Chapter 8 discusses these findings to analyse the state of acceptability of earth construction to be presented as the conclusions, implications and recommendations of this thesis. This will support the proposed paradigm changes in order to enhance a state of acceptability of contemporary earth construction.

CHAPTER 8
DISCUSSION, IMPLICATIONS AND RECOMMENDATIONS

8.1 Introduction

This chapter discusses the findings presented in the previous two chapters in the light of some observations. These observations are then discussed within the three research questions in order to draw conclusions, indicate the implications and present some recommendations. The research questions are answered in order to test the hypothesis before the final conclusions are drawn.

8.2 Summary of findings

The findings, in the section below, show the potential linkages between specific variables and the acceptability of earth constructed houses.

8.2.1 Housing characteristics

- Wall types and the time respondents have lived in their houses are associated with the acceptability characteristics of earth constructed houses. The longer respondents live in an earth constructed house, the more positive they are about the material.
- RDP opinion parameters and all three basic services are strongly associated with the acceptability characteristics of earth constructed houses. The more positive respondents are about their own RDP houses, the more negative they are about earth constructed houses.

8.2.2 Context characteristics

- Area types (urban formal, urban informal and rural) and locations (nine in total) are strongly associated with the acceptability of earth constructed houses. Respondents in the three area types in the nine locations, showed the same levels of acceptability as a result of the homogenous nature of the

area and location. Urban informal respondents were more positive than urban formal and rural respondents.

8.2.3 Personal and household characteristics with housing and context characteristics

- Regression analyses were used to examine if personal and household, together with housing and context characteristics, impact on the acceptability of earth constructed houses. Personal characteristics, together with all household, housing, and context characteristics, had no significant association with acceptability characteristics of earth constructed houses.
- Personal characteristics, such as home language, showed associations with some housing characteristics (wall type, ownership, three basic services and ever lived in earth) and all context characteristics (area type and location), but could not predict the acceptability of earth constructed houses.
- Household characteristics such as household size showed associations with some housing characteristics (wall type, ownership and three basic services) and all context characteristics (area type and location), but could not predict the acceptability of earth constructed houses.
- Household characteristics such as household income showed associations with some housing characteristics (wall type, house size and three basic services) and all context characteristics (area type and location), but could not predict the acceptability of earth constructed houses.

8.3 Discussion of overall findings from the data and the literature review

8.3.1 Data analyses

This thesis posed three main research questions regarding the potential impact of attitude and individual personality on people's views regarding earth constructed walls. These attitudes, in turn, could be influenced by their current, socio-economic background and the social-cultural context. But how could influences on the perceptions of building materials be measured? The social sciences literature highlights some of the complexities of measuring attitudes. It was clear that a

person's behavioural intention, at most, can be predicted, but not directly measured. According to Henerson, Morris, & Fitz-Gibbon, (1987: 12-13) it is impossible to measure attitudes directly; therefore, inferences have to be used to measure attitudes.

The thesis findings confirm the low acceptability of earth construction from the survey results. This thesis investigated the relationship between personal, social and cultural factors and the acceptability of earth constructed houses in detail. The literature review and the new quantitative analyses (correlations and regressions) guided the testing of data against the three research questions.

The measurable factors, deduced from the analyses, which seem to play a role in the preference of wall building material, are:

- the desire to progress from informal to formal dwellings (upward social mobility and the need to have basic services, not just electricity, but a toilet with sewerage system and running water),
- the current wall building material of the respondents' own houses compared to their choice of wall building material, and
- the dominant wall building material and technique (most favoured and commonly used) in the location and surrounding areas.

8.3.2 Literature review

The literature review in Chapter 3 suggested that building material preferences, influenced by normative beliefs (social acceptability) and attitudes, were linked to acceptability. People want to improve their life, based on how they observe other people improve their life. These were investigated in Research question 1 (in section 6.7) where housing characteristics (more basic services and good RDP housing attributes) were positively associated with the acceptability of earth construction. Furthermore, the literature suggests that personal attitude is influenced by:

- personal factors and normative beliefs (experienced as conformity and imitation), and
- the effect of upward social mobility.

The context characteristics (area and location) are influencing factors based on the associations with acceptability characteristics recorded in the findings. These were investigated in Research question 2 (in section 6.7) that shows the added restricting factors of:

- the availability and proximity of building materials,
- the influence of the building culture characteristics, and
- the availability of basic services as supported by the contextual characteristic of area type.

The findings suggest that the area and location factors influence people's building preferences, particularly if building materials are available locally. Furthermore, people's choices are influenced by the local building culture, as well as the availability of local building services.

Although a minority, some people state a preference for earth construction (to be used in their preferred houses), possibly because it remains the dominant construction method in some of the locations.

There is ample evidence from the literature review that a person's behavioural intention is influenced by his or her attitude toward the behaviour, and by his or her subjective norm. From the literature, observations and the data, the importance of the following connections should be highlighted:

- **Imitation:** The most obvious manner in which one person may affect others is through imitation or direct and usually immediate reproduction of behaviour in one's environment (see section 3.4). This might be successful if the act already possesses meaning and functional significance to the mimic. As in the saying "imitation is the sincerest form of flattery", the behaviour may be imitated, if it appears to have brought success to others (Klineberg, 1961: 441).
- **Conformity:** One of the consequences of the group situation is a tendency to conform (see section 3.4). "Even non-conformists conform

most of the time". Individuals often, uncritically, accept the customary behaviour of their communities (Klineberg, 1961: 457).

- **Upward social mobility:** The personal driving force behind climbing the social ladder is seldom used to explain trends and popular stylistic support in the built environment (see Table 3.1). The notion of "living up to the Joneses" appears to be alive and well in the study locations. Additional research is required on upward social mobility and housing preferences in South Africa. The vast majority of respondents expressed a desire to live in a burnt brick dwelling, like middle and upper class citizens, and they also see and support local burnt brick yards or in other locations cement block block/brick yards supplying the blocks or bricks for these dwellings.

Thus, imitation and conformity can be linked to the availability of building material, together with the building culture discussed in Research question 1. Upward social mobility can be linked to the satisfaction of RDP residences, discussed under Research question 2.

There should be correspondence or a direct link between the intention to use earth construction (as a contemporary application) in future and the current attitude and normative belief as indicated by the findings. This link can be illustrated to provide a possible prediction of intention.

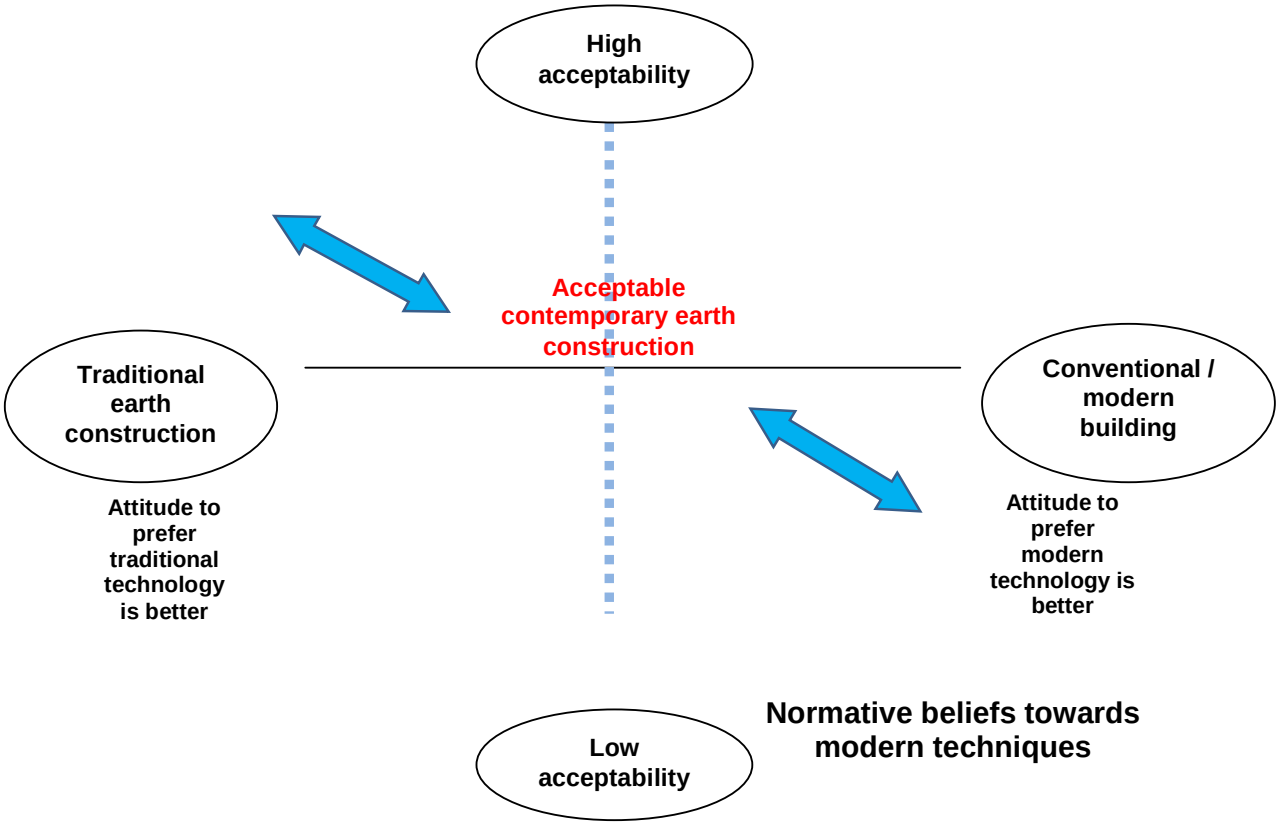

Figure 8.1 **Analytical Diagram 1 to explain the path from opposites building material preferences to acceptable contemporary earth construction through promotion.**

Figure 8.1 attempts to explain the paths that individuals find themselves on between the opposite ends of modern and traditional building techniques. The links between the intention and attitudinal and normative elements are shown in Figure 8.2 as working in two directions; vertically and horizontally. Personal behavioural intention can be influenced by the promotion of contemporary earth construction. Restrictions regarding available material and corresponding building culture need to be considered. Social pressure, as a result of environmental sustainable issues (reducing of the carbon foot print, protection of natural resources and others), together with the effect of USM will be the factors that influence the acceptability of contemporary earth construction.

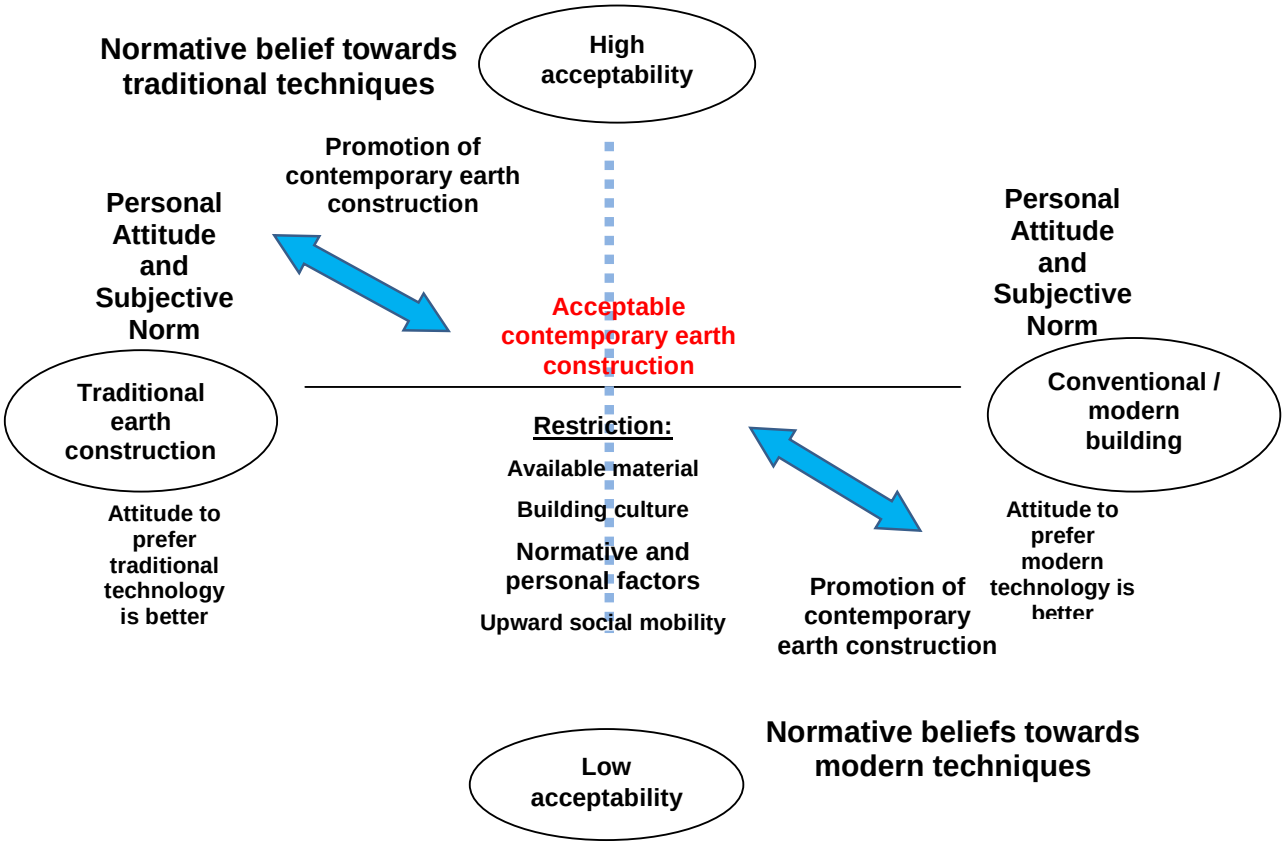

Figure 8.2 **Analytical Diagram 2 to explain the path from opposites building material preferences to acceptable contemporary earth construction through promotion.**

8.4 Discussion of Research question 1

Research question 1: *Are housing characteristics associated with the acceptability of earth constructed buildings?*

At the beginning of the study, it was expected that the variables 1) who made, 2) who taught, and 3) if ever lived in an earth constructed house, would correlate with the acceptability characteristics presented to the respondents. It, however, was not supported by the empirical findings.

The conclusions of the univariate analysis (correlations) between the housing variables (characteristics) are that, 1) who made, 2) who taught, and 3) if ever lived

in an earth constructed house, 4) the house size and 5) roof material, showed no significant association with the acceptability of earth-construction or the quality of adobe.

Table 8.1 Nature of housing associations and significance on the acceptability of earth constructed housing

Housing variables	Association with acceptability of earth construction	Correlation and direction of preference: In favour or against earth construction
Ownership	no	-
Water service	strong	Availability of water service associated with negative attitude
Electricity service	weak	Availability of electricity service associated with negative attitude
Toilet with sewerage service	strong	Availability of toilet service associated with negative attitude
All services	weak	Availability of all service associated with negative attitude
Time lived in house	weak	Associated with positive attitude
Past exposure to earth house	no	-
RDP opinion	weak	Associated with negative attitude
Wall type	weak	Associated with positive attitude
Who built the house	no	-
Who taught to build the house	no	-
House size	no	-
Roof material	no	-

Table 8.1 gives a summary of the nature of the housing characteristics that may be associated with the acceptability of earth constructed housing. The significant association (Mantel-Haenzel chi-square test) can be either strong, weak or with no association. The correlation test (Kendall-tua coefficient) can indicate the direction as positive (in favour of traditional earth construction) or negative (against traditional earth construction).

There are weak associations in favour of acceptability and 1) the time the respondents lived in the house, and 2) the wall type (earth or informal wall) associated with a positive attitude. There are strong negative (against) associations with acceptability if 1) water, or 2) toilet with sewerage service are available. Weak

negative (against) associations were recorded for 3) electrical service, or if 4) all three services are available. There is a strong positive (in favour) association, if respondents are positive about RDP housing. **Specific housing characteristics, therefore, can be associated with the acceptability of earth constructed buildings.**

Housing characteristics like water born toilets with sewerage service, together with electricity and water services are influencing factors to consider regarding the acceptability of earth constructed housing. The fact that RDP houses (in formal urban areas) often have two of the three basic services (as provided by the state) in formal area types seems to be associated with upward social mobility (USM). RDP housing constitute more than just services. Running water in the form of a tap on a stand with or with-out electricity will not make respondents more positive about earth construction, since informal area types will often only have running water and/or electricity as services. Having all the services does not satisfy respondents' needs for USM, since properly built houses are absent in order to satisfy USM.

The implications are that if services for RDP housing, in combination with contemporary earth construction (together with local labour, local materials, and job-creation) can be provided by the state, this type of housing can be made socially more acceptable.

8.4.1 Recommendation: arguments in favour of contemporary earth construction

The state must start to accommodate the use of cement stabilised compressed earth blocks (CEB) as part of RDP programmes or other state supported self-help building projects, it can provide a link to social acceptability. This link will probably satisfy new home owners' need for upward social mobility (USM).

Modern building techniques are, furthermore, appropriate for contemporary earth constructed housing. These techniques will combine all the advantages of improved compressive strength and erosion and abrasion resistance. This can be achieved by making use of:

- the inherent qualities of selected soils (physical stabilization);
- the reduction of voids in soil through compaction (mechanical stabilization); and
- by adding 5-8% of cement or lime (of the dry weight) to the soil mix (chemical stabilisation).

New contemporary earth constructed housing projects may be more acceptable in areas where all three basic services are available. The earth constructed housing projects, as part of the RDP housing delivery or self-help housing projects, in combination with all three basic services on the lot or stand, may make respondents more positive about earth constructed walls. These associations may be useful when considering earth construction as housing option to show the sustainable development contributions. The South African Government should give contemporary earth building technology a clear position within the National Building Regulations. These efforts will be mutually beneficial to home-owners who experience USM, but also see the advantages of the state making use of wall building materials that:

- are locally produced with abundant and affordable raw material with less cement used than needed for cement blocks or concrete hollow blocks (20% cement stabilization);
- can create job opportunities in local small scale brick yards; and
- can provide a sustainable solution to a global energy crisis, as bricks/blocks would be made locally.

The findings indicated that contextual factors also influenced respondents' perceptions, which formulated Research question 2.

8.5 Discussion of Research question 2

Research question 2: *Are contextual characteristics of the built environment associated with the acceptability of earth constructed houses?*

The conclusions of the frequency and means procedures between the contextual variables (characteristics) are that 1) formal urban area, and 2) rural area types are more negative (see Table 7.18) associated with earth constructed walls than 3) informal area types. Furthermore, there is a strong significant association (see Table 7.25) between type and locations, and the acceptability characteristics of earth construction. The areas were individually homogenous (described in Chapter 6) regarding 1) formal houses with serviced lots, 2) informal housing with no or minimum electrical service, and/or running water on the site or in the street, and 3) rural housing with no services provided. Since the Mantel-Haenzel chi-square test was performed, only the significance of association could be established and no negative or positive directions. The frequency and means procedures were used to establish the strength of the associations. No correlation coefficient could be established between the variables.

Table 8.2 gives a summary of the nature of the context characteristics that can be associated with the acceptability of earth constructed housing.

Table 8.2 Nature of context associations and significance on the acceptability of earth constructed housing

Context *variables*	**Significant association with acceptability of earth constructed housing**
Area: Urban formal	most negative association
Area: Urban informal	more positive association
Area: Rural	more negative association
Three Area types	strong significance
All nine location	strong significance
All context variables	strong significance

The nine locations were individually homogenous regarding socio-economical background, the construction typology (construction techniques used), the type of wall building materials and basic services. There are strong significant associations

(see Table 7.25) between the nine locations and all the parameters of acceptability of earth construction and the quality of adobe. **All context characteristics, therefore, can be associated with the acceptability of earth constructed houses.**

Respondents in informal urban area types can experience independence and upward social mobility (USM) if young adults move out of their parents' houses into informal areas. Rural respondents who migrated, urbanised and moved into an informal urban area type may also experience USM. These conditions/implications can explain why respondents in informal urban areas are more positive towards the acceptability of earth constructed walls, than respondents in formal urban area.

It was anticipated that there would be a socio-economic progression within individual families, from living in a corrugated iron shack or traditional earth constructed house (the traditional vernacular) to a cement-stabilised block or brick house, and even later in a burnt brick (plastered or face brick) house. In reference to the comparison of the current wall material with their preferred wall building material (Table 7.28) in five of the nine locations (different contexts), it can be concluded that USM cannot always explain why some home owners still prefer traditional earth construction.

It seems that what is readily available also affects material choices. In both rural informal areas, respondents who lived in earth houses (Mapoteng 42.8% and Magolokweng 62.3%) showed the highest scores for traditional earth as preferred material in Mapoteng (3.6%) and Magolokweng (3.1%) compared to other building materials. In these areas an abundant supply of soil was available on the bigger rural lots/plots.

The manner and degree in which behaviour of an individual is altered by the presence of others should be considered (Klineberg, 1961: 437). The behaviour of others in the social context on the individual's choice of building material is, therefore, important.

During personal observations in some of the location it was found that the impact of the local building culture should be considered. The conclusion is that respondents in the same location will be influenced by the status of the locally available building material, together with the skill and quality of craftsmanship – in this thesis referred to as the building culture – in a specific location, with a local identity and character. This identity and character is affected by imitation and conformity. Besides the effect of USM to be considered, the personal conformity and imitation will be dictated by the stronger social culture and even the building culture. Klineberg (1961: 441) states that imitation is not a force or an instinct, but occurs when the action has value for the subject. This can be extended to other individuals and new situations if it has been found successful for one problem or situation.

Respondents in the five locations who were observed showed clear signs that the majority of the inhabitants of Bothshabelo (75.6%) and Bulfontein (77.8%) preferred brick walls in a predominant brick wall building culture with brick yards (that manufacture fire bricks) and hardware stores between 5-10km away. Fewer inhabitants in Bankhara Bodulong (64.9%), Magolokweng (63.8%) and Mapoteng (61.2%) preferred burnt brick wall buildings, since these locations have no brick yards that burn or fire clay bricks, but are surrounded by cement block yards with hardware stores between 15-35km away. Respondents in these two areas (with 41.8-62.3% of respondents who lived in traditional earth constructed houses at the time) are influenced by the building culture, since the highest percentages of respondents in these two areas (compared to the other three observed locations), still would prefer to live in traditional earth constructed houses (3.1-3.6%). People seem to conform to the building culture used by the majority of home owners.

8.5.1 Recommendation: improved earth construction techniques

Consequently, one recommendation is that the promotion of contemporary earth constructed housing will be more acceptable within areas where upward social mobility (USM) regarding a thriving building culture is already established (with different material options). Experimental earth construction projects will find it more difficult to convince the public of the advantages of cement compressed earth blocks in an area where burnt clay bricks form the predominant building culture. Areas

where cement stabilised blocks are the predominant building culture may possibly show higher acceptability in new or experimental earth constructed projects. In these areas, for example, Bankhara Bodulong and Mapoteng in the Northern Cape Province (more sandy soils available), there are many established (small scale) cement block/brick yards that successfully produce cement stabilised concrete blocks. The promotional earth construction projects and work of the UEC in Bankhara Bodulong have shown that the community in the settlement have bought the idea of using compressed earth blocks (CEB), by supporting and buying these blocks (see Figure 8.3) from a prototype brickyard established in 2004 (Bosman, 2003: 23, 2006: 300-301; Steÿn 2009: 28). Other local brickyards can also be trained in the production of CEB and local brick layers can be trained in construction, implementing good bricklaying principles and construction detailing. Mitra (2008: 268) proposes entrepreneurship, co-operatives and group activities to improve income, housing and other welfare issues of low-income households.

Figure 8.3 **Use of cement stabilised compressed earth blocks (CEB) bought from local entrepreneurs for a self-help house in Bankhara Bodulong, near Kuruman**

These efforts will expand the existing concrete block industry, and will provide a more sustainable solution since the best qualities of the locally available soils will be used. Furthermore, the compressed earth blocks are compacted and contain less than half of the conventional 20% cement stabilisation, as in the case of the local block/brick yards that currently produce concrete blocks/bricks.

In Chapter 3 section 3.4, the potential importance of external variables such as personality characteristics, demographics, gender, age and social class are recognised as an integral part of the *theory of reasoned action.* The last research question considers the personal and household characteristics to establish associations with housing, context and the acceptability characteristics to determine the behaviour of respondents.

8.6 Discussion of Research question 3

Research question 3: *Are personal and household characteristics associated with the housing and the contextual characteristics, and the acceptability of earth constructed houses?*

Table 8.3 gives a summary of the nature of the significant associations in multi-variate analyses. Personal and household characteristics, which can be associated with housing and context characteristics to predict the acceptability of earth constructed housing, are indicated.

Table 8.3 Associations and significance between personal, household, housing and context characteristics and acceptability

Personal characteristics	Significance/association with housing and acceptability	
Gender	**No significance/association for**: Area Location Opinion on RDP Ownership Electrical service Toilet with sewerage service Ever lived in earth Perceived quality Problems adobe Adobe good Size of house Water service	**Strong significance/association with**: Wall type
Home language	**No significance/association for**: House size Opinion on RDP Perceived quality Problems adobe Adobe good	**Strong significance/association with**: Wall type Ownership Water service Electrical service Toilet with sewerage service Ever lived in earth

		Area Location
All personal characteristics combined	**No prediction for acceptability**	

Household characteristics	**Significance/association with context and acceptability**	
Household size	**No significance/association with**: Wall type Opinion on RDP Ownership Perceived quality Problems adobe Adobe good	**Strong significance/association with**: Water service Electrical service Toilet with sewerage service Ever lived in earth Area Location
Household income	**No significance/association with**: Opinion on RDP Ownership Ever lived in earth Perceived quality Problems adobe Adobe good	**Strong significance/association with**: Wall type House size Water service Electrical service Toilet with sewerage service Area location
All household characteristics combined	**No prediction for acceptability**	

Gender showed no associations with any other characteristics.

Home language showed strong associations with the housing characteristics of 1) wall type, 2) ownership, 3) all three basic services, and 4) ever lived in earth. Home language also showed strong associations with the context characteristics 1) area type, and 2) location, as indicated in Table 7.32.

People sharing a home language also share the same culture (Frescura, 1989); therefore, the choices made will be associated with language. The more isolated an area, the more homogenous it will be in terms of values. The location is a proxy for ever lived in earth, thus, the association between languages and ever lived in earth.

The implications are that location and area are proxies for home language, which can explain the strong association with 1) wall type, since locations within the Free

State Province are mainly Sesotho speaking areas and locations within the Northern Cape and North Western provinces are mainly Setswana speaking areas.

Household size only showed strong associations with the housing characteristics of 1) all three basic services, and 2) ever lived in earth. Household size showed strong associations with the context characteristics 1) area type, and 2) location.

The conclusion is that rural houses often have bigger households than informal urban houses.

The implications are that types and locations are proxies for household size, which can explain the strong association with 1) wall type, since the nine locations are within three areas in the Free State Province, the Northern Cape Province and North Western Province. Furthermore, location and area type are proxies for all three basic services, which can explain the strong association between all basic services and household size.

The implications are that location and area are proxies for all three basic services, which can explain the strong association between all basic services and household size. The possible explanation for the association between the household size and ever lived in earth, is that many rural home dwellers who were familiar to homesteads with often more than one building, have urbanised and currently lives in a smaller urban house or dwelling.

Household income only showed strong (positive and negative) associations with the housing characteristics of 1) wall type, 2) house size, and 3) all three basic services. Household income showed strong associations with the context characteristics 1) area type, and 2) location, which are individually homogenous.

The conclusion is that the context characteristics 1) area type, and 2) location are proxies for 1) wall type, 2) house size, and 3) all three basic services. This will explain the strong association with household income.

The implication is that it is possible for bigger urban households (bigger house sizes) to secure a bigger monthly income, than smaller urban households (smaller house sizes) On the other hand, bigger rural households may earn less than smaller urban households.

The conclusions of the multi-variate analyses (regressions) are that personal, household, housing and context characteristics did not show any prediction for acceptability of earth construction.

No recommendations can be made within these parameters to change the acceptability of traditional earth constructed housing or to promote contemporary earth constructed housing. **Personal and household characteristics do not act as control variables. Personal and household characteristics, therefore, cannot be associated with housing and the contextual characteristics, and the acceptability of earth constructed houses.**

The findings on personal and household characteristics show no clear association with the acceptability of earth constructed houses (the belief that traditional earth constructed walls are the best for their own house). This supports the previous findings of Ajzen and Fishbein (1980: 91), who state that moderating variables such as demographic characteristics, personality traits and traditional measures of attitudes towards objects, persons, institutions and policies have no clear relation to any particular behaviour (to make use of earth as building material in a preferred situation), since they have no consistent effect on the beliefs underlying these behaviours.

8.7 Testing the hypothesis

The thesis that a better understanding of the factors (living conditions of earth constructed houses) will influence the inhabitants' attitudes towards traditional earth constructed houses may help us to devise strategies to make contemporary earth construction for housing more successful. **The hypothesis is therefore correct (alternative hypothesis): understanding the factors that influence people's**

attitudes towards traditional earth construction will help to make contemporary earth construction more acceptable.

The three research questions were formulated to test the hypothesis. The alternative hypothesis is that there will be some form of change if there is an understanding of the factors that influence people's attitudes towards traditional earth construction. This is a directional hypothesis, according to Gravetter and Wallnau (2001: 170), because if more is known of the influencing factors (there will be others), the better the strategies will be to influence people's attitudes towards achieving higher acceptability of contemporary earth construction.

8.8 Meaning and relevance of this study for earth construction

The aim of this thesis is to promote the application of contemporary earth construction in South Africa. The previous research efforts of local contemporary earth construction provide strategies and a better understanding of using earth construction in South Africa. A better understanding of these strategies often connects earth construction, as discipline, to the following concepts:

South African earth constructed heritage: The public needs to be educated regarding the importance of preserving not only existing forms of earth construction, but also the methods that have been used by previous generations. If not, we could easily lose a large part of our cultural heritage (Steÿn, 2009: 96). The public needs to be educated regarding the importance of preserving existing forms and methods of earth construction in vernacular architecture and its useful applications in contemporary architecture. If this does not happen, the different local cultural buildings heritage will wane. It is time to turn earth construction from an old fashioned building method for the poor to an innovative, sustainable and contemporary practice for a future prosperous South Africa.

Local identities and culture: The influence of modernity and technical progression supports the growing movement away from vernacular and traditional building practices, although there is a general need for a cultural identity that is often preserved and maintained. "The house, the village and the town express the fact that

societies share certain generally accepted goals and life values." (Rapoport, 1969: 47).

Building construction skills: Informal training and education, as a vernacular indigenous shared knowledge, has sustained and changed the way communities have shaped their built environments over many centuries. The skills needed for this kind of building range from the basic to the specialised. The transformation from historical methods to contemporary applications can easily be bridged. The housing sector in general needs to be trained and given incentives for using earth construction methods. By setting the trend, professionals can contribute to changing the status of earth construction. Good house construction depends on the quality of the building materials and proper building skills and techniques. Home dwellers are not always knowledgeable of the best contemporary building practices, and there is a wide range of skill levels, from self-help home builders to the most skilled workmen. Training related to the different building trades in all types of built environments is vital for both suppliers and end users. The housing sector, overall, would benefit from further training, evaluation, and control. South Africa requires a variety of skills, from the basic to the specialised, and from historical vernacular methods to more contemporary and modern techniques.

Sustainable development: If the commitment towards sustainable development is to be taken seriously, the importance of earth construction must not be overlooked. Earth construction can be as effective and versatile and compares very well to other forms of wall construction, if not more so. It has the added advantage of making use of locally available resources, incurring less transport costs and producing very few waste products. The SANPAD study concluded that earth construction should be a sustainable building method in South Africa (Steÿn, 2009). Greener buildings are the inevitable, inescapable future of architecture worldwide (Buchanan, 2005: 9).

Education in earth construction techniques: Many architect learning sites (schools of architecture) are trapped in the same confusion as the building profession and the Department of Human Settlements. A multi-disciplinary foundation course is needed, containing humanity, nature, technology and culture,

human ecology and settlement of the relationship between climate and culture, and the flow of resources from extraction to waste. These ‘objective’ courses would be backed by an introduction to ‘subjective’ fields of psychology, culture, phenomenology, mechanics of perception, and the need for ritual and order. Furthermore, building professionals have to work in teams with highly skilled specialists from a wide range of fields where the individual genius have to be prepared to work in effective collaboration with others (Cooke, 2013: 16-17).

High profile institutional earth buildings: Previous efforts to construct office buildings and community buildings in contemporary earth construction are laudable, but high profile institutional earth constructed buildings are needed to address the social status of the material. The importance of these institutions should not look like showrooms and should not only depend on training programmes for skilled labour (masons and others), but for all building professionals. According to Siwe (1983: 44), the efforts to make earth acceptable as a building material, founded on affordability to the poorest, clashes with the conviction, inevitably linked to the low status if earth. The same low acceptability was experienced with housing projects constructed out of waste products (Pawley, 1975).

Community participation in earth constructed public buildings: Previous small-scale community-based projects proved to be an effective way, not only to promote contemporary earth construction in the Free State Province and the Northern Cape Province, but also to work towards a communal goal. These projects, conducted by the Earth Unit of the University of the Free State, have brought small communities together since 1997. According to Ngowi (1997b: 145), if the earth construction technology is less complex and easier to comprehend, it will offer a bigger scope for active participation of the beneficiaries in design through sharing of information and consultation. Furthermore, community beneficiaries can be given a decision-making and managerial role to develop the communities’ organisational ability to secure the future maintenance of the building.

Cement stabilised adobe and compressed earth blocks: Since 1995, several South African building professionals have constructed well-designed contemporary

earth buildings in rural and urban areas with the help of locally trained construction teams (Bosman, 2006). Many projects used cement stabilised adobe and compressed earth blocks. These projects are well documented and available to the building industry. The reviews and debates about these often innovative earth constructed buildings enjoy the support of the South African and international green building movement (Buchanan, 2005). Excellent stabilisation results have been obtained on very different soil materials with various stabilisers. It is important to guarantee quality, to choose a stabiliser adapted to the soil type, to study proper earth mix design and to carry out the work in compliance with well-established rules (Siyan Siwe, 1983: 43).

Creative housing models: Education and the lack of means in academic institutions (Bosman, 2009) are directly challenged in order to generate new concepts and architectural models. The need to improve the quality of low-cost earth habitat projects is crucial to develop new and more rewarding architectural expressions and help to save earth construction from the stigma of traditionalism, poverty and mediocrity. The lost skills of using earth as building material and the crude application in construction (Guillaud, 2010: 21-23) are major problems for conservation of the earth constructed heritage. Too few architectural educational programmes address conservation issues that widen the gap between culture, tradition and modernity further (Bosman, 2009). Existing training efforts by the UNESCO Chair in Earth Architecture partners, to enhance architectural heritage, may include vernacular housing. This aims to create new perceptions of local building cultures in order to sensitise students about the risk of losing the mentioned cultures. Research on earth construction can enhance teaching methods, materials and practices.

Government involvement: The South African Government can reinforce existing networks and research on innovative housing solutions. This can help to solve or reduce the many problems that local communities in the developing world need to address, such as unemployment and the demand for housing. Non-governmental organisations need to form stronger partnerships with the local and national governments. Together with more and continued support from international

academic and scientific communities, the government can support international partnerships for multi-disciplined research specifically in earth construction.

8.9 Final conclusions

This thesis reflected on the many aspects that influence the acceptability of building material, housing delivery and the connection to acceptable housing and 'green' building materials. Hopefully, this simple effort can support a more substantial contribution to housing and architecture, through other social sciences filters.

The many different building materials that home-builders may use for their own houses are seldom a true reflection of the type of building materials they prefer. If an existing structure has to be extended, the choice of material will often not even reflect their choice of building material for a potential new or dream house. Very often building materials just reflect what can be afforded. It can be influenced by the culture, the context or the individual's ability to deal with what normative beliefs will dictate. It is also possible for a home owner to simply express a sense of continuity to extend the existing character of the house by blending new materials with the existing materials. More scientific research in the truly subjective nature of home building material preferences – as with the preference of architectural language or stylistic fads – will be welcomed contributions to the elusive answers regarding the acceptability of earth constructed houses.

The aim of the study was to have a better understanding of the factors that influence the acceptability of earth constructed housing in South Africa. This understanding will help to formulate strategies in order to promote earth construction.

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APPENDICES
Appendix 1 - Questionnaire

Die aanvaarbaarheid van volhoubare, hoë kwaliteit, publieke en private geboue, opgerig in grond, wat plaaslike ekonomiese ontwikkeling ondersteun

Acceptability of sustainable, high quality, earth constructed, public and private buildings to support local economic development

Kamogelo ya tsweleditsweng, boleng bo bo godimo, meago ya setšhaba le meago ya batho e e agileng mo mmung go tshegetsa tlhabologo ya pabalelo e e selegae

Die departement Argitektuur en die departement Stads- en Streek-beplanning van die Vrystaatse Universiteit saam met die Tegniese Universiteit van Eindhoven in Nederland doen navorsing vir die volhoubaarheid van grondbou in die Vrystaat en Noord-Kaap. Alle inligting wat u aan ons verskaf is vertroulik en sal net vir akademiese doeleindes gebruik word.

The department of Architecture and the department of Urban and Regional Planning of the University of the Free State together with the Eindhoven University of Technology in the Netherlands are doing research on the sustainability of earth construction in the Free State and Northern Cape. All information you will give us will be confidential and will only be used for academic purposes.

Lefapha la Boagi le lefapha la Togemaano ya Semotseng le ya Kgaolo ya Yinibeseti ya Foreistata mmogo le Yinibeseti ya Eindhoven ya Thekenoloji ya mo Holane, tsona di dira tlhotlhomiso mo tsweleditsweng yak ago ka mmu mo Foreistata le mo Kapa ya Bokone (Northern Cape). Tshedimosetso yotlhe e e lo tlo re neelang e tla nna khuparama le e tla diriswa fela go ditebo tsa botlhalefi.

Name: **……** Student No.: **……**

1.	Ligging / *Location* / Lefelo	**……**	**1**
2.	**Erf no. / *Lot no.* / Palo ya setsha**	**……**	**2-7**

Persoon met wie gepraat / *Person spoken to* / Motho yo o mo buileng ke mang?

3.	**Watter een van die volgende persone is u?** ***Which one of the following persons are you?*** **Mongwe ofe wa batho ba ba latelang ke wean?**	☐ **hoof van u huishouding / *head of your household* / tlhogo ya motse** ☐ **eggenoot of eggenote / *husband or wife* / monono kgotsa mohumagadi** ☐ **huurder / *tenant* / mohiri** ☐ **volwasse kind / *adult child* / ngwana yo o mogolo** ☐ **ander / *other* / -sele……**	**8**
	☐ **E** ☐ **C**		**E/C** **9**
4.	**U huistaal is?** ***Your home language is?*** **O bua sekae kwa lelapa?**	☐ **Sotho / Sesotho** ☐ **Tswana / Setswana** ☐ **Xhosa / Isixhosa** ☐ **Afrikaans / Seaferikanse** ☐ **English / Seesimane** ☐ **ander / *other* / -sele ……**	**10**

Huishouding / *Household* / Motse

5.	**Hoeveel mense woon in die huis?** ***How many people live in the house?*** **Batho ba bakae ba phela mo nbtlong e?**	**……**	**11-12**

6.	**Hoe oud is die mense wat in die huis woon?** ***How old are the people living in the house?*** **Bogodi jwa batho ba baphelang mo ntlong e, ke eng?**	**Ouderdom** ***Age*** **Bogodi**	**Γ**	**E**	**Γ**	**E**
		0 - 6			**13**	**14**
		7 - 19			**15**	**16**
		20 - 29			**17**	**18**
		30 - 39			**19**	**20**
		40 - 49			**21**	**22**
		50 - 59			**23**	**24**
		60 - 69			**25**	**26**
		70+			**27**	**28**

7.	**Hoeveel mense in hierdie woning 'n vaste werk?**	**……**

	How many people in the household have a permanent job? **Batho ba bakae mo motseng o ban a le tiro e e ruri?**		☐ 29
	Indien ja, wie? ***If yes, who?*** **Fa 'ewe' – Ke mang?**	**……** **……**	☐ 30
8.	**Kry iemand in die huis…** ***Does anybody in the household get…*** **A mongwe mo motseng o o bona …** **[MEER AS EEN MOONTLIKE ANTWOORD.]** **[MORE THAN ONE ANSWER POSSIBLE.]** **[DIKARBO DI KA NNA GAPE GO NNGWE.]**	☐ **pensioen / *pension* / phenšene** ☐ **ongeskiktheidstoelae / *disability benefits* / mesola ya bokoa** ☐ **kindertoelaag / *child benefits* / mesolo ya bana (vir hoeveel kinders / for how many children / go bana ba bakae ……..)** ☐ **geen een van bogenoemde / *none of the above* / gope ga mo godimo**	☐ 31 ☐ 32 ☐ 33 ☐ 34 ☐ 35
9.	**Wat is die maandelijkse inkomste van die huishouding?** ***What is the monthly income of the household?*** **Lotseno lwa motes o ke bokae ka kgwedi?**	☐ **0 - 250** ☐ **251 - 500** ☐ **501 - 750** ☐ **751 - 1000** ☐ **1001 - 1250** ☐ **1251 - 1500** ☐ **1501 - 1750** ☐ **1751 - 2000** ☐ **2001 - 2500** ☐ **2501 - 3000** ☐ **3001 - 5000** ☐ **5000+**	☐☐ 36-37

Woning / *House* / Ntlo

10.	**Is hierdie woning…** ***Is the house…*** **A ntlo e …**	☐ **u familie se eiendom / *owned by your family* / thoto ya balelapa ba gago** ☐ **gehuur / *rented* / go hiriwa** ☐ **ander / *other* / -sele ……..…….**	☐ 38
	Indien u 'n huiseienaar is: **hoe het u die huis bekom?** ***If you're a house-owner:*** ***how did you acquire the house?*** **Fa o mong wa ntlo e: O no wa bapala ntlo e jang?**	☐ **van staat gekry / *given by the government* / neilwe ka mmuso** ☐ **self gebou / *self-built* / agilwe ke nna** ☐ **gekoop / *bought* / rekile** ☐ **geërf / *inherited* / boswa** ☐ **ander / *other* / -sele ……**	☐ 39
11.	**Hoeveel vertrekke het die woning?** ***How many rooms does the house have?*** **Ntlo e na le diphaposi tse dikae?**	**……..**	☐☐ 40-41
12.	**Watter een van die volgende dienste het die woning?** ***What services does the house have?*** **Ntlo e na le ditirelo dife?**	**water / *water* / metsi**: ☐ **lopende water in huis / *running water in the house* / metsi wa gotaboga mo ntlong** ☐ **kraan op erf / *tap on lot* / thepi ka setsha** ☐ **kraan in straat / *tap in the street* / thepi mo mmilang** ☐ **geen / *none* / metsi ape**	☐ 42
		elektrisiteit / *electricity* / motlakase: ☐ **elektriese aansluiting / *electrical connection* / kgolagano ya motlakase** ☐ **ander / *other* / -sele ……..** ☐ **geen / *none* / motlakase ope**	☐ 43
		toilet / *toilet* / boithomelo: ☐ **spoeltoilet aan systeem / *flushing toilet connected to drain* / boithomelo bo bo golaganyang le leela la mesele** ☐ **spoeltoilet met tenk / *flushing toilet with tank* / boithomelo le tanka** ☐ **pitlatrine / pit-latrine / ntlwana le lehuti** ☐ **ander / *other* / -sele ……..** ☐ **geen / *none* / boithomelo bope**	☐ 44
13.	**Watter tipe mure het die huis?** ***What type of walls does this house have?***	☐ **grondmure / *earth walls* / mabota a mmu** ☐ **baksteenmure / *brick walls* / mabota a ditena** ☐ **sementsteenmure / *cement block walls* /**	☐ 45

	Mofuta wa mabota a ntlo e ke efe?	**mabota a mekasa ya samente** **☐ sink mure / *zinc walls* / mabota a senke** **☐ ander / *other* / -sele ……**	
	Indien grondmure, waar kom grond vandaan? ***If earth walls, where did the soil come from?*** **Fa mabota a mmu, mmu o tswa kae?**	**……**	**46-47**
	Indien grondmure en self gebou, wie het hulle geleer om dit te bou? ***If earth walls and self-built, who taught them how to build it?*** **Fa ke mabota a mmu, mme batho ba ikagetse, bona ba rutiwe go a aga ke mang?**	**……**	**48-49**
	Indien grondmure, watter tipe grondmure? ***If earth walls, what kind of earth walls?*** **Fa ke mabota a mmu, ke mabota a mmu ofe?**	**……**	**50-51**
	Indien grondstene, wie het stene gemaak? ***If earth blocks, who made the blocks?*** **Fa ke mekasa ya mmu, ke mang yo o dirileng mekase e?**	**……**	**52-53**
14.	**Van watter materiaal is die dak gemaak?** ***What material is the roof made of?*** **Dithulelo dife di dirisiwe go borulelo?**	**☐ sink / *zinc* / senke** **☐ ander / *other* / -sele ……**	**54**
15.	**Hoe lank woon u in hierdie woning?** ***How long have you been living in this house?*** **Ke nako e kana kang gore o phela mo ntlong e?**	**……..**	**55-56**
16.	**Het u al in 'n huis gewoon wat van grondstene gebou is?** ***Have you ever lived in a house that was built with adobe?*** **A o kile wa phela mo ntlong e e agilweng ke ditena tsa seloko?**	**☐ ja / *yes* / Ewe** **☐ nee / *no* / Nnyaa** **☐ weet nie / *don't know* / Ia ke itse**	**57**

Voorkeure / *Preferences* / Dithatego

17.	**Wat sou u verkies as bouwmateriaal vir u huis se mure?** ***What building material would you prefer for the walls of your house?*** **O tla rata eng ka ga dikagi tsa mabota a ntlo ya gago?**	**……** **……**	**58**
	Hoekom? ***Why?*** **Ke eng?**	**……** **……** **……** **……**	**59** **60** **61** **62**

18. Watter twee materiale sou u verkies vir u mure, plaas in volgorde.
Choose the two materials you prefer most for building your walls.
Tlhopha dikagi tse Pedi tsa mantlo tse o ka di ratang mo ntlong ya gago.
[SHOW PICTURES OF DIFFERENT TYPES OF WALLS AND LET THE PERSON SPOKEN TO CHOOSE THE TWO HE OR SHE PREFERS MOST. PUT A 1 AFTER THE MATERIAL THAT IS MOST PREFERRED, A 2 AFTER THE ONE THAT IS THOUGHT OF AS SECOND BEST.]
[BONTSWA DITSHWANTSHO TSA MEFUTA EFE YA MABOTA, MME MOTHO YO O GO BUILWENG LE ENA A O TLHOPE TSE PEDI TSE DI RATANG BOGOLO. THATEGO YA NTLHA KE "1", LE THATEGO YA BOBEDI KE "2".

sink / *zinc* / senke	**…**	**63**
bakstene / *bricks* / ditena	**…**	**64**
sementstene / *cement blocks* / mekasa ya samente	**…**	**65**
grondstene / *adobe blocks* / mekasa ya seloko	**…**	**66**
hout / *wood* / dikgong	**…**	**67**
hout en grond / *wood and earth* / dikgong le mmu	**…**	**68**

Grondbou / *Earth Construction* / Kago ya mmu

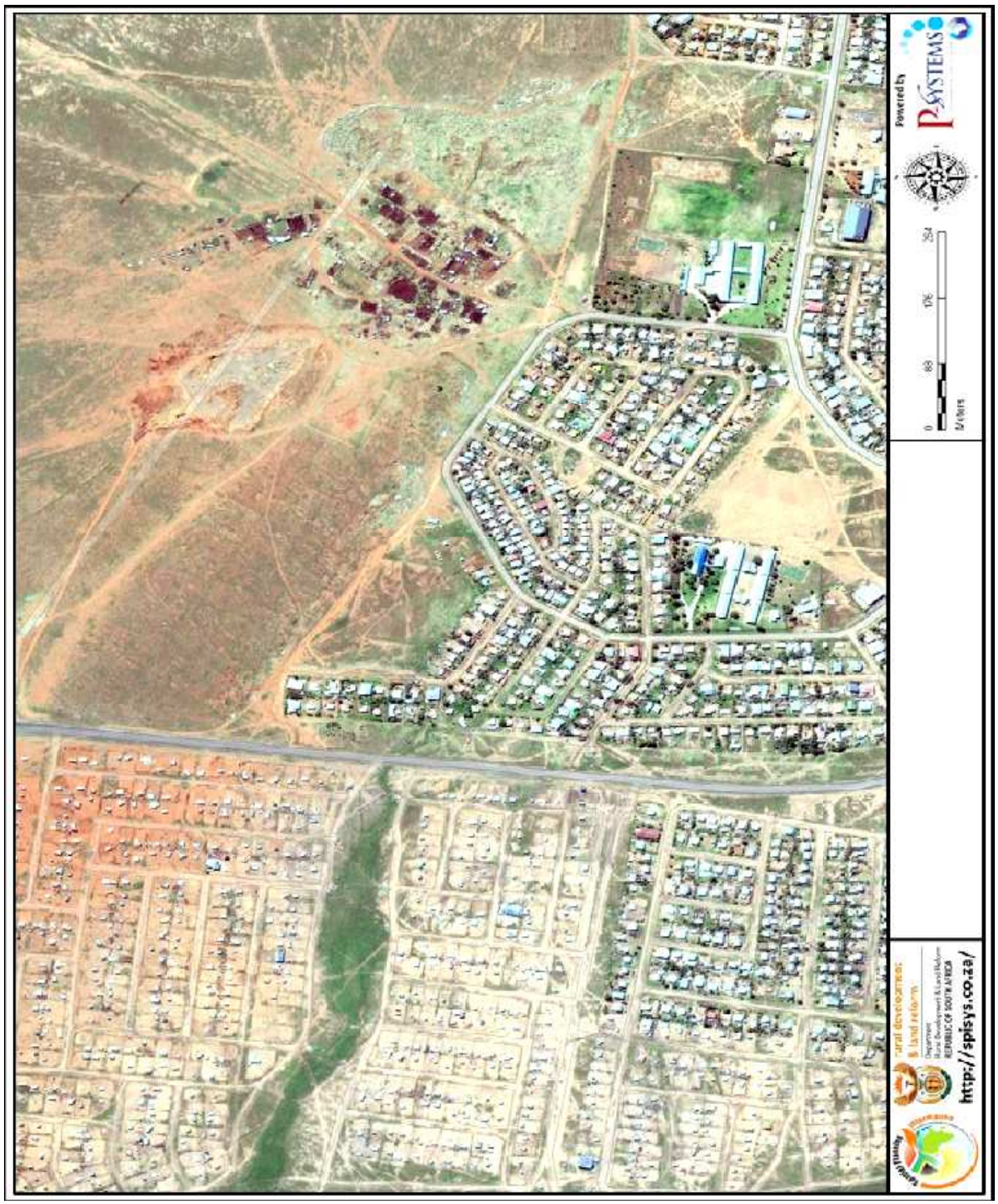
19.	**Watter eienskappe is belangrik vir 'n materiaal om mure mee te bou?** ***What properties do you find important for a building material for walls?*** **Ditlhago dife di botlhokwa ka ga dikagi tsa mabota?**	**……** **……** **……** **……** **……** **……**	**69** **70** **71** **72** **73**
20.	**Wat dink jy is die gemiddelde kwaliteit van**	**☐ baie goed / *very good* / molemo thata**	

	mure wat van songedroogde stene gemaak is? ***What do you think the average quality of walls made from adobe blocks is?*** **O okanya eng ke boleng bo bo palogare jwa mabota a mekasa ya seloko?**	☐ **goed /** ***good*** **/ molemo** ☐ **neutraal /** ***neutral*** **/ -emelathoko** ☐ **swak /** ***poor*** **/ bokoa** ☐ **baie swak /** ***very poor*** **/ bokoa thata**		☐ **74**
21.	**Hoeveel sal jy betaal vir die volgende stene/blokke? (prys per steen)** ***How much would you be willing to pay for the following bricks/blocks? (price per brick)*** **O tla duela bokae go ditena tse di latelang / mekasa e e latelang?** **[SHOW PICTURES OR SAMPLES OF DIFFERENT TYPES OF BRICKS/BLOCKS.]**	**1. songedroogde stene /** ***sun-dried bricks*** **/ mekosa ya seloko tse ditlhomameng**	**R ……..**	☐☐☐☐ **75-78**
		2. gestabiliseerde adobe / stabilized adobe / ditena tsa mmu tse dipapietseng	**R ……..**	☐☐☐☐ **79-82**
		3. gekompakteerde grondstene / ***compressed earth bricks (CEB)*** **/ ditena tsa mmu tse dipapietseng**	**R ……..**	☐☐☐☐ **83-86**
		4. gebakte steen / ***baked brick*** **/ setena se sebe-sitseng**	**R ……..**	☐☐☐☐ **87-90**
22.	**Sien jy enige probleme met die gebruik van songedroogde stene vir mure?** ***Do you see any problems with the use of adobe blocks for walls?*** **A o bona mathata mangwe le mangwe go dirisa mekasa ya seloko go bamota?**	☐ **ja /** ***yes*** **/ Ewe** ☐ **nee /** ***no*** **/ Nnyaa**		☐ **91**
	Indien ja, watter probleme? ***If yes, what problems?*** **Fa 'ewe' – Mathata afe**	**……** **……** **……** **……**		☐ **92** ☐ **93** ☐ **94** ☐ **95** ☐ **96**
23.	**Dink jy die gebruik van songedroogde stene vir geboue is 'n goeie ding?** ***Do you think the use of adobe for building is a good thing?*** **A o akanya gore tiriso ya mekasa ya seloko ya go aga go siame?**	☐ **ja /** ***yes*** **/ Ewe** ☐ **nee /** ***no*** **/ Nnyaa** ☐ **geen opinie/** ***no opinion*** **/ Kakanyo epe**		☐ **97**
	Redes: ***Reasons:*** **Mabaka:**	**……** **……** **……** **……** **……**		☐ **98** ☐ **99** ☐ **100** ☐ **101** ☐ **102**

Allerlei / Miscellaneous / Isele le tsele			
24.	**Wie dink u is verantwoordelik om vir die mense huise te bou?** ***Who do you think is responsible for building houses for people?*** **O kanya gore ke mangy o o ikarabelang go agela batho dintlo?**	☐ **hulself /** ***the people themselves*** **/ batho le bona** ☐ **die staat /** ***the state*** **/ naga** ☐ **die kerk /** ***the church*** **/ kereke** ☐ **familie /** ***family*** **/ balelapa** ☐ **ander /** ***other*** **/ -sele ……**	☐ **103**
25.	**Wat dink u is die belangrikste om te kry vir iemand wat dit nie het nie?** ***What do you think is most important for someone to get, who hasn't got it?*** **O akanya ke eng se botlhokwa thata go bapadisa seo se motho san eng?**	☐ **'n huis /** ***a house*** **/ ntlo** ☐ **water, ligte, riool /** ***water, lights, sewerage*** **/ metsi, mabone, kgogolelo-leswe** ☐ **'n werk /** ***a job*** **/ tiro** ☐ **ander /** ***other*** **/ -sele**	☐ **104**
26.	**Wat is u mening oor die RDP huise?** ***What's your opinion on the RDP houses?*** **Kakanyo ya gago ke eng ka ga dintlo tsa RDP?**	**……** **……** **……** **……**	☐☐ **105-106**

Appendix 2

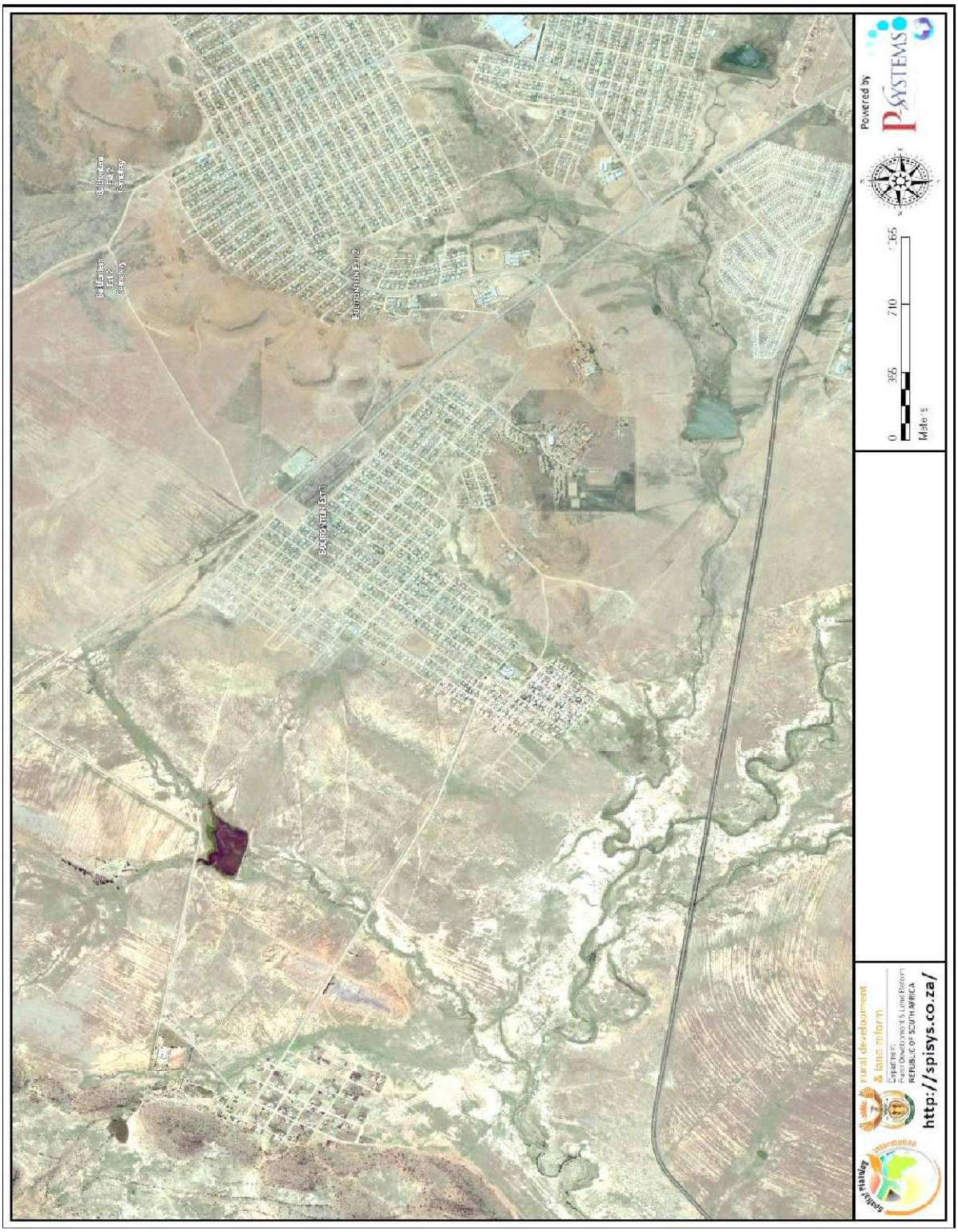
Geo-rectified image: Botshabelo, (Rural Development and Land Reform, 2014)



Appendix 3
Geo-rectified image: Thaba Nchu, (Rural Development and Land Reform, 2014)

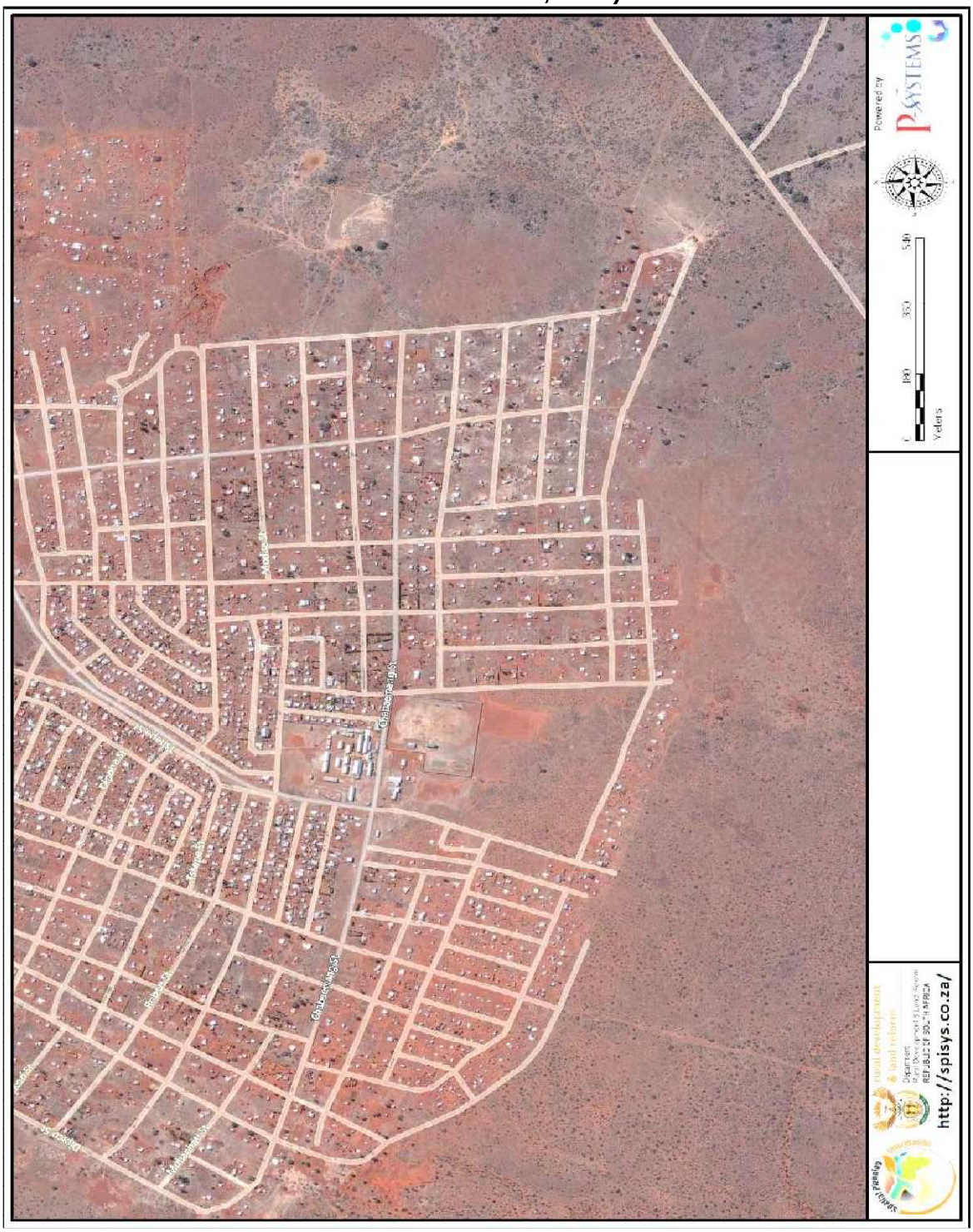
Appendix 4

Geo-rectified image: Bulfontein, (Rural Development and Land Reform, 2014)



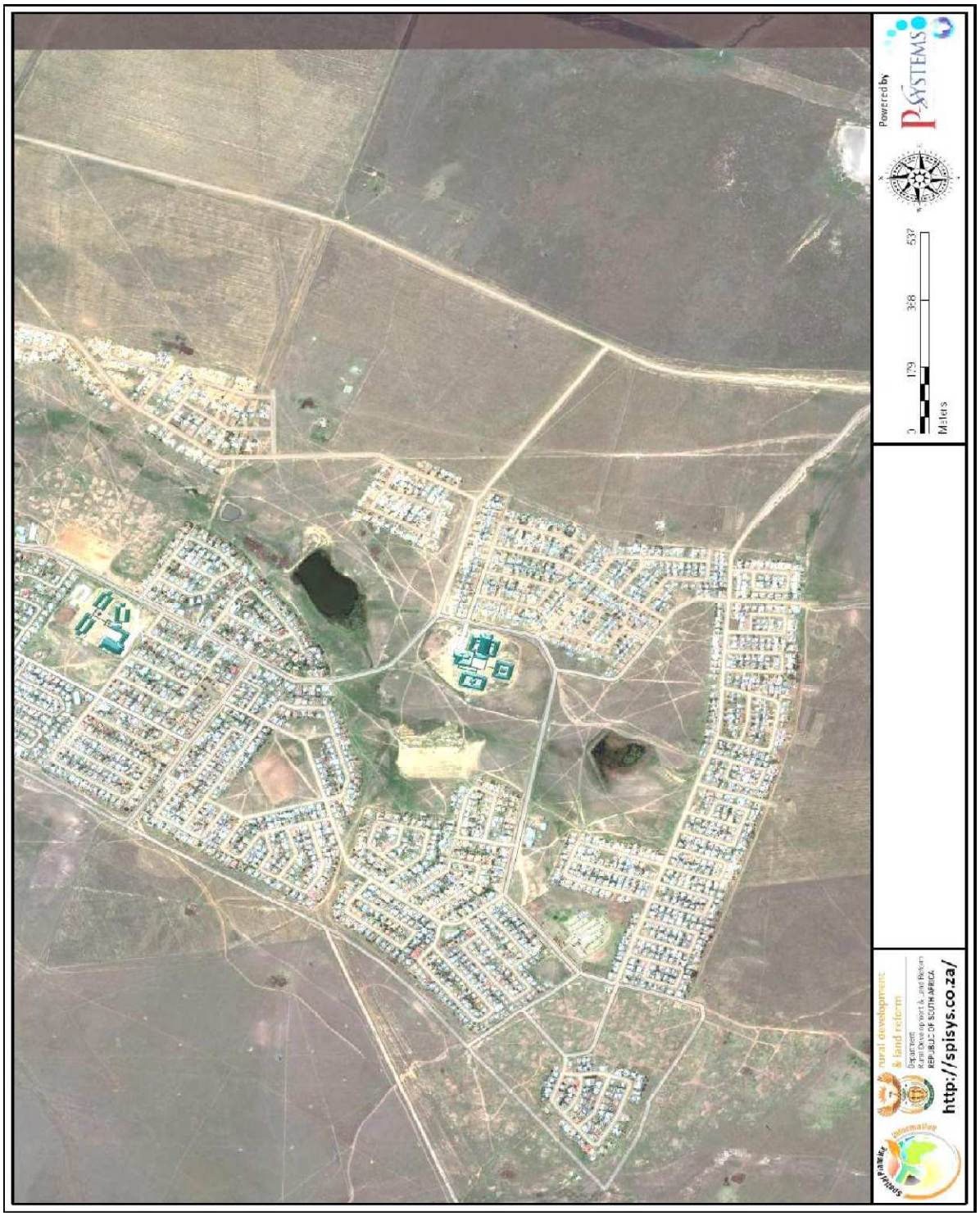
Appendix 5

Geo-rectified image: Bhankhara Bodulong, (Rural Development and Land Reform, 2014)



Appendix 6

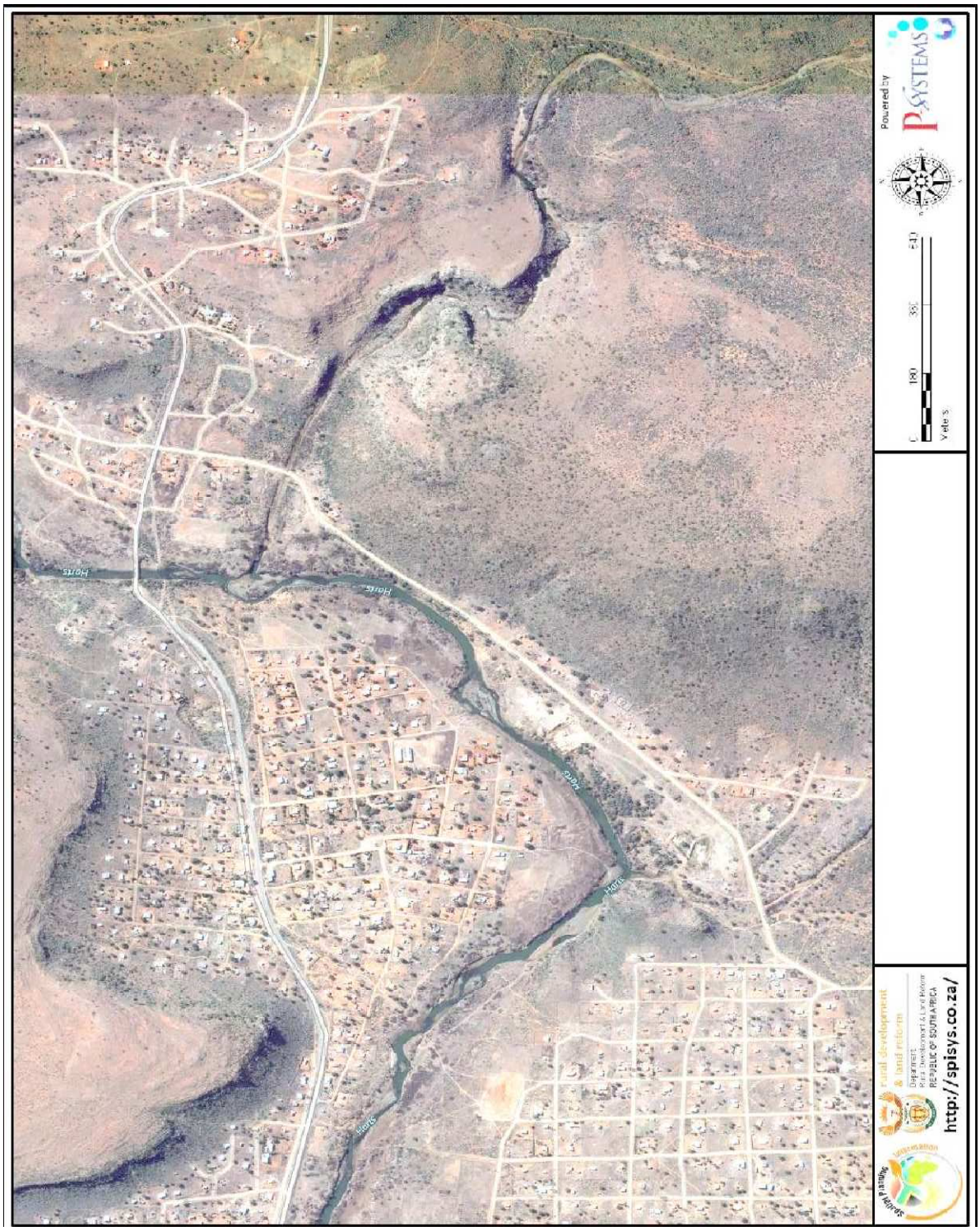
Geo-rectified image: Tshiam B, (Rural Development and Land Reform, 2014)



Appendix 7

Geo-rectified image: Makgolokweng, (Rural Development and Land Reform, 2014)

Appendix 8
Geo-rectified image: Manokwane, (Rural Development and Land Reform, 2014)



Appendix 9
Geo-rectified image: Pampierstad, (Rural Development and Land Reform, 2014)

Appendix 10
Geo-rectified image: Mapoteng, (Rural Development and Land Reform, 2014)