

Assessing the physical characteristics of medium density mixed housing in South Africa

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Abstract

The new housing plan in South Africa promotes the development of medium density and mixed housing developments. The nature and organisation of the physical characteristics of this type of housing has been identified as one of the key factors that could influence the success of these developments. However, while there is a growing need for empirical research in the built environment discipline, there are very few tools or methods for measuring the built environment, especially in terms of the physical design characteristics. In order to address this, a housing measurement tool was developed for assessing the physical characteristics of selected medium density mixed housing developments and determine medium density mixed housing's relevance for the implementation of the housing plan. It was found that the tool provides a useful mechanism to built environment professionals to assess the physical characteristics of these housing types.

'N ONDERSOEK AANGAANDE DIE FISIESE KARAKTEREIEKAPPE VAN MEDIUM DIGTHEIDS, GEMENGDE BEHUISING IN SUID-AFRIKA

Die nuwe behuisingsplan in Suid Afrika ondersteun die ontwikkeling van medium digtheid, gemengde behuising. Die aard en organisering van die fisiese karakteristieke van hierdie tipe behuising is geïdentifiseer as een van die sleutel faktore wat die sukses van hierdie tipe ontwikkelings kan beïnvloed. Tog, ten spyte van 'n groeiende behoefte vir empiriese navorsing in die dissipline van die beboude omgewing, is daar baie min instrumente of metodes om aspekte daarvan te meet, veral dié wat verband hou met die fisiese karakteristieke. 'n Behuisingsmaatstaaf of instrument is ontwikkel om voornemende mense in staat te stel om mediumdigtheids gemengdebehuisingprojekte te kan evalueer en die projekte se waarde te bepaal vir die implementering van die nuwe behuisingsplan. Daar is bevind dat die instrument van waarde is om mense vanuit die beboude omgewingprofessies behulpsaam te wees in die evaluering van die fisiese eienskappe van hierdie tipe behuising.

TEKOLO YA DIKAROLO TŠA MENGWAKO YA GOLEKANELA EBILE E TSWAKANYA BATHO BA GOFAPAFAPANA MO AFRIKA BORWA

Leano le leswa la mengwako mo Afrika Borwa le hloholetša kago ya mengwako ya golekanela ebile e tswakanya batho ba gofapafapana ka gare ga kagokgolo e tee. Sebopogo le peyakanyo ya dikarolo tša mohuta wo wa mengwako dišupilwe goba le khuetšo e kgolo mo go atlegeng ga mohuta wo wa mengwako. Efela, gona le hlokagalo ye kgolo ya dinyakišišo gošwa lefapheng ladithuto tša boagi. Dinyakišišo tše bjalo di ka utulla bohlatse bja mmakgonthe lefapheng lena. Kateko le phišego ya go araba hlokego yena, sedirišwa sa golekanyetša le golekola go šoma ga dikarolo tša mengwako ye ekgwethilweng ya mohuta wona se ile sa agiwa. Gape go lekola gore sedirišwa se se loketše morero mokgolo wa polane kgolo ya kago ya dintlo monageng. Dipoele tša dinyakišišo di laediše gore sedirišwa se gobolelwang ka sona se bohlokwa ka kudu go batho ba lefapha le la meakgo gobane sekgona go lekola go šoma ga dikarolo tša mohuta wona wa mengwako.

1. INTRODUCTION

It has often been argued that the gap between policy-makers and designers, and between designers and end-users has become greater and that buildings and urban places have increasingly failed to meet the needs of users, both for themselves and the well-being of their communities and cities (Lawrence, 2004; Lawrence & Despres, 2004; Burton, Weich, Blanchard & Prince, 2005). Consequently there has been an increased focus on sustainable development to prevent negative impacts on the environment and increase the quality of life and well-being of people, especially in large urban areas. As the quality of life of people in cities is closely linked to the quality of the built environment, there is a growing need for empirical research in the built environment discipline.

Acknowledging this relationship between quality of life and the built environment, recent planning policies (including the *Development Facilitation Act*, 1995 and the *White Paper on Spatial Planning and Land Use Management*, 2001) promote the development of sustainable settlements in South Africa, with a particular emphasis on integration and densification. The current housing plan and strategy in South Africa, outlined in *The Comprehensive Plan for the Development of Sustainable Human Settlements* (2004) or more commonly known as 'Breaking New Ground' (BNG) also reinforces the vision of government "to promote the achievement of a non-racial, integrated society through the development of sustainable human settlements and quality housing" (South Africa. Department of Housing, 2004: 7). This is to be achieved through seven objectives, namely (1) stimulating the residential property market, (2) spatial restructuring, (3) social (medium-density) housing, (4) informal settlement upgrading, (5) institutional reform and capacity building, (6) housing subsidy reform, and

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(7) housing and job creation. BNG advocates a greater degree of demand responsiveness, which requires a greater differentiation in the types, mechanisms and localities of housing delivery. It suggests moving from a 'commoditised focus of housing delivery toward more responsive mechanisms which addressed the multi-dimensional needs of sustainable human settlements' (South Africa. Department of Housing, 2004: 8). This plan should furthermore respond to the needs of communities though:

a diversified range of support measures which are able to accommodate qualification and affordability variations, tenure preferences and investment priorities. There is also a need to stimulate the supply of a more diverse set of housing environments and settlement types through greater choice of housing types, densities, location, tenure options, housing credit, and delivery routes ... (South Africa. Department of Housing, 2004: 8).

Sustainable human settlements are broadly defined in BNG as:

well-managed entities in which economic growth and social development are in balance with the carrying capacity of the natural systems on which they depend for their existence and result in sustainable development, wealth creation, poverty allocation and equity (South Africa. Department of Housing, 2004: 11).

In line with this, the present and future inhabitants of sustainable settlements should:

live in a safe and secure environment and have adequate access to economic opportunities, a mix of safe and secure housing and tenure types, reliable and affordable basic services, educational, entertainment and cultural activities and health, welfare and police services (South Africa. Department of Housing, 2004: 12).

Land utilisation is thus to ensure "compact, mixed land use, diverse, life enhancing environments with maximum possibilities for pedestrian movement and transit via safe and efficient public transport..." These sustainable settlements should also contribute towards 'greater social cohesion and ... crime prevention' (South Africa. Department of Housing, 2004: 11-12). A number of focus areas are therefore identified to support spatial restructuring, including a

focus on spatial and social integration and densification, through among others the development of medium-density mixed housing.

All of these illustrate the belief that the built environment can have a significant influence on people's quality of life. This, however, poses a number of challenges to policy-makers, designers and developers as they need to know what built environment characteristics are likely to work and how in terms of satisfying sustainability and other requirements such as integration and densification. For example, while the benefits of and need for medium-density and mixed housing are widely proclaimed internationally (including Turner, Hewitt, Wagner, Su, & Davies, 2004; Berube, 2005; Baily, Haworth, Manzi, Paranagamage & Roberts, 2006, Tunstall & Fenton, 2006), a number of concerns remains about a lack of sufficient research to support some of the assumptions, especially related to the benefits of spatial and social mix or those of gentrification (Smith, 1996; Schwartz & Tajbakhsh, 1997; Cole & Goodchild, 2001; Damaris, 2004; Tiesdell, 2004; Atkinson, 2006; Slater, 2006; Roberts, 2007; Lees, 2008). For example, Tiesdell (2004) points out that a range of micro-design issues can sometimes subvert the macro-design strategy and also questions whether 'mixed developments' will always create 'mixed communities'. Roberts (2007) investigated this further and found that a variety of designs could facilitate successful mixed communities, provided that the layout draws on locally established principles of urban design and that no stigma can be attached to the social housing through its appearance. In general, however, there is limited research to substantiate some of the design claims made about the impacts of medium density mixed housing and to guide the development of design guidelines for specific contexts. According to Burton *et al.* (2005), the main reason for the limited research is that there are very few tools or methods for measuring the built environment, especially in terms of the physical design characteristics.

This article identifies the requirement of tools to measure the physical characteristics of medium density mixed housing in the South African context. The nature of the spatial measurement tool is described as well as its application in a number of initial case studies on medium density mixed housing in the country. The final section considers

the impact of the findings from the case studies for the implementation of BNG in South Africa.

2. REQUIREMENTS OF A SPATIAL MEASUREMENT TOOL

The organisation and nature of the physical characteristics of housing, including design and layout, have been identified as a critical success factor for medium density mixed housing developments. The recognition of the relevance of urban design principles in the design of medium density and mixed housing developments is well established in the literature (Llewellyn-Davis, 2000; Turner *et al.*, 2004), as is the importance of good design to the success of these projects (Davis, 1977; Tiesdell, 2004; Roberts, 2007). This includes both the design of the buildings and that of the entire site and immediate surroundings, i.e. the urban design. Empirical research on medium density mixed housing identifies a range of individual design aspects that are said to contribute to more successful developments. However, many of these are often very context-specific and may not be relevant or applicable in other types of contexts, for example, in developing countries such as South Africa, with high levels of violent crime (Burger, 2007), a culture of fear (Dirsuweit, 2002), and a tradition of segregated development (Swilling, 1991). Given this, there is a need to identify which physical characteristics would be relevant and applicable in medium density mixed developments in South Africa.

Research on housing has tended to focus on non physical housing characteristics of housing, such as tenure and affordability (Burton *et al.*, 2005). According to Turner (1976), housing can be considered as both a product (from individual housing unit to housing stock in a neighbourhood or city) or as a process (referring to the provision and maintenance of various residential buildings by public authorities, intermediaries, private entities or end-users). Lawrence (2004) points out that this definition of Turner enables researchers and practitioners to consider the multiple interrelationships between housing conditions and human processes in precise localities. In this way, the residential environment can be considered as a complex set of physical structures and processes that are mutually defined supply (property owners, public authorities, standards)

and demand (residents, building users, owners) at various geographical scales (unit, site, neighbourhoods) at different times. The demand and supply is continuously influenced by socio-geo-and political factors influencing a particular housing market (Lawrence, 2004: 294). Urban and housing environments are complex environments and hence there is a need to address the whole housing environment, including the physical characteristics of dwellings and the wider environment (Lawrence, 2004; Burton *et al.*, 2005; Minnery & Lim, 2005).

Research on the physical characteristics of housing and even empirical research in the built environment in general is hampered by the lack of a reliable tool to measure the physical characteristics of housing developments. Given this, there is a need for a built environment and specifically housing spatial performance measurement tool that is objective, descriptive, comprehensive, reliable and practical and that address several scales (Burton *et al.*, 2005). However, challenges for empirical research and in particular for such a tool in the built environment include the dangers of sacrificing subjective and qualitative elements at the expense of more quantifiable ones (Burton *et al.*, 2005). Utilising mixed methods for built environment research could address this challenge (Amaratunga, Baldry, Sarshar & Newton, 2002). A mixed research strategy refers to a methodological approach to research that combines the use of qualitative and quantitative research in one project. There are different options related to various combinations and these have implications for the research design and procedures, i.e. whether to mix qualitative and quantitative methods within or across the stages of the research process (mixed model) or the inclusion of a quantitative phase and a qualitative phase in an overall research study (mixed method) (Johnson & Onwuegbuzie, 2004). This would imply that a measurement tool incorporate both a qualitative and quantitative approach.

3. DEVELOPMENT OF A SPATIAL HOUSING MEASUREMENT TOOL

3.1 Project context

The housing measurement tool reviewed in this article was researched and developed as part of a broader multi-year CSIR research project. The overall aim of the research was to

determine the appropriateness and applicability of medium density mixed housing developments in South Africa. Two important subsidiary objectives were to (1) determine the factors that various stakeholders consider to be necessary for medium density mixed housing to be successful in this country and (2) to determine whether these factors can be successfully achieved in South Africa. The initial phase of the project involved a series of interviews with key role-players to get an understanding of the situational analysis surrounding housing delivery and quality environments in South Africa, as well as to identify emerging issues, gaps and key questions for further investigation. In addition, a few site visits were undertaken to flagship projects to identify the key issues in their development. This was followed by a detailed desk top review of international literature that identified key trends, patterns and lessons regarding medium density mixed housing developments. Part of the literature review also included a brief overview of current housing practices and policies in South Africa (Landman, Ntombela & Matsebe, 2007).

The findings of the literature review contributed to the development of a working definition of medium density

and grouped into five categories, namely positive perceptions, affordability, location, design and layout, safety and security, and neighbourliness. These three main layers are inter-related and co-dependant and so are the various issues that comprise each of them. It was therefore, necessary to consider these levels and their components in a holistic approach to recognise their relationships and the impact that they can have on each other (for more details see Landman & du Toit, 2008).

The methodology comprised multiple case studies utilising mixed methods. The case studies included two components, namely investigating the context (socio-spatial environment) and understanding the views of key stakeholders (residents, developers, financiers and housing officials). A number of research components, methods and tools were used to investigate these issues (Figure 1). In this article we focus only on one component namely the physical context and describe the findings from the spatial analysis as obtained through the spatial analysis or housing measurement tool. The remaining part of this section briefly outlines the details of the measures used for the spatial analysis, namely what was measured, where and how.

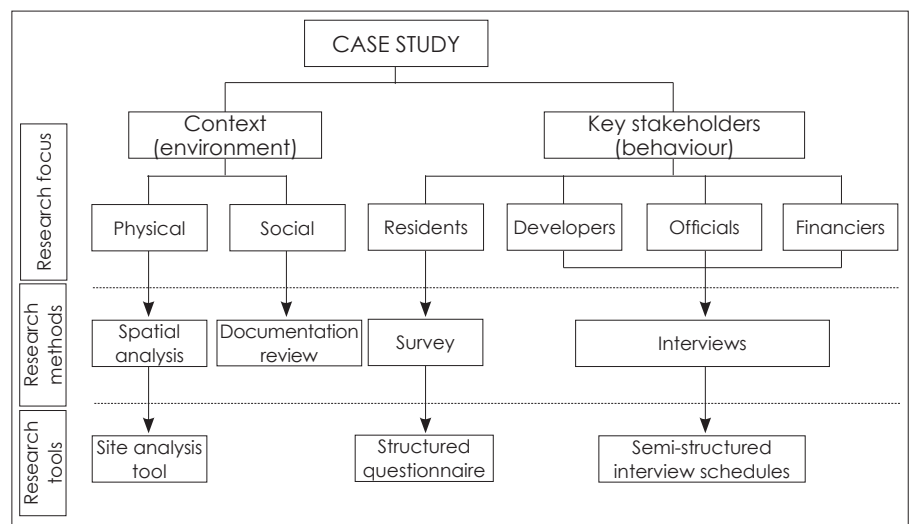


Figure 1: Relationships between research focus areas, methods and tools

mixed developments (see below) and a conceptual framework for understanding and analysing medium density mixed housing, as well as a methodology to guide further research. The framework consists of three main layers, namely critical success factors, enabling environment and the relation of these two layers to the creation of sustainable human settlements. A number of critical success factors have been identified

3.2 Case studies on 'medium density mixed' housing

Despite the increased occurrence of 'medium density mixed housing internationally, there is no common definition of this type of' housing development. For the purpose of the CSIR study it broadly includes housing developments that have a minimum of 50 du/ha and a maximum of 125 dwelling units per hectare (du/ha) and are generally

characterised by all or a number of the following aspects: ground level entry to each unit; dwelling type with private, external space, such as a small private garden, patio or balcony; dwelling type with direct or close proximity to secure parking; and ground related, i.e. not more than 3 – 4 storeys above ground. Mixed housing refers to developments that have all or most of the following characteristics: mix of building and/or dwelling / unit types; mix of tenure forms; mix of income groups (facilitated by for example affordable¹ and market-rate housing in the same development); and a mix of land uses.

The CSIR conducted two pilot case studies in Johannesburg to test the methodology developed in response to the research questions and objectives. These cases confirmed that the methodology was suitable to study medium density mixed housing in South Africa and that the selection criteria (namely that they encompass a medium density and various forms of mix [with at least two of the four] within a low-rise development) were appropriate. The CSIR research team then selected a number of additional case studies across the country (focus of this article) to investigate the appropriateness and relevance of medium density mixed housing in South Africa. These case

studies vary in nature and size, but all adhere to the selection criteria. The key characteristics relate to location, number of units and forms of mix of the case studies are summarised in Table 1.

From the selection of case studies it is evident that 'medium density mixed housing' can differ quite extensively in practice in terms of size, built form and types of mix involved. The size of the projects were therefore not the critical determinant and selected projects included smaller mixed housing developments contained on less than an urban block (Amalinda and Sakhasonke) ranging to larger developments that comprise of a number of blocks (Hull Street) or an entire neighbourhood (Pennyville). Similarly, the housing model was also not critical, but rather what various models would facilitate, for example a mix of tenure types through a mix of social and RDP housing in one development.

3.3 Components of the tool

The housing measurement tool comprised a standard list of items to be discussed and rated. The tool was structured according to a set of principles and measures to assess the physical characteristics of medium density mixed housing projects in South Africa. These principles and measures were derived from international and local research

and policies on medium density mixed housing. Table 2 lists the principles and the items included under each principle, along with the main reasons why they were considered to be worth measuring. Particular efforts were also made to include issues listed in South African policy documents (including BNG) and other relevant local publications (including Senior, Wood & Walker [1988] and Poulsen & Silverman [2005]).

Table 1: Selected case studies

Projects	Location & Municipality	No of units and built form	Types of Mix
Amalinda	Buffalo City Municipality	77 du/ha (598 units) Three and four storey walk-ups with loft rooms on the top floor in some cases	Mixed units Mix tenure Mixed income (facilitated by various sizes of units) Mixed land use (limited)
Hull Street Project	Sol Plaatjie Municipality	Phase 1 - 375 units All 4 phases - 2200 units Social Housing (semi-detached and attached single and double storey units), Bonded houses (planned)	Mixed units / buildings Mixed tenure Mixed land use (zoned) Mixed income (facilitated by various sizes of units)
Pennyville	City of Johannesburg	84 du/ha (2800 units) Social housing (double-storey walk-ups) RDP (Semi detached houses) Bonded (4 storey walk-ups in clusters)	Mixed units / buildings Mixed tenure Mixed income groups (facilitated by market-rate & affordable housing) Mixed land use (limited)
Sakhasonke	Nelson Mandela Bay Metropolitan Municipality	69 du/ha (337 units) Semi-detached, duplex RDP houses in building blocks of two and three units	Mixed units / buildings Mixed land use (limited)

¹ There is currently very little supply of housing for those households earning between R3 500 and R8 000 in South Africa. These households do not qualify for a housing subsidy, yet are unable to afford housing in the market. House price data indicates that the cheapest house, or formal market entry level housing, exceeds R200 000, requiring a monthly income of over R11 000 on a loan instalment of R3 400. This gap in the housing market is known as the 'housing gap' (Rust, 2008) and housing built to address this market is referred to as 'gap housing'. Housing that would be affordable to this income group, is generally regarded as affordable housing in South Africa.

Table 2: Principles and items included in the housing measurement tool

Principles	Items	Justification	Source
Integration	Mixed housing types (units and/or buildings)	Promotes greater choice and housing diversification, and offers opportunities to move within the same development as household needs change, while maintaining social networks.	Llewellyn-Davis (2004); CABE (2006); Baily <i>et al.</i> (2006); Senior <i>et al.</i> (1988); Dewar & Uytenbogaardt (1991); South Africa. Department of Housing (2004).
	Mixed income groups and tenure options (variety of price options)	Increases affordability, may be able to attract and support a higher level of services, facilities and a variety of shops and may reduce negative area effects.	CABE (2006); Tunstall & Fenton (2006); Baily <i>et al.</i> (2006); South Africa. Department of Housing (2004);
	Mixed social groups (ethnicity, age, race, & religion)	Creates greater opportunities for social and spatial integration and social interaction between various groups.	Brophy & Smit (1997); Berube (2005); Baily <i>et al.</i> (2006); South Africa. Department of Housing (2004).
	Mixed land use	Enables more convenient access to facilities, opportunities for socially diverse communities, a greater feeling of safety, more efficient use of space and buildings, greater consumer choice, lifestyle and location, improved urban vitality and street life and increased viability of urban facilities and support for small businesses.	Jacobs (1961); Wekerle & Whitzman (1995); Llewellyn-Davis (2000); Llewellyn-Davis (2004); Minnery & Lim (2005); CABE (2006); Baily <i>et al.</i> (2006); Poulsen & Silverman (2005); South Africa. Department of Housing (2004).
	Proximity to public transport, services and facilities	Minimising transport costs and travel-to-work congestion, reducing the distance pedestrians have to walk, influencing social interaction and well-being in a positive way.	Llewellyn-Davis (2000); CABE (2006); Dewar & Uytenbogaardt (1991); South Africa. Department of Housing (2004).
Accessibility	Safe routes for pedestrians and cyclists	Providing a greater choice in how to make journeys, contributing to more vibrant environments, increasing "eyes on the street" - enhancing safety, allowing opportunities to facilitate "bumping into strangers" that would enhance social cohesion.	Jacobs (1961); Llewellyn-Davis (2000); Llewellyn-Davis (2004); Minnery & Lim (2005); CABE (2006); Baily <i>et al.</i> (2006); Roberts (2007); Dewar & Uytenbogaardt (1991); Kruger, Landman, & Liebermann (2001); South Africa. Department of Housing (2004).
	Type of access (visible and legible)	Promoting integration and safety through multiple access points and increasing the convenience of movement spaces.	Lynch (1979); Jacobs (1961); Coleman (1985); Kruger <i>et al.</i> (2001).
	Resource efficiency (related to use of land, materials and energy)	Maximising land costs and increasing levels of affordability, reducing the use of scarce resources and enhancing energy efficiency through the use of appropriate materials and alternative technologies.	Llewellyn-Davis (2000); CABE (2006); South Africa. Department of Housing (2004).
Efficiency	Medium-density, scale, height, form, variety	Reducing costs of land acquisition and site infrastructure, avoiding costs of lifts, forming terraces or low rise apartments (one of the most cost effective building forms in housing), and increasing energy efficiency and the ability of units to be orientated for passive solar gain, increasing potential to create a sense of identity.	Llewellyn-Davis (2000); Turner <i>et al.</i> (2004); Llewellyn-Davis (2004); CABE (2006); Baily <i>et al.</i> (2006); Senior <i>et al.</i> (1988); Poulsen & Silverman (2005); South Africa. Department of Housing (2004).
	High quality buildings	Reducing social stigma and maintenance costs, increasing acceptability and reducing fear of crime and unsocial behaviour.	Llewellyn-Davis (2004); Tiesdell (2004); Turner <i>et al.</i> (2004); CABE (2006); Roberts (2007).
Image and aesthetics	High quality open spaces and facilities (related to the nature and maintenance of common spaces and facilities and amount of greenery).	Promoting social interaction, reducing maintenance costs, increasing feelings of safety and security, encouraging more frequent use, creating a positive perception of and enhancing the image of the development.	Town, Davey & Wootton (2004); Llewellyn-Davis (2004); Tiesdell (2004); Turner <i>et al.</i> (2004); CABE (2006); Roberts (2007).
	A 'sense of place'	Turning housing projects into desirable places, improving neighbourhood quality and introducing an element of diversity to identify 'distinctive places'.	Llewellyn-Davis (2000); Housing Corporation (2003); CABE (2006).

Table 2: Principles and items included in the housing measurement tool (cont.)

Principles	Items	Justification	Source
Surveillance	Clear visibility and opportunities to overlook common spaces	Streets that are overlooked by homes have been found to feel and be safer. This reduces opportunities for crime and increases crime reporting.	Town et al. (2004); Llewellyn-Davis (2004); CABE (2006); Kruger et al. (2001).
	Demarcation between public and private areas	Clearly defined and purposeful spaces support legitimate activity and indicate legitimate 'ownership', for the public, specific housing residents or a household.	Jacobs (1961); Town et al. (2004); Llewellyn-Davis (2004); Kruger et al. (2001).
Ownership and territoriality	Sufficient level of privacy (private outdoor spaces, sound isolation and visual privacy).	Private spaces for units offer secure places for the household to relax on its own and have been identified as key issue for successful medium density mixed housing.	Sorenson, Walsh & Myhre (1998); Llewellyn-Davis (2004); Turner et al. (2004); CABE (2006).
	Visibility	Permeable fences allow opportunities for surveillance and interaction based on what is observed, if necessary.	Sorenson et al. (1998); Llewellyn-Davis (2000); Llewellyn-Davis (2004); Town et al. (2004).
	Good quality barriers	The standard of the barrier has an impact on the level of security and the image.	Llewellyn-Davis (2004).
Target hardening and access control	Good quality of locks	The standard of the locks used has an impact on the level and feeling of security.	Llewellyn-Davis (2004).

3.4 Assessment methods

The spatial analysis tool was designed to be applied [that is the projects inspected and rated] by built environment professionals or post graduate built environment students. The five housing areas (case studies) were rated on site by CSIR researchers and post-graduate students from the University of Pretoria and one checklist was used for each project. The data were collected in 2008.

In order to apply the tool to measure the degree to which each principle had been applied in practice in each particular case study location, a system was developed that involved working down a particular hierarchy from principles to broad measures to performance measures and finally to scale measures. A similar system was used in Australia to measure the incorporation of Crime Prevention through Environmental Design (CPTED) in the Gold Coast and was found to work well in practice (Minnery & Lim, 2005). This system was then adapted to be applicable to medium density mixed housing in South Africa, based on the principles derived from studies in the literature reviewed.

For each of the seven principles, more concrete measures were developed based on the items listed in Table 2. The measures identified what the principle meant in practice, for example, 'efficiency' in practice meant that

there should be a number of physical characteristics to facilitate greater resource efficiency and medium residential density. For each measure, one or more performance measures were developed to which specific measurable indicators could be attached. For example, greater resource efficiency in turn would be dependent on (1) use of land, (2) use of building materials, (3) energy use / design for the local climate, and (4) recycling of waste materials. Each performance measure was then operationalised through a series of scale measures. The scale measure was standardised so that it ranged from 1 (lowest) to 3 (highest). The progression through this hierarchy of measurement determinants and indicators is illustrated in Table 3 using the principle of 'Integration'. The tool was piloted in the two case studies and adapted where necessary.

One of the advantages of the tool is that it accommodates both a qualitative and quantitative method of assessment. Making use of the principles and measures as guidelines, the 'notes' column provides room for a more descriptive interpretation of the incorporation of the principles in practice. At the same time, making use of the scale measures to rate the performance of the housing developments facilitates a more objective and comparative assessment through a systematic rating system.

4. FINDINGS FROM THE PROJECTS AND ITS IMPLICATIONS FOR BNG

4.1 Incorporation of the principles in the case studies

This section provides a brief discussion of the incorporation of the principles in the case studies. The first part offers a qualitative assessment of the incorporation of the principles (through a narrative of each of the principles), while the second offers a quantitative assessment.

4.1.1 Qualitative assessment

The aim of this discussion is not to offer a comprehensive discussion of the spatial principles, but rather to indicate the application of the spatial analysis tool to guide the qualitative assessment of the incorporation of the various principles in the various medium density mixed housing projects.

4.1.1.a Integration

Integration can be achieved through a well-integrated mix of adequate houses of different types, tenure and price in a defined geographical area to support a range of household sizes, ages and income groups in close proximity to well-functioning services and facilities. This implies the incorporation of mixed land use in the area. Designers of mixed land use projects should however be mindful that mixed land uses are compatible

Table 3: Example of the process to derive performance measures and scale measures for each of the principles aimed at facilitating spatially well-performing medium density mixed housing

Principle	Measure	Performance measure	Scale measure	Notes	
Integration	Mixed housing types (units and/or buildings)	Various sizes of units	All units or buildings are exactly the same.	1	
			Two types of different units and/or building types.	2	
			A range of different units and/or building types.	3	
		Various levels of finishes inside the units	All units are finished-off or painted in the same way.	1	
			Two types of finishes available for different price options.	2	
			A range of levels of finishes available from luxury apartments to affordable units.	3	
	Mixed income	Various levels of income groups living in close proximity (in same development)	People from various levels of income sharing the same development.	1	
			People from various levels of income sharing the same building.	2	
			People from various levels of income sharing the same corridor.	3	
	Mixed social groups (social heterogeneity)	People from various ages / backgrounds living in close proximity (social and spatial mix)	People from various social backgrounds (age/race/religion) sharing the same development.	1	
			People from various social backgrounds sharing the same building.	2	
			People from various social backgrounds sharing the same corridor.	3	
	Mixed land use	Compatible uses	Most of the land uses are not compatible with each other.	1	
			Certain land uses are not compatible with each other.	2	
			All uses in the development / area are compatible.	3	

with each other¹. All five case study projects have a well integrated mix of units. Some form of mixed building types, tenure and price options are present in some of the projects. For instance, Amalinda has a mix of building types and four types of dwelling units. The development consists of a number of a mixed units and building types. In total the project has 598 units, with a variety of unit sizes varying from 31m² to 51m² per unit, accommodated in various unit designs and building forms (Figures 2 and 3). These different types of housing units cater for a range of needs of a mixed income tenancy.



Figures 2 & 3: A variety of unit and building types in Amalinda, including three- and four storey walk-ups
Source: Landman, 2008

In Pennyville, income mix is facilitated through the provision of market-rate (bonded) houses, affordable housing (FSC³) and RDP houses in the same development.

4.1.1.b Accessibility



Figures 4 & 5: A variety of building types in Pennyville, including double (left) and single storey (right) semi-detached RDP houses.
Source: Landman, 2008

This refers to places with well-defined routes for various modes (vehicles, pedestrians and cyclists) and spaces that are easy to approach or enter through the provision for convenient movement without compromising safety and security. It also refers to an environment where basic services, infrastructure,

amenities and facilities are available in close proximity or obtainable through various modes of transport. All five of the case studies are on well-located sites close to a range of social and economic opportunities or close to public transport facilities. Access to public transport in Amalinda is facilitated with mini-bus taxis that drive through the development, while Pennyville is located opposite a major train station with a number of taxi ranks within walking distance. The Highgate shopping centre and other services such as schools are located in the surrounding areas. The smaller or more compact



4.1.1.c Efficiency

This refers to places that strike a balance between the natural and man made environment and utilise each environment's intrinsic resources, as related to the climate, landform, landscape and ecology – to maximise energy conservation and amenity. Efficiency would therefore imply buildings that can meet different needs over time, sufficient in size, scale and density and the appropriate design to support basic amenities in the development or neighbourhood to ensure efficient use of land, materials and energy.



Figure 6: Pennyville crèche
Source: Landman, 2008

projects, for example Amalinda and Sakhasonke, have visible access points into the development that are overlooked by buildings, and some of these access points are controlled. Pennyville



The construction materials used in these developments are locally available and mostly have low to moderate levels of embodied energy. Materials range from steel and wooden framed windows and solid wooden doors to tiled and corrugated iron roofs. Some of the buildings or units are designed to save energy through passive solar design. This was observed at Amalinda, whereby many of the windows are facing north to allow winter sun into the units. It was also confirmed by the developer that the materials were obtained from local suppliers – reducing transport costs. Other projects incorporate even more advanced technologies such as solar water geysers. In Hull Street, the existing electrical geysers are in a process of being converted into solar geysers. In all the units at Hull Street, showers were installed instead of baths, in order to save energy and water, while urine diversion toilets were installed to save water. This is especially significant in the water-scarce environment of the Northern Cape.

comprise a much larger area and the various types of houses are clustered in different smaller precincts with access to transport facilities (e.g. a taxi or bus stop) and other facilities and amenities within the larger development such as schools, crèches and neighbourhood parks (Figure 6).

² Utilising mixed use in a development should not include uses that are not compatible, e.g. residential and heavy industrial or use that could provide opportunities for crime if located in close proximity, e.g. a school next to a shebeen.

³ FSC refers to the Financial Service Charter, according to which the leading banks in South Africa agreed to assist households earning between R3500 and R7500 per month with access to housing. This is also referred to as the "gap market", as mentioned before.

In most cases, the design of these developments also incorporated measures to achieve a human scale and environments that are pedestrian-friendly, including pedestrian paths, lower level lighting and well articulated building facades, for example through the use of colour variations in the façades of the buildings in Amalinda to indicate scale or pedestrian paths between the RDP houses in Pennyville. All of the developments provide a mix of densities through a variety of choice in terms of dwelling units, finishes, size, form, character and location.

4.1.1.d Image and aesthetics



Figure 7: Solar geyser installed in a Hull Street
Source: Matsebe, 2008



Figure 8: Urine diversion toilet and a shower in a Hull Street house
Source: Matsebe, 2008

This refers to a safe and healthy local environment with well-designed living, public and green space and physical features and landscaping designed with management and maintenance in mind. The units and buildings in most of the case studies are aesthetically pleasing with moderate to high quality finishes. In Amalinda, there is a colour variation in paint for both the interior and exterior parts of the buildings and units, which enhances the aesthetic appeal. Carpets have been used to cover the floors for other rooms and vinyl tiles are used in the bathroom and kitchen. All the units are fitted with a geyser underneath the hand basin in the bathroom. The use of moderate to high quality finishes is of significance

in adding value to the image of the development, which in turn attracts potential tenants, including slightly higher (lower-middle) income groups. In Pennyville, specific attention was given to the detailing of windows in the bonded houses, contributing to the aesthetic value of these houses. The houses in Sakhasonke (Figure 9) also boost the aesthetic appeal in that it gives careful attention to the painting (in various colours), variation of design and use of colour. In the Hull Street project, great attention was given to the aesthetic quality of the buildings and street appearance (Figure 10),



Figure 9: Character of the houses in Sakhasonke
Source: Matsebe, 2008



Figure 10: Character of the houses in Hull Street
Source: Landman, 2008

which contributes significantly to the creation of a distinctive sense of place.

4.1.1.e Surveillance

This refers to places where all publicly or commonly accessible spaces can be overlooked by residents, visitors or security personnel. The main route from the gate to unit entrance or most of the roads in the larger development is visible from the houses in most of the developments. In Sakhasonke, the main road is lined with units, ensuring clear visibility. Most of the doors and windows are placed in such a way that residents are able to see individuals entering or leaving the building or unit. The smaller common open spaces in the

development are also surrounded by houses, presenting increased opportunities for surveillance. The design and layout of all of the other projects also facilitate opportunities for surveillance over the common spaces outside.

4.1.1.f Ownership and territoriality

This refers to places that promote a sense of ownership, respect, territorial responsibility, and privacy and community, as well as effective engagement and participation of local people in maintenance of the physical infrastructure. It does not refer to ownership in the sense of a tenure option. In most of the developments, it is clear to users and visitors which spaces are public, communal, semi-private and private. This is especially evident at Sakhasonke, mainly due to the fact that most residents have low fences around their units (Figure 11). The boundaries between different types of spaces are signified in the most appropriate manner, such as units, paved footpaths, or common areas (play, seating and parking). In Pennyville, almost all of the housing types offer some form of private or semi-private outdoor space.



Figure 11: Low fences around houses in Sakhasonke demarcate private space and indicates ownership and allow opportunities for surveillance.
Source: Landman, 2008

4.1.1.g Target-hardening

Target-hardening refers to measures that enhance security and control access into an area without compromising any of the other principles, for example security locks, burglar bars on windows, security gates, and fences. Some form of target-hardening is present in all of the developments. Both Sakhasonke and Amalinda are surrounded by walls with one entry point into the development. Individual units are also often fenced in in Sakhasonke, as mentioned before (Figure 11). In the case of Pennyville, target hardening is only occasionally present in the form of fences or walls around individual

houses. In many cases the houses have no property walls or fences that demarcate private and public areas.

4.1.2 Quantitative assessment

As indicated before, the tool could also be used to measure the incorporation of the principles using a quantitative method. When applying the various 'scale' measures in the case studies, it was found that all of them incorporated the principles to a large extent, as indicated in Figure 12.

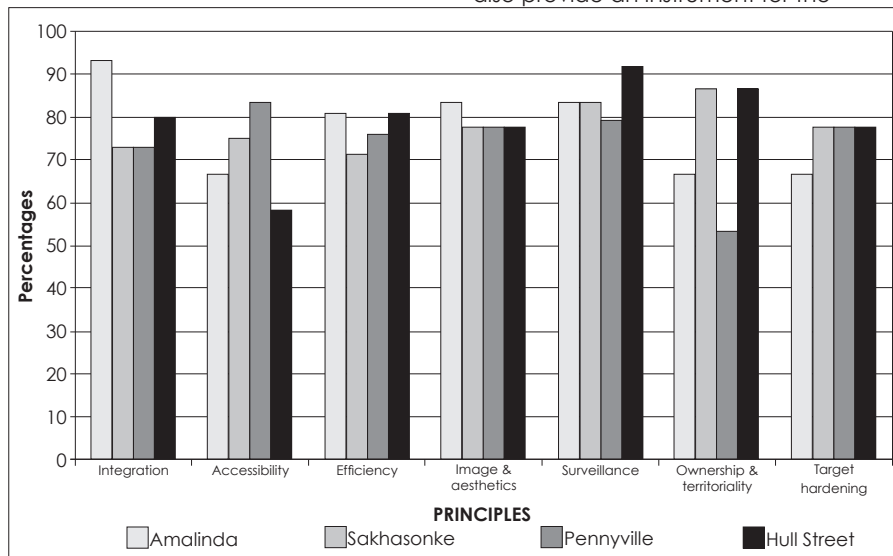


Figure 12: Percentages indicating various levels to which the principles have been incorporated into the housing developments.

4.2 Implications for the implementation of BNG

As mentioned before, it is important to note there are benefits and challenges associated to the implementation of medium density mixed housing developments. This form of housing should not be regarded as a *panacea* to address all the context-specific socio-spatial challenges, but it can offer one way of contributing to the creation of more integrated and sustainable human settlements in South Africa. The housing developments evaluated reinforce the vision contained in BNG that relates to the promotion of a non-racial, integrated society through the development of sustainable human settlements and quality housing and in particular through the implementation of medium-density mixed housing projects that facilitates integration and densification.

A review of the physical characteristics of these projects showed that the medium density mixed projects offer opportunities for utilising housing as an instrument for the development of sustainable human settlements in support

of spatial restructuring. These developments offer a more responsive mechanism to address the multidimensional needs of sustainable human settlements, including addressing diverse needs in terms of affordability variations, tenure preferences and investment priorities. The case studies illustrated that these types of projects stimulate the supply of a more diverse set of housing environments and settlement types through a greater choice of housing types.

Medium density mixed developments also provide an instrument for the

development of sustainable human settlements in support of spatial restructuring through other mechanisms such as the promotion of densification and integration, enhancing the location and nature of new housing products and developing social and economic infrastructure to enhance the entire living environment. Compared to the average density of around 25 – 30 du/ha (gross) for standard RDP houses on 216 m² plots, medium density housing offers densities that generally range between 50 – 125 du/ha. It can therefore increase the density, which has positive implications for development costs and affordability of households, offering the opportunity to more people to live on well-located sites and in high quality living environments through the provision of all or a number of the following aspects: ground level entry to the unit; dwelling type with private, external space, such as a small private garden, patio or balcony; dwelling type with direct or close proximity to secure parking; and ground related, i.e. not more than 3 – 4 storeys above ground.

Mixed developments also offer numerous opportunities for greater spatial and social integration through a mix of housing types, tenure options, income groups and land uses, as was evident from the case studies. The success of the inclusion of these mixes are directly related to the location and the nature of the design and layout of the development, through for example the nature and types of different dwelling units (size, shape, etc) or housing options and tenure models incorporated (e.g. bonded, credit-linked, RDP or social housing). The location of the projects also serves to assist with spatial restructuring by facilitating greater spatial integration in closer proximity, for example in the case of Pennyville. The improved location of medium density mixed developments also assist to provide more affordable housing options in closer proximity to primary municipal facilities such as parks, playgrounds, sports facilities, crèches, community halls, taxi ranks, police stations, clinics, trading facilities and employment opportunities, as was the case in all five projects. Where some of these facilities were not present in the immediate environment, the large scale development of mixed housing projects also allowed for the inclusion of many of these facilities, for example in Pennyville.

The design and layout of the medium density mixed developments contributed to the development of more appropriate settlement design and higher quality housing products to contribute to the improvement of the quality of the built environment and lives of the residents. This illustrates that it is possible to implement a variety of medium density mixed developments in South Africa and therefore achieve some of the physical aims and characteristics promoted in BNG.

4.3 Further questions and future research

As indicated before, the spatial analysis of the physical context only comprised one component of the broader CSIR project investigating the appropriateness and applicability of medium density mixed housing in South Africa. A large part of the project centres on an understanding of the views of various stakeholders (residents, housing companies/developers, housing officials and housing financiers) regarding the nature of relevant success factors for the implementation and occupation of medium density mixed housing in

South Africa. International studies have indicated that there are a range of perceptual and institutional barriers that hamper the development and demand for medium density and mixed developments (Schwartz & Tajbakhsh, 1997; CABE, 2006; California Roundtable, 2002; Haughey, 2005; Llewellyn-Davis, 2004; Tiesdell, 2004; Turner *et al.*, 2004; Atkinson, 2006; Roberts 2007). In addition, it has been pointed out that an assessment of the performance of the built environment or physical characteristics should ideally be supplemented with a household survey or broader social understanding of the experiences of key stakeholders (Raudenbush & Sampson, 1999; Weich, Burton, Blanchard, Prince, Sproston & Erens, 2001; Burton *et al.*, 2005). It therefore remains to further analyse the findings from the spatial analysis in relation to the findings from the household surveys and interviews conducted as part of the case studies to understand the views of the stakeholders regarding the importance of these spatial measures for the success of medium density mixed housing developments in South Africa. This, however, fell outside the scope of the present article.

In addition, there is also a need to expand the scope of the research on medium density mixed housing in South Africa to look at a range of income variations, spatial options and likely income thresholds that would support the implementation of successful projects. For example, it may be feasible to combine low income households with lower medium income groups (affordable housing), but not with higher income groups. Similarly, it may be possible to incorporate various ranges of middle income groups in one development, for example in typical South African townhouse complexes or clusters where various households may earn a range of total household incomes, yet choosing this type of development for various reasons. In these cases, the cost of the house may constitute various proportions of their total household incomes. Finally, it may be possible to incorporate middle to higher income groups in one development, for example in a few luxury estates that incorporate cluster housing and larger houses on a single plot in one development.

5. CONCLUSION

This article introduced a tool to measure the physical characteristics of medium density mixed housing developments in South Africa. The findings suggest that it is both possible and feasible to describe and rate the characteristics of the built environment in an urban setting independent of the residents' perceptions that may be subjective. It was found that the tool provides a useful mechanism to built environment professionals to analyse the physical characteristics of these types of housing. The tool furthermore facilitates a qualitative and quantitative (mixed) approach and therefore allows for a descriptive and objective assessment that is comprehensive and practical.

In addition, it also offers a way to confirm the spatial relevance of these projects for the implementation of some of the physical aims outlined in BNG, including to support the creation of more sustainable human settlements through the provision of greater choice in terms of housing options and types, increase urban densities and a more compact urban form through a focus on medium density housing, facilitating a greater mix of land use, tenure options and income groups in close proximity and thus enabling greater spatial and social integration in practice. In this way, some developers, housing agencies, planners and designers and municipalities, are starting to utilise medium density mixed housing projects as an instrument in support of spatial restructuring. This was illustrated through a number of case studies of medium density housing projects in South Africa and the incorporation of all seven principles in the organisation and nature of their physical characteristics. Although this type of housing is not yet mainstreamed, it was found that those projects that were assessed performed well spatially. It also showed that medium density mixed housing can differ in practice in terms of size, built form, densities and types of mixes, while still including all the principles to various degrees.

The spatial analysis or housing measurement tool has relevant potential. With further refinement, the measures could be used to investigate, through empirical research, the impact a specific type of housing can have on various urban aspects such as improved urban performance or social interaction, the quality of life of urban residents and ultimately, together with other tools and measures, assess the contribution

of different housing forms to urban sustainability. The tool could also be used to generate more informed design guidance based on empirical research, as well as assess proposals or plans for new developments or redevelopments. In this way, the tool could start to bridge the gap between policy-makers, designers, developers and end-users and thus, albeit in a small way, contribute to the creation of a higher quality of environments in South African cities.

REFERENCES

- AMARATUNGA, D., BALDRY, D. SARSHAR, M. & NEWTON, R. 2002. Quantitative and qualitative research in the built environment: application of 'mixed' research approach. *Work Study*, 51(1), pp: 17–31.
- ATKINSON, R. 2006. Neighbourhoods and the Impacts of Social Mix: Crime, Tenure Diversification and Assisted Mobility, UTAS: Housing and Community Research Unit, Paper 29.
- BAILY, N., HAWORTH, A., MANZI, T., PARANAGAMAGE, P. & ROBERTS, M. 2006. *Creating and sustaining mixed income communities: A good practice guide*. Published for the Joseph Rowntree Foundation by the Chartered Institute of Housing, UK.
- BERUBE, A. 2005. *Mixed communities in England: A US perspective on evidence and policy prospects*. Joseph Rowntree Foundation, York.
- BROPHY, C.P. & SMITH, R. N. 1997. *Mixed Income Housing: Factors for Success*. *Cityscape: A Journal of Policy Development and Research*, 3(2), pp. 3-31.
- BURGER, J. 2007. A Golden Goal for South Africa - Security arrangements for the 2010 FIFA Soccer World Cup. *SA Crime Quarterly*, No 19, pp.1-6.
- BURTON, E., WEICH, S., BLANCHARD, M. & PRINCE, M. 2005. Measuring physical characteristics of housing: the Built Environment Site Survey Checklists (BESSC). *Environment and Planning B: Planning and Design*, 32(2), pp. 265-280.
- CABE (CENTRE FOR ARCHITECTURE AND THE BUILT ENVIRONMENT). 2006. *Better Neighbourhoods: Making Higher Densities Work*. Publication prepared by the Centre for Architecture and the Built Environment (CABE) and the Corporation of London by URBED, pp. 1-28.
- CALIFORNIA ROUNDTABLE. 2002. *Myths and Facts about Affordable and High Density Housing*. A report by California Roundtable, California Department of Housing and Community Development, pp. 1-11.

- COLE, I. & GOODCHILD, B. 2001. Social Mix and the 'Balanced Community' in British Housing Policy – A Tale of Two Epochs, *GeoJournal*, 51, pp. 351 – 360.
- COLEMAN, A. 1985. *Utopia on Trial: Vision and Reality in Planned Housing*. London: Hilary Shipman.
- DAMARIS, R. 2004. Discourses and Experiences of Social Mix in Gentrifying Neighbourhoods: A Montreal Case Study. *Canadian Journal of Urban Research*, 13(2), pp. 278-316.
- DAVIS, S. 1977. The House versus Housing. In: Davies, S. (Ed.). *The Form of Housing*. New York: Van Nostrand Reinhold, pp.1-39.
- DEWAR, D. & UYTENBOGAARDT, R. 1991. *South African Cities: A Manifesto for change*. Cape Town: Urban Problems Research Unit and Urban Foundation.
- DIRSUWEIT, T. 2002. Johannesburg: Fearful city? *Urban Forum*, 13(3), pp. 3-17, Jul-Sep.
- HAUGHEY, R.M. 2005. *Higher-density Development: Myth and Fact*. Washington DC: ULI-the Urban Land Institute.
- HOUSING CORPORATION. 2006. *Neighbourhoods and communities strategy*. London: Housing Cooperation.
- JACOBS, J. 1961. *The life and death of great American cities*. New York: Vintage Books.
- JOHNSON, R.B. & ONWUEGBUZIE, A.J. 2004. Mixed methods research: a research paradigm whose time has come. *Educational Researcher*, 33(7), pp. 14 – 26.
- KRUGER, T., LANDMAN, K. & LIEBERMANN, S. 2001. *Designing Safer Places: A Manual for Crime Prevention through Planning and Design*. Pretoria: South African Police Service & CSIR.
- LANDMAN, K. 2008. Pictures of Amalinda (Eastern Cape), Hull Street (Northern Cape), Pennyville (Gauteng) and Sakhasonke (Eastern Cape) as projects of medium density mixed housing in South Africa.
- LANDMAN, K. & DU TOIT, J. 2008. Case studies utilising mixed methods to research medium density mixed housing developments in South Africa, CSIR Report: Document Reference number: CSIR/BE/PSS/IR/2007/0015/B.
- LANDMAN, K., NTOMBELA, N. & MATSEBE, G. 2007. Medium density mixed housing developments: an overview of international and South African policies and practices, CSIR Report: Document Reference number: CSIR/BE/RIS/IR/2007/0079/B
- LAWRENCE, R.J. 2004. Housing and health: from interdisciplinary principles to transdisciplinary research and practice. *Futures*, 36(4), pp. 487 – 502.
- LAWRENCE, R.J. & DESPRES, C. 2004. Introduction. *Futures* 36(4), pp. 379 – 405.
- LEES, L. 2008. Gentrification and Social Mixing: Towards an Inclusive Urban Renaissance? *Urban Studies*, 45(12), pp. 2449-2470.
- LLEWELLYN-DAVIS. 2000. *Urban Design Compendium*. Prepared for English Partnership and the Housing Corporation.
- LLEWELLYN-DAVIS. 2004. *Safer Places: The Planning system and crime prevention*. UK: Latimer Trend & Company Limited.
- LYNCH, K. 1979. *The Image of the City*. Cambridge, MA: MIT Press.
- MATSEBE, G. 2008. Pictures of Hull Street (Northern Cape), as a project of medium density mixed housing in South Africa.
- MINNERY, J.R. & LIM, B. 2005. Measuring Crime Prevention through Environmental Design. *Journal of Architectural and Planning Research*, 22(4), pp. 330 – 341.
- POULSEN, L. & SILVERMAN, M. 2005. Design Strategies for the Densification of Low-Income Housing. School of Architecture and Planning, University of Witwatersrand. Paper presented at the Thirty-Third IAHS conference, 29 September 2005, University of Pretoria, South Africa.
- RAUDENBUSH, S.W. & SAMPSON, R.J. 1999. Ecometrics: towards a science of assessing ecological settings, with application to the systematic observations of neighbourhoods. *Sociological Methodology*, 29(1), pp. 1-41.
- ROBERTS, M. 2007. Sharing space: Urban Design and Social Mixing in Mixed Income New Communities. *Planning Theory and Practice*, 8(2), pp. 183 – 204.
- RUST, K. 2008. *Housing Finance in sub-Saharan Africa: Reflections from South Africa*, FinMark Trust.
- SCHWARTZ, A. & TAJBAKHSI, K. 1997. Mixed-Income Housing: Unanswered Questions. *Cityscape: A Journal of Policy Development and Research*, 3(2), pp. 71-92.
- SENIOR, B., WOOD, E. & WALKER, B. 1988. *A Housing Options Assessment Manual: A Decision-Making Framework for Assessing Housing Options and their density implications*. An Urban Foundation Study – Housing Policy Unit, Johannesburg.
- SLATER, T. 2006. The eviction of critical perspectives from gentrification research, *International Journal of Urban and Regional Research* 30(4), pp. 737-757.
- SMITH, N. 1996. *The new urban frontier: gentrification and the revanchist city*. London: Routledge.
- SORENSEN, S.L., WALSH, E. & MYHRE, M. 1998. *Crime Prevention through Environmental Design in Public Housing*. Prepared for the US Department of Housing and Urban Development (HUD), Washington DC.
- SOUTH AFRICA. DEPARTMENT OF HOUSING, 2004. *Breaking New Ground: A Comprehensive Plan for the Development of Sustainable Human Settlements*. Prepared by the National Department of Housing, Pretoria.
- SWILLING, M. 1991. Introduction. In: Swilling, M., Humphries, R., & Shubane, K. (Eds.). *Apartheid City in Transition*. Cape Town: Oxford University Press.
- TIESDELL, S. 2004. Integrating affordable housing with market-rate developments: the design dimension. *Environment and Planning B: Planning and design*, 31(2), pp. 195 – 212.
- TOWN, S., DAVEY, C.L., & WOOTTON, A.B., 2004. *Design against Crime: secure urban environments by design*. Salford: University of Salford.
- TUNSTALL, R. & FENTON, A. 2006. *In the Mix: A Review of Mixed Income, Mixed Tenure and Mixed Communities*. London: Published by Housing Cooperation, Joseph Rowntree Foundation and English Partnerships.
- TURNER, J. 1976. *Housing by People: Towards autonomy in the built environment*. New York: Pantheon Books.
- TURNER, D., HEWITT, J. WAGNER, C., SU, B. & DAVIES, K. 2004. A Report on Best Practice in Medium-Density Housing Design. Prepared for New Zealand Corporation: Unitec New Zealand.
- WEICH, S., BURTON, E., BLANCHARD, M., PRINCE, M., SPROSTON, K., & ERENS, B. 2001. Measuring the built environment: validity of a site survey instrument for use in the urban settings, *Health and Place*, 7(4), pp. 283 – 292.
- WEKERLE, G. R., & WHITZMAN, C. 1995. *Safe Cities: Guidelines for Planning, Design and Management*. New York: Van Nostrand Reinhold.