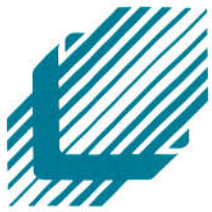
Development Bank
of Southern Africa



Urban densification through low-rise/ high-density housing :

Jorge L. Arrigone

B Shaw

Urban densification through low-rise/ high-density housing

Development Bank of Southern Africa

Centre for Policy, Information and Evaluation

Development Paper 66

April 1995

ISSN 1022-0127

ISBN 1-874878-32-3

Jorge L Arrigone

Price: R40.00

Mission of the Development Bank of Southern Africa

The Development Bank of Southern Africa is a development finance institution whose primary aim is to facilitate development and empower people in the region.

Acknowledgements

Comments made by members of the DBSA Urban Policy Programme Advisory Panel are gratefully acknowledged, especially the constructive and detailed input made by G Davies, P Goede, D Christianson and P du Plessis.

Useful suggestions about the general content and format of the reference table on generic dwelling-types, and other sections of the paper, were made by H Atkins. Thanks are also extended to the following persons: H Smit, J Hickfang and JC Nel of the City Planner's Department, City of Cape Town, for information and site visits; J Weaver and D van Wyk of Newhco West Cape, Cape Town, for the information, drawings and site visits organised; V Watson of the Urban Problems Research Unit, UCT, for valuable information; Prof D Dewar of the School of Architecture and Planning, UCT, for the interchange of ideas and general information; A Rendell of Development Action Group, Cape Town, for information; A Barbera of Newhco Transvaal for information and drawings; and finally to M Morkel of Settlement Dynamics, Johannesburg, for suggesting names of urban development and housing organisations in the Western Cape and Gauteng provinces.

Figures 1 and 2 are from Dewar et al, (1977 p.43,46). Figures 3, 4 and 5 from drawings provided by Newhco West Cape, Cape Town. The remaining figures in the main text and the Annexure C are based on information and drawings from the author's files. The figures were prepared under the supervision of M D Schonken DBSA Technical Services. Typing and formatting was patiently undertaken by Sandra Calitz.

Order this document from

Development Bank of Southern Africa
Publications Division
P O Box 1234
Halfway House, 1685
South Africa
Tel: (011) 313-3911
Fax: (011) 313-3086

Preface

One of the overwhelming facts of 20th century urban development has been the emergence of new decentralised urban forms. In many countries, the new city often does not have a defined urban core. Instead, urban growth spreads along main road corridors in low-density settlements that combine urban, suburban and semi-rural landscapes in a boundless collage.

In South Africa during apartheid, cities were often characterised by sprawl, low densities and segregation. This situation seriously impaired the economic performance of the country's cities and towns.

Against this backdrop, urban specialists and urban regional planners often agreed on the need to restructure the cities and their built environment. A consensus seemed to emerge that higher urban residential and building densities will provide more efficient cities.

This paper deals with urban densification and compaction low-rise housing. It informs the reader about how this can be achieved through the use of single or double storey dwellings on individual plots. Walk-up apartments on shared plots are not dealt with.

Hopefully this paper, prepared under the aegis of the DBSA Urban Policy Programme, will be a constructive contribution to the debate on urban development and shelter within the context of the Reconstruction and Development Programme.

GJ Richter
General Manager
Policy, Information and Evaluation

CS Heymans
Manager
Urban Policy Programme

Contents

1. Introduction

The urban planning legal framework developed during apartheid shaped the physical and socio-economic environment of South Africa's present urban structures. Segregation, poor urban economic performance, sprawl and low building densities characterise country's cities.

One of the major findings of the World Bank Urban Economic Mission, South Africa (1993:5) was the following: 'The spatial policies of apartheid in South Africa have introduced the most extreme form of spatial distortions which, one could arguably say, has not been observed in any other place in modern history. Such policy resulted in inefficient and inequitable cities with a "dual urban economic structure": (1) a central city with adjacent predominantly white suburbs, and (2) black "townships" surrounding the city in the periphery with a buffer zone of 10 to 20 kilometers in distance.'

South Africa presents an unique case indeed. While most of the Third World cities are overcrowded and require a reduction in residential densities, this country is calling for 'densification' and 'compaction' of its urban centres.

As Bloch (1994) explained: 'In the last couple of years, a consensus has apparently been reached by many of the actors and analysts who are concerned with South Africa's urban structure. This consensus revolves around the necessity for a thorough-going restructuring of the spatial structures and built environments of the country's cities.' The problems affecting the cities 'are now to be remediated by a spatial restructuring agenda which blends measures – these drawn from the repertoire of physical planning – to compact, densify and reintegrate the city'.

This debate continues as analysts explore options for integration and the extent to which these options necessitate compacting or not. This paper will not attempt to readdress these issues. Bearing in mind the intricacies of the debate, its emphasis is rather on how 'densification' would address spatial and poverty dilemmas in the context of low-income housing.

2. Purpose and target readership

This paper discusses urban 'densification' and 'compaction' issues, and quality of life resulting from low-rise/high-density housing. The aim is to offer the reader insight into the suitability of the low-rise/high-density housing approach in the South African context.

Special attention is given to single or double storey dwellings on individual plots as an appropriate means to achieve 'densification' and 'compaction' in this country.

The intended readers are those in government, private consultancies and non-governmental organisations (NGOs) who are in a position to influence the establishment of appropriate frameworks and institutional structures to implement urban 'densification' programmes. Furthermore, the paper should interest all those addressing practical issues of site planning and house design in low-rise/low-income housing.

3. Urban 'densification' and 'compaction' definitions

Urban densification implies an increase in residential density, that is the number of dwellings per hectare. Urban compaction implies an increase in building density, that is the total built residential floor area (usually expressed in square metres) per hectare.

In urban planning, densities may be expressed in terms of 'residential', 'building' and 'population' densities; each of these may be represented as 'gross', 'net' and 'real' densities. (Definitions on the above and on 'plot coverage' are given in Annexure B.)[1]

4. Factors influencing urban densification when new housing programmes or projects are prepared

Residential density mainly depends on factors related to

- physical planning and house design
  - residential plot size
  - site layout (grouping of residential plots)
  - topography and site conditions
  - appropriateness of dwelling-types used
- user acceptability
- statutory planning and building regulations.

4.1 Physical planning and house design

The size of the residential plot is the major factor influencing residential density. When single or double-storey dwellings are provided on individual plots, the natural approach to increasing residential density and reducing costs is to provide more plots on the same area of land, thus reducing plot size. There are low-rise/high-density housing projects in developing countries with plot areas as low as 35 m². In Aranya Township, Indore, India, which was planned in 1982 by the Indore Development Authority, a total of 6 500 residential plots were provided ranging in size from 35 m² for the lowest income groups, to 457 m² for the highest income groups. Of the 6 500 plots, about 65 per cent (ie 4 225 plots), were allocated to the former category (Mumtaz, 1988:24-5).

Several proposals have been made in South Africa to increase residential density through a reduction of plot sizes in greenfield low-income housing developments. For example, a proposal was made for Khayalitsha in the Western Cape Province (Van Niekerk et al, 1985:6) to provide 72 m² (6 m × 12 m) serviced plots and 'starter houses'. At a later stage, 98 m² and 120 m² serviced plots were provided in 1985 (in Town 1, villages 3 and 4) and in 1987 (in Town 2, village 3), respectively. Plots with a frontage of about 7 metres were allocated to private developers who built and sold dwellings on the open housing market. Some developers opted to build detached free-standing dwellings separated from plot boundary lines with unfortunate results: the close proximity of the housing structures with windows on both sides prevented minimum interfamily privacy and considerably reduced the open space for the on-plot needs of resident families.

[1] The density measure related to 'residential occupancy' is not referred to in this paper.

Housing design should always be a function of plot size and shape; small residential plots as those in the above example, are undoubtedly more suitable for either detached dwellings built up to the plot boundary line(s), or semi-detached, or row or courtyard housing (Arrigone, 1990:2-4; Van Niekerk et al, 1988:1).

The type of site layout adopted also influences residential density. For example, in 1977 the National Building Research Institute (NBRI) of the Council for Scientific and Industrial Research (CSIR) commenced a demonstration housing project in KaNyamanzane, Eastern Transvaal, to assist a private sector employer, Delta Manganese (Pty) Ltd, in the provision of housing. The project area was planned for 340 dwellings laid out in conventional style. With a view to increasing the land available for residential use and reducing the services costs, the project area was replanned by the NBRI. The general approach was to group the residential plots around forecourts which were connected to the distributor road system. This prevented vehicle through-traffic while allowing vehicular access to all individual plots. As a result, a higher residential density was achieved by reducing the public areas and roads. Additional residential plots were created and the reduction in services costs was an additional advantage (CSIR, 1987:C20-1).

Topography and site conditions are significant design determinants in all housing layouts. Residential density may sometimes change substantially in response to topography and site conditions. There are cases in which large areas of land, when properly surveyed and inspected, only allow development to take place on a small portion of the site owing to the presence of, for example, swamps, unstable site conditions, rocky outcrops or steep gradients.

When single or double-storey dwellings on individual plots are being considered, the appropriateness of the dwelling-types and their location in relation to plot boundary lines are two important factors.

The common perception in South Africa of a detached house is a free-standing dwelling-unit which does not touch any of the plot boundary lines. Detached housing is generally seen as conducive to urban sprawl and low-residential densities. This does not, however, imply that detached housing is always synonymous with low-residential density and urban sprawl. There are cases in developing countries where middle to high residential densities have been achieved using clustered detached and semi-detached single-storey houses on small plots. The dwellings have been built up to the plot boundary line(s), as shown in generic housing types A2, A3 and A4 of the reference table (Annexure C).

Residential densities of walk-up apartments are influenced by floor plan. For example, shared kitchens and sanitation facilities increase residential density. The Kampung Improvement Programme of Indonesia is an example of this approach. When a kampung – the name given to an informal settlement in Indonesia – is too costly to upgrade, the authorities offer as a rental alternative dwellings in two to four-storey walk-up apartments, with shared kitchens and sanitation facilities on each storey. The sharing of facilities is very much a cultural trait, which might not be acceptable in another context.

4.2 User acceptability

The acceptability of dwelling-types and plot sizes among users is of paramount importance. Innovative physical planning concepts, plot sizes and generic dwelling-types not sufficiently tested – such as clustered housing, single or double-storey quadruplex housing, courtyard housing and walk-up apartment buildings – should be discussed with potential end users during the planning stage of housing projects. Consultation with beneficiary communities is crucial to gain acceptability for new site planning concepts, plot sizes and dwelling forms.

4.3 Planning and building regulatory frameworks

The recently released White Paper on Housing acknowledges the need for policies and practices that encourage higher urban densities (Department of Housing, 1994:14, 55). However, the implementation of high-density housing schemes will depend on the ability and willingness of public authorities either to introduce and enforce appropriate new legal planning and building regulatory frameworks, or to relax existing regulations so as to allow higher densities.

Planning and building regulations are often set by one authority and enforced by another; the former may be a central government body and the latter a local authority or council. There often is a considerable disparity in their professional and technical expertise, as the regulation-setting agency has access to a much higher level of expertise than does a small municipality. The problem is usually compounded by the lack of feedback from the enforcement agency to the original setting agency. This problem can be overcome if the regulation-setting agency is also responsible for enforcement (UNESCAP, 1979:10). According to GAPS Architects and Urban Designers (1993:24), the promotion of an enabling framework in the Johannesburg metropolitan area would require, firstly, a review of all housing practices and restrictive planning policies within existing activity nodes, urban corridors and those areas having a high quality and spare capacity of service and social infrastructure; and secondly, a study of the areas identified as voids within the existing urban fabric with a view to enabling urban 'infill' initiatives (see Section 5.1 below).

5. Approaches to densify and compact urban areas

Broadly speaking, urban 'densification' and/or 'compaction' could be achieved through either one or a combination of the following approaches:

- 'infill' housing
- 'consolidation' of informal settlements
- conversion of existing buildings
- legal subdivision of existing plots in low-density residential areas
- legal construction of additional dwellings on existing plots in low-density residential areas.

5.1 'Infill' housing

'Infill' housing is housing provided in 'pockets' of vacant land located in metropolitan areas. Recent studies on land availability in major South African cities have identified large areas of predominantly vacant land suitable for housing. More detailed studies should however be made to determine availability, possibility of incorporation into the urban system, spare capacity of the bulk infrastructure and what the additional costs, if any, would be of servicing these areas (Behrens & Watson, 1993; Wolfson, 1993). (See Annexure A, Note 1.)

The World Bank Urban Economic Mission (World Bank, 1993:7) analysed South African urban patterns and submitted recommendations in this regard: 'The "infill development" strategy for densification should not be followed without careful consideration of its impact on the efficiency of the emerging spatial structure ... In Central Witwatersrand, creating another new township such as "Norweto" (or another "Orange Farm") should not take place since it will replicate the low-density residential townships without economic and other functional linkages with the central city, and the accompanying residential infrastructure investment will be prohibitively costly.'

5.2 'Consolidation' of informal settlements

(See Annexure A, Note 2.) 'Consolidation' is a word adopted by various international and national development organisations to define the progressive community upgrading and densification – mostly building densification – of settlements. It follows from the provision of technical, financial and legal assistance to households and community-based organisations. In South Africa the Independent Development Trust (IDT) defines 'consolidation' as 'the process of upgrading of informal communities in both physical, environmental and socio-economic terms. As "consolidation" proceeds housing is upgraded from informal to formal structures, infrastructure services are improved, public and private sector community services are improved, thus facilitating increased income-generation in the community, friendship networks are established, social programmes are initiated and so on' (IDT, 1991:11-2). (See Annexure A, Note 3.)

The consolidation process and urban densification and/or compaction of IDT-subsidised housing projects could be facilitated greatly if public agencies and NGOs involved in developmental programmes were to provide technical, financial and legal assistance to 'allocatees' of these projects. The establishment of advice centres and supply materials depots could contribute substantially to their consolidation.

In those squatter settlements which have not yet reached high density levels, an increase of residential density and compaction can take place by

- constructing an additional storey on dwelling structures that can carry the load
- subdividing the land, creating new residential plots each with private access
- replanning the settlement and reducing the public open spaces and roads, which will increase land available for residential use (UNCHS, 1992:103).

A proposal for Winterveld that follows the latter approach, was recently made by a private consulting firm (Taylor & Associates, 1994, Vol 1:41 and Fig 16.2).

5.3 Conversion of existing buildings

This can be done in two ways: the legal change of use of a non-residential building to residential; and the increase in residential use of an existing residential building.

The former has been practised in a limited way in urban rehabilitation and densification programmes in Europe, most of which originated from the combined initiative of local authorities and the private sector. For example, a proposal was recently made in Italy to convert a large, old and obsolete building formally used by Fiat to manufacture cars, into a modern housing complex. To the best of this author's knowledge, there are not meaningful examples of this approach in South Africa.

Regarding the increase in residential use of existing residential buildings, the Hostel Redevelopment Programme recently approved by the Department of Housing (NHCC, 1994) enables densification through the upgrading and extension of selected hostels (Clarke, 1994:6).

5.4 Legal subdivision of existing plots

In low-density residential areas of the major South African cities there is a trend to subdivide existing plots legally into two or more new plots for new dwellings. Local planning regulations determine – according to zoning ordinances – the minimum area required for the new subdivided plots. The typical solution adopted for the middle-block plots is the panhandle layout. However, this approach has a negligible impact on the overall residential density at city level since the number of plots subdivided in this fashion is proportionately small.

5.5 Legal construction of additional dwellings on existing plots

The legal construction of additional dwellings on existing plots in low density areas is usually done in response to the households' changing needs, for example elderly couples who do not require their large home any longer and have made arrangements to move into a smaller dwelling legally built on the existing plot. This approach does not have a meaningful impact on the overall density at city level because the scope for additional dwellings is often rather limited.

6. Low-rise/high-density housing – advantages and disadvantages

Low-rise/high-density housing can play an important role in densifying and compacting urban areas.

Broadly speaking, low-rise housing is the provision of housing through single or double-storey houses or walk-up apartment buildings. The single or double-storey housing types could be provided on different plot sizes and grouped in ways that substantially increase residential densities, while optimising engineering service costs and land use. In planning and designing such housing, the basic house design principles (such as ventilation,

orientation, health and safety) should be kept in mind, and it should be noted how the dwellings are positioned on each plot and how they relate to other dwellings.

According to Correa (1976:33) the urban dilemma concerning residential density should be resolved by a trade-off between the options of high-rise and low-rise housing: high-rise apartments (usually located near the city centres) cost more to build yet save on transport and other infrastructure costs; low-rise housing schemes (usually located on the periphery of cities) cost less to build but occupy a greater area and may cost more in terms of bulk infrastructure and transport.

Considerable research on the above issues has been undertaken in developing countries and it appears that in most urban areas these trade-offs would most likely favour a pattern of ground-floor housing on plots of 45 to 100 m² (Correa, 1976:36). Unfortunately, the concept of low-rise housing is often associated with suburban sprawl. However, if a mix of generic housing types is used, such as single or double-storey units, row housing and walk-up apartments, a reasonable level of compaction and densification could be achieved.

A fundamental aspect of low-rise/high-density housing is that of territoriality, that is all spaces, inside and outside, are clearly defined as to their place in the public/private hierarchy. The residential dwelling-units and walk-up apartment blocks should be designed so that even the casual visitor, walking through them, is made aware of the transition from purely public areas (such as streets with corner shops, small offices and light or cottage industries), to semi-public (such as some gardens, and access entrance halls and stairways), to purely private (such as individual dwellings, apartments and some gardens).

This avoids one of the major problems experienced in conventional single-use developments, namely long, monotonous rows of dwelling-units, and large, anonymous, ill-defined spaces between residential blocks which fall into disuse and neglect, and often become a no-man's land of antisocial behaviour and informal refuse disposal.

Some of the advantages of low-rise/high-density housing are listed below.

- It facilitates construction and upgrading of the units through self-help, mutual-aid and/or self-management construction, especially when ground-floor housing is used.
- It can be incremental according to the owner's requirements and economic capacity, so that it does not need large capital investment which would drain the national economy. Extensions can only be made in the category of single or double-storey housing types.
- It usually has a shorter construction period than high-rise housing. Therefore, the interest cost of the capital input during the construction period is considerably less.
- It can provide greater variety to the physical environment of neighbourhoods, since individual owners are able to design and build extensions according to their own needs.
- It need not to use expensive materials and sophisticated building systems such as those used in high-rise buildings, for example reinforced concrete structures.
- It can create an attractive and vibrant physical environment if principles of mixed land use are applied.

- It makes possible free, 'open to the sky', highly usable spaces in moderate climates.

The following disadvantages of low-rise/high-density housing can be mentioned:

- It requires greater physical planning, engineering services and house design input.
- It is difficult to provide on-plot disposal of sewage, for example pit latrines or septic tanks combined with soak pits.
- It decreases planning flexibility over long-term development.
- It is likely to increase social tension and disruption.
- It is conducive to intensive use of private, semi-public and public spaces.
- It is likely that many family activities may spill over into the semi-public and public spaces because backyard areas are often small and front spaces are equally confined.

7. Housing trends and perceptions in South Africa

A considerable portion of South African cities and towns are marked by low to medium residential density derived from detached dwellings on individual plots. This generally applies to all income groups, although densities among the poor are relatively higher.

Local planning and building standards in South Africa follow the British model. Over the years they have shaped the urban form and housing types; detached dwelling-units are usually built with pitched roofs on sites of a generous area.

This trend has moulded people's housing perceptions over generations. Physical planning and house design patterns in South Africa generally provide households with the feeling of interfamily privacy and physical separation between housing structures. Households usually do not share boundary walls or live in rise housing mixed with shops, offices and small industries, as is so common in many developing countries. This applies to all income groups in formal housing: from wealthy families in very low-density residential areas to low-income families in townships planned and built under apartheid.

Backyard shacks and mixed land uses in formal settlements, and the ever-growing informal housing markets in the major cities, only came about during the last decade with the abolition of restrictive legislation on population movement and land use. The commercial use of residential plots in townships, with the establishment of small shops and consulting-rooms for medical doctors, dentists, and so on in front rooms, are some of the changes that took place during the same period. Most developed outside the formal (legal) planning and building systems.

According to Bloch (1994:8), '... South Africa is a profoundly suburban nation, not an easy thing to change ... What people want in this regard cannot be assumed (there is little information, but it is interesting to note that in one of the few surveys done to date on residential preference, public housing tenants in Cape Town indicated a strong preference for free-standing housing units over new houses and flats above shops)'. Bearing in mind the realities of South African history, it may be difficult to change people's housing perceptions over a short period of time. Therefore, every recommendation to be made in future in order to compact and densify cities should be made with caution, learning from local and foreign experience but never trying to replicate models without prior testing through demonstration projects and people participation.

8. Single land use vs mixed land use – advantages and disadvantages

There is an outdated 'monoculture' zoning clinging to a changing society on the dubious assumption that tidy, single-use developments are a more durable investment (Aldous, 1992). In South Africa there is a strong tendency towards single-use developments, for example urban areas which are exclusively for housing, the shopping industry or offices. Single-use developments, however, impose penalties on a society. Housing areas tend to be far from shops and recreational facilities; shopping centres and office areas are deserted in the evening; and commuting contributes to traffic congestion.

The alternative is a mixed land use approach. Watson (1992:13) defined this as 'the spatial integration of residential, commercial, industrial, recreational and social/public land uses. It can take the form of different activities taking place within the same building ... or different activities located adjacent to, or in close proximity to each other'. She highlighted the advantages and disadvantages of this approach as follows:

Advantages:

- A person operating a business from home saves paying for additional premises.
- Operating a business from home, or nearby, reduces daily transport costs and time.
- It reduces pressure on a city's transport infrastructure and can be a major cost savings for the city's population.
- It can contribute to the reduction of crime levels in certain parts of cities.
- It adds variety, diversity and excitement to what are otherwise monotonous and dreary unfunctional areas.

Disadvantages:

- It can have a nuisance effect on residential areas where industrial and commercial uses are mixed with residential uses (eg noise, smells, air and water pollution, generation of greater volumes of traffic, litter problems).
- It has frequently been argued, particularly by advocates of single land use zoning, that the nuisances above described may reduce property values of residential plot owners (Watson, 1992:13-6).

9. Lessons to be learnt

Lessons are to be learnt from local experiences. The old urban areas of Woodstock/Salt River, Wynberg and Harfield Road in Cape Town have relatively high residential densities, a mixed land use and a compact urban fabric achieved through many years of incremental development. Small residential plot areas (usually under 100 m^2) with narrow frontages and a variety of generic housing types, such as semi-detached, single and double-storey row dwellings, have been extensively used in these neighbourhoods. (See Figures 1 and 2.)

Figure 1: Woodstock/Salt River, Cape Town. An evolutionary development with a relatively high residential density, mixed land uses and compact urban fabric. Dwellings are close to shops, manufacturing industries and public facilities. The highlighted area is shown to a larger scale in Figure 2. (Source: Dewar et al, 1977).

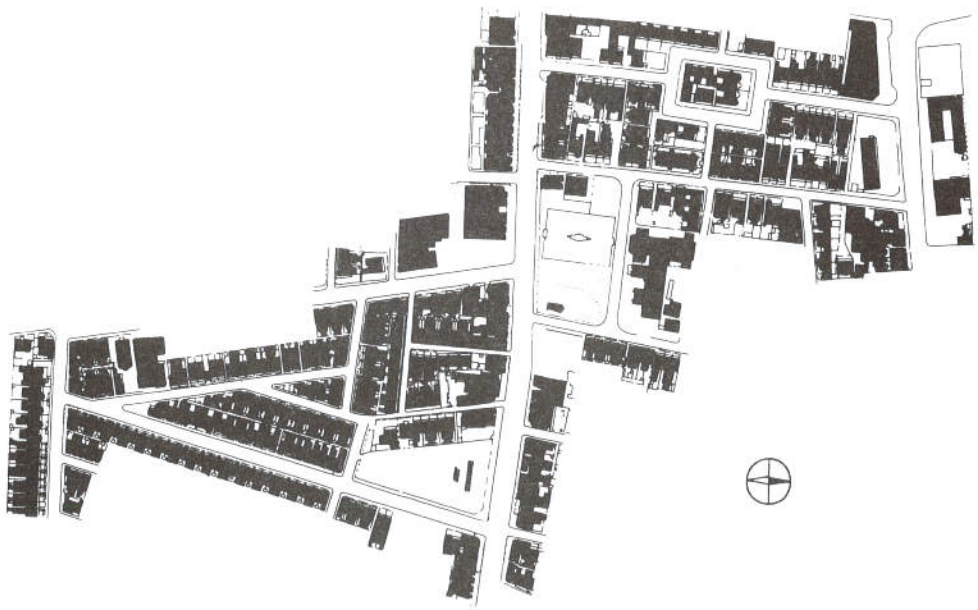


Figure 2: Woodstock. This representative segment of Woodstock clearly reveals the compactness of the urban fabric. The areas for commercial use are mainly located at both sides of the main road running East-West. The remaining area consists of houses (semi-detached, row housing and flats) and industries. (Source: Dewar et al, 1977).

Dewar et al (1977:17-65) described in detail and critically analysed these areas: 'These evolutionary developed areas have two characteristics: firstly, their development was not entirely predetermined: rather the areas grew over a long period of time through a process of action and reaction. An articulate action in one place drew counter-actions from other places. In this sense then, the development was "ecological". Secondly, development did not occur in isolation but was related to, and controlled by, a major structuring element. In almost every case, this element was a through road (later reinforced by a railway line) linking the initial settlement of Cape Town with its hinterland' (p 17).

'Salt River/Woodstock has a wide range of facilities, including two shopping strips of metropolitan significance, a large amount of manufacturing industry and many local corner shops and public facilities. Residents are conveniently located in relation to these facilities, enabling them to engage in many activities, and thereby maximising choice in the area' (p 24).

'Woodstock was subdivided over a relatively long period with many developers involved in smaller, differentiated subdivisions. The subdivision pattern was also affected by movement between the major directional routes. In Salt River, the subdivision was consolidated over a shorter period and dominated less by specific directional movement' (p 42).

'Another factor contributing to the range and variety of conditions in the area is that the creativity and ideas of many people have been involved in its making. Evidence of this diversity can be seen in the wide range of housing types in existence: semi's, rows, double storeys and flats on shops. It is not so much the variety *per se* which contributes positively to the environmental quality of the area: rather it is the complex interdependence which exists between the various types of units ... The result is a complex and mutually reinforcing environment in which the different house types complement each other and together enhance the quality of the whole.' (p 46)

There are two 'inner-city' higher density housing projects currently under development by Newhco in Woodstock which follow a similar urban pattern to that described above: dwellings built on small plots with narrow frontage, resulting in high residential densities and high plot coverages. They are the 'Dublin Street' project with 27 double-storey row houses on plots of about 43 m² (3,21 m × 13,50 m), and the 'Devon Street' project with six single storey row houses on plots of about 97 m² (4,14 m × 23,40 m). (See Figures 3, 4 and 5.) The resulting net densities are about 147 dwellings per hectare and 87 dwellings per hectare, respectively. The units being built in Devon Street are core houses in different stages of extension: 28 m² (1 bedroom), 32 m² (1 bedroom), 42,50 m² (2 bedrooms) and 59 m² (3 bedrooms). The double-storey units for Dublin Street will be built in four different types with 59,50 m² of built area each. Both projects offer the units for sale under freehold title. These higher density concepts will enable the sponsoring body to determine effective levels of demand for the various unit types and, if necessary, adjust strategies and action plans for future developments.

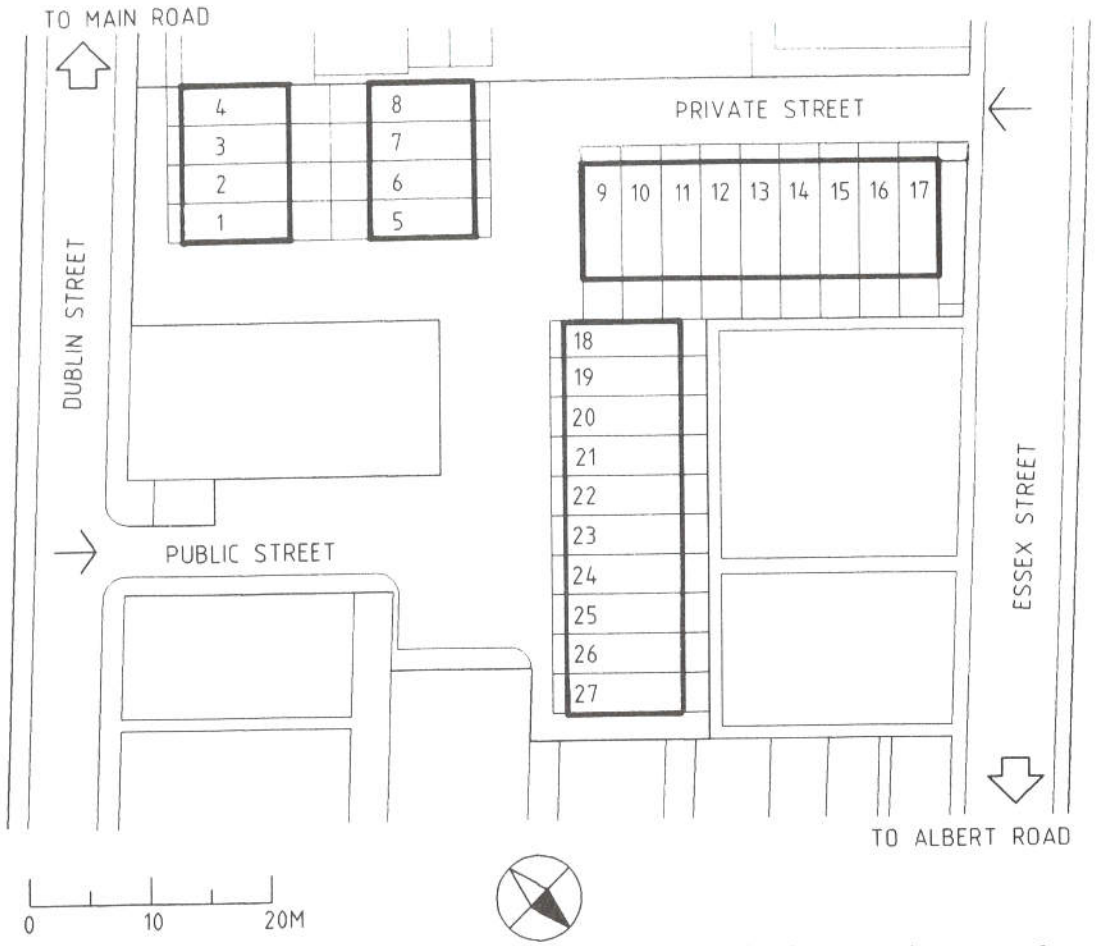


Figure 3: Dublin Street project. Woodstock, Cape Town. Plot layout. Plots are of 43 m². (Source: Newhco West Cape).

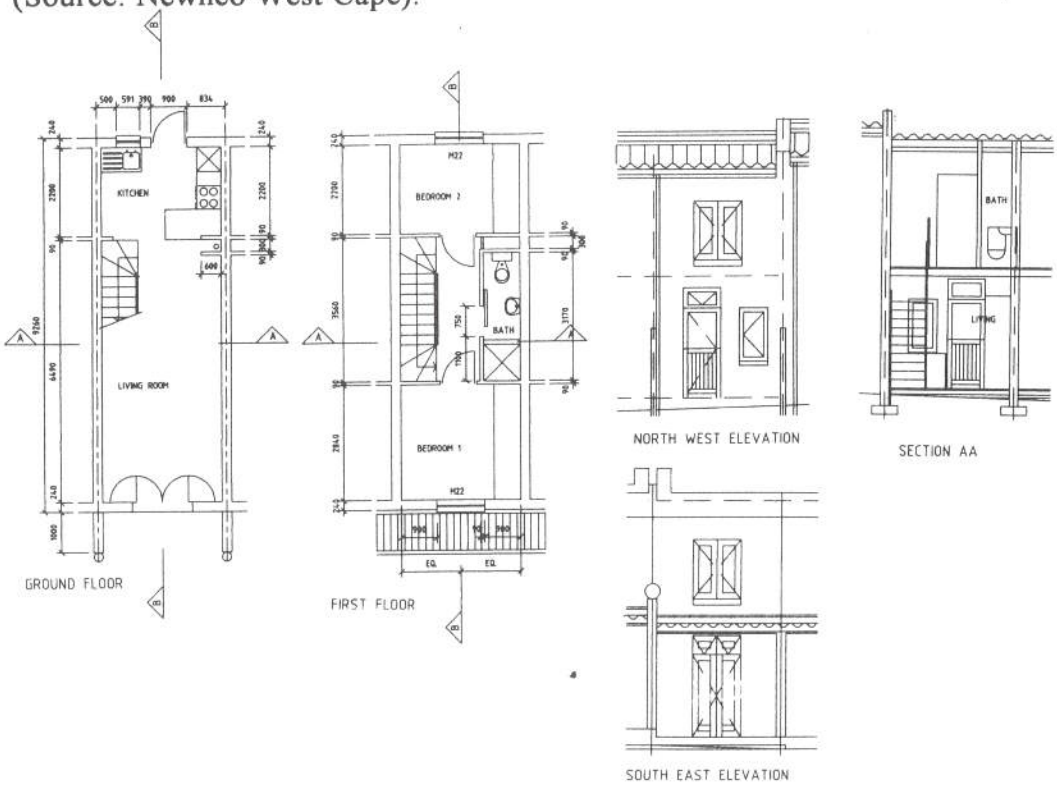


Figure 4: Dublin Street project. Woodstock, Cape Town. House type B. Plans, sections and elevations. (Source: Newhco West Cape).

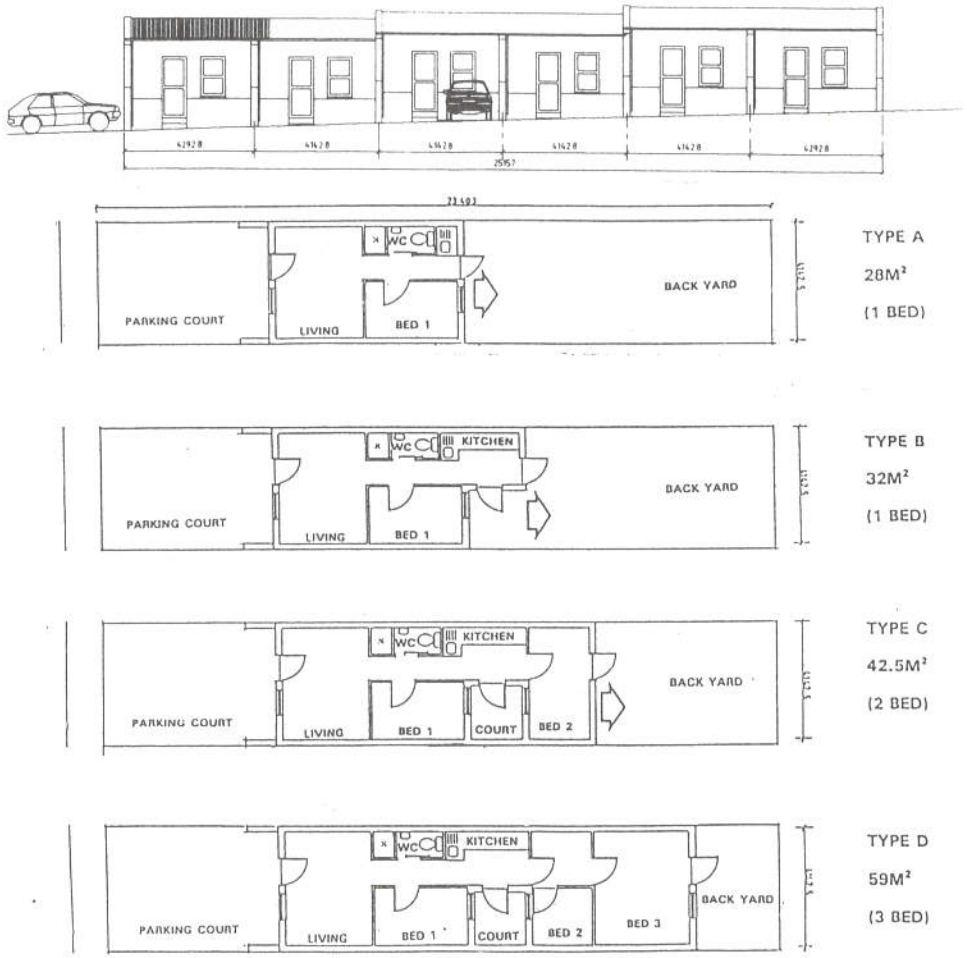


Figure 5: Devon Street project. Woodstock, Cape Town. Front elevations and plans. Plots are of 97 m². (This project was under construction in November 1994.) (Source: Newhco West Cape).

10. Low-rise housing options and plot sizes for South African conditions

Sample surveys and research work must be undertaken to understand the social and behavioural reactions of people when subjected to increased residential densities and urban compaction through innovative planning layout and house design. It would however appear that the more acceptable low-rise housing options to South African low-income groups are likely to be detached dwellings built up to plot boundaries, semi-detached and partially attached dwellings and row and courtyard housing. The walk-up apartments are likely to be more suitable for middle income, single people and couples than for families. The latter would also apply to walk-up/walk-down apartments built on steep slopes. Access to these apartments, if from an intermediate floor, would be upward or downward by stairs.

Single or double storey dwellings on individual plots, if well planned, may allow dwelling extensions and a variety of uses on the rest of the plot e.g. vegetable gardens, work yard. This represents a fundamental advantage over the walk-up apartments which are inflexible physical solutions incapable of future expansions. Walk-up apartments deny occupants the possibility to progressively add to the existing structure. Growth can only be

accommodated by moving house with the consequent social upheaval.

In the South African context, when single or double-storey dwellings are planned for low-rise/high-density in greenfield developments, an increase in density will most likely be effective if the plot areas do not exceed 180 m². The range of plot areas likely to be more acceptable to low-income families is from 100 to 180 m². This empirical hypothesis should however be tested through the implementation of demonstration projects and consultation with prospective beneficiary communities. In this respect, grass roots leadership and NGOs in coordination with local authorities can play an important role in introducing to prospective beneficiary families the advantages of low-rise/high-density housing. Du Plooy (1993) argued in favour of the implementation of low-rise urban housing demonstration projects in which high residential densities are achieved.

11. Generic low-rise dwelling-types

Broadly speaking, low-rise housing falls into two categories:
- single or double-storey dwellings on individual plots
- walk-up apartments on shared plots.

The generic dwelling-types referred to in the reference table (Annexure C) relate only to the former category. Seven generic dwelling-types are included in the table:
A. Detached dwelling
B. Detached dwelling in separate structures
C. Semi-detached dwelling
D. Partially attached dwelling
E. Dwelling in a quadruplex layout
F. Row dwelling
G. Courtyard dwelling.

The reference table illustrates only a number of generic low-rise dwelling-types used in low-income housing projects in developing countries. Some architectural designs may share characteristics common to more than one generic type.

The following format is used in the table:
- generic dwelling-type (name)
- theoretical site layout plan
- axonometric projection
- number of storeys
- achievable net residential density (dwellings per ha)
- achievable net population density (persons per ha)
- selected example (included in only some of the generic dwelling types).

When examples are included in the table, the following information is given: name of the project; location; year of implementation; sponsor(s); plot size and area; dwelling floor area; plot coverage; net residential density and net population density (at six persons per dwelling).

12. Tenure options in low-rise housing

A brief description of the main types of tenure which may be applied in low-rise housing follows.

- *Rental:* The users pay a daily, weekly or monthly fee for the use of the dwelling-unit and/or the plot.
- *Lease:* The users pay a fee for the use of the dwelling-unit and/or the plot (eg short-term lease: one year; long-term lease: 99 years).
- *Ownership:* The following subtypes of tenure are possible:
  - *Individual freehold tenure:* Usually applied in single or double-storey dwellings on individual plots.
  - *Horizontal property (sectional title):* Usually applied in walk-up apartment buildings. The dwelling-units are individually owned, while the areas in the building which are for collective use such as parking for visitors, the lobby, the caretaker's office, corridors and stairs, are collectively owned.
  - *Collective tenure:* The users are members of a housing cooperative which owns and controls the dwelling-units. Security of tenure to each member is ensured by the cooperative as long as he or she continues to be a member. This subtype of tenure may be applied in both categories of low-rise housing, that is dwellings on individual plots and walk-up apartments on shared plots.
- *Employer provided:* The users are provided a dwelling-unit by an employer in exchange for services, for example domestic live-in servants.

13. Low-rise/high-density housing in other countries – relevance to South Africa

Latin America provides models of low-rise/high-density housing and high levels of urban compaction. The urban fabric in most countries of the region was moulded by the Spanish and Portuguese planning and building standards introduced in the sixteenth and seventeenth centuries. In time, these standards allowed plots to be subdivided into smaller and usually narrow residential plots, typically arranged in rectangular or square blocks.

It was therefore common for low and middle-income urban households to build up the initial dwelling structures to share boundary walls. Many dwellings were also built up to the front building line. Ventilation and illumination of central rooms were commonly achieved through interior courtyards and backyards.

In addition, building technology – the flat reinforced concrete roofs extensively used in Latin America – easily allowed vertical extensions on the existing roof. Pitched roofs, as used in South Africa, make vertical extensions laborious as first the roof has to be removed and an intermediate floor built.

Although the urban development process of Latin American cities has taken different directions in different countries of the region, most urban dwellers basically live in compact and dense low-rise neighbourhoods. Historically the local by-laws have also allowed mixed land uses.

This process has made it easier for low-income people to accept high residential densities and compact housing through row and courtyard housing, and walk-up apartments. In South Africa the urban poor have not yet been sufficiently exposed to higher density forms in low-rise buildings. Middle and upper-income groups have lately been more inclined to high-density models such as those mentioned above. Personal security considerations and higher educational levels are important factors influencing acceptability among these income groups.

For the past 25 years a number of low-income housing projects were implemented in developing countries, using innovative site layouts with residential plot areas of less than 150 m². A noteworthy project extensively reviewed in international journals, is the Experimental Housing Project (PREVI) in Lima, carried out by the Peruvian government in collaboration with the United Nations Development Programme (UNDP) during 1968 to 1974.

The objective of the PREVI project was to develop methods and techniques to be applied on a larger scale as part of Peru's housing policy. PREVI comprised three pilot schemes. The first was for the design and construction of a community of 1 500 low-cost houses along low-rise/high-density housing principles and with appropriate community facilities. Cars were to be separated from pedestrians, housing was to be clustered, and the houses themselves were to be expandable. It was also mandatory in the first scheme that the residential plot area should be between 80 m² and 150 m² (AD Architectural Design, 1970:187-205). This scheme began as an international competition sponsored by the UNDP open to all Peruvian architects and to a limited number of invited foreign architects. Of the 1 500 houses in the competition programme only a third were built in an experimental area according to 23 different design schemes (Fromm, 1985:49-54). (See Figure 6.)

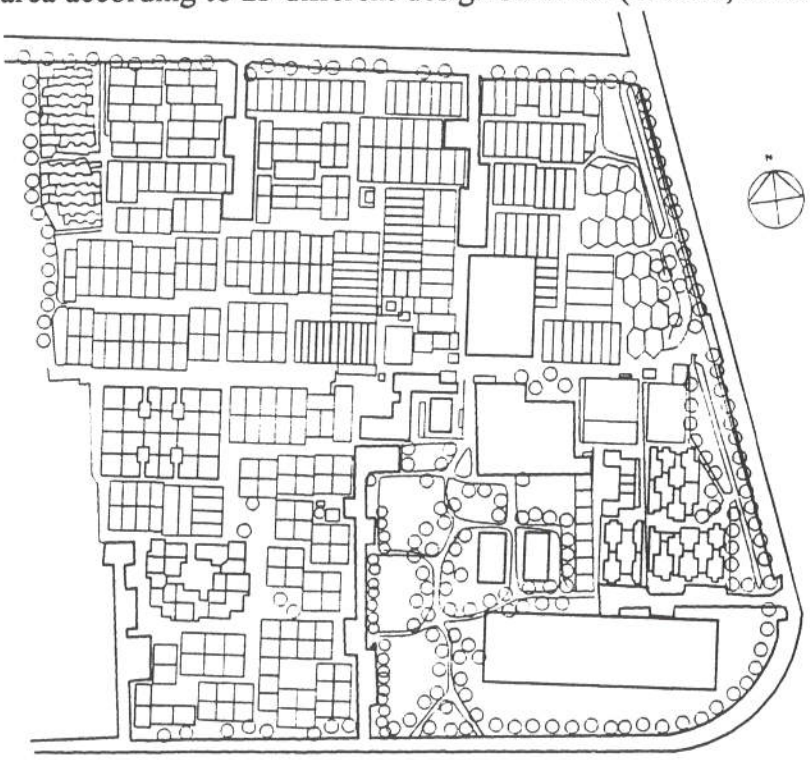


Figure 6. Experimental housing project, PREVI pilot project 1, Lima, Peru. Experimental area showing different plot shapes and groupings according to 23 selected design schemes. (Source: Fromm, 1985).

The second pilot scheme of PREVI was to develop procedures and techniques to rehabilitate old and obsolete neighbourhoods. The third pilot scheme was to develop methods and techniques for planning the rational establishment of low-income housing settlements. In this scheme, an experimental neighbourhood with 1 004 plots was proposed. The plot areas ranged from 87 m² (6,60 m × 13,20 m) to 96 m² (9,80 m × 9,80 m) for single and double-storey units. Densities achieved were of 39 dwellings per hectare (gross residential density) and 232 persons per hectare (at six persons/household per dwelling; gross population density) (Arrigone, 1972:23-6). (See Figures 7, 8 and 9.)

Figure 7: Experimental housing project, PREVI pilot project 3, Lima, Peru. Site layout with 1 004 plots showing the central pedestrian spine with community facilities and looped vehicular circulation. (Source: Arrigone, 1972).

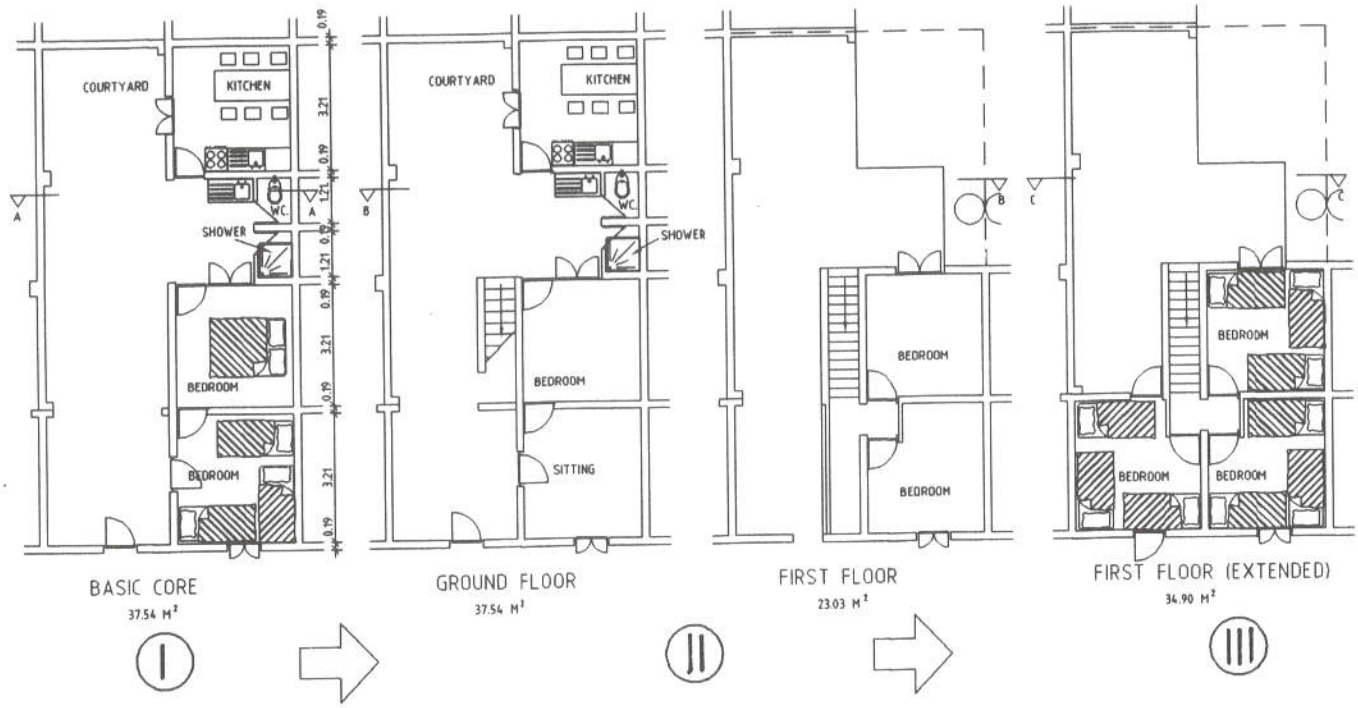


Figure 8: Experimental housing project, PREVI pilot project 3, Lima, Peru. House type LR1 in a rectangular plot of 87 m². (Source: Arrigone, 1972).

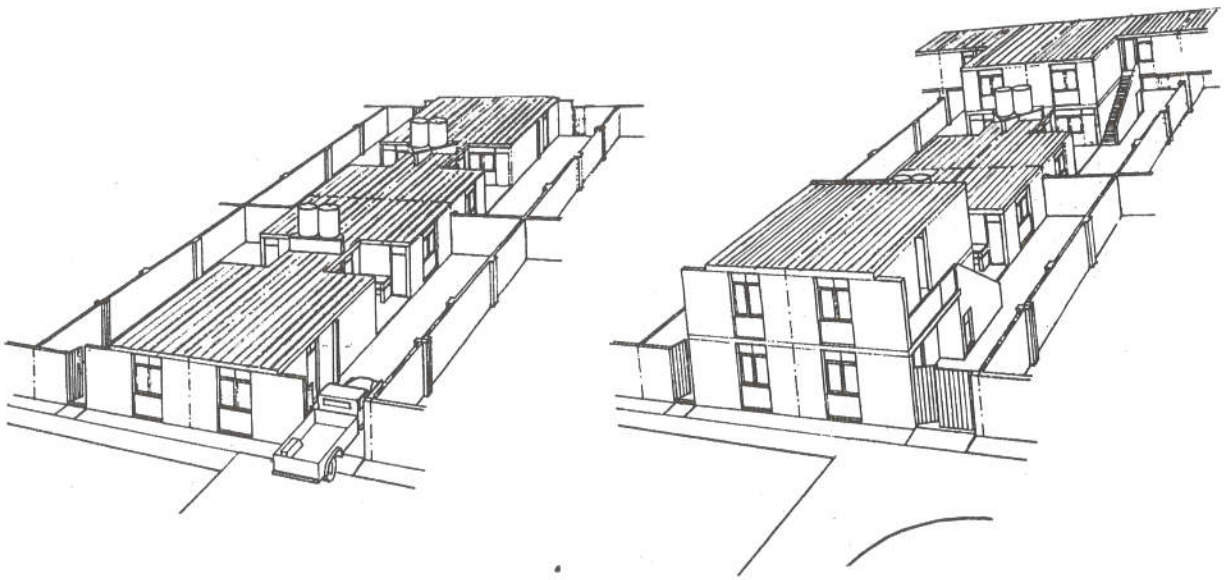


Figure 9: Experimental housing project, PREVI pilot project 3, Lima, Peru. Perspective showing quadruplex LR1 type on rectangular plots. (Source: Arrigone, 1972).

14. Conclusions

The urban spatial and socio-economic distortions in South Africa are characterised by segregation, sprawl, low residential densities and poor urban economic performance.

More than 60 per cent of the population is concentrated in urban areas; similarly, more than 80 per cent of the GDP derives from the urban sector of the economy. However, the spatial patterns of South African cities have prevented the private sector and households from taking advantage of the economies of scale and agglomeration generally found in urban concentrations.

To correct these anomalies, it has been suggested that the government should pursue urban policies and strategies to facilitate integration, densification and consolidation. The White Paper on Housing (1994) has acknowledged the importance of increasing urban densities through policies and practices that discourage urban sprawl. Moreover, similar sentiments have increasingly become commonplace in the urban debate. In pursuit of these sentiments, this paper suggests the following.

- 'Infill' developments and consolidation of informal settlements as two means of enhancing urban density and compaction, and of facilitating an integrated development.
- Involvement of communities as a precondition to low-rise/high-density housing, particularly when low-income households are targeted. An efficient way to make low-rise/high-density housing schemes acceptable to communities, is through demonstration projects. Different innovative site layouts and dwelling options conducive to densification can thus be tested at a low cost.
- Medium to high residential densities can be achieved with the above approach if site layouts, dwelling-types, and their positioning in relation to individual plot boundaries are appropriate.
- Planning innovations should however be preceded by changes in the present regulatory framework regarding minimum residential plot sizes, plot coverage, residential densities, mixed land uses and other related matters. Appropriate enforcement mechanisms should also be put in place.
- Urban densification is not the result of instant recipes or interventions. It follows from many years of incremental development facilitated by an appropriate planning and building regulatory framework and the active participation of the private sector and households. For this reason, urban densification programmes should be started as soon as possible.

Annexure A: Notes

Note 1
The recently established legal framework on land issues enables the development of more normal site planning and housing patterns and more efficient land use through urban 'infill' developments and higher residential densities. However, as Trail et al (1992:5) cautioned, 'the increased value of such urban land will place it beyond the reach of those who should have access to the inner-city areas (workers who can least afford high transport costs), unless government intervention takes place to expropriate such land and make it available at affordable prices. In the main metropolitan areas, the undeveloped land between the central business districts and the townships has a high market value and, in the case of the Pretoria-Witwatersrand-Vaal area (PWV), much of the inner-city land belongs to the mining houses, whose owners have entrenched legislated rights'.

Note 2
An informal urban settlement is a settlement developed outside the formal (legal) planning and building systems. Most traditional urban development has come about in this way, including squatting (Davidson & Payne, 1983:141; Hardoy, 1982:31). The label 'self-help' housing is usually attached to informal urban settlements. In some cities of developing countries, the informal housing markets have grown so rapidly that they now represent the majority of the housing stock and are the most common means by which the urban poor obtain residential land and housing (Payne, 1989:1). For example, in the Philippines informal housing markets account for 86 per cent of housing production, in Brazil 82 per cent and in Venezuela 77 per cent (Durand-Lesserve, 1987:330). The figures are equally high in some of the world's largest cities. In Cairo, informal housing processes account for 60 per cent of all the new housing units (Steinberg, 1987).

Informal urban settlements can be broadly classified in three categories:
- squatter settlements
- 'self-planned' squatter settlements
- 'planned' informal settlements.

Squatter settlements are spontaneous settlements usually located on invaded land on the periphery of major cities and in the backyards of formal houses (Department of Housing, 1994:9-10). The housing is generally poor without formal tenure and with minimal or no basic services.

Densities of the squatter settlements in South Africa vary considerably. For example, low densities of around 18-20 dwellings per hectare are found in some areas of Winterveld, North West Province (Taylor & Associates, 1994, Vol. 1:34-42). High densities of possibly up to three times more exist, as in Soweto-on-Sea near Port Elizabeth.

A Markinor study of Alexandra (1990) estimated approximately seven backyard shacks per residential plot, which gives an estimated density of about 160 dwellings per hectare (including formal dwellings and backyard shacks). (See Wolfson, 1991:232.)

In the category of 'self-planned' squatter settlements the extension of Mangaung, on the outskirts of Bloemfontein, can be mentioned. The planned subdivision of land resulted in a low-density area with plot sizes varying between 375 m² (15 m × 25 m) and 280 m² (14 m × 20 m). The site plan and peg survey were made in 1990 by the OFS Provincial Administration in consultation with community leaders, and were handed over to the local civic association who allocated the plots to candidate families with the promise of secure individual ownership tenure. The Provincial Administration defined and scraped roads, provided communal toilets combined with hand basins, wash troughs and water taps at central points. The residents were responsible for their dwellings: initially shacks to be upgraded and extended at a later stage (MacLeod & Atkins, 1990).

Huaycan, Peru, is a unique experimental 'self-planned' squatter settlement in which collective tenure was practised (Anzorena, 1988). The local civic association, the local municipality and a NGO worked closely together. To ensure that the reception area would be properly serviced, a grid of hectare squares (100 m × 100 m) was marked out and served by loop roads. Each square was served with communal water-points, washing-places and toilets. Each square was to be developed with 60 dwellings on plots of 90 m² each around a communal open space at the centre of the square. The unit for municipal service was not the private household but the organised civic association of 60 families called the UCV (Unidad Comunal de Vivienda – Communal Housing Unit). The circulation areas and open spaces inside the one-hectare squares belong to the UCVs which are responsible for their maintenance. The net residential density achieved through this method was about 100 dwellings per hectare.

In the category of 'planned' informal settlements, it is worth mentioning the serviced sites with secure tenure which were planned and delivered during the last three years through the IDT's capital subsidy scheme and by the former provincial authorities. The informality of the IDT-funded settlements reflects the building processes used, and not the planning systems which are formal (legal). Accommodation generally consists of an informal dwelling, upgradable over time. The White Paper on Housing classifies the above serviced sites projects as 'urban informal housing' (Department of Housing, 1994:9).

Note 3

According to the White Paper on Housing (Department of Housing, 1994:45), a project-based consolidation subsidy to be implemented will make available a supplementary grant of R5 000 per beneficiary on approved projects where serviced sites were previously provided by the state or with state grants (including IDT projects).

Annexure B: Glossary

A brief, alphabetical glossary of technical terms used in the text follows. After most entries, an abbreviated reference is shown in brackets, for example (Caminos). The definitions are from the following sources:

- Caminos & Goethert (1978:311-9)
- Davidson & Payne (1983:141-2)
- Scott (1974)
- Fleming, Honour & Pevsner (1966)
- *Collins Cobuild English Language Dictionary* (1991)
- technical papers and articles in journals.

axonometric projection
A geometrical drawing showing a building in three dimensions. The plan is set up truly to a convenient angle, and the verticals projected to scale, with the result that all dimensions on a horizontal plane and all verticals are to scale, but diagonals and curves on a vertical plane are distorted (Fleming).

block
Smallest developed area surrounded by local or higher order streets (Davidson).

boundary
The line which marks the outer edge of an area of land and which separates it from the adjoining land (Collins).

cluster (housing)
A group of plots around a communal space (Davidson).

communal facilities
Facilities used in common by a number of people, including those for health and recreation, schools, the police, fire brigade, public transportation and community centres (Caminos).

communal space
Unbuilt land used for access, recreation and domestic uses, maintained by the surrounding residences. Responsibility for maintenance may be written into agreements for plots fronting onto the communal space (Davidson).

density (building)
The ratio between the built residential floor area of a given area and the area.

- *Gross* building density is obtained by dividing the total built residential floor area (m^2) by the total site area (ha) which includes areas of residential plots, community facilities, public open spaces and roads. It is usually expressed in square metres of built residential floor area per hectare.
- *Net* building density is obtained by dividing the total built residential floor area (m^2) by the sum of the areas of residential plots and fifty per cent of the areas of the access

road to each residential plot. It is usually expressed in square metres of built residential floor area per hectare.
- *Real* building density is obtained by dividing the total built residential floor area (m^2) by the sum of the areas of residential plots only. It is usually expressed in square metres of built residential floor area per hectare.

density (population)
The ratio between the population of a given area and the area.
- *Gross* population density is obtained by dividing the number of residents by the total site area which includes areas of residential plots, community facilities, public open spaces and roads. It is usually expressed in people per hectare.
- *Net* population density is obtained by dividing the number of residents by the sum of the areas of residential plots and fifty per cent of the areas of the access road to each residential plot. It is usually expressed in people per hectare.
- *Real* population density is obtained by dividing the number of residents by the sum of the areas of residential plots only. It is usually expressed in people per hectare.

density (residential)
The ratio between the dwellings of a given area and the area.
- *Gross* residential density is obtained by dividing the number of dwellings on a site by the total site area which includes areas of residential plots, community facilities, public open spaces and roads. It is usually expressed in dwellings per hectare.
- *Net* residential density is obtained by dividing the number of dwellings on a site by the sum of the areas of residential plots and fifty per cent of the areas of the access road to each residential plot. It is usually expressed in dwellings per hectare.
- *Real* residential density is obtained by dividing the number of dwellings on a site by the sum of the areas of residential plots only. It is usually expressed in dwellings per hectare.

dwelling
A house or habitable unit or form of shelter; residential accommodation (Davidson).
- Detached dwelling: Free-standing dwelling on a plot.
- Semi-detached dwelling: Two dwellings sharing a common main wall.
- Partially attached dwelling: Two dwellings sharing a common secondary wall.
- Dwelling in a quadruplex layout: Four attached dwellings, built around the corner common to their plots and sharing party walls.
- Row dwelling: Continuous line of dwellings with common walls separating each dwelling from its adjoining one.
- Courtyard dwelling: Usually an L or a U-shaped dwelling partially or totally enclosing a court.

freehold
If one has the freehold of a building or piece of land, it is yours for life and there are no conditions regarding your ownership (Collins).

GDP
An abbreviation for 'gross domestic product', the total value of goods and services produced within a country in a year; a technical term in economics (Collins).

household
All people living in one house who share food on a regular basis.

housing cooperative
A community-run organisation, representing a membership from diverse (or limited) interest groups in the community, with the aim to provide and ensure appropriate and affordable housing to the membership, and not to profit economically.

infill housing
Housing provided in 'pockets' of vacant land located in metropolitan areas.

infill plots
Plots of land developed on vacant or underused land within existing built-up areas (Davidson).

informal urban settlement
A settlement developed outside the formal (legal) planning and building systems. Most traditional urban development has come about in this way, including squatting (Davidson).

infrastructure
Basic installations on which urban development depends. In this context it means roads, water, sewerage, the solid waste disposal system, electricity and telephones (Davidson).

land use (controls)
The physical or legal means or methods of directing, regulating and coordinating the use and maintenance of land by the owners or users.

leasehold
If a building or land is described as leasehold, it is allowed to be used in return for payment of money as arranged according to a lease (Collins).

low-rise housing
The housing provision through single or double-storey houses or walk-up apartment buildings.

pit latrine
Latrine comprising a hole in the ground usually hand dug, for the collection of excreta. The hole is generally located beneath the squatting plate and is protected by a superstructure. (Davidson).

pitched roof
The commonest type of roof, usually one with two slopes at more than 20° to the horizontal, meeting in a central ridge (Scott).

plot
A measured parcel of land having fixed boundaries and access to public circulation (Caminos).

plot coverage (residential)
The percentage of a residential plot area covered by a residential building.

private open space
Open space available exclusively for the use of occupants on a plot (Davidson).

progressive development
A form of development in which buildings and services are gradually improved as funds become available (Davidson).

public space
Land not in private, revenue-generating use. Includes all roads and public recreational spaces (Davidson).

self-help housing
Housing where the dwelling-unit is totally or partially built by the user or occupant.

semi-public space
Land designated for use by specialist agencies or groups (ie schools or sports clubs), but which is normally accessible for public use (Davidson).

sewage
Human waste and waste water, usually carried along a sewer pipe or stored in a septic tank or pit latrine (Davidson).

sewer
Conduit in a subterranean network used to carry off water and waste matter (Caminos).

sewerage
A system of sewer pipes (Davidson).

sites and services
A method of land subdivision in which individual plots are provided together with a certain level of infrastructure. Subdivisions include opportunities for employment and social facilities (Davidson).

tenure
The legal right to live in a particular building or to use a particular piece of land during a fixed period of time (Collins).

walk-up apartment building
Dwelling-units grouped into two to five-storey (including the ground floor) buildings with stairs for vertical circulation.

zoning
The demarcation of a city by ordinance into zones (areas/districts) and the establishment of regulations to govern the use of land and the location, bulk, height, shape, use, population density, and coverage of structures within each zone (Caminos).

Annexure C: Reference table

Generic dwelling types and densities (single or double-storey units on individual plots)

A DETACHED DWELLING
A1 Free-standing (rectangular or L-shaped)
A2 Built up to side plot boundary (rectangular or L-shaped)
A3 Built up to side and back plot boundaries (rectangular or L-shaped)
A4 Built up to side, back and front boundaries (rectangular or L-shaped)

B DETACHED DWELLING IN SEPARATE STRUCTURES
B1 Each separate structure built up to side boundary
B2 Free-standing (rectangular or L-shaped)

C SEMI-DETACHED DWELLING
C1 Rectangular or other shapes
C2 Built up to front boundary (rectangular or other shapes)
C3 Built up to front and back boundaries (rectangular or L-shaped)

D PARTIALLY ATTACHED DWELLING
D1 Built up to side boundary (rectangular or L-shaped)
D2 Built up to side and front boundaries (rectangular or L-shaped)

E DWELLING IN A QUADRUPLEX LAYOUT
E1 Generic quadruplex (rectangular or L-shaped)
E2 Built up to front and side boundaries (L-shaped)
E3 Built up to front boundary (rectangular or L-shaped)

F ROW DWELLING
F1 Generic row dwelling

G COURTYARD DWELLING
G1 In row layout (L-shaped)
G2 In row of symmetrical twin units

Notes to table

1. For comparison purposes only rectangular plots of 140 m² (10 m × 14 m), and dwelling-plan sketches of about 50 m² are represented in the theoretical layout plans. Sketches are to 1:500 scale.
2. The theoretical layout plans are only indicative. The plot and dwelling proportions and the position of dwelling-types in relation to plot boundaries may vary.
3. The axonometric projections represent ideal volumetric forms of dwellings and are not the actual representation of roof shapes and walls.
4. It is assumed that in all theoretical layout plans, the terrain is flat or gently sloping.

5. Arrows in layout plans show plot access points from the road.
6. The net residential densities shown in the table are approximate, calculated on the assumption that the average residential plot area for low-income housing projects is 140 m², with plot widths varying from 6 to 10 metres. It was further assumed that plots are rectangular and grouped in conventional blocks. Net residential densities may be increased substantially with cluster and other innovative layouts.
7. The calculation of net residential density may be difficult when the plot layout provides an overabundance of semi-public open spaces and pedestrian ways. (Semi-public open spaces are usually next to plot entrances in cluster developments.)
8. The calculation of net population density is based on a six person household per dwelling.

Format key

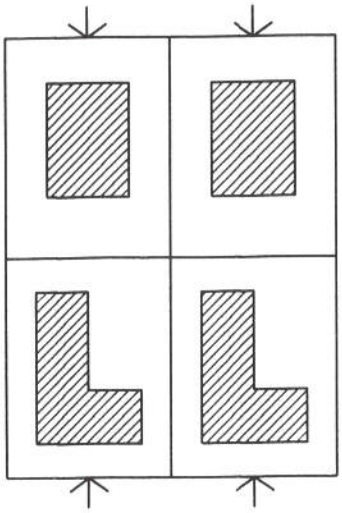
Name of generic dwelling type
Name of generic dwelling subtype
1. Theoretical layout plan
2. Axonometric projection
3. Number of storeys
4. Achievable net residential density (dwellings per ha)
5. Achievable net population density (persons per ha)
6. Selected example (included in only some of the generic dwelling types).

When examples are included, the following information is given: name of project; location; year of implementation; sponsor(s); plot size and area; dwelling floor area; plot coverage; net residential density and net population density (at six persons/household per dwelling).

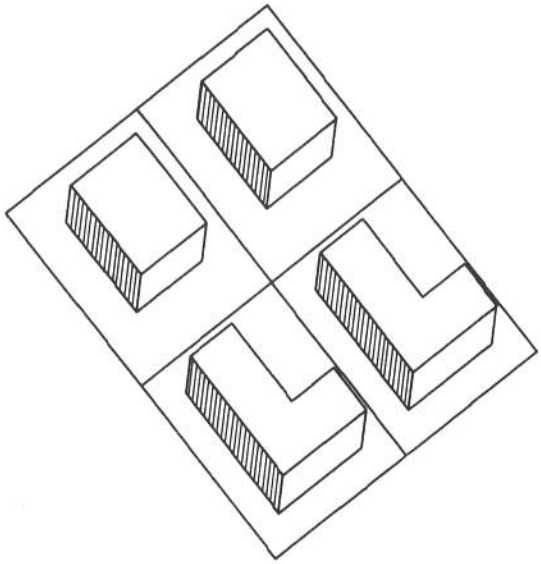
A. DETACHED DWELLING

A1. Free-standing (rectangular or L-shaped)

1. Theoretical layout plan



2. Axonometric projection

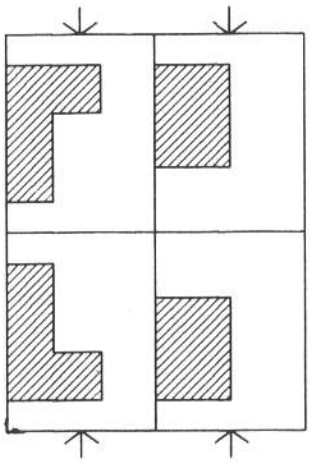


3. Usually one storey
4. 40-55 dwellings per ha
5. 240-330 persons per ha

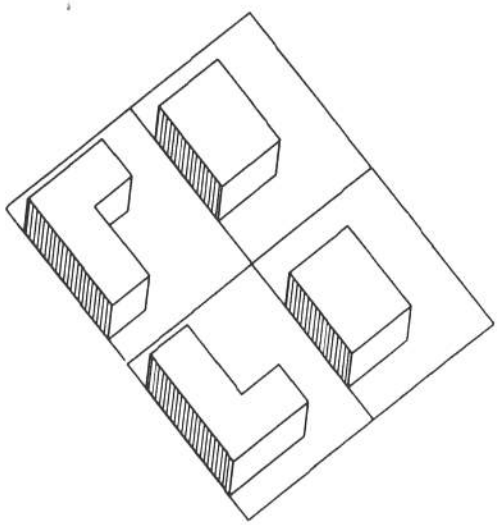
Note: Residential rectangular plots which have less than 140 m² are usually not suitable for free-standing detached dwellings.

A2. Built up to side plot boundary (rectangular or L-shaped)

1. Theoretical layout plan



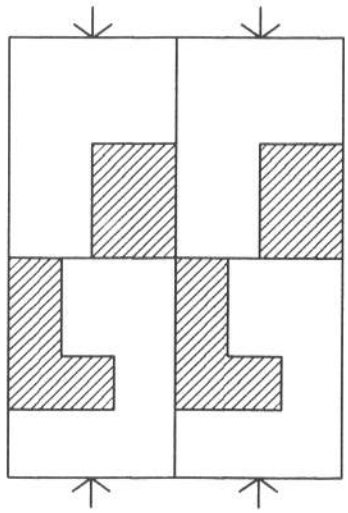
2. Axonometric projection



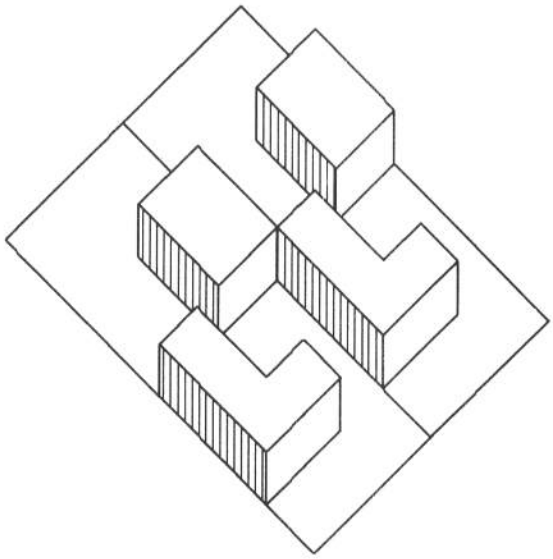
3. One/two storey
4. 40-70 dwellings per ha
5. 240-420 persons per ha

A3. Built up to side and back plot boundaries (rectangular or L-shaped)

1. Theoretical layout plan



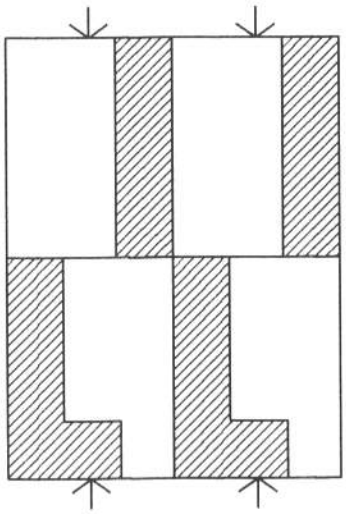
2. Axonometric projection



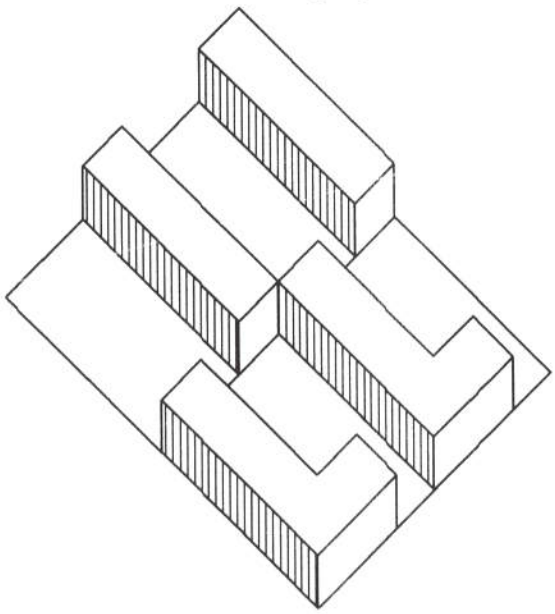
3. One/two storeys
4. 40-70 dwellings per ha
5. 240-420 persons per ha

A4. Built up to side, back and front plot boundaries (rectangular or L-shaped)

1. Theoretical layout plan



2. Axonometric projection

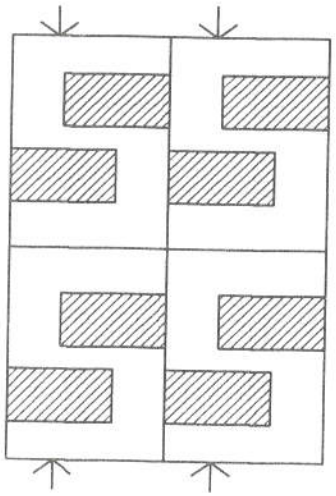


3. One/two storeys
4. 40-70 dwellings per ha
5. 240-420 persons per ha

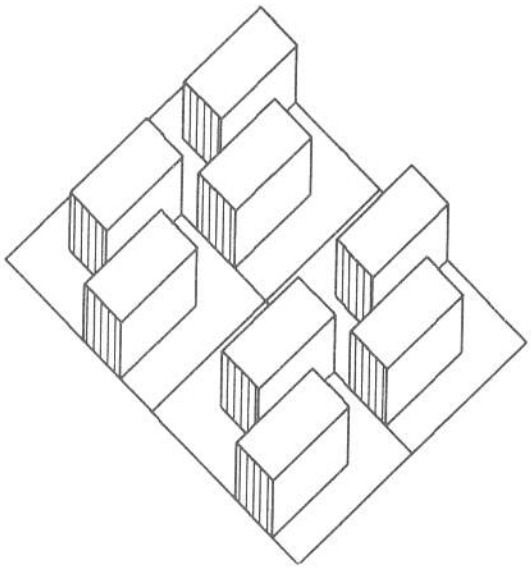
B. DETACHED DWELLING IN SEPARATE STRUCTURES

B1. Each separate structure built up to side boundary

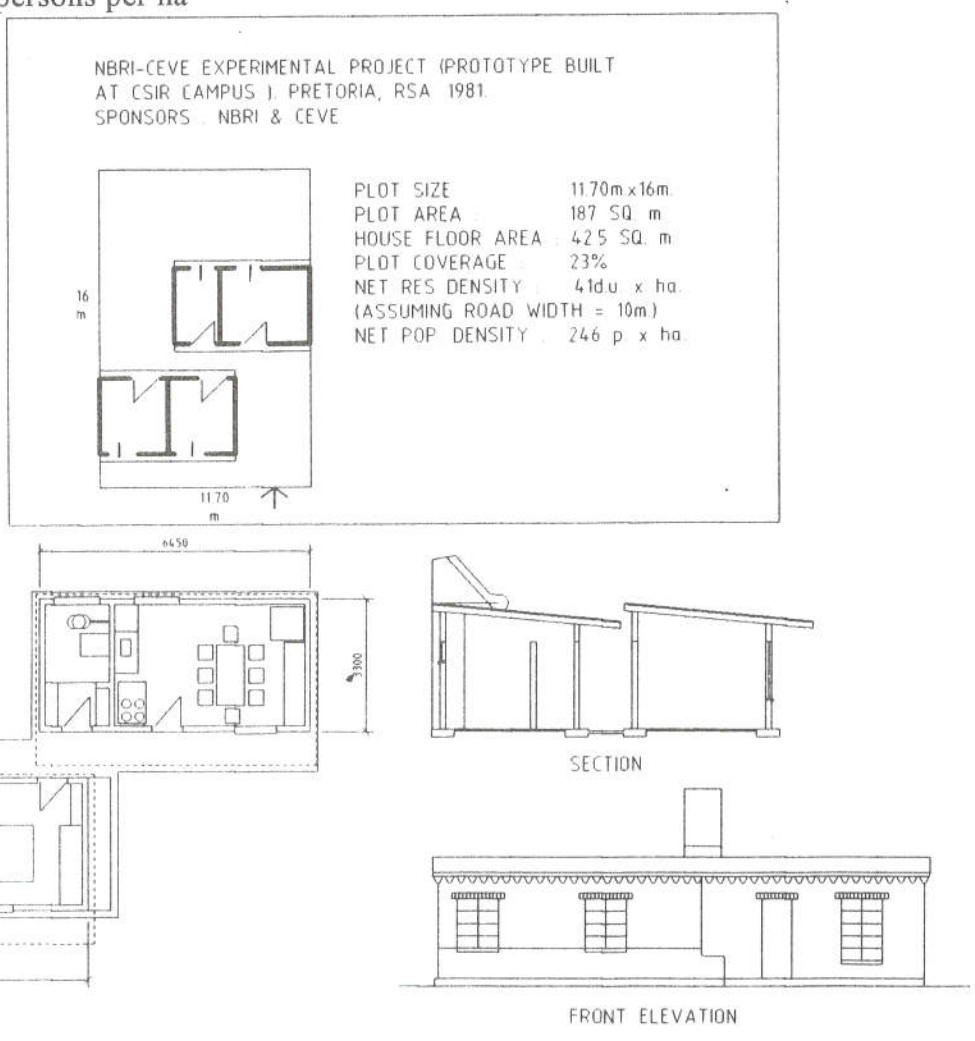
1. Theoretical layout plan



2. Axonometric projection

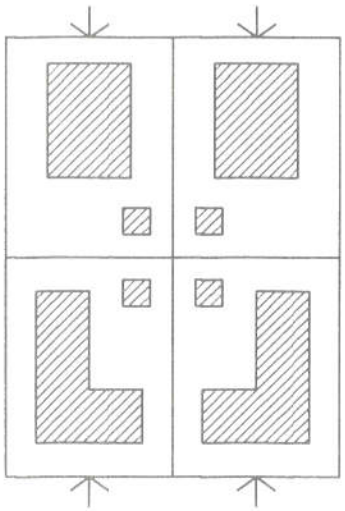


3. Usually one storey
4. 40-70 dwellings per ha
5. 240-420 persons per ha
6. Example

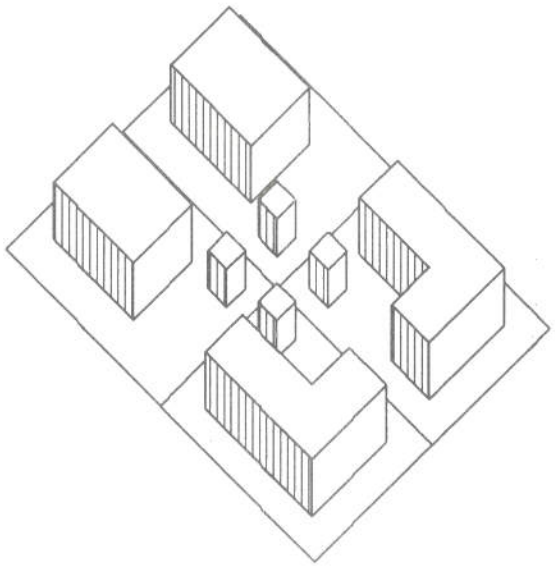


B2. Free-standing (rectangular or L-shaped)

1. Theoretical layout plan



2. Axonometric projection

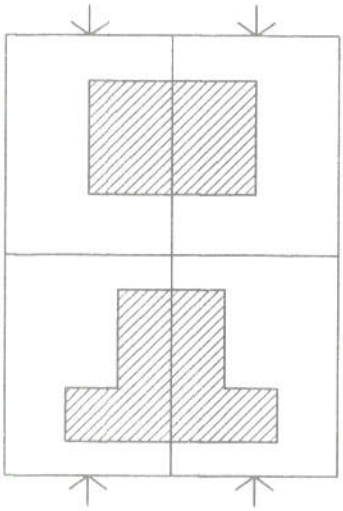


3. Usually one storey
4. 40-55 dwellings per ha
5. 240-330 persons per ha

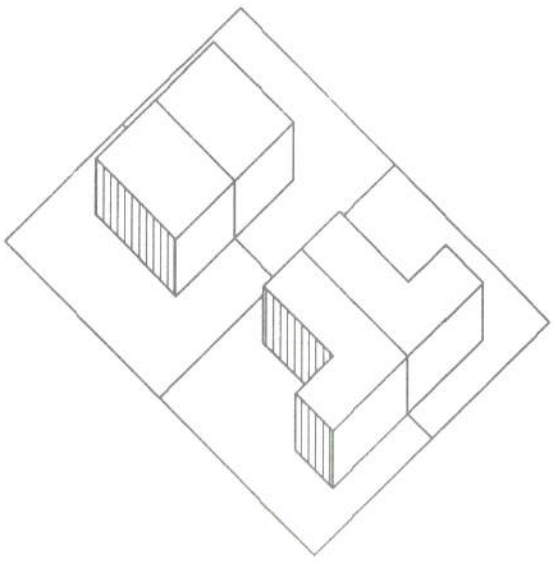
C. SEMI-DETACHED DWELLING

C1. Rectangular or other shapes

1. Theoretical layout plan



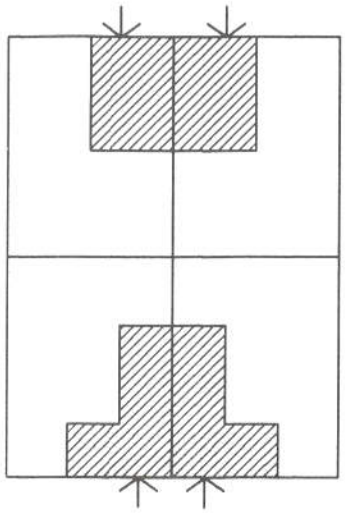
2. Axonometric projection



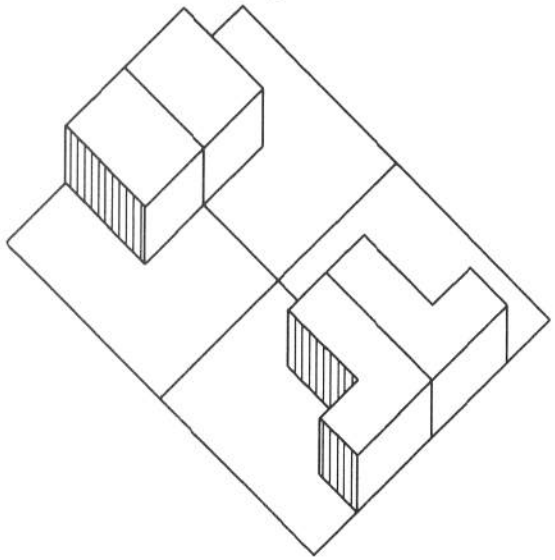
3. One/two storeys
4. 40-70 dwellings per ha
5. 240-420 persons per ha

C2. Built up to front boundary (rectangular or other shapes)

1. Theoretical layout plan



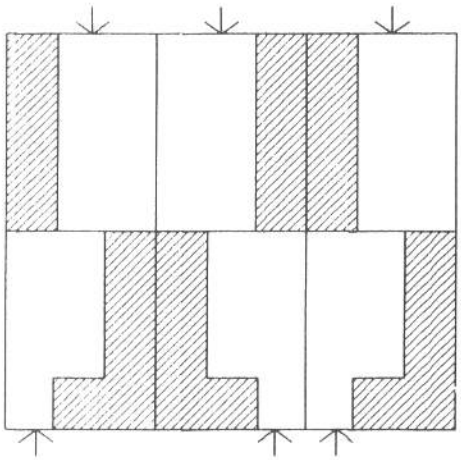
2. Axonometric projection



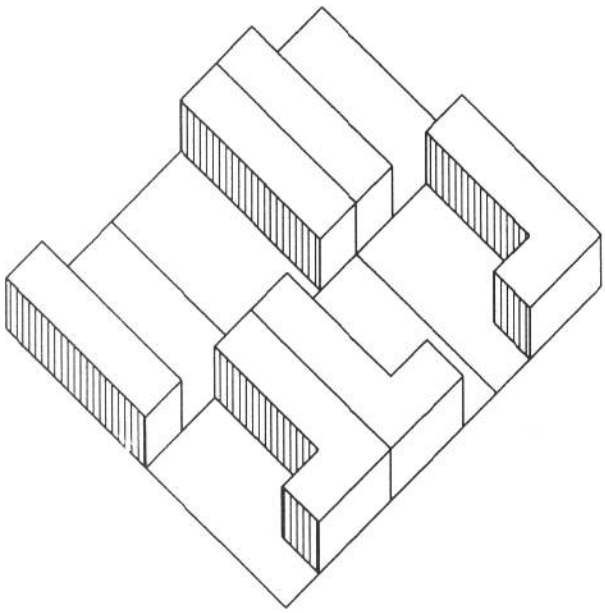
3. One/two storeys
4. 40-70 dwellings per ha
5. 240-420 persons per ha

C3. Built up to front and back boundaries (rectangular or L-shaped)

1. Theoretical layout plan



2. Axonometric projection

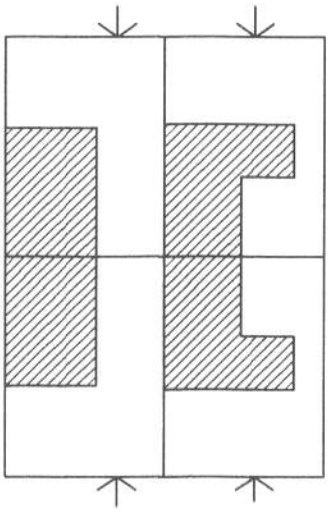


3. One/two storeys
4. 40-70 dwellings per ha
5. 240-420 persons per ha

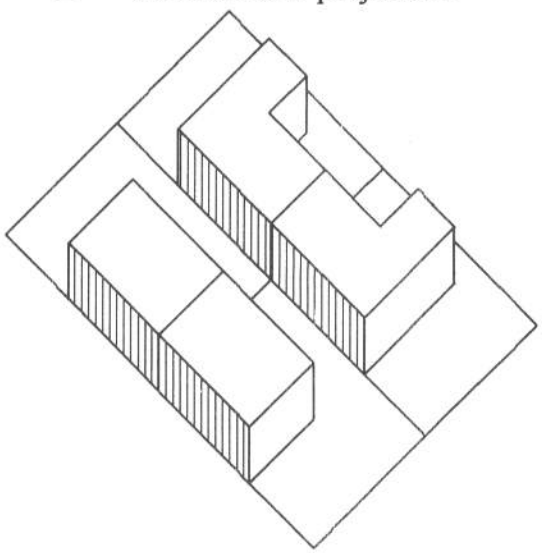
D. PARTIALLY ATTACHED DWELLING

D1. Built up to side boundary (rectangular or L-shaped)

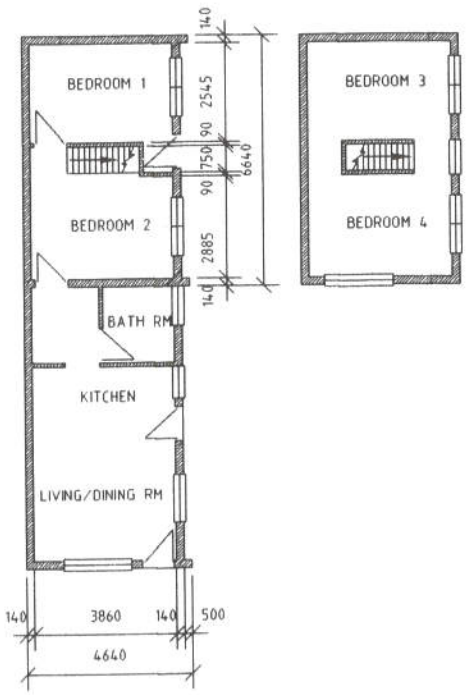
1. Theoretical layout plan



2. Axonometric projection

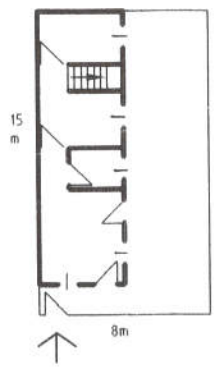


3. One/two storeys
4. 40-70 dwellings per ha
5. 240-420 persons per ha
6. Example



GROUND FLOOR FIRST FLOOR

CROSSROAD'S PROPOSAL. CAPE PROV., SOUTH AFRICA. 1987
SPONSOR : SAHT., JOHANNESBURG.

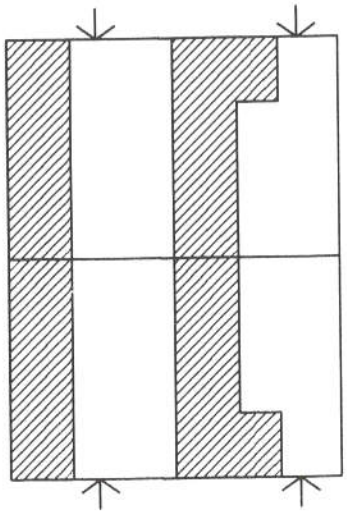


PLOT SIZE :	8m x 15m.
PLOT AREA :	120 SQ. m
HOUSE FLOOR AREA :	56.40 SQ. m.(G.F.)
	27.40 SQ. m.(1st.F.)
TOTAL :	83.80 SQ. m.
PLOT COVERAGE :	47%
NET RES. DENSITY :	62 d.u. x ha.
(ASSUMING ROAD WIDTH : 10m.)	
NET POP. DENSITY :	372 p. x ha.

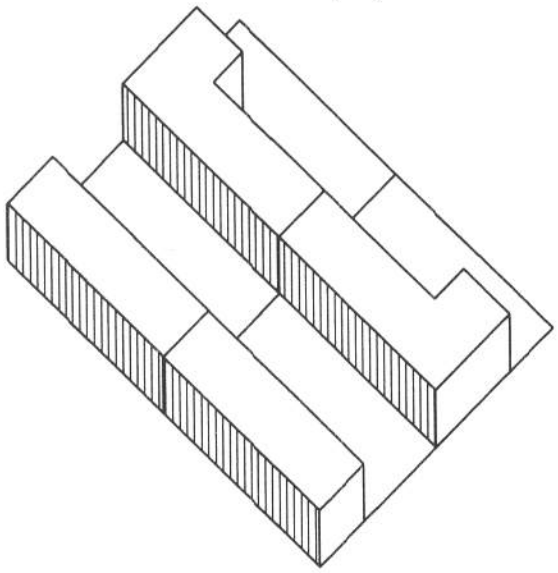
NOTE : THIS TYPE CAN BE USED AS SEMI-DETACHED, PARTIALLY ATTACHED AND QUADRUPLEX DWELLING.

D2. Built up to side and front boundaries (rectangular or L-shaped)

1. Theoretical layout plan



2. Axonometric projection

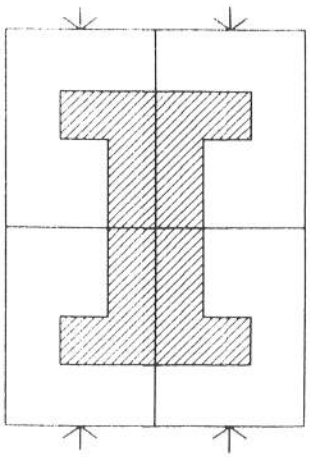


3. One/two storeys
4. 40-70 dwellings per ha
5. 240-420 persons per ha

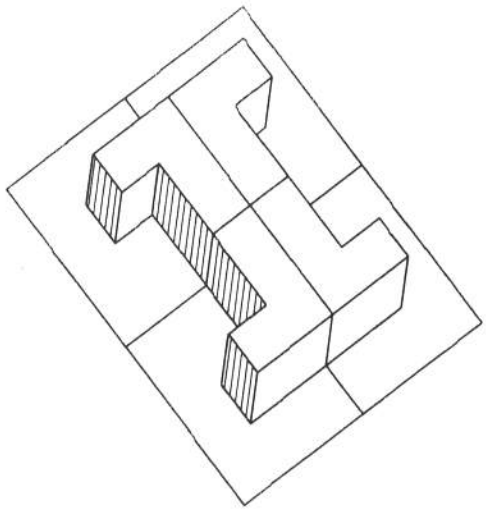
E. DWELLING IN A QUADRUPLEX LAYOUT

E1. Generic quadruplex (rectangular or L-shaped)

1. Theoretical layout plan



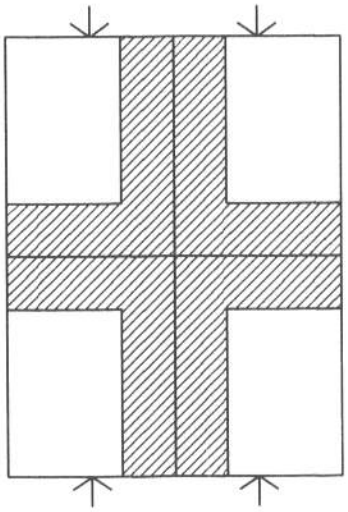
2. Axonometric projection



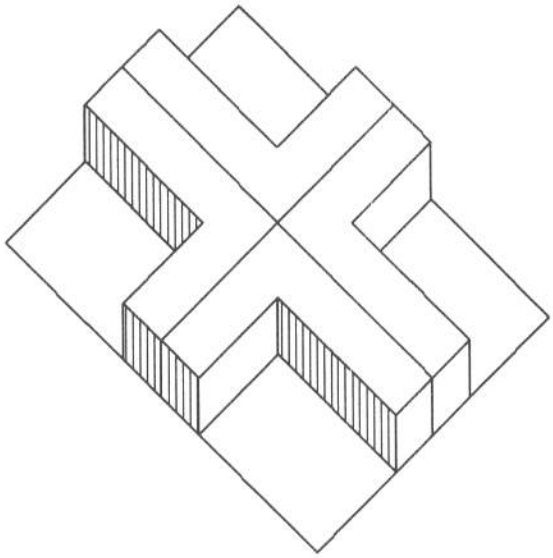
3. One/two storeys
4. 40-70 dwellings per ha
5. 240-420 persons per ha

E2. Built up to front and side boundaries (L-shaped)

1. Theoretical layout plan

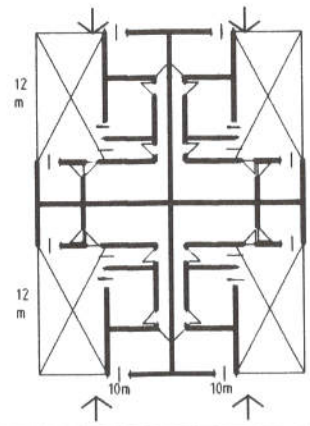


2. Axonometric projection



3. One/two storeys
4. 40-70 dwellings per ha
5. 240-420 persons per ha
6. Example

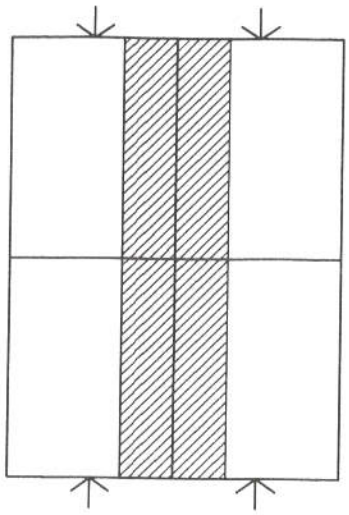
'LA GLORIA' GODOY CRUZ PROV. MENDOZA. ARGENTINA.
1977. SPONSOR: IPV (PROVINCIAL HOUSING INSTITUTE).



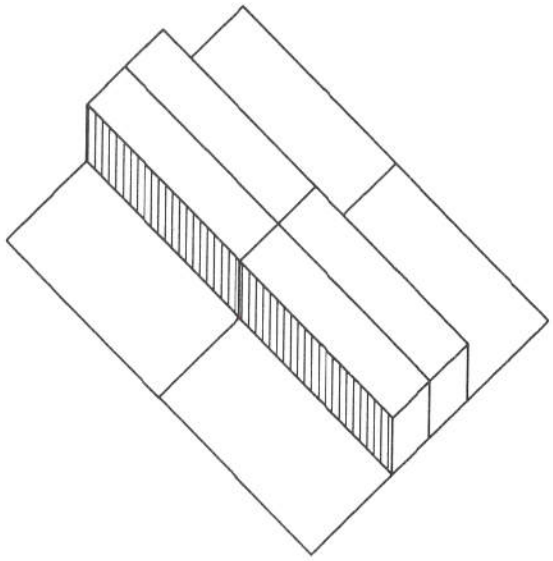
No. OF D.UNITS : 1074
PLOT SIZE : 10m.x12m.
PLOT AREA : 120 SQ. m.
HOUSE FLOOR AREA : 72,50 SQ. m.
PLOT COVERAGE : 60%
NET RES DENSITY : 66d.u. x ha.
(ACESS ROAD WIDTH = 6.50m.)
NET POP. DENSITY : 396 p. x ha.
NOTES : 1. SQUATTER RESETTLEMENT SCHEME. CONSTRUCTION BY PUBLIC TENDER.
2. THIS GENERIC HOUSING TYPE IS A COMBINATION OF QUADRUPLEX AND COURTYARD DWELLING.

E3. Built up to front boundary (rectangular or L-shaped)

1. Theoretical layout plan



2. Axonometric projection

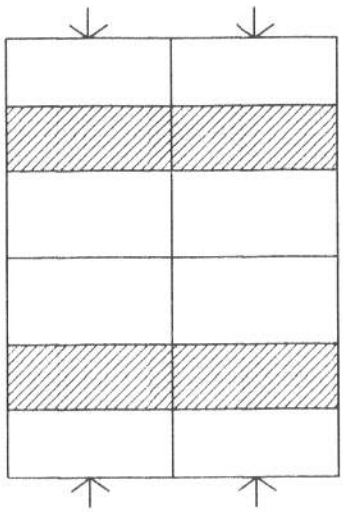


3. One/two storeys
4. 40-70 dwellings per ha
5. 240-420 persons per ha
6. This generic housing type is illustrated in Figure 8 and 9 of this paper.

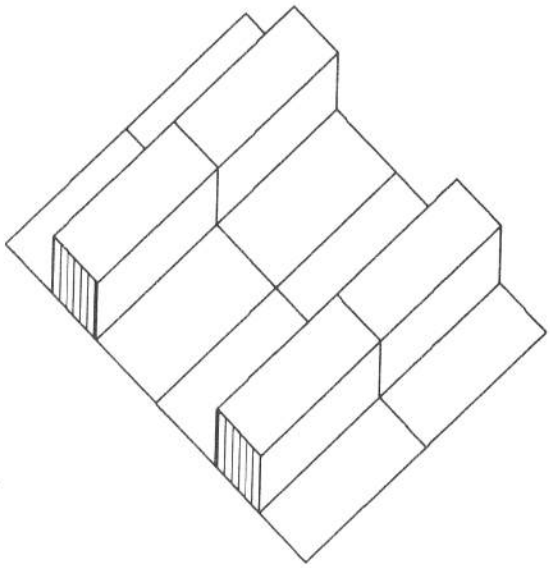
F. ROW DWELLING

F1. Generic row dwelling

1. Theoretical layout plan



2. Axonometric projection

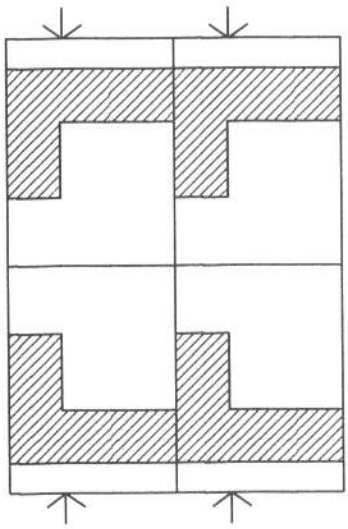


3. One/two storeys
4. 40-70 dwellings per ha
5. 240-420 persons per ha

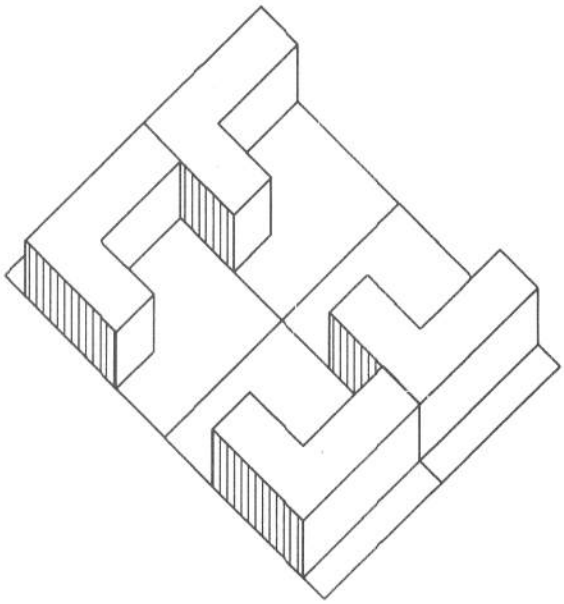
G. COURTYARD DWELLING

G1. In row layout (L-shaped)

1. Theoretical layout plan



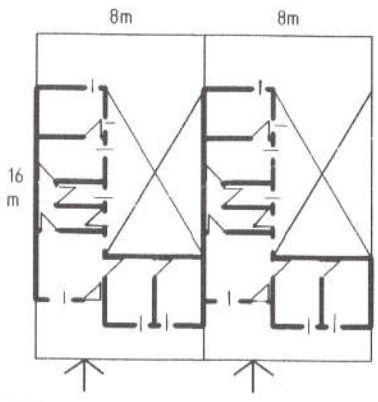
2. Axonometric projection

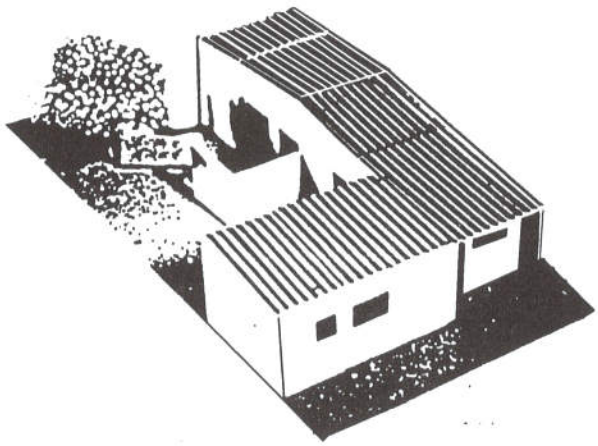


3. One/two storeys
4. 50-75 dwellings per ha
5. 300-450 persons per ha
6. Example

'WILDEBEESFONTEIN EXPERIMENTAL PROJECT' (PROPOSAL)
TRANSVAAL PROV., SOUTH AFRICA. 1989. (PROTOTYPE 1).
SPONSOR : SAHT., JOHANNESBURG.

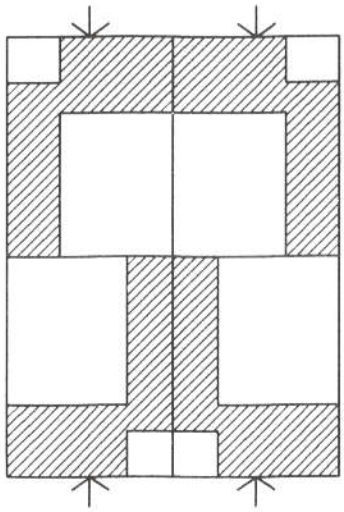
No OF UNITS :	1000
PLOT SIZE :	8m x 16m.
PLOT AREA :	128 SQ. m.
HOUSE FLOOR AREA :	47 SQ. m.
PLOT COVERAGE :	37%
NET RES DENSITY :	63d.u. x ha.
(ACCESS ROAD WIDTH = 8m.)	
NET POP. DENSITY :	378 p. x ha.



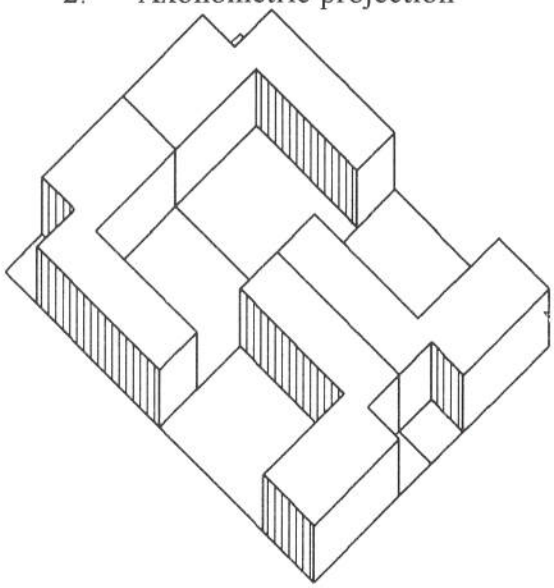


G2. In row of symmetrical twin units

1. Theoretical layout plan

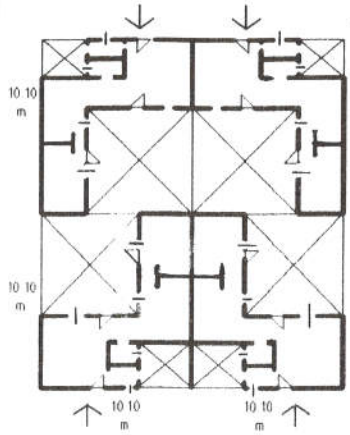


2. Axonometric projection

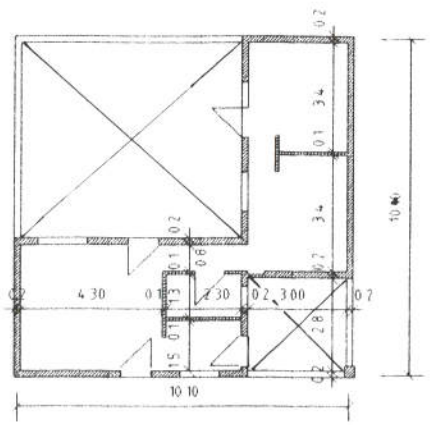


3. One/two storeys
4. 50-75 dwellings per ha
5. 300-450 persons per ha
6. Example

'EXPERIMENTAL PROJECT QUINTA DEL REGIMIENTO'.
SANTIAGO DEL ESTERO, ARGENTINA 1977
SPONSORS : UNDP AND IPVU (PROV. HOUSING INSTITUTE)



No OF UNITS :	292
PLOT SIZE :	10.10m x 10.10m.
PLOT AREA :	102 SQ. m
HOUSE FLOOR AREA :	54 SQ. m.
(2 BEDROOMS, SINGLE STOREY)	
PLOT COVERAGE :	52%
NET RES. DENSITY :	75d.u. x ha.
(SEE NOTE 6 TO TABLES)	
NET POP. DENSITY :	450 p. x ha.



Annexure D: References

Aldous, T. 1992. *Urban villages.* London: Urban Villages Group.

Anzorena, J. 1988. *Lima and Huaycan.* Selavip Newsletter, March. Quezon City, Philippines: Selavip.

Arrigone, JL. 1972. *Informe final.* PREVI project, final (unpublished) report, 9 October. Lima, Peru: UNDP.

Arrigone, JL. 1990. *Notes on the Wildebeesfontein demonstration housing project.* Technical memorandum (unpublished). Midrand: DBSA.

AD Architectural Design. 1970. Previ/Lima: Low-cost housing project. *AD Architectural Design* 4(70), 187-205. London.

Behrens, R & Watson, V. 1993. *Infill development and lower income housing in Cape Town.* Proceedings of the 21st IAHS World Housing Congress, 10-14 May, pp 1046-63. Cape Town.

Bloch, R. 1994. *Spatial restructuring in South Africa: A literature scan.* Johannesburg: Office for Metropolitan and Industrial Research.

Caminos, H & Goethert, R. 1978. *Urbanization primer.* Cambridge, Massachusetts: MIT.

Clarke, V. 1994. *Hostel initiatives: An urban reconstruction and development perspective.* Midrand: DBSA.

Collins-Birmingham University. 1991. *Collins Cobuild English language dictionary.* Glasgow: Harper Collins.

Correa, C. 1976. Third World housing: Space as a resource. *Ekistics*, 242, January, 33-8. Athens.

Council for Scientific and Industrial Research. 1987. *Low-cost housing.* National Building Research Institute. Pretoria: NBRI.

Davidson, F & Payne, J. 1983. *Urban projects manual: A guide to preparing upgrading and new development projects accessible to low-income groups.* Liverpool Planning Manual 1. Liverpool: Liverpool University Press.

Department of Housing. 1994. White Paper: A New Housing Policy and Strategy for South Africa. *Government Gazette*, Vol 354, No 16178, 23 December. Pretoria: Government Printer.

Dewar, D, Uytenbogaardt, R, Hutton-Squire, M, Levy, C & Menidis, P. 1977. *Housing: A comparative evaluation of urbanism in Cape Town.* Cape Town: UPRU.

Du Plooy, DW. 1993. *A case for higher density/low-income housing: Demonstration projects.* Proceedings of the 21st IAHS World Housing Congress, 10-14 May: 1163-70, Cape Town.

Durand-Lesserve, A. 1987. Land and housing in Third World cities: Are public and private strategies contradictory? *Cities,* Vol 4, No 4, November: 325-38.

Fleming, J, Honour, H & Pevsner, N. 1966. *Penguin dictionary of architecture.* Harmondsworth, Middlesex: Penguin.

Fromm, D. 1985. Peru: PREVI. *The Architectural Review.* Vol 178, No 1062, 49-54. London: Architectural Press.

GAPS Architects & Urban Designers. 1993. *An interim strategic framework for the Central Witwatersrand: Document 2, Policy approaches.* Johannesburg: Central Witwatersrand Metropolitan Chamber.

Independent Development Trust. 1991. *Housing portfolio.* Cape Town: IDT.

MacLeod A & Atkins, H. 1990. *Improvement of an informal settlement in Bloemfontein.*

Internal Memorandum. Midrand: DBSA.
Mumtaz, B. 1988. The housing question (and some answers). *Mimar,* No. 28, June.
National Hostels Coordinating Committee. 1994. *Hostels redevelopment programme: Policy for the upgrading of public sector hostels and hostels initiative.* Operations manual. Approved by the Minister of Housing on 27 June 1994. Pretoria: NHCC.
Payne, G. 1989. *Informal housing and land subdivisions in Third World cities: A review of the literature.* Oxford: Centre for Development and Environmental Planning (CENDEP), Oxford Polytechnic.
Scott, JS. 1974. *A dictionary of building,* 2nd ed. Harmondsworth, Middlesex: Penguin.
Steinberg, F. 1987. Cairo: Informal housing and urbanization. Positive contribution and a challenge for the future. *Institute for Housing Studies,* Rotterdam: BIE Mimeo.
Taylor & Associates. 1994. *Winterveld structure plan and development guidelines. Vol 1 and 2.* Technical Report, 27 September, Johannesburg.
Trail, SM, Minis, HP Jr & De Groot, DG. 1992. *Strategy for shelter and urban development.* North Carolina: Research Triangle Institute.
United Nations Centre for Human Settlements. 1992. *Improving shelter: Actions by non-governmental organizations.* Nairobi: UNCHS.
United Nations ESCAP. 1979. *Guidelines for human settlements standards.* Report by an Expert Group Meeting, 11-17 December. Bangkok: UNESCAP.
Van Niekerk, Kleyn & Edwards. 1985. *Khayelitsha: Revisions to the draft structure plan for Khayelitsha.* Cape Town: VKE.
Van Niekerk, Kleyn & Edwards. 1988. *Khayelitsha project: Review of civil engineering design standards.* Cape Town: VKE.
Watson, V. 1992. *The promotion and regulation of multifunctional urban land use: International trends and practices.* UPRU Working Paper No 47, Occasional paper No 34. Cape Town: University of Cape Town.
Wolfson, T. 1991. Access to urban land. In M Swilling, R Humphries & K Shubane (eds), *Apartheid city in transition.* Cape Town: Oxford University Press.
Wolfson, T. 1993. *The key to the door: Developing the mining land between Soweto and Johannesburg.* Proceedings of the 21st IAHS World Housing Congress, 10-14 May, 639-52, Cape Town.
World Bank Urban Economic Mission: South Africa. 1993 *Aide memoire,* 12 February. Washington: World Bank.

Annexure E: Further reading

Agency for International Development (AID). 1966. *Proposed minimum standards.* Ideas and Methods Exchange No 64. Washington: Department of Housing and Urban Development.

Arrigone, JL. 1993. *Urban compaction through low-rise/high-density housing.* Technical memorandum (unpublished). Midrand: DBSA.

Behrens, R. 1993. *Higher density development: A review of policy measures.* Restrictive regulations and residential trends in Greater Cape Town. Urban Problems Research Unit and Development Action Group, Cape Town.

Brawne, M. 1985. *Correa prospects.* AJ, January, 26. London.

Coetzee, SF & Olivier, JJ. 1989. A strategy framework for urban development in South Africa. In JK Coetzee (ed), *Development is for people.* Johannesburg: Southern.

Council for Scientific and Industrial Research. 1988. *Towards guidelines for services and amenities in developing communities.* Pretoria: CSIR.

Dewar, D. 1988. City planning and urbanisation strategies: Meeting the challenges. In C Heymans & G Totemeyer (eds), *Government by the people?* Cape Town: Juta.

Gallagher, Aspoas, Poplak & Senior, Walker & Walker. 1988. *A housing options assessment manual: A decision-making framework for assessing housing options and their density implications.* Johannesburg: Urban Foundation.

Gilbert, A & Ward, P. 1985. *Housing, the state and the poor.* Cambridge: Cambridge University Press.

Hardoy, JE. 1982. The building of Latin American cities. In A Gilbert, JE Hardoy & R Ramirez (eds), *Urbanization in contemporary Latin America.* Chichester: John Wiley.

Hendler, P. 1991. The housing crisis. In M Swilling, R Humphries & K Shubane (eds), *Apartheid city in transition.* Cape Town: Oxford University Press.

Koenigskerger, O. 1976. Cities for urban pioneers. *Ekistics,* 249, August, 72-8. Athens.

Lemon, A. 1991. Towards the post-apartheid city. In A Lemon (ed), *Apart-South Africa's segregated cities.* Cape Town: David Philip Homes.

Martin, R. 1976a. Institutional involvement in squatter settlements. *Architectural Design.* 4 (76), 232-7, London.

Martin, R. 1976b. Zambia: Toward a new architecture. *RIBA Journal.* October, London.

New Housing Company Group. 1993. *Annual Report of the New Housing Company Holdings.* Johannesburg.

Smith, WF. 1971. *Housing: The social and economic elements.* Berkeley, USA: University of California Press.

Tomlinson, R. 1990. *Urbanization in post-apartheid South Africa.* London: Unwin Hyman.

Urban Foundation (no date). Housing for all: Proposals for a national urban housing policy. *Policies for a New Urban Future series,* No 9. Johannesburg: Urban Foundation.

Urban Foundation. 1993. *Managing urban growth: The international experience. An executive summary.* UP research, summaries on critical issues. Johannesburg: Urban Foundation.

Van der Merwe, J. 1993 The South African city in relation to international city form. *Development Southern Africa,* Vol 10, No 4, November. Midrand: DBSA.

Watermeyer, Legge, Piesold & Uhlmann. 1994. *Winterveld pilot scheme development: Provision of services.* Study Phase 1. Johannesburg: WLPU.