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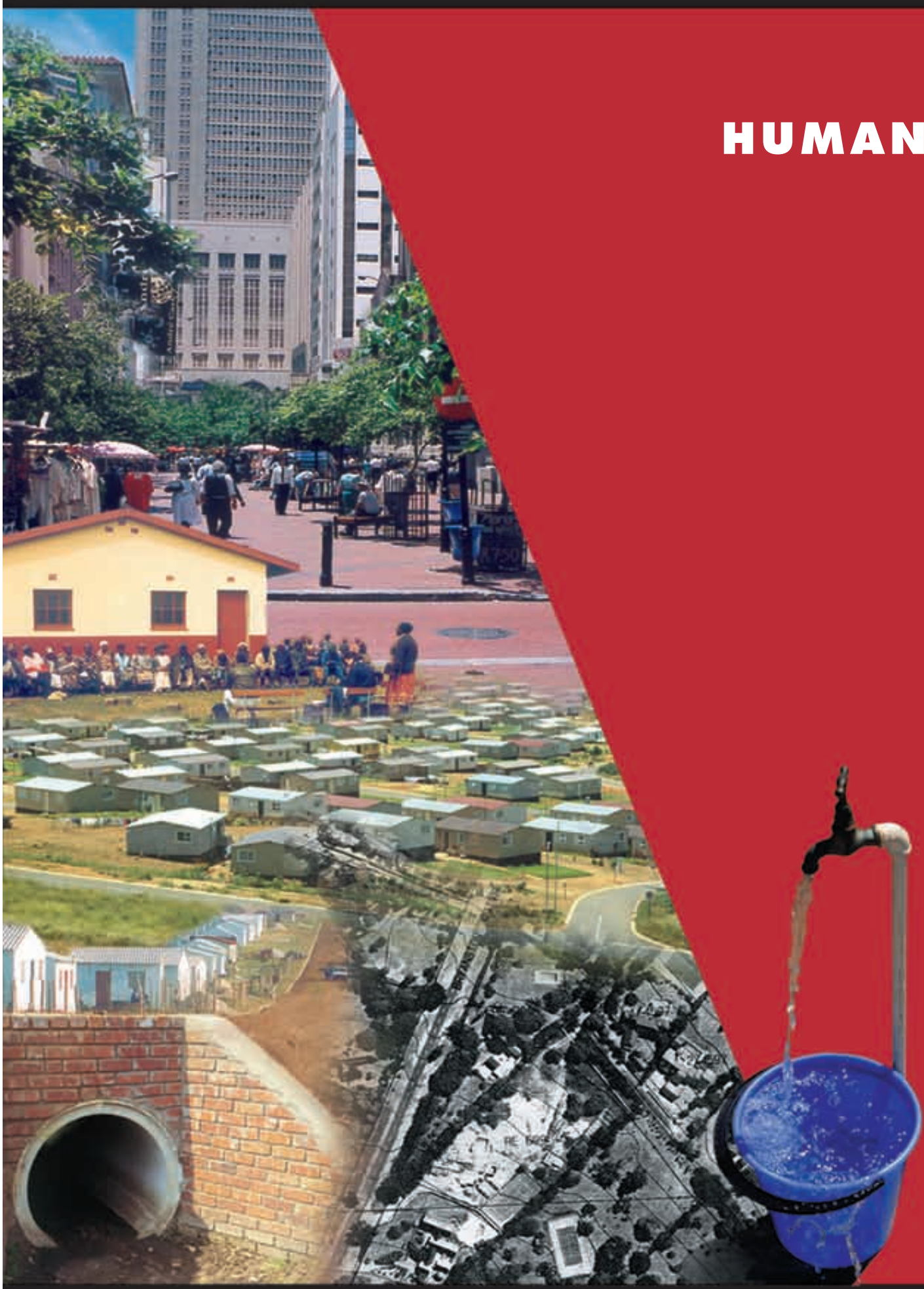

HUMAN SETTLEMENT PLANNING AND DESIGN

VOLUME 1

Compiled under the patronage of the Department of Housing

by CSIR Building and Construction Technology

Compiled under the patronage of the Department of Housing

by CSIR Building and Construction Technology

FOREWORD

The establishment of economically, physically, environmentally and socially integrated and sustainable built environments is one of the most important factors which will contribute to harnessing the full development potential of South Africa and addressing distortions of the past and the future needs of our growing population. This goal cannot be achieved without the active participation of especially local government, the private sector and communities in partnership with one another.

This manual, *Guidelines for Human Settlement Planning and Design*, provides a guiding vision for South African settlement formation, addressing the qualities that should be sought after in our human settlements, and providing guidance on how these can be achieved. The publication has been developed over a period of more than two years through a participative process in which stakeholders and experts from various disciplines were involved.

This book is intended to be a living document and you, the reader, are one of its architects. I therefore encourage you to use it, discuss it and debate the guidelines it contains. Still, this work is not the last word on the subject, and your feedback and comments would be welcome. Your active involvement will be the key to the successful attainment of sustainable, habitable living environments in South Africa.

MS S MTHEMBI-MAHANYELE
MINISTER OF HOUSING

Published by CSIR Building and Construction Technology
P O Box 395, Pretoria, 0001

Boutek Report No. BOU/E2001

Reprint 2005
Capture Press, Pretoria

ISBN 0-7988-5498-7

ACKNOWLEDGEMENTS

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Cover design:

Truter & Truter Design & Advertising (Pty) Ltd

Design and layout:

African Watermark Graphic Design

RECORD OF REVISIONS AND AMENDMENTS

Revisions: Remove existing chapter(s) and substitute with the attached revised chapter(s).

Amendments: Remove existing page(s) and substitute the attached new page(s). A vertical line in the margin shows where a change has been made (there are no amendments to date).

Date	Chapter	Title	Rev No.	Amdt No.	Page number(s)
August 2003	9	Water supply	1	-	All
August 2003	10	Sanitation	1	-	All

Index

Volume 1

Volume 2

Chapter 1

1

Introduction

TABLE OF CONTENTS

BACKGROUND

This document is the result of a collaborative effort by several government departments under the auspices of the Department of Housing. Mutual concern for the quality of the built environment and the country's natural resources, as well as a common recognition of the role that human settlement planning and the provision of engineering services plays in its protection or destruction, was the catalyst for this multi-departmental cooperation. The process was overseen by a coordinating committee consisting of representatives of the various departments, whose main role was overall guidance, policy direction and financial control. Detailed guidance and control of the written content was provided by various steering committees, each consisting of a number of practitioners acknowledged for their expertise in the particular fields. The work was contracted to the CSIR in accordance with a detailed proposal submitted to the then National Housing Board in August 1995. Overall project management was undertaken by the CSIR's Division of Building and Construction Technology, while other divisions, as well as various external organisations, also provided technical and related expertise.

NEED FOR A REVISED DOCUMENT

This aspect is best explained by a brief summary of, first, the developments leading to the publication of the first edition of the *Red Book* and, second, the workshops that followed this event. These ultimately led to the formulation of a detailed proposal for a complete revision of the document and the multi-departmental initiatives for funding and guiding the process.

Historical perspective

For many years it has been widely recognised that the cost of providing engineering services forms a significant component of the overall cost of housing. Where capital subsidies for housing schemes are involved, the cost of engineering services could consume anything between 50 and 100% of the subsidy, depending on, among other things, site conditions and levels of service provided (Schlotfeldt 1995b). In any development scheme, therefore, layout planning and the concomitant design of engineering services should receive particular care and attention in order to optimise the levels of service within the given financial parameters. Until comparatively recently engineers were seldom presented with the complex task of choosing between a great variety of service options, particularly in the fields of water supply and sanitation. The policies of the various authorities largely dictated the levels of service to be provided in each case, and engineers merely confined themselves to the technical and contractual aspects of design and construction (Austin 1996).

The last two decades, however, have seen the recognition of, first, the effect of layout planning on the cost of providing engineering services and, second, the impact of services on the continually rising cost of housing. They have also seen the appearance of various guideline documents aimed at optimising the provision of services which are not only of sound engineering quality but acceptable (both financially and technologically) to the recipient communities as well. *The Blue Book*, *Green Book* and *Red Book* guidelines prepared by the CSIR take their titles from the colour of their respective ring binders, and represent some of the efforts made over this period to address the issue. This revised document has evolved partly as a natural progression from the previous guidelines, but has also been substantially revised and expanded to present a holistic, integrated approach to settlement planning.

The previous edition of the Red Book, entitled *Guidelines for the provision of engineering services and amenities in residential township development*, was completed in 1992. Due to the political changes taking place in the country at the time, however, the document was not published until 1994. It was furthermore realised that the guidelines were no longer capable of meeting the challenges facing developers in the times of societal change which the country was experiencing. The book was considered to have a number of shortcomings which restricted its usefulness in the drive to produce sustainable and vibrant human settlements, as opposed to mere serviced townships (Austin and Biermann 1998). Some of the perceived shortcomings were: outdated and unwieldy urban-planning principles, insufficient information on various appropriate engineering technologies, and a general lack of an integrated approach to settlement planning. It was therefore decided to gather feedback from users of the book by means of a series of countrywide workshops, where these and other problems could be debated by experienced professionals.

The purpose of this document is not merely to assist professionals in producing efficiently serviced "townships", but rather to create sustainable and vibrant human settlements. This approach is reflected in the new title of the book - *Guidelines for Human Settlement Planning and Design* (Austin and Biermann 1998). In this context, a "human settlement" is regarded as any built environment where people live, work and play, with the provision that only residential areas, and other developments associated therewith, are considered in this book.

A "living document": the Red Book workshops

In terms of its mandate, the Division of Building and Construction Technology has undertaken to maintain the *Red Book* as a continually updated "living document" (Schlotfeldt 1995a). Standards should be seen as a reflection of society's values at any given time; moreover, values and priorities are not inflexible but rather in a constant state of change. Technology also develops and changes and the *Red Book* should reflect this evolution. A series of five workshops were held in February and March 1995 in Bloemfontein, Cape Town, Pretoria, Durban and Port Elizabeth, where users and other interested parties were afforded the opportunity to discuss the applicability of the guidelines and provide constructive criticism with a view to the document's improvement and further development. Other forums, such as conferences and meetings of a number of professional societies, were also used as platforms for discussion and information concerning the book.

The workshops were attended by nearly 700 delegates representing a wide range of interests (e.g. consulting engineers, urban planners, local and regional authorities, provincial and central government departments, universities, technikons, developers, manufacturers, financiers and NGOs). The result of the deliberations was a great number of valuable recommendations and suggestions for improving the guidelines, as well as many requests for additional guidelines on various subjects. All the recommendations received serious consideration and the vast majority have been taken up in this revised document. There was consensus amongst all parties present at the workshops that, in any development, a holistic, integrated planning process is an essential requirement and that planners, engineers and other professionals need to work together right from the conceptual stage of a project to achieve this. It is largely as a result of the input from the planning profession during these and later deliberations that not only was a framework for the redevelopment of the urban planning guidelines produced, but also the guiding philosophy for the entire document.

Investment in infrastructure is crucial to the efficiency and habitability of our urban areas. World Bank research (South Africa 1995) indicates that investment in infrastructure stock has a significant impact on GDP growth, as infrastructure raises general levels of welfare and health. It is also realised, however, that eliminating - or even just reducing - the housing backlog will simply be beyond reach if the highest level of infrastructure (i.e. fully reticulated water and electricity supply, full waterborne sanitation, etc) is regarded as the norm. There needs to be space for incremental approaches to provide sustainable and affordable levels of service while ensuring acceptable and adequate functionality. Creative and varied solutions are thus required, and it is not necessary to confine housing strategies to conventional methods and technologies. A balance between established practices and new ideas and developments is thus required.

PURPOSE AND LEGAL STATUS OF THIS DOCUMENT

Urban planners and engineers are continually confronted with the dichotomy of the needs or aspirations of communities versus their ability to pay for housing and services (Austin 1996). The central government has set limits on its ability to provide grants and subsidies for services. Local governments will therefore be largely responsible for making provision for access to most of the engineering services and amenities by persons residing within their area of jurisdiction. Furthermore, these services and amenities must be rendered in an environmentally sustainable manner and must also be financially and physically practicable. Information is thus required on all available service technologies and complementary spatial settlement planning, so that informed decisions may be made on what is most suited to a particular community and what is sustainable.

The need for this information is not confined to technical professionals only. All those who are required to take decisions on policy at the various levels of government or within non-governmental organisations can benefit substantially by having greater insight into the possibilities and limitations of various available options. Such insights will enable them to interact more effectively with consultants and community structures, and the *Red Book* is also aimed at providing these insights in a manner that is both understandable and useful to non-technical persons.

For sustainable progress, as well as for the general health and well-being of the population, settlements should be coherently planned; there should furthermore be a choice between a range of affordable technologies, particularly in the water-supply and sanitation fields. Service levels should be appropriate, as a high level of service which fails (for whatever reason) may well pose a greater threat to public health and the environment than an inadequate lower level of service. Various factors, for example high population densities or adverse geotechnical conditions, may also dictate that consideration be given to alternative types of service technology. However, only proven designs should be used and, ideally, communities should be able to exercise choice within a range of approved designs. In this context, appropriate technology may be defined as "meeting the needs of a particular community at a particular time".

In order to achieve the above objectives, engineers and urban planners need to be provided with *guidelines*, as opposed to standards. Guidelines are intended to assist decision-making, whereas standards are enforceable absolute limits (Schlotfeldt 1995a). It is recognised that both the rigid application of guidelines as well as the setting of inappropriate standards can have the opposite effect to that intended. The inter-departmental coordinating committee tasked with overall direction of the revision of the *Red Book*, as well as the steering committees involved, were of the opinion that the concept of "guidelines" should continue to prevail, and that the provisions of this document could thus not be legally enforceable. The use of these guidelines by the various disciplines involved in the design, supply and management of serviced land for residential development would be strongly encouraged, however.

It should be noted that only "local" services and planning issues are considered. Bulk services and amenities - for example main water supply pipelines, outfall sewers, treatment works, landfills, freeways and so forth - are considered beyond the scope of this document.

The intention of the new *Red Book* is to provide performance-based guidelines for informed decision-making. The purpose is essentially to indicate the qualities that should be sought in South African settlements, and to provide practical guidance on how these qualities can be achieved. The document is therefore intended to be educative, providing ideas and useful information, and not as a substitute for innovative planning and engineering practice (Behrens 1997).

ROLES AND INTERACTION OF PROFESSIONALS INVOLVED IN THE BUILT ENVIRONMENT

The primary readers of this book will be the range of professional and other persons that contribute to the planning and design of human settlements (i.e. architects, urban designers, town and regional planners, civil, transportation and electrical engineers, energy practitioners, etc) from both the private and public sectors. The document attempts to integrate information that is relevant across different disciplines and, unlike its predecessor, moves away from having separate and exclusive sections on "engineering" and "planning".

The fullest cooperation between the various professionals engaged in human-settlement planning is crucial to achieving sustainability, and thus also replicability (Austin and Biermann 1998). A common strategy is required in order for the development process to be geared towards meeting the particular needs of communities in a manner which is acceptable to them, and not merely acceptable to the planner, designer, financier or local authority. The guidelines represent a balanced and integrated approach to settlement planning and, although unlikely to satisfy everybody, represent the culmination of four years of intensive planning, research, writing, debate, questioning, criticism and rewriting. Engineers, architects, urban planners and academics have worked together and achieved basic agreement on the requirements for housing the nation in a sustainable manner.

This document is the result of input from a wide range of participants. Relevant national and provincial government departments were involved through representation on the coordinating committee. Local government, the private sector, academics and organised professional bodies participated through the various steering committees. Academic and practising experts contributed by authoring sections of the book. Specialist workshops, involving a broader spectrum of expertise, were held at key stages during the process to debate concepts and drafts. Universities, professional engineering and planning bodies, relevant national, provincial and local government departments and bodies, as well as selected practising consultants, all formed part of a beta-testing programme, where the final draft was distributed to a sample of potential users of the book for comment.

HOW TO USE THE DOCUMENT

This document is explicitly not intended to be an administrative "check list" for local authority officials (Behrens 1997). It will instead provide guidance on appropriate practices and technologies. Emphasis is placed on assessing "performance" (in relation to issues like health, safety, recreation, education and trade) as opposed to simply assessing the quantitative dimensions of the plan to ensure some form of compliance with stated norms. Once again it is emphasised that these are *guidelines*, not specifications. The document therefore does not remove professional responsibility from practitioners, and certainly does not replace the need for professional experience and judgement. The contents should therefore not be rigidly applied, but rather perceived as an aid to preparing one's own project plans and specifications.

Various national and provincial government departments, statutory bodies and local authorities may also have their own sets of guidelines for use by planners and engineers. It is not the intention of this document to take the place of these other guidelines. Rather, the *Red Book* should be considered as being supplementary to them, because local conditions and experiences can often dictate what procedure should be followed in specific cases.

STRUCTURE OF THE DOCUMENT

Although significant effort was made to approach the revision process in an integrated manner, the presentation of the material in document form required it to be divided into manageable and readable sections.

Chapter 2 provides a guiding philosophical framework for the entire document and discusses an appropriate context for settlement-making relating to the two central concerns of human- and nature-centred development. Performance qualities are identified, clarifying desirable achievements in settlement formation. The nature and planning of human settlements is described and the importance of structure is emphasised.

Chapter 3 focuses on settlements as systems made up of functionally interrelated elements. The chapter sets out the starting points for achieving positively-performing settlements, the principles that are important in achieving highly functional settlements and provides a synthesis of the principles as well as an application of the principles and the planning guidelines. Chapter 3 can therefore be seen as providing the link between the framework presented in Chapter 2 and the practical guidelines provided from, and including, Chapter 5.

Guidance on the planning method and the participation required is given in Chapter 4, where human-scale development and partnership-based participation are advocated.

Chapter 5 provides qualitative and quantitative guidelines relating to the planned elements of a settlement system. Its sections relate to the following interrelated - and somewhat artificially separated - planned elements of settlement systems: (5.1) movement networks; (5.2) public transport systems; (5.3) hard open spaces; (5.4) soft open spaces; (5.5) public facilities; (5.6) land subdivision; (5.7) public utilities and (5.8) cross-cutting issues. The purpose of presenting the various planned elements of settlement systems separately, is to present useful information relating to settlement systems in an accessible and distinguishable way, rather than to suggest that these elements of the settlement system should be planned in isolation.

Section 5.8 focuses on cross-cutting issues that have relevance across both the planning and engineering spectrums. These include environmental design for safer communities (5.8.1), ecologically sound urban development (5.8.2), and fire safety (5.8.3).

Chapter 6 sets out stormwater management principles in a manner which complements and reinforces the foregoing urban design principles and the following chapters on road design, sanitation and solid waste management. Road layout issues were prepared largely in conjunction with the movement networks guidelines (5.1) with the result that Chapter 7 has been confined largely to detailed engineering issues while the geometric planning component has been incorporated into section 5.1. Chapter 8 provides a comprehensive and modern approach to road pavement design, construction and maintenance, with special emphasis on lower-order roads.

The water supply and sanitation chapters (Chapters 9 and 10) have been thoroughly revised in order to make them more useful and relevant. The previously incorporated section on water treatment has been removed as it is considered to be a bulk service and thus beyond the scope of this book; it is furthermore regarded as a specialised subject, which cannot be given justice in a broad guideline document of this nature. The details on waterborne sewerage design have also been removed, with other design manuals being referred to instead. The guidelines have concentrated, rather, on providing designers with broad background information on the multiplicity of sanitation systems available, to enable them to apply the most appropriate technologies under the specific circumstances, while providing sufficient reference material for their needs.

The solid waste management section (Chapter 11) sketches the legislative background pertaining to waste handling and also sets out the different levels of service in a way which maximises employment and opportunities for entrepreneurship. On-site storage, transfer stations and recycling operations are also described. Landfills are not dealt with as they are regarded as a bulk service. However, broad guidelines pertaining to landfills, in so far as they are required for settlement planning purposes, have been included.

Guidelines on energy (Chapter 12) have been presented in two parts, the first part dealing with conventional grid electricity and the second with alternative and renewable energy sources. The latter section includes details on "clean" technologies such as solar power and other appropriate energy opportunities for poor or small rural communities. Urban planning principles which facilitate the application of alternative energy technologies are also encouraged.

CONCLUSION

The concept of *sustainability* is a philosophy common to all sections of this guideline document. Sustainability should always be the main concern in any type of development. This has the following implications (Miles 1995):

- development projects should contribute to technology transfer and skills development;

- beneficiaries must have effective control of their environment;
- an operational and sustainable product or system must be delivered; and
- systems should be capable of being operated and maintained using local resources.

The emphasis has shifted from merely providing serviced erven in the most cost-effective manner to the creation of sustainable living environments and thriving communities. New demands are being placed on professionals involved with the development of human settlements, from the application of unfamiliar technologies to social science and community organising skills, as well as technology transfer and skills development. It is expected that such professionals will increasingly turn to guideline-type documents in order to obtain the required information. It is thus imperative that the revised *Red Book* remains a living document; constant input by practitioners and researchers will ensure that this goal is achieved. Constructive criticism and comment from users of the document will therefore be welcomed.

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Chapter 2

A framework for settlement-making

2

TABLE OF CONTENTS

INTRODUCTION

The purpose of this chapter is to provide a guiding framework for settlement-making. The chapter provides a brief overview of planning and design in South Africa, which expresses the need for a new framework, before setting out the two central concerns - namely human and nature-centred development - which form the basis of the framework. The starting points to achieve positively performing settlements are provided before performance qualities, clarifying the desired achievements in settlement formation (guided by developments in the planning policy arena) are identified. These are applicable to all the subsequent planning and engineering chapters. Finally, the importance of structure in the planning of human settlements is described.

BACKGROUND

For some fifty years, the planning and design of settlements in South Africa has been dominated by the political ideology of separate development and the planning ideology of modernism.

A central theme of the modernist movement is its basis in functionalist thought, which is dominated by concerns with efficiency and technology. Efficiency is largely defined in technological terms, with urban settlements seen as "machines". Urban life is compartmentalised into broad categories of activity (live, work, play, move), resulting in spatial separation of these activities.

These ideologies have lead to the development of mono-functional settlements, often fragmented and environmentally sterile. These settlements - particularly those created for the disadvantaged members of our society - are characterised by low levels of service and high levels of inconvenience; they generate enormous amounts of movement at great cost in terms of money, time, energy and pollution; they are expensive for inhabitants, and the quality of their public environments is appalling. There is little evidence of a cohesive spatial environment which integrates urban activities and structures.

With the advent of the "new South Africa", it is necessary to reverse the effects of these ideologies. The challenge is to create a framework for settlement-making which will enrich life in settlements and serve as an instrument of urban reconstruction and development. This has already been accepted in policy terms. The government's Urban Development Framework (South Africa 1997) calls for "the physical, social and economic integration of our towns and cities" and stresses the need for higher density, more compact and, in terms of land use, more mixed-use settlements. Similarly, the Development Facilitation Act, No 67 of 1995 (South Africa 1995), inter alia, calls for environments which

- promote the integration of the social, economic, institutional and physical aspects of land development;
- promote integrated land development in rural and urban areas in support of each other;
- promote the availability of residential and employment opportunities in close proximity to or integrated with each other;
- optimise the use of existing resources, including resources relating to agriculture, land, minerals, bulk infrastructure, roads, transportation and social facilities;
- promote a diverse combination of land uses, also at the level of individual erven or sub-divisions of land;
- discourage the phenomenon of "urban sprawl" and contribute to the development of more compact towns and cities;
- contribute to the correction of historically distorted spatial patterns of settlement in the Republic and to the optimum use of existing infrastructure; and
- encourage environmentally sustainable land development practices and processes.

This framework should begin to move us in this direction. It is based on the integration of the human and nature-centred approaches to settlement-making.

CENTRAL CONCERNS

The human-centred approach emphasises that a central purpose of planning is to ensure that the developmental needs and activities of people living in settlements are catered for and, in particular, that opportunities for people to achieve their full potential through their own efforts are maximised. This approach, rather than being purely cost - or technologically-driven, is people-driven and democratic.

The nature-centred approach recognises that natural systems interact in highly synergistic ways, which must be respected if breakdowns in them are to be prevented. Human actions on the landscape, such as settlement-making, must thus be sensitive to ecological processes. Therefore, rather than imposing settlement development on the environment, this approach emphasises design with nature, thereby creating synergy between man-made and ecological systems.

THE STARTING POINTS

There are three starting points for achieving positively performing settlements.

- The first is the importance of pedestrian movement. A fundamental dimension of scale is related to movement on foot. The pedestrian condition describes the reality for the majority of residents in towns and cities in the country. Large numbers of people do not, and will not in the foreseeable future, own private motor vehicles. Obviously, though, settlements cannot be only pedestrian-based.

  Settlement growth brings with it higher order opportunities, services and movement systems. Consistent with the principle of equity, particularly in communities with low levels of car ownership, public transport becomes a necessity once the pedestrian scale is exceeded.

- The second starting point is the importance of thinking spatially. In pedestrian-scaled environments the public spatial environment should be viewed as the highest level of social infrastructure. In these environments a great deal of activity occurs in the public spaces, with the result that the quality of the public-spatial environment profoundly affects the quality of life. Thinking spatially, in this context, requires that all public spaces, particularly streets, be viewed as public space.

- The third starting point is the importance of a *minimalist approach* to settlement-making. This requires that the basic structure and most important actions required to create the preconditions for a positively performing settlement be defined at the outset of the settlement-making process. Over-design of the process reduces spontaneous settlement-making activities.

WHAT WE SHOULD BE TRYING TO ACHIEVE: PERFORMANCE QUALITIES

The integrated approach on which the framework for settlement-making is based, makes it possible to identify performance qualities, which should guide plan-making and against which plans and settlements can be monitored and measured.

Environments reflecting these performance qualities have the following physical characteristics:

- they are scaled to the pedestrian, although commonly neither the pedestrian nor the motor car has absolute dominance;
- they are compact, having relatively high building densities;
- their structural elements are integrated and the composite parts reinforce each other;
- they have a strong spatial feel, with well-defined public spaces; and
- their spatial structures are complex, offering choices in terms of intensity of interaction, privacy of living conditions, lifestyles, housing options and movement systems.

Efficiency of resource use

The development of settlements requires the use of a wide range of resources, including land, money, building materials, manpower, energy and water. As a general principle, it is essential that resources be used as efficiently as possible.

Opportunity generation

People come to settlements to improve their personal welfare. The opportunity to improve one's lot derives from the economic, social, cultural and recreational opportunities resulting from the physical agglomeration of people in settlements. However, the capability of settlements to generate opportunities is not only determined by numbers of people, it is also affected by how settlements are ordered and made.

Of importance to developing countries, such as South Africa, is the need to create opportunities for small-scale economic activity. The reality is that, within the foreseeable future, large numbers of people will not be absorbed in the formal economic sector and will have to generate their own survival activities, via the small-scale - and often the informal - economic sector.

There are a number of ways in which spatial conditions in settlements create opportunities for economic activity.

- The first is *intensification*. This requires the promotion of higher unit densities than is the norm under the current model of settlement development. The case for increasing densities rests on a number of grounds. Higher densities create more opportunities for interaction, a climate in which economic activity - and small-scale economic activity, in particular - can thrive. A further effect of increased densities is an increased local demand for goods and services, promoting increasing specialisation and diversification in the small business sector.

The promotion of economic activity is also affected by the efficiency of movement systems. Efficiency of movement creates higher levels of support for goods, services and social facilities, simultaneously ensuring a wider range of goods and social facilities and increasing the viability of the services provided. In this way higher densities play a crucial role in achieving higher levels of convenience.

Higher densities lead to increased support for public transport systems, improving their viability. Higher densities, by lowering unit costs, can also contribute to the more efficient use of infrastructure.

Finally, higher densities can contribute to the efficient utilisation of land, the counteracting of urban sprawl, a reduction in travelling and a reduction in energy consumption and pollution.

- A second way in which settlements maximise opportunities is by integrating the *different parts of the settlement*, so that they contribute to each other. When a settlement is fragmented into a number of smaller, inwardly orientated parts, each part is largely reliant on its own internally generated resources. Consequently, levels of service and convenience may be low. By contrast, when the parts of a settlement are integrated, each part benefits from a much larger area. New settlements should accordingly not be viewed as ends in themselves only. They should also be viewed as instruments of restructuring, in the sense that they can be used to integrate a fragmented settlement environment.

  The above has implications for our thinking about movement. The challenge is to establish and maximise a continuity of movement systems, tying local living areas together. Movement systems need to be viewed not just as movement channels, but as spatial structuring elements. This line of thought leads to the conclusion that maximising access is as important as maximising mobility.

- A third way of increasing opportunities is by *enabling the evolutionary development of more complex settlements*. When this occurs, a diversity of large- and small-scale activities can find viable locations within the settlement system.

- A fourth way of creating opportunities is by *using the generating power of larger activities to attract smaller activities*, both of which benefit from the movement flows that result from the presence of the other.

Convenience

Good urban environments are, by definition, convenient. They allow inhabitants to conduct daily activities quickly and easily. Inconvenient environments, on the other hand, impose on lifestyles, reduce choices and increase costs.

Access lies at the heart of convenience. In this regard, access needs to be conceived of in terms of movement modes. The first mode is *pedestrian movement*, which is the lowest common denominator of movement and which describes the primary movement mode of large numbers of people in South Africa. The second is *motorised movement* in the form of public and private transport. Not all human activities and interaction opportunities exist within walking range. When this occurs, motorised transport becomes the more convenient movement mode.

For millions of South Africans, who cannot afford a motor car, public transport is crucial to facilitate movement. Although this does not deny the need to accommodate motor vehicles in settlements, the structuring of settlements, particularly for those who cannot afford private transport, should encourage and facilitate pedestrian movement and public transport systems.

Two forms of access are central to promoting convenience.

- The first form is access to the economic, social, cultural and recreational benefits which result from the agglomeration of people. This requires the intensification of settlements, the generation of opportunities for a greater range of activities and choices promoting more complex levels of spatial order and encouraging a greater range of development processes. Movement is the integrating structural element underpinning the above.

- The second is access to nature. Since settlements are, as a rule, places of intense human activity, the opportunity to escape from this intensity and to experience nature is of great importance to people. For many, for reasons of affordability, contact with nature has to be collective contact as it cannot always be provided adequately within private gardens. In addition, the productive capacity of the land can be a vital settlement resource. For many settlement dwellers the opportunity to use the land productively, or to engage in lifestyles which incorporate dimensions of both urban and rural living, is crucial to their survival.

Choice

Settlements which perform well are multifaceted places. They offer a diversity, and thus choice, of places, lifestyles, activities and interaction opportunities.

On the one hand, positively-performing settlements offer opportunities for human contact and interaction. Their activities and events play a major part in shaping the identity of the settlements. Importantly, settlements provide opportunities where people can live on their own but not be alone. They also provide people with choices regarding the extent to which they wish to engage in social activity.

On the other hand, people also require places which are private, particularly in the sense of knowing who "the locals" and who the strangers are.

The degree to which people wish to live in intensive and vibrant environments - or quieter, more private, places - varies from person to person and over the life-cycle of households.

The challenge is to promote environments which provide a *diversity of choices*, so that people do not have "either-or" choices, but rather choices which relate to relative degrees of privacy or exposure. The key to this lies in hierarchies of movement, public spaces and social institutions, and the design of living areas.

Equality of access

It is neither possible nor desirable for all parts of settlements to be the same. The reason for this is that clustering tendencies emerge in the structure of settlements as they grow. Activities requiring public support tend to cluster at the most accessible places. Nevertheless, it is important that all people have reasonably equal access to the opportunities and facilities which support living in settlements.

Spatially, two issues are central to this:

- The first is the recognition that balance is not so much a geographical as a structural concept. The issue is not one of attempting to achieve an even distribution of facilities over the surface of settlements. Rather, it is one of integrating public facilities and events with movement systems, so that access is equalised.

- The second issue is that of creating the access preconditions for more intensive activities to spread in a logical way, consistent with the growth of the settlement.

Quality of place

Quality of place is attained by embracing uniqueness as opposed to standardisation. In terms of the natural environment it requires the identification, a response to and the emphasis of the distinguishing features and characteristics of landscapes. Different natural landscapes suggest different responses. Accordingly, settlement design should respond to nature.

In addition, quality of place can be achieved by site-making actions, including topographical moulding in areas where soil is easily movable, to create greater diversity in the land form; tree planting, to provide areas of shade and recreation; the use of supplementary sources of energy and building materials; wind protection and space definition; the creation of water bodies as recreational features, sites of aqua-culture and visual relief; and creating choices of living condition.

In terms of the human-made environment, quality of place recognises that there are points where elements of settlement structure, particularly the movement system, come together to create places of high accessibility and special significance. These are the meeting places of the settlement. Business and commercial activities, schools, clinics, libraries, community halls and other facilities and activities requiring exposure to large numbers of people are associated with these places. In the best cases, the importance of these places is recognised in that they become the focus of public investment, aimed at making them attractive, user-friendly, and comfortable to experience.

They also become the places that accommodate symbolic statements, such as objects of remembrance. These, then, become the memorable places, which shape lasting impressions of a settlement. Their significance is strengthened by their dominant locations in terms of the movement network and from the significance of the social events or rituals they accommodate.

Sensory qualities

Positively performing environments reflect powerful sensory qualities. They are places which are aesthetically appealing and which add to the quality of peoples' lives.

The quality of the public spatial environment plays a critical role as far as the sensory qualities of settlements are concerned. The public spaces and places are the primary areas within which people engage in, and experience, urban life.

The role of public spaces in the lives of the urban poor is particularly critical. When people are poor, the full range of a household's needs cannot be adequately

met by the individual dwelling. Accordingly, a significant part of their lives is played out in public spaces. If properly made, these spaces can give dignity and a sense of permanence to environments. They are places where many social experiences occur and, in a real sense, they operate as extensions to the private dwelling. The implication is that all public spaces, of which the residential street is one of the important forms, should be viewed and constructed as social spaces.

It is the integrated framework of public spaces that enhances the sensory qualities of settlements.

Sustainability

Sustainability has two main dimensions. The one relates to the relationship between the built environment and the natural landscape. The other is the degree to which the settlement reflects "timeless" qualities .

- Settlements exist as adaptations of natural landscapes and are dependent on resources drawn from a much larger area. Two issues are central to achieving environmental sustainability. The first is the need to work harmoniously with the natural landscape, rather than causing breakdowns in natural systems, such as filling in wetlands to obtain developable land rather than developing higher-lying ground. The second issue is the need to recycle wastes to the greatest possible degree. For example, stormwater runoff can be used for irrigation purposes, and treated sewage as fertiliser.

- The second dimension of sustainability is the degree to which the settlement reflects, in its structure and form, "timeless qualities". Sustainable settlements accommodate growth and change well, and are in turn enriched by processes of change. They have three primary characteristics. They are scaled to the pedestrian. They reflect a structural order, which allows logical reinterpretation by successive generations. They have a strongly spatial feel, with defined and generously made public spaces, spaces not determined only by immediate development needs, but made with the recognition that public space is important in its own right.

PLANNING OF HUMAN SETTLEMENTS: THE ROLE AND IMPORTANCE OF STRUCTURE

The meaning of structure

Spatial structure is a concept used to interpret, design and make human settlements. The spatial structure of a settlement results from an interplay between the formally planned (or programmatic) and the spontaneous (or non-programmatic) dimensions of settlement-making. The planned dimension is essentially quantitative. It requires the identification of the major elements of land use and the development of a land and engineering services budget.

By contrast, the spontaneous, or non-programmatic, spatial structure is essentially qualitative, having at its core a concern with the whole rather than the parts. It reflects how people, over time, have addressed the making of a place to meet their needs and enrich their lives. Spontaneous environments reflect the timeless qualities referred to above. They do not depend on particular levels of technology, or minimum levels of personal means, to operate well.

The term "structure", as used here, refers to the creation of the public environment: that realm which is shared by all inhabitants, as opposed to the private realms of individual households and businesses. In investment terms, this usually equates with public investment in the spatial structure, to which private investment and decision-making responds.

The art of planning and design is to arrange the elements of structure into a system of references that supports the processes of living, and which establishes a spatial logic eliciting responses from the many actors who contribute to settlement-making. Settlement plans should therefore be able to accommodate uncertainty and change, rather than simply accommodate the initial development programme that necessitates the plan in the first place.

The elements of structure

In conventional planning, the elements of structure are described in terms such as circulation networks, public transport systems, open spaces, public facilities, and public utilities (engineering services). However, in the context of spontaneous settlement-making, it is useful to describe the structural elements as connection, space, public institutions and utility services. How each of these elements gives structure to a settlement is outlined below.

Connection

Connection refers to movement of all kinds, including fixed line systems such as roads, light - and heavy - rail systems, underground rail systems,

as well as pedestrian and bicycle routes. As a general principle, movement should be seen as an activity which occurs within space. The movement system, therefore, is the network of spaces through which people move in various ways, from the pedestrian mode to modes specifically conceived for fast movement. It is primarily within this network of movement spaces that the public life of a community takes place. Consequently, its making should be informed not only by technocratic considerations, but also by human and environmental considerations.

The movement system has considerable structural significance as it defines the pattern of accessibility, both within the settlement and between settlements. It is this pattern, in turn, which sends structural signals to individuals, entrepreneurs and place-makers, and which significantly affects the range of choices and opportunities the settlement offers inhabitants.

Space

Space lies at the heart of the non-programmatic approach to settlement-making. It is not just one element of a settlement programme, such as "public open space" (as designated in town planning schemes), but should be approached as part of thinking about the whole.

Settlements are characterised by diversity. They are many-placed places. Some parts are more public, others are more private, while others are more neutral, serving broader, more diverse sets of citizens and urban activities. It is apparent, therefore, that there is a structural order in settlements. This order lies at the heart of the concept of structure.

Public spaces are the meeting places of people in settlements. The public spaces comprise the urban "rooms" and "seams" of connectivity. There also exists a continuum of spaces, which represents a transition from more public to more private living. The order in settlements thus not only relates to access, but also to degrees of publicness and privacy. A similar order of publicness and privacy exists in relation to social institutions and activities, and places of perceived value.

At the heart of settlement-making lies the creation of a continuum, or hierarchy, of public spaces and movement systems, which attract, and give order to, activities, events and elements in accordance with their need for publicness or privacy.

Space becomes particularly significant when one is considering movement at a local scale. At this scale the concept of "road" needs to be replaced by the concept of providing spaces which are comfortable for people to be in, and within which movement can take place. In spaces so conceived, neither the pedestrian nor the vehicle has complete dominance or right of way.

Public institutions

Historically, the institutions which were most valued by society - such as institutions of learning, worship, exchange, markets and universities - served as the key structuring elements of settlements. The siting of these, in turn, formed the basis for the locational choices of other, more private, uses, such as housing. It is considered important to revive this tradition. However, a difficulty is that, in modern times, societies occupying settlements have become increasingly heterogeneous and diversified. As a consequence it has become difficult to identify institutions which have generally recognised value. This does not, however, negate the importance of thinking about settlement structure in this manner. In the absence of certainty about what institutions will be prioritised by communities, the social space itself becomes the highest form of social institution.

The location of institutions in relation to the other elements of structure is also of critical importance. Commonly, institutions occur in central places, are easily accessible in terms of movement patterns, and are announced by public spaces. The institution abutting onto the space gives unique character to the space and often attracts informal activities.

Public utility services

Public utility services refer to those engineering services that are essential to the functioning of settlements. They include water provision, sewage removal, stormwater disposal, solid-waste removal and electricity supply. These services are essential to the maintenance of public health in settlements. They can be provided in various technological forms, all of which have different cost implications and environmental and geometric requirements.

As a general principle, utility services should be provided as efficiently and as cost-effectively as possible, taking due cognisance of the human- and nature-centred approach to settlement-making proposed herein. However, in terms of structuring settlements, utility services should follow, not lead.

An approach to structure: minimalism and complexity

The appropriate approach to settlement-making is *minimalist*. This approach requires that the minimum number of strong actions necessary to give direction to the settlement-making process be clearly defined in the framework plan.

A failure to clearly define the minimum actions required will almost certainly destroy the quality of the whole. Essential public and private sector investments may not materialise, leading to unfavourable and unintended outcomes and failure of the plan.

However, if the plan for settlement-making goes too far, freedom, and thus complexity, will be reduced. A hallmark of positive environments is that they are complex. Complexity, however, cannot be designed. Environmental diversity results from freedom of action and the iterative application of the ingenuity of many decision-makers and actors in meeting their particular requirements, as well as the needs of their fellow human beings.

Spatial structure, in a sense, can be seen as the enabling "constraint" which gives direction, and some predictability, to settlement-making processes, without defining their precise form or outcomes. It is the function of structure to generate a range of opportunities to which individuals and groups can respond, and around which a diversity of human activities can take root.

While growth and development processes take many forms and are not always predictable, an enabling plan should nevertheless be aimed at unlocking the energies, ingenuity and resources of settlement-builders and implementing agencies. These include individuals, groups, communities, small and large developers, utility companies, investors, semi-governmental organisations and a range of governmental institutions and agencies.

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Chapter 3

Spatial and structural principles for settlement-making

3

TABLE OF CONTENTS

LIST OF FIGURES

INTRODUCTION

This chapter focuses on settlements as systems made up of functionally interrelated elements. It builds on Chapter 2 by providing principles important to achieving well-performing settlements, and guidance on how they can be achieved. Chapter 3 can therefore be seen as providing the link between the framework presented in Chapter 2 and the practical guidelines provided in Chapter 5 and those that follow.

NATURE OF THE GUIDELINES

The guidelines are essentially concerned with *principle*, *idea* and *context*.

- "Principle" refers to a set of spatial "rules", which should be applied in the settlement-making process.

- "Idea" refers to the relationships between elements of structure, which best capture the desired performance qualities in the context of a particular problem.

- "Context" has two dimensions.

  - Time: Time impacts on the technologies which can be applied to, or which have to be accommodated in, the challenge of settlement-making.

  - Place: Place refers to the specifics of the natural, socio-economic and cultural environments.

  Context is the catalyst which transforms an idea into design. It makes it possible to develop a variety of different designs, based on the principles and the idea.

In these guidelines *principle* and *idea* are addressed, where necessary, by means of generic diagrams, as these are helpful in defining spatial relationships. They do not, however, represent designs. They are a-contextual. In this document the diagrams use geometric conventions, such as the grid and the pin-wheel, to clarify important relationships. It must be stressed, however, that the principles can be expressed in many different forms. It is the principle which is important, not the geometric form.

PRINCIPLES

The principles which are important in achieving well-performing settlements are of a structural and a spatial nature.

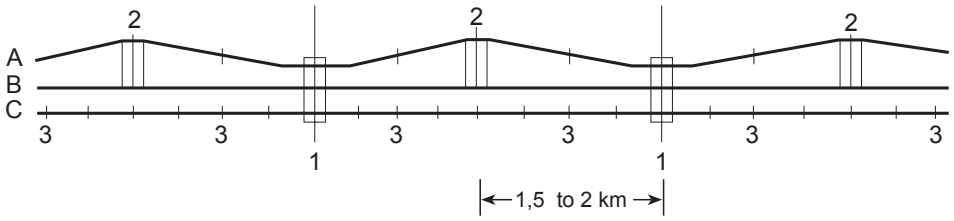
Structural principles

The principle of reinforcement

It is necessary to think structurally about all elements within the settlement. This means that each structural element should reinforce the others. This is illustrated in Figure 3.1.

The figure illustrates how interconnected modes of movement (pedestrian, bicycle, train, tax, bus, car) are brought together into a single corridor, thereby creating a range of structural opportunities. At points of major connectivity, where stopping points for all modes come together (marked 1 on the diagram) the potential exists for the creation of a major place with high-order urban activities, as these will tend to gravitate towards such points.

The integration of the elements increases the potential impact to a far greater extent than if they



LEGEND

A. Road-based public transport and private vehicles on high order limited-access routes: bus, taxi and private vehicles.
B. Heavy rail-based public transport: train.
C. Light rail-based and road-based public transport as well as private vehicles: tram, bus, taxi, private vehicles.
   1. First order centre. All modes of transportation.
   2. Second order centre. Mixed transportation: train, bus, taxi, private vehicle, walk.
   3. Local order centre. Local transportation: taxi, private vehicle, bicycle, walk.

Figure 3.1: Reinforcing modes of movement

were to be considered in isolation. Where two of the non-pedestrian links merge, a major place (marked 2 on the diagram) will also emerge, albeit of lesser intensity than 1. At places of local accessibility (marked 3), however, local order activities, supported mostly by local demand, will cluster.

The principle of continuity

Continuities of green space

Human society functions in a landscape that consists of the original (or primeval) natural landscape, as well as rural and urban landscapes. Access to all elements can be considered a basic need for human beings. As a result, establishing continuities of green space becomes an important element in the settlement-making process. Apart from fulfilling an important human need, this principle also promotes ecological diversity. Ecological systems are complex, with the migration of species and their exposure to different habitats forming integral components of the systems. Natural habitats should thus be continuous to allow for this to occur. At a larger settlement scale, the promotion and protection of such continuous systems become important planning principles. At a smaller scale of settlement, green spaces in new developments should contribute to emerging continuous green systems.

Two additional points can be made about green space:

- Green space within settlements should be productive space. Green space requires maintenance. If maintenance becomes too expensive or, for any other reason, breaks down, the space becomes environmentally negative. In addition, in many areas, urban agriculture has a vital role to play in the support of urban systems. In this role green space is an important supplementary source of nutrition and income for poorer people.

- Green spaces can absorb outputs from settlements. In this regard they can be used for evaporation ponds to remove partially treated wastewater; and as stormwater-retention systems.

Continuities of movement

The movement, or flow, of people, finance, goods and services is the energy network of settlements. Activities requiring the greatest degree of exposure will tend to gravitate towards the most accessible points and links in the energy network. The movement network exhibits its own ordering structure. At the settlement level the energy potential contained in the network is released through stopping, not through movement. Different movement modes have different patterns of stopping. Pedestrians and cars can theoretically stop anywhere along a route, bus stops may be spaced at 500 m to 800 m intervals, and train stations at intervals of 1,5 km to 2 km. Accordingly, these modes establish different rhythms of accessibility. The co-ordination of different modes enables certain points to be strongly reinforced, thus attracting and creating opportunities for the clustering of activities.

By definition, routes which do not allow stopping, such as freeways, have little positive structural impact (as defined in these guidelines) at the local level. They serve as the integrators of space at the inter-settlement level. At the local level of settlement they tend to emphasise points of exit and entry, rather than lines of accessibility. At this level they sever - rather than integrate - space.

The application of the principle of continuity consists of the creation of a complex and diverse pattern of movement and accessibility. This will enable all settlement activities, large and small, formal and informal, to find a place within the structural system. The resultant land-use pattern will be highly synergistic, with each part of the system benefiting - and being benefited by - the other parts.

Continuity of built form

New parcels of development should be integrated with existing development to obtain agglomeration economies. There is, however, a scale dimension to this. At places, the continuity should be consciously broken to ensure convenient access to green space as well as the natural and rural landscapes.

Continuity of public space

As discussed earlier, public spaces should make up a continuous network of space. Achieving a sense of enclosure and definition is important in this regard. Every building, either through the building itself, its walls, or planting, should contribute to defining the public space it abuts.

The principle of discontinuity

In the settlement-making context the principle of discontinuity refers to the promotion of breaks in particular components of the urban system, to achieve particular effects.

Discontinuities of movement

Along higher-order routes, discontinuities can be used to create special places, such as public squares

and parks. The discontinuity principle can also be used to integrate natural and rural areas and existing features into the urban landscape.

Discontinuities of movement on lower-order routes can be used to create qualities of secrecy or privacy, particularly in that through-traffic is discouraged.

Discontinuities of built form

Public space, such as a square or a park, can be used as a device to interrupt built form, thereby creating visual diversity in the built environment.

The principle of externalisation

Social facilities and higher-order urban activities should not be "embedded" within residential precincts, but should be externalised by locating them along more continuous movement routes.

This will ensure that the future of facilities is not entirely dependent upon the fortunes and resources of particular local communities. It will also maximise the potential return on the investment in facilities, by making the facilities accessible to a wider range of people. In addition, it will reinforce the private quality of the residential areas. Lastly, it will contribute to the establishment of symbiotic relationships between different activities and facilities.

The principle of concentration along routes

While intensive activities and facilities should be externalised along continuous routes, it is important to recognise that development along them will not be even. The accessibility of different points along routes is not the same, as there are powerful tendencies for more intensive activities to concentrate at the most accessible points along movement routes. These tendencies are illustrated in Figure 3.2.

The principle of accommodating sameness and diversity

This principle relates to accommodating both homogeneity (sameness) and heterogeneity (diversity) in settlements. It is this principle that accommodates both cultural and economic diversity and expression within settlements. It recognises that in a democratic, multicultured, society all communities, individuals and cultures are to be accorded equivalent respect.

This realisation has significant implications as far as the approach to structure and space in the settlement-making process is concerned.

The connection between space and structure lies in the recognition that different activities, cultures, and lifestyles have their own requirements, which must be met in the settlement-making process. As a result, successful settlements are ones that reflect diversity in terms of areas of sameness, areas of diversity or mixed-use development, areas of cultural homogeneity and areas of cultural diversity.

At a fundamental level, the requirements of sameness and diversity relate to variations in the need for privacy and exposure. Certain institutions and public places are more "owned" by particular groups, communities, lifestyles and cultures and are thus more private, while others are more neutral or public in the sense that they serve broader, more diverse, communities. Thus, for example, commercial activities and sport stadiums, when compared to religious activities, are heterogeneous. A mosque, or church, however, is "owned", by a smaller, more specific set of people.

In the sense that there is an order of homogeneity and heterogeneity in successful settlements, there exists a similar ordering of space, which reflects a transition from more public to more private living.

At the heart of positive settlement-making lies the creation of systems of public spaces which order activities, events and facilities according to their need for exposure or secrecy, and the integration of this system of spaces with the movement system, which, in itself, forms part of the system of public spaces.

In terms of the minimalist approach to planning and design, it is inappropriate to make centralised decisions about everything. Greater freedom, and

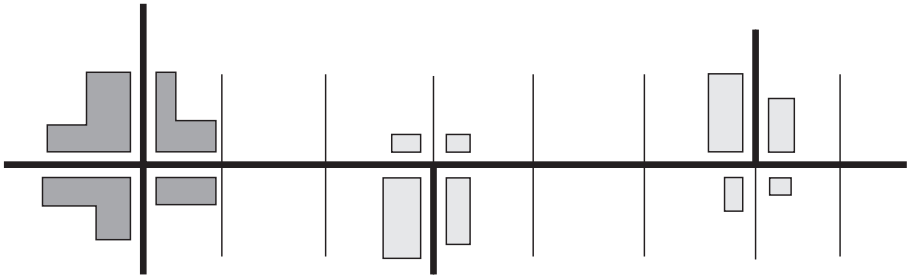


Figure 3.2: Hierarchical concentrations along routes

the more complex process of development which results from this, allow many actors to participate in and contribute to the settlement-making process. The result of this approach is settlement-making and planning in the form of a process, a process enabling and involving a diverse range of delivery agents.

Spatial principles

There are four spatial principles, which are central to creating positive settlements. These are *definition*, *scale, flexibility* and *intensity of space-use.*

Definition

In positive environments the public space is defined by buildings and other space-defining elements, such as walls and planting. This creates a sense of enclosure. The contrast is free-standing elements in a formless sea of space.

Scale

Scale refers to judgement about relationships such as size, distance and height. In settlement terms, reference is usually made to a "human scale", which is the scale that human beings feel comfortable with. Although a quality that can be difficult to define, it is one that should be striven for in modest, as well as bold, settlement-making processes.

Flexibility

Positive environments reflect flexibility in their spatial structures. The principle of flexibility thus refers to the creation of spatial structures which can accommodate the unexpected demands made upon them over time.

Intensity of space use

Land should be used as intensively as possible as this has positive spin-offs for settlement-making. These include:

- the creation of higher levels of support for economic and social goods and services;
- the establishment of an economic climate in which economic activity can thrive;
- the creation of the preconditions for viable public transportation systems;
- the efficient use of infrastructure; and
- the achievement of better utilisation of the land, contributing to compact urban environments, reduced travelling and energy consumption, as well as a reduction in pollution.

Intensification does not imply a standardisation of living conditions, or uniform densities. In the context of the minimalist approach, a choice of living conditions, which is an important objective of settlement-making, is facilitated in a number of ways, such as:

- by encouraging the development of areas of different character throughout the settlement;
- by the presence of contrasts within the structural system, with respect to space that is private and space that is public;
- by the natural development or evolution of a range of urban densities; and
- by an evolution of configurations of plot shapes and sizes, which result in the promotion of different housing types.

A SYNTHESIS OF THE PRINCIPLES

A synthesis of the settlement-making principles, discussed in the preceding sections, is depicted in Figures 3.3 and 3.4. The synthesis indicates how the principles can be integrated, thereby establishing a set of locational responses.

Figure 3.3 depicts an intense, mixed-use, but primarily residential area. The area contains a wide range of uses: housing, education and other social facilities, formal and informal economic activity, small-scale manufacturing and small-scale agriculture.

Economic activity, both formal and informal, is linked with the continuous intra-settlement route. It is backed by a belt of schools. These play an integrative role, since they serve pupils from a much wider area. Pupils can access them via public transport along the main road. The library, which serves a number of schools and the community at large, is located on the main road. The informal play space is associated with the schools but also serves the broader community. In order not to disrupt the continuity of building along streets it is located on the periphery.

Opportunities for urban agriculture are created on the periphery of the site. Stormwater runoff is organised so that this area is irrigated. The agricultural area forms part of the storm-water management system.

A small-scale manufacturing hive forms the western edge of the agricultural belt. This is associated with larger scale manufacturing to the west of the site.

All space is designated as social space. A continuous hierarchical system of public spaces organises the location of educational and other public facilities, all of which are externalised.

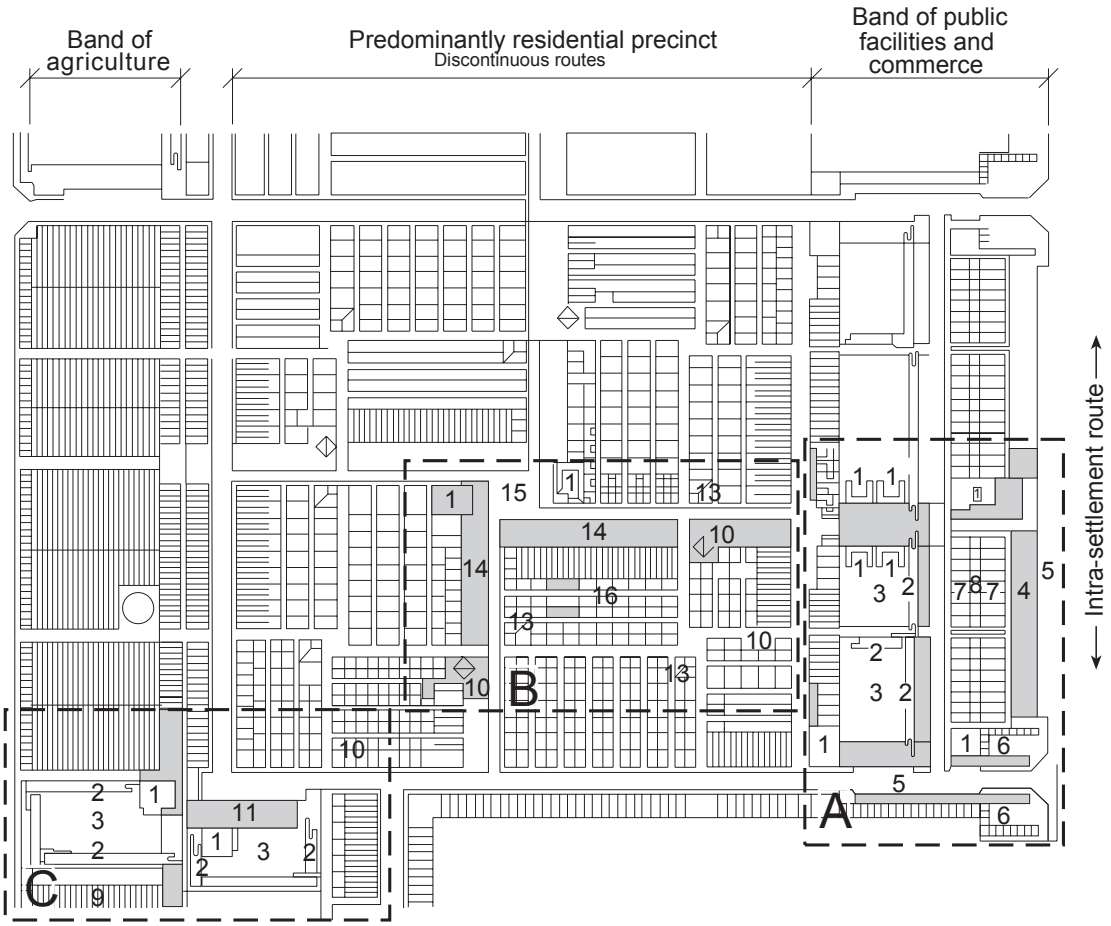


Figure 3.3: A synthesis of principles

The residential precinct is primarily organised around a 400 m by 400 m super-block module. There is no one ideal block size, as this will vary with context. The choice of the block and its internal organisation reflects an attempt to optimise efficiencies in terms of pedestrian and vehicular movement. The organising system is one of nesting blocks. At the larger scale, blocks are approximately 200 m by 200 m (although some variation in size is necessitated by the need for space-making), which is efficient in terms of vehicular use. At the smaller scale, the basic block size is 80 m by 80 m, a comfortable scale for pedestrians and one which is found in many cities of the world. The smallest blocks can also be accessed by car, but are chiefly pedestrian.

A hierarchical system of discontinuous routes create varying levels of privacy: there is a wide range of living conditions in terms of publicness and privacy.

The larger movement channels also serve as linear green spaces. They also accommodate vehicular and pedestrian movement and parking, which function as part of the green system.

The plan also shows how a variety of plot sizes and configurations, and thus house types, can be accommodated and how higher densities can be achieved.

Figure 3.4 shows areas A, B and C (indicated in Figure 3.3) in greater detail. Numbers in parenthesis refer to numbering in Figure 3.4.

- The community facilities are externalised (1). There is a pronounced dimension of order in the system, with the largest and most important facilities associated with the highest-order spaces. It is not necessary to predetermine the form of these facilities. Communities can establish their own priorities.

- The educational facilities comprise urban schools. Where possible, they should be atomised (i.e. broken up into parts), with community facilities such as sports fields, halls, libraries, computer centres and laboratories being shared between schools and between school and community (2, 3).

- Informal play spaces associated with the schools are located on the periphery, to maintain the continuity of the built form along streets (2, 3).

- The planted spaces can be used in many ways, including community events and parking (4).
- The main road is made into a space to accommodate parking (5).
- Main market sites for informal trading occur at highly accessible points (6).
- An intensive mixed-used zone, with flats above shops is promoted (7).
- There is a service zone serving the shops (8).
- There are communal gardens for agricultural activity (9).
- Refuse-sorting points are planned. Their location is determined by the main refuse-removal route (10).
- An important forecourt space is located at the end of a discontinuous route (11).
- There are manufacturing hives (12).
- In low-income, informal housing areas, corner sites may be used as communal bath-houses and laundry points (13).
- Elongated planted spaces are shown. These are social places that operate as social extensions of the houses. They are important play spaces for children (14).

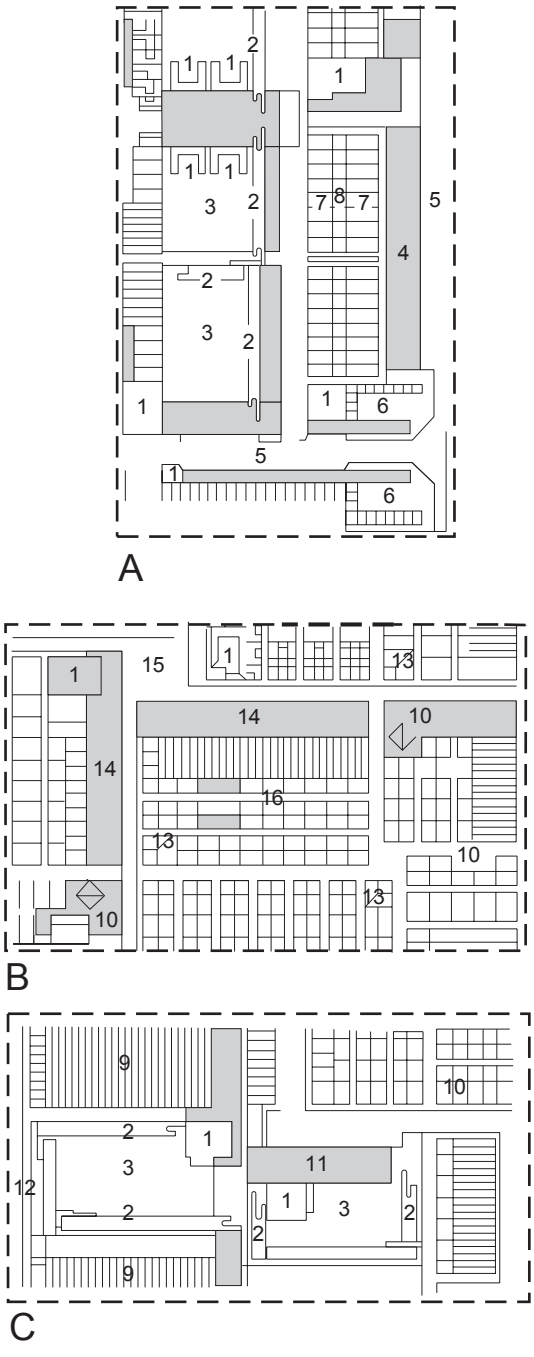


Figure 3.4: The detail of the plan

- An important public space gathers to it community facilities and commercial activity. As with 14, in these spaces neither the car nor the pedestrian dominates (15).

- A fine-grained housing precinct which is effectively pedestrian dominated (16).

APPLICATION OF THE PRINCIPLES

The guidelines for settlement-making have been formulated on the basis of principles. In their application to a site, however, they can obviously be captured in many forms and need to be applied on an integrated basis. Some brief notes in this regard are provided below.

At present there are in essence three generic urban conditions prevailing in South Africa. These are greenfield or undeveloped sites, urban restructuring, and the upgrading of informal settlements. In each of these cases the form is different but the application of the principles should be the same.

Greenfield sites

The generic problem of greenfield developments is to provide a spatial ordering system to guide growth (which may occur relatively quickly) on the site, while integrating it with surrounding urban systems to the greatest degree possible.

The plan for a greenfield site should seek to create an area of settlement which is highly liveable and which has inherent qualities that will promote ongoing processes of consolidation and upgrading over time. It should be informed by the needs of the main affected parties, including existing residents, entrepreneurs and industrialists, as well as new residents. It should be recognised that each of these constituencies has different requirements of, and within, the settlement system, which need to be respected and protected. Existing communities and entrepreneurs need to be part of an environment with which they are familiar, the new settlement needs to be closely tied into broader city-wide systems but at the same time must have its own logic, identity and, over time, sense of community and belonging.

Urban restructuring

At the heart of urban restructuring is increasing investor confidence - for people to invest in the environment, from both an economic and residential point of view. To improve the urban environment over time, they must have confidence that the area is improving and that their investment will be safe. In depressed environments the application of the identified settlement-making principles can play an important role in creating a climate of confidence.

In essence, restructuring involves a number of generic actions:

- establishing a spatial structural logic or order by creating spaces and achieving the greatest possible continuities of movement at different scales - in particular, breaking down the fragmented urban pattern which is characteristic in South African urban settlements;

- improving the quality of the public spatial environment;

- creating new public spaces where they are required;

- intensification, through housing-infill programmes, in order to increase thresholds of support and thus levels of service.

Urban restructuring also requires channelling of new development into existing areas in order to improve them. This can be achieved by using new development, particularly housing, to increase densities in order to improve levels of service (for example, along existing or new transportation corridors), or to make better use of existing investments (for example, in inner city areas, around existing commercial and industrial nodes). This approach is consistent with the principle of reinforcement.

Upgrading informal settlements

A common challenge in terms of South African settlements is that of upgrading informal settlements. In terms of greenfield sites the generic problem is to provide, from the beginning, a public spatial structure to guide new development. In the case of informal settlements, the problem is one of the later provision of a public spatial structure to provide relief from overcrowding, to create public gathering places, to guide public and private investment and to improve movement systems. Whereas, in the greenfield case, housing and economic development is generated by means of infill development in the context of the spatial structure, in the case of upgrading projects the negotiated relocation of residents and economic activities may be necessary to create a spatial structure consistent with settlement-making principles.

KEY PLANNING GUIDELINES

In this section key planning guidelines are established, within the context of the minimalist approach to settlement-making. The guidelines deal specifically with those elements of the settlement-making process over which the planner has relative control.

General observations

- Different communities have different priorities in terms of social facilities. The important thing is not to predetermine the form of all facilities, but rather the positioning of social institutions valued by the community. The precise nature and form of many of these facilities can be determined over time by the community itself.

- The principle of lump-sum funding should be adopted in financing new settlement-formation. Funds should preferably not be allocated in a predetermined manner (for example Rx amount for roads, Ry for community halls) but should be allocated as a lump-sum to allow for negotiated trade-offs within the planning process.

- Community facilities are important place-making elements and they should be deliberately used, in combination with public space, to make memorable places.

- Social facilities are dependent upon public support and play an important integrating function in and between communities. They should therefore be "externalised", by being located in places of high accessibility, and made accessible to the local and surrounding communities. In this way, they bring together people from a number of local areas and are not tied to the fortunes of any one community.

- Realities of resource scarcity demand that public spaces and buildings be used for more than one purpose. This is consistent with the principles of multifunctionality and the sharing of resources between user groups.

The movement network and public transport

- Public transport is essential in areas that are characterised by low levels of car ownership. As far as possible, new development in such areas should support public transport. Higher densities increase the viability of public transport and should be encouraged along public transport routes.

- Coordinating the stopping points and terminals of different movement modes significantly increases the attractive power of the zones in which they are found. These zones are ideal for high intensity, mixed-use development.

- Movement should not be seen as a separate element but as an activity which occurs within social space.

- The degree to which movement dominates space varies from spaces which are entirely pedestrian-dominated to spaces which are entirely vehicle-dominated. As a general principle, however, most spaces within settlements should accommodate both pedestrian and vehicular activity. However, entirely pedestrian routes, which vehicles cannot penetrate, have their place in settlements.

- Movement spaces should be flexible, to allow them to meet other demands - such as markets, meeting places and parking.

- There is a strong ordering dimension to movement. At all scales, it is necessary to maximise continuities of movement, as this promotes choice and integration. Land uses should be able to respond freely to movement patterns as this encourages diversity and a mix of activities.

- While being ordered, rigid approaches to movement hierarchies, such as inflexible stipulations regarding intersection spacing and access should be avoided, as these mitigate against spontaneous settlement-making.

- The most important social spaces are low-order, local streets and these, in particular, must accommodate pedestrian activities.

The open space system

- In the case of large city-wide green space systems, continuity is important to promote ecological diversity.

- Sports facilities form an important part of the green recreation system.

- Formal sports fields, which function as green spaces, should be located to ensure a maximum degree of sharing of space, such as sharing between sports clubs, seasonal sports, schools and communities.

- Passive recreational places where people can walk, picnic or reflect on life are important settlement facilities. Wherever possible, these should take "natural" forms, which do not require maintenance and should be associated with unique natural features such as forests or plantations, hills, rivers and streams.

Urban agriculture

- Land for urban agriculture is particularly important in settlements where people are dependent on their own produce for food and nutrition, or have to supplement their incomes.

- Urban agriculture is an environmental feature that can operate as an area of visual relief, particularly in situations where finance to maintain "public open space" is not available.

- Space for urban agriculture should generally be provided on the edge of the settlement, in order not to disrupt the continuity of the urban fabric.

Public facilities

Education

- The creation of environments which promote learning forms an integral part of the settlement-making process. Learning has both formal and informal dimensions. Schooling relates to the formal dimension of education. Informal learning stems from exposing people to experiences outside the formal learning environment, such as experiencing nature, urban activities and social events. In this respect, the informal part of the learning experience can be enhanced by integrating educational facilities with the broader settlement structure. This can be achieved by locating schools, colleges, technikons, adult-education centres and universities close to places of intensive urban activities.

- The concept of the specialised self-contained school, accommodated on a spatially discrete site and serving only its pupil population, needs a rethink. Schools should be seen as resources serving both pupils and the broader community. In this regard schools can accommodate the school population during the day and, where possible, adult education during the evenings. Similarly, halls and libraries can serve the school population during the day and the broader community during the evening, ensuring 18-hour usage of facilities.

- The need for informal school play space can be supplemented by public space adjacent to which the school is located. Formal sports fields can serve both the school and the broader community.

- In terms of their location, schools should be part of an accessible, city-wide system of education facilities. Accordingly, they should be located close to continuous public transport routes. This will make schools sustainable over a longer period, since they will draw pupils from a larger area, thus becoming less susceptible to fluctuations in the local population.

Health

- Health considerations must inform all dimensions of settlement-making and design. Particularly important is ensuring clean air, potable water, the disposal of human and toxic waste, air circulation, shelter and the prevention of overcrowding.

- Health facilities should be accessible and should be integrated with public transportation. This can be achieved by locating such facilities close to activity areas and regular places of gathering.

- The location of preventively orientated health facilities, such as clinics, in association with primary and pre-primary schools, offers advantages. Preventive functions, such as inoculation and nutritional programmes are best delivered through schools. Where a multipurpose hall serves a number of schools, a clinic may be beneficially located within or adjacent to that hall.

Meeting spaces

- Both open-air public spaces and enclosed spaces such as community halls are important parts of social infrastructure. Halls should be located in association with public spaces as this will allow for events in one to spill over into the other, or provide alternatives in case of weather changes.

- Halls should also be associated with other public facilities, such as schools and markets. Given the limited number of public facilities which can be provided in any one settlement, it makes sense to concentrate these to create a limited number of special places, which become the memorable parts of the settlement.

- The number and location of meeting places cannot simply be numerically derived. Rather, it is necessary to create "forum" places, places which over time assume a symbolic significance outstripping their purely functional role.

<u>Religion</u>

- Religious facilities are "public" in the sense of serving large numbers of people and being of great significance to the communities that they serve. They should, therefore, be accorded equivalent respect, regardless of their denomination.

- They should be located at equivalent, significant places within the settlement. Their symbolic importance can be emphasised by using them to define vistas and by associating them with significant natural landmarks.

Public utilities

Public utility services are engineering services, such as potable water and electricity into settlements, and sewage, refuse, stormwater and wastewater removal from settlements.

As far as possible, it is necessary to work with nature in terms of these "inputs" and "outputs". Thus:

- Water-collection technologies (e.g. roof tanks) should form an important part of the infrastructure in water-scarce areas.
- Woodlots can form important supplementary sources of energy.
- In certain places, solar energy is a viable alternative energy form.
- Stormwater and partially treated wastewater can be used for irrigation by being channelled to playing fields and urban agricultural areas.

Engineering services can be provided through a wide variety of technologies; all these have different cost implications. The choice of appropriate technology should, however, result from an examination of social, environmental and cost issues.

Cross-cutting issues

Crime prevention

It is generally accepted that certain types of crime can be limited if the environment is designed appropriately.

- Ensure surveillance and visibility through multifunctional land uses, rather than monofunctional zoning, to ensure long hours of use; provide inviting and well-defined outdoor spaces conducive to users meeting and communicating; all paths and pedestrian routes should be in areas where there is surveillance, good lighting, controlled vegetation and high levels of activity; small open spaces should be strategically located within the neighbourhood.
- Owners/users should be encouraged to take responsibility for places by avoiding tracts of vacant land without designated users or control; design the public realm to increase people's ability to read the built environment; networks of small neighbourhood parks are preferred to uncontrolled large open spaces.
- Limit easy access and escape routes for criminals by carefully planning the location, size and design of large open spaces; avoid ending roads on vacant/undeveloped land; clearly mark pedestrian routes.

Environmental concerns

The following ecological factors need to be considered when designing human settlements:

- Identify geological conditions and assess risks and costs associated with development on less ideal geological terrain.
- Consider hydrological concerns, especially with regard to stormwater runoff and its direct relationship with urban development (e.g. plot size, type of land use).
- Take note of atmospheric considerations in terms of orientation and layout of erven, the impact of the prevailing wind direction, plus air and noise pollution.
- Consider implications of development on biodiversity.

Emergency services

The main emergency services are ambulance, fire-fighting and police services.

- Fire stations and ambulance depots should be located near the intersection of major continuous urban routes to facilitate rapid access to the movement network. Similarly, police stations should be centrally located relative to the areas they serve.
- At a local scale, it is not necessary to enable access to every housing unit by emergency vehicles. However, in such cases, distances should be short enough for easy stretcher-bearing, and for buildings to be reached by fire hoses.
- The public spatial structure, which includes streets and public spaces, should be deliberately used for fire-breaks. In informal housing areas, which are not served by electricity, provision should be made, as part of the essential public infrastructure, for spaces where fires can be made, as cooking frequently occurs in these spaces.

Economic services

Economic considerations should be taken into account in all the planned elements of a settlement. Some of the related concepts and applications are discussed below.

Employment generation

In South Africa employment generation is one of the highest priorities facing society. The reality is that the majority of potentially economically active people have no option but to generate their own employment, usually in the form of "informal-sector" activity. It follows that a pressing priority in settlement-making is to create opportunities for

people to manufacture, trade and provide services. Settlement plans should ensure that sufficient intensity is generated at points in the settlement structure to generate local markets. A plan should provide an easily readable spatial structure which unambiguously suggests major movement channels and places of gathering, allowing entrepreneurs to respond to the structure created.

As a rule, entrepreneurs will find their own place in the structure and will provide their own infrastructure where necessary. However, given problems of entry capital and urban management in many settlements, it may be necessary to establish urban markets and manufacturing infrastructure by means of deliberate public actions.

Urban markets

Urban markets result from the physical agglomeration of large numbers of traders in public spaces.

There are a number of advantages in promoting markets by means of public actions.

- The creation of urban markets enables small operators to gain access to viable locations.
- The physical concentration of numbers of traders increases their drawing capacity and enables them to compete with larger, formal operators.
- The agglomeration of large numbers of traders establishes the potential for other forms of mutually advantageous co-operation, such as delivery of bulk supplies from wholesalers, the sharing of vehicles, and so on.
- Markets in low-income areas can provide an important service to consumers, in that they offer variety and choice of goods and services to people who are unable to travel large distances.
- From the perspective of urban management, the creation of urban markets contributes to the resolution of problems of hygiene.

Markets should be located at points of maximum accessibility. Particularly, they should seek a close association with public transport and major pedestrian flows. Wherever possible, they should be associated with public transport terminals, such as railway stations and bus and taxi ranks.

The centrality of the market should be reinforced by associating other forms of public infrastructure, such as clinics, halls, community resource centres, pension pay-points and services pay-points, with it.

Engineering services required to maintain adequate levels of hygiene, including water, public toilets, and refuse storage facilities, should also be provided.

Markets need not always be permanent. The use of public spaces, including streets, for periodic markets, at certain times of the day, week or year is also a positive, cost-efficient option.

Manufacturing infrastructure

Most of the arguments associated with the provision of markets also apply to the provision of hives for small-scale manufacturing.

The critical elements of infrastructure are sheltered work spaces, electricity, water and toilet facilities. The use of metered water and electricity enables regulated usage by small-scale operators.

From a locational point of view, small-scale manufacturing needs to be associated with points of movement - in particular pedestrian activity. Because they are frequently single-person operations, it is difficult for operators to separate manufacturing and selling functions. Consequently, they should be associated with urban markets and other forms of trade agglomerations.

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Chapter 4

Planning method and participation

4

TABLE OF CONTENTS

INTRODUCTION

Besides moving into a more democratic planning environment in South Africa, there is a definite move away from the blueprint nature of planning and to a lesser degree, away from procedural planning. At the same time, there is a shift away from non-participation and/or token processes to more inclusive and interactive planning processes. The current trend in planning is largely based on the satisfaction of fundamental human needs, as stated in Chapters 2 and 3. Accordingly, the "human scale development planning method" is advocated. The form of public participation proposed is that of partnerships as a form of citizen empowerment. This chapter takes the following into account as its points of departure:

- That there is current approved planning legislation such as the Development Facilitation Act (No 67 of 1995) which emphasises a planning framework and process based on need, integration and community participation.

- That current and/or new planning legislation does not exclude existing planning legislation and reference to previous legislation such as guide plans, zoning schemes, ordinances, and so on.

- Due to the multi-disciplinary nature of planning it must be accepted that there is a tendency in planning practice for planning and development to be managed by project managers who are not necessarily professional planners. The specific role of the planner in the planning process has shifted from purely technical to that of mainly a technical expert, coordinator, facilitator and advocate.

- While the role of theory in understanding method and participation is very important, context and realistic circumstances prevailing in South Africa must also inform method and participation.

- In the past, communities did not play an important role in planning and development. However, communities have a wealth of local knowledge that they can offer as well as a natural understanding of their needs, requirements, local conditions and relationships. This knowledge is a vitally important part of planning and development.

- There is a place for procedural planning methods, albeit not in the form that it was practiced in the 1970's, but in a more appropriate and relevant form.

APPROPRIATE NATURE OF THE PLANNING METHOD

Human scale development "is focused and based on the satisfaction of fundamental human needs, on the generation of growing levels of self-reliance, and on the construction of organic articulations of people with nature and technology, of global processes with local activity, of the personal with the social, of planning with autonomy and of civil society with the state" (Max-Neef 1991, p 8). These pillars must be sustained on a solid foundation of creating conditions where people are the protagonists in their own future. The focus of planning method and participation should be on the response to basic human needs. Human scale development assumes a direct and participatory democracy that nurtures those conditions that help to transform the conventional, paternalistic role of a state into a role that encourages creative solutions flowing from the bottom up.

APPROPRIATE NATURE OF PARTICIPATION

Governance is a term that encompasses the relationship between civil society and government. It should create an environment in which there is representativeness, legitimacy, accountability and transparency. The achievement of sustainable development within cities is impossible without competent, effective and representative city and local government that works in partnership with citizen groups, business, societies and non-governmental organisations (NGOs) (Global Forum '94 Conference 1994).

One of the fundamental sources of conflict is the competition for scarce resources. Development in South Africa very often introduces scarce resources into resource-starved communities and therefore focuses on the existing power struggles in these communities, because individuals and organisations controlling resources command political allegiance (Hindson and Swilling 1995). Power structures in divided communities are part of reality and means of dealing with them must be incorporated in any development process.

At the one end of the participation spectrum, recipient communities are not involved at all in the decision-making process whereas at the other end of the spectrum, more radical planning processes such as that advocated by the organised homeless in the country, essentially find little need for government and professional input into their planning processes. Rather than any of these two extremes, a partnership approach to planning is advocated in these guidelines.

Partnerships provide the integrated planning framework within which development initiatives occur. Partnerships also ensure cooperation among stakeholders as the parties

"agree to share the planning and decision-making responsibilities through structures such as joint policy boards, planning committees and mechanisms for resolving impasses " (Arnstein 1996).

Partnership-based planning processes provide more than a mechanism for public participation. They mobilise community expertise, commitment, and resources for joint action. It is agreed that there is no single correct way to create a partnership planning process, but trial and error and reviewing success stories offer some useful guidelines.

The focus of participation is on delivery and not on ideologies and/or political power; accordingly, a public participation process is required that is flexible enough to address the realities of the stakeholder participation and community dynamics, while keeping focus.

ROLE-PLAYERS IN THE PLANNING PROCESS

The "role" of each group involved in the *partnership*, being the community, the local authority (or decision-makers/politicians) and the professionals is as follows:

- The *community* has a wealth of local knowledge that it brings to the project as well as a natural understanding of the local conditions and relationships. The community can identify needs and measure improvements. One of the important roles of community representatives is to disseminate information into the broader community. Professionals can also benefit from community representatives, as they collect and bring socio-economic and demographic information and personal experience from the communities, which can be used to inform the planning process and strengthen the community's case during negotiations. When the community is involved, proposals or plans are more likely to be acceptable.

  In a greenfield situation, "the community" includes surrounding stakeholders and/or potential users of a settlement. In most instances, potential users are known, whether they are on a waiting list or waiting to be housed in public housing or private developments. There is always a sense of "the potential users". Other stakeholders include interested and affected parties such as developers, local authorities, etc. In in-situ or renewal situations, "the community" is usually already resident.

- The *decision-maker* (or government organisation) has power by virtue of laws - laws that ensure implementation. The local council can also provide the information centres required by all parties, including staff, financing, and other resources to encourage and improve public-participation programmes.

- The *professionals* have technical expertise and experience in land delivery. They can also fulfil various roles, such as that of facilitator, coordinator, advocate, etc. Included in this group is the developer who could be a private developer or the local authority.

ROLE OF THE PLANNER IN THE PLANNING PROCESS

The traditional role of the planner is that of principal coordinator, project manager and technical professional in the settlement-development process. The planner operates within the realm of legal requirements for township establishment, rezonings and consent uses, and his or her technical role is in motivating the changes in land use. In motivating the land use change, the planner needs to consult widely with other professionals from other disciplines, and the ability to think holistically and integrate various inputs is essential. The traditional role of the planner remains. However, with the involvement of the community in the planning process, additional skills are required. These skills do not necessarily reside within a planner or any other one professional. If the planner does have the necessary additional skills, such as conflict resolution and negotiation, his or her role can be expanded. If not, the additional required skills can be brought in as part of the project team, and the planner co-operates and co-ordinates with all members of the team.

THE PLAN-MAKING PROCESS

Other than the broad directive that the plan-making process should be centered on human needs and driven by a partnership between the community, the professionals and decision-makers, these guidelines are not intended to suggest a step-by-step plan-making process which needs to be strictly adhered to under all circumstances, but rather to outline typical actions necessary in plan-making, which can be adapted, ordered and applied under various conditions and contexts at the discretion of the partnership team. In addition, the dynamics brought to the process by including the community cannot be predicted or stifled and the plan-making process needs almost to unfold as the process progresses, appropriate to that group of participants, at that point in time, and for that particular set of needs and circumstances. Despite this requirement for flexibility in the process, there are a number of common key actions which are typically followed in plan-making. Broadly, the actions stem from two kinds of decision sequences: those concerned with making the plan and those concerned with administering it.

Identification and notification of interested and affected parties and other stakeholders

Partnerships work most effectively where there is an organised power-base in the community to which citizen leaders are accountable (Arnstein 1996). Effective participation can be obtained if representatives, who have been elected through democratic structures, are involved. It is, however, extremely difficult to develop and operate an organisational system that reaches the majority of citizens; therefore one must use existing institutions and their networks to achieve what needs to be done, for example local councils, residents organisations, business organisations, NGOs and civic organisations, etc. As community-based organisations (CBOs) and NGOs are not always well resourced, it is important to build up capacity in the communities one is working with, so as not to put resources solely in the hands of professionals and have the government merely be a facilitator (Schiceka 1994).

The NGOs require particular consideration on the issue of how people need to be represented at local level. The NGOs are recognised as having an important role in initiating, facilitating and sustaining community action. However, while promoting the initial steps in democracy and participation, they can also be counter-productive if they become self-serving and compete for resources themselves. Communities should both value and capitalise on the inputs from NGOs. Representatives of communities should be elected democratically to prevent misrepresentation; however, the initiative should come from the communities.

The means of notifying stakeholders is through
- press releases;
- scheduled meetings with representative bodies;
- pamphlets/photos;
- telephone calls; and
- mail drop.

Negotiation of a participation strategy

Once the groups have been identified, the public participation requirements or strategy need to be negotiated with all parties including communities. One must not merely inform the community of its role in a specific project. It is very important to set ground rules for participation where all the roles, responsibilities, participation limits and rights, as well as the process, are understood and agreed upon up-front.

Careful consideration should be given to the design of the consultation process, as the players could change and then the only "fixed" issue is the agreed-upon participation process. As there are various levels of participation, active and passive, the interested and affected parties should not necessarily be the focus but rather the proposed participation process. There should never be a barrier to participants' joining at any stage during the participation process, but the rules for joining should be specified in the participation strategy.

Once the participation strategy has been agreed upon, it should be documented and signed as a partnership agreement which can be referred to at any stage in the participation process. The fundamental purpose of the partnership agreement is to facilitate the process of bringing together all stakeholders, for them to agree on the details of the type of development to take place and establish what each party has to offer the development. Stakeholders should enter into a partnership agreement to establish a decision-making forum directed at creating an environment of cooperation, in addition to obtaining the commitment of all. A partnership agreement should also be a dynamic agreement, which should permit additional stakeholders to become signatories at any point during the process. It is the document that formally records the content and terms of this agreement. Thereafter projects should be implemented, monitored and evaluated in terms of the abovementioned agreement so that the objectives of this agreement are met.

Local councils and decision-makers should have strategies that outline their commitment to working in partnership with communities. Such strategies should be defined and have measurable objectives, promoting an interdisciplinary culture that values community participation. Examples exist in the Local Agenda 21 programme. Depending on the way institutions are structured, their interactions will either facilitate or obstruct participation and partnership. It is vitally important for members of communities to be able to meet members of government, the decision-makers, in order to facilitate participation. Institutions may need to alter their structures and modes of operation in order to promote appropriate interactions.

Mediation skills and mechanisms need to be built into planning and reconstruction because the possibility exists at almost every stage of the development process that negotiations will break down. The approach to development is therefore the formulation of partnership agreements as a framework for conflict resolution. In order to reduce conflict it is important for the client to attend public meetings in the plan-preparation process, in order to be exposed to communities' needs and perceptions.

A forum or steering committee should be established by the partners to ensure that adequate and appropriate planning occurs, that a process of participation is established, and that a mechanism for management of the project is created, as well as to ensure the implementation, monitoring and evaluation of the project in terms of the negotiated agreement.

Needs identification and prioritisation

The identification and prioritisation of needs is best informed by the people whose needs are to be fulfilled. This action can be coordinated and facilitated by a planner, a project manager or any other person with facilitation skills. The community needs to be the main role-player and take the lead where possible and necessary. Essential tasks in this action involve the following:

Capacity-building and empowerment

If required, capacity-building must happen prior to setting goals, objectives, etc, for the project. The community needs to be aware of its minimum rights, responsibilities, technical considerations and the options available to it. In addition it needs to be aware of the operations and decision-making processes of the client (local authority, government or a major developer).

Sustainable development cannot be achieved unless problems and issues are addressed in a cooperative and interdisciplinary way. Structures and channels of communication that promote this should therefore be created (Global Forum '94 Conference 1994). The degree to which citizens are actually placated depends on two factors: the quality of technical assistance they have in articulating their needs and priorities, and the extent to which the community has been organised to press for those priorities (Arnstein 1996).

Disseminating information

Successful sustainable development programmes depend to a large extent on the ability to make wise decisions on options and actions. Wise decisions can be made only if good quality information is available. It is thus very important that such an information system be put in place. Such a system could include resource and information centres, with appropriate technological and human-resource back-up (Global Forum '94 Conference 1994).

Choice of living conditions

The best settlements are created when people have a wide range of choices in relation to living conditions. Each new development should therefore contribute to broadening the range of choices. A basic decision is whether the range of choices is created on-site, or whether development on the site provides one option in a range of choices over a larger area. As a general principle, the larger the site, the greater the choice of living conditions becomes an issue.

Site assessment

In this action, the planner takes the lead as coordinator and facilitator. Assistance from communities is encouraged. Other professionals (such as engineers, environmental planners, etc) will gather the data necessary to undertake their specialist tasks. All relevant information necessary to undertake a detailed site assessment or analysis of context needs to be acquired. The site assessment needs to occur within the context of the identified needs, from a number of perspectives.

Site potential and relationships

Each land parcel has unique relationships with other land parcels, each with their different structuring elements and relationships. The potential of each parcel in terms of these relationships, and uses which could be accommodated on it, need to be discovered.

Site integration and/or discontinuity

It is essential to integrate the site with other land parcels. The principles of achieving continuities and discontinuities are central to the integration process.

The natural system

Each land parcel is unique in terms of the natural system (geology, soils, topography, hydrology, climate, flora and fauna) which gives it its character. These features need to be carefully understood to determine the following:

- The presence of important ecological systems, which should be protected to ensure their continued functioning.

- The appropriate approach to development. There are two basic approaches. The first relies on a strong, imposed geometry to create place. The other, which is a more organic approach, gives less direct direction and is usually more responsive to the natural landscape. The chosen approach is usually a combination of these basic approaches.

- The orientation. This is informed by aspects such as views, wind protection, the need to optimise light and shade, shelter from the elements, and so on.

- The engineering constraints. Natural conditions can play an important role in determining which engineering technologies should be used.

- The availability of resources. Sites may contain resources, such as building materials, which can

be used in a development and which contribute to a unique sense of place.

- The potential of natural place-making features. Water bodies can, for example, be used as place-making elements.

See also Sub-chapter 5.8.2 for further elaboration regarding ecological considerations.

The higher-order planning system

The site must be contextualised in terms of higher-level existing requirements of integrated development plans (IDPs)/local development objectives (LDOs)/spatial development frameworks, integrated transport plans, local economic development and environmental plans applicable in the area.

Setting of goals and objectives

This phase requires the translation of needs into goals and objectives that are realistic, given the nature and conditions of the site, parameters of the brief and financial and time constraints. It is important for the planner to introduce and debate the performance qualities to be achieved in the development of settlements, and for technical professionals to ensure that stakeholders understand all aspects of the site assessment. The participation process should focus on

- enabling interested and affected parties and authorities to bring to the attention of the project team their concerns, attitudes and perceptions about the project and related investigations; and

- ensuring that the interested and affected parties' concerns, attitudes and perceptions are addressed by the project team.

Establishment of a crude land allocation budget

Having assessed the site and needs and set broad goals and objectives, it is useful to calculate a coarse land-allocation budget, which includes

- a determination of what activities and land uses should be accommodated on the site; and

- a determination of the approximate land areas required for the various components of the settlement.

Although the land budget cannot be calculated precisely, it is useful in that it establishes a general sense of scale and it identifies the public and institutional elements that are appropriate to the site, over which the planner has relative control.

Preparation of a conceptual plan

This action involves the formulation of a conceptual spatial ordering system for the settlement. It requires the articulation of the main *principles* and *ideas* informing the plan. The conceptual plan, which is an abstract device, has the following purposes:

- it ensures clarity by enabling the idea to be questioned and taking plan-making out of the realm of simple intuition;

- it enables continuity by ensuring that the relationships between ideas are addressed;

- it serves as a management tool by providing the framework to which plan-makers can refer in searching for solutions to particular problems and in the making of the formal plan itself; and

- it provides the basis for discussion and incorporation of stakeholders views and inputs.

Preparation of a framework plan

The framework plan is made by refining the conceptual plan. This is the design stage of plan-making, and consists of a number of components:

- The first involves working with nature. The specific site conditions will mould the plan and suggest new possibilities and options for the settlement-making process.

- The second component requires the refinement of the "land budget" and identifying those parts of the framework plan about which there is some certainty, such as the investment of public resources.

- A third component is closely related to the above and requires the inputs of a range of experts involved in the settlement-making process. This includes a range of fields including engineering, urban design, ecology, demography, economics, finance, and so on.

- The fourth component is involving stakeholders in the plan refinement process. In some instances, trade-offs will need to be made and this must be discussed and workshopped closely with stakeholders.

- The last component consists of obtaining the required approval of the local authority and relevant government agencies before proceeding with the implementation plan.

Costing and budgeting

The cost of implementing the framework plan needs to be determined. An important part of this is determining who pays for different elements of the structure envisaged in the plan. At this stage, the financial viability of the plan is tested by considering the availability of resources and by comparing expenditure with the expected return on investment. This process may result in further refinements and adaptations of the plan.

Preparation of an implementation process plan

The "Process Plan" is an action or implementation plan and is concerned with ensuring an efficient implementation process. If the site is relatively large, an important part of the settlement-making process is ensuring that a wide range of implementing agents, including local and provincial authorities, individuals, communities, housing utility companies, small and large developers, etc., is involved in the settlement-building process. Where appropriate, local labour needs to be identified and invited to work on development. Tender documents need to be simplified to make them understandable by local entrepreneurs. The process plan should incorporate a land-release programme, a detailed management framework (incorporating institutional arrangements), and a financial plan.

Applications for land use changes and amendments to higher order plans such as IDPs, LDOs or spatial development frameworks, need to be made if and where necessary.

The management framework should incorporate land-use management recommendations, concerned with the definition and application of appropriate rules to the settlement-making process, including

- land use or zoning restrictions, specifying the types of activities permitted on the land;
- coverage, height, density, floor area and access restrictions for specific sites; and
- site layout and landscaping requirements.

Land-use controls need to be applied cautiously, as they are by nature cumbersome. The pre-determination of land uses often reduces flexibility, thus mitigating against spontaneous settlement-making. The primary form of land-use control - at least during the initial stages of development - should be the logic of the framework plan itself. Land uses will commonly respond in a predictable way if the settlement structure is clear and easy to read.

In the South African situation, particularly where rapid settlement-making occurs, consideration should be given to a system where land uses acquire post hoc rights; that is, legal rights are established after the particular use is developed, and subsequent changes in land uses are handled on the basis of impact and nuisance.

Implementation

A dynamic project manager plays the leading role in the implementation phase. The project manager plays a key coordinating function. The planner's role becomes one of monitoring, along with the other stakeholders. Other key players include training and development facilitators and administrators. Implementation includes the following actions:

- Preparing tenders;
- Awarding tenders;
- Site plans and preparation;
- Building plans;
- Beginning construction and development;
- Managing and coordinating construction and development;
- Financial management;
- Landscaping; and
- Provision of movement networks, engineering services, public facilities and utilities, and open space.

Administering the plan

It is the primary responsibility of the local authority to ensure that the desired performance qualities of the plan have been met but it is recommended that when people become resident on the site, a sub-committee should be formed in conjunction with representatives from relevant authorities to monitor and evaluate development progress, performance and sustainability of the local area and fulfillment of basic needs.

Since there is no one ideal form of plan, the administration process must be a reactive one. Ideally, the process should be creative and interactive, allowing for adaptation of the plan as and when circumstances may require, and where community support for such changes exists.

ADAPTING THE METHOD AND THE PARTICIPATION PROCESS

The proposed methodology was specifically designed for the planning and development of greenfields areas but is applicable to all development situations with certain minor adaptations and changes in emphasis at certain points in the process. While the methodology and generic guidelines are similar for in-situ upgrading and renewal circumstances, some differences do exist, particularly relating to the process of participation, site-assessment, and implementation.

In the case of upgrading and renewal, the stakeholder-identification step is easier, as the primary stakeholders are physically resident in the area. The actual participation process is likely to be more complex, however, due to the fact that the specific community already has a history at that location, together with existing problems, issues and politics. The design and implementation of the participation strategy and the setting of ground rules is of particular importance to ensure that focus on the pertinent issues is maintained, and that only the relevant issues and problems are considered.

The degree of participation will vary according to specific circumstances and particularly according to the willingness and desire of the particular community to become involved. Existing provincial town planning ordinances, in terms of which many land-use changes are still applied for, have specific requirements regarding advertising and informing the public of the proposed development. These and other applicable provincial legislation, should be regarded as the minimum requirements. The recently promulgated environmental legislation, requires a greater degree of stakeholder identification and involvement. The methodology proposed in this chapter accommodates the entire range of degrees of participation, but it is in the hands of the practising planner to decide, in terms of prevailing legislation and specific circumstances, what degree of participation is appropriate to each situation.

Regarding site-assessment differences, in the case of greenfields development the emphasis will be on the natural and physical characteristics of the site, whereas with upgrading and renewal the emphasis will be on social aspects and the limitations and opportunities provided by the already built physical environment. A socio-economic survey is likely to be an important component of upgrading and renewal developments (Behrens and Watson 1996).

The implementation process for renewal and upgrading is also more complex than for greenfields developments as it may be necessary for people to temporarily move out of the area, be accommodated elsewhere, and then move back into the area once the upgrading has been completed. The logistics of managing this process are significantly more difficult than in the greenfields situation.

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Chapter 5

Planning guidelines

5

Movement networks

TABLE OF CONTENTS

LIST OF FIGURES

INTRODUCTION

"Movement networks" are defined broadly as public right-of-way networks, accommodating land-based movement by a range of movement modes. Earlier guidelines have referred to "movement networks" as "road layouts".

While the guidelines presented in the previous version of the "Red Book" (1994) were intended for application in both high- and low-income residential development, its guidelines on road layout planning were drawn directly from the initial "Blue Book" (1983). It was acknowledged in the subsequent "Green Book" (1988) that the "Blue Book" had been prepared for "developed communities" or "municipal townships", not "developing communities". In the review of the previous "Red Book" (in 1995), its road layout planning guidelines were criticised for being car-oriented and for largely ignoring the movement needs of those sectors of the South African population without access to private motor cars.

The intention of this sub-chapter is therefore to provide guidance on the design of local area movement networks in both higher and lower income areas that are primarily convenient for pedestrians and public transport users, while at the same time restrictive of unwanted and potentially dangerous fast-moving through-traffic. The guidelines have been prepared for application in predominantly residential, but also mixed, land-use developments that seek to be consistent with current housing, transport and land-development policy objectives.

A different approach to those of past guideline documents has been adopted in that

- public right-of-way networks (as opposed to road layouts) are the focus of planning and design;
- reference to conventional road classifications such as "access roads", "collectors", "local distributors" or "arterials" is avoided to prevent preconceptions regarding the functions and cross-section of any particular public right-of-way; and
- continuous, pedestrian-friendly, public right-of-way networks are promoted ahead of conventional discontinuous suburban road layouts.

These differences are consistent with recent shifts in international practice - which have included site layout design as one of a series of "travel demand management" (TDM) strategies - often referred to as "transit-oriented" or "(neo)traditional" design. These design ideas have emerged largely in response to growing automobile dependency and associated efficiency and equity problems, and to the prospect of global warming as a result of increasing greenhouse gas emissions (to which vehicle tailpipe emissions are a significant contributor). Government authorities and professional institutions in various parts of the world have begun either replacing or supplementing their design codes to take account of these ideas. The list of key literature at the end of this sub-chapter provides references to some examples of these design codes.

The sub-chapter is divided into five sections. The first section clarifies what is meant by the term "movement network". The second discusses the role movement networks play in human settlements, and the qualities they should have. The third section provides guidance on how these qualities can be achieved in the configuration of movement networks in general. The fourth section provides guidance on the contextual factors that should inform the configuration of a movement network on a particular site. The final section provides guidance on the adaptation and conversion of movement networks to accommodate changing patterns of movement demand and right-of-way functions.

These guidelines should be read in conjunction with Chapter 7 on geometric design, as well as the Department of Transport's "Transport planning guidelines" (TPGs) - particularly TPGs 1, 5, 9, 12 and 14 on "integrated transport plans", "spatial planning", "travel demand management", "transport systems management", and "traffic calming" respectively. Further guidelines on road design, which adopt an approach similar to that of the earlier Blue Book, can be found in the former Committee of Urban Transport Authorities' (now replaced by the Committee of Land Transport Officials) "Urban transport guidelines" (UTGs) - particularly UTGs 1, 5, 7 and 10 on "urban arterial roads", "urban collector roads", "local residential streets", and "commercial and industrial local streets", respectively.

ELEMENTS OF MOVEMENT NETWORKS

Local movement networks are made up of (a) links and (b) junctions of public rights-of-way or reserves. These links and junctions contain overlaid systems of "ways" for different movement modes - including footways, roadways, pathways, cycleways, and sometimes railways (see Figure 5.1.1). Viewing a movement network as a network of public rights-of-way, as opposed to simply as a network of roads, is central to the planning approach presented in this sub-chapter; it is argued to be essential to the design of local movement systems that move away from being car-oriented.

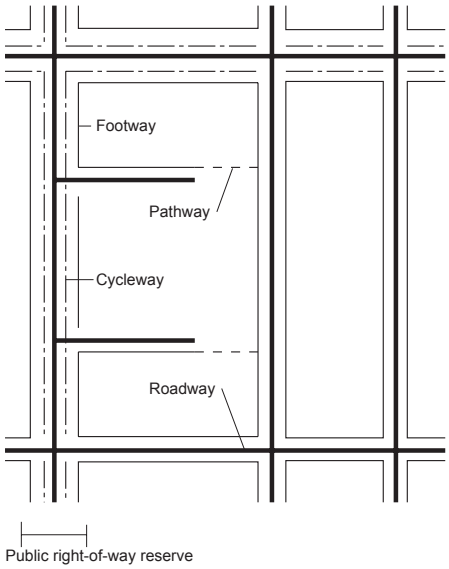

Figure 5.1.1: Diagram illustrating a movement network as a series of overlaying "ways"

Links

This network of public rights-of-way within a local mixed land use development has numerous functions - including the facilitation of movement by different modes, accommodating utility services, providing commercial activities with exposure to potential consumers, and so on. The configuration of movement networks and the functional differentiation of links therefore needs to be informed by a variety of socio-economic factors (e.g. the accommodation of street trading, child play and social interaction), as well as movement factors. Movement networks, based on a functional road hierarchy that is tiered solely on the basis of traffic distribution, do not take into consideration - and often cannot accommodate - all the functions the network needs to perform.

In order to avoid overlooking or excluding some of the functions they perform, public right-of-way links are broadly categorised below on the basis of the users they accommodate. More detailed functional differentiation should occur on a context-specific basis.

- There are links within a movement network where the needs of longer distance vehicular traffic predominate over those of other users and functions, and these links therefore need to be designed to accommodate motorised modes only. These *vehicle-only links*, corresponding with major arterial roads or freeways, should be designed to provide uninterrupted vehicular channels which accommodate the needs and requirements of fast-moving inter- and intra-settlement traffic. The need for uniform operating conditions and high levels of safety requires, inter alia, control over direct frontage access and intersection spacing, and frequently grade separation at intersections.

- On the bulk of the remainder of links within a network it is necessary to achieve a balance between the variety of social, recreational, economic and movement functions the link performs. These *mixed-mode links*, which may be collector or local roads, should therefore be planned to reconcile the diverse requirements of a multiplicity of users, with the recognition that inevitably no one function will operate with optimum efficiency. In terms of vehicular traffic circulation, different mixed-mode links perform a variety of access, collection, and even shorter distance mobility functions. Higher order mixed-mode links would be those designed to accommodate the shorter distance distribution and stopping of relatively large volumes of mixed traffic (often referred to as "activity" or "main" streets). Middle order mixed mode links would be those designed to collect traffic onto vehicle-only distributors. Lower order mixed-mode links would be those designed to provide access to individual properties - some of which would be designed primarily for pedestrians, and vehicle behaviour would essentially be determined by a set of pedestrian rules (e.g. *woonerven*). Conventional hierarchical road classification systems therefore fall within this categorisation of higher, middle and lower order mixed-mode links - arterial roads fall within the category of higher order mixed-mode links, collectors fall into the category of middle order mixed mode links, and local streets (also known as "access roads") fall into the category of lower order mixed-mode links.

- As some routes accommodate only motorised modes, other routes accommodate only non-motorised modes (e.g. pedestrians and cyclists). The entrances to such *pedestrian-only links* are typically designed to prevent access by vehicles. The links themselves are, however, often designed to enable the movement of occasional emergency or service vehicles. The functions of pedestrian-only links can vary significantly, from those links abutting and accommodating intensive commercial activities (e.g. "pedestrianised" streets in city centres), to links performing a primarily pedestrian- or bicycle-access function within "superblocks" or across soft public open spaces.

An understanding of the potential range of functions that each link within a movement network may be expected to perform enables the appropriate number of lanes, the pavement structure, the footway width, the on-street parking provisions, and the intersection configurations and spacings, etc, to be selected. Contextual factors that inform the derivation of mixed-mode link functions include:

- the existing and expected composition, volume and destinations of motorised and non-motorised traffic on the "external" movement network

surrounding the site, the degree to which this traffic may wish to pass through the site, and the routes they select;

- the number of consumers that may wish to pass through the site, and the exposure of local entrepreneurs to potential non-local consumers along the routes they may select;
- the composition, volume and destinations of motorised and non-motorised traffic that is likely to be generated and attracted by the expected land use pattern on the site, and the routes they may select; and
- the alignment of existing and anticipated "external" road-based public transport services, how these services may be integrated into and through the site, and points at which modal interchange is likely to occur.

Junctions

Junctions, as in the case of links, perform a variety of movement and non-movement functions. With regard to movement functions, the carrying capacity of an urban roadway network is determined by intersection capacity, not by route capacity, and it is therefore intersection performance that often determines the operational efficiency of the roadway network as a whole. The non-movement functions of junctions relate primarily to economic activity. Each quadrant of a junction is exposed to two adjacent movement routes, and consequently is the site of maximum potential consumer exposure in the immediate area.

THE ROLE OF MOVEMENT NETWORKS IN HUMAN SETTLEMENTS AND THE QUALITIES THEY SHOULD HAVE

The role of a movement network in the process of settlement-making is essentially to provide the basic spatial framework within which a number of urban processes that involve the physical movement or reticulation of people, goods and services, find spatial form. A measure of the performance of a movement network should therefore be the degree to which the network can effectively accommodate a variety of changing urban processes.

The role of a movement network in the daily operation of a settlement system is essentially to enable the convenient, efficient, affordable and safe movement of people, goods and services and, in doing so, to satisfy the needs of a variety of users and facilitate the effective operation of local space economies. A further measure of the performance of a movement network should therefore be the degree to which the network minimises the demand for movement, and hence the degree to which ease of access is increased. Movement should not be seen as an end in itself, but as a means through which needs can be satisfied.

In performing these roles, a local settlement movement network should have the following basic qualities:

- A movement network should prioritise the needs of non-motorised modes most sensitive to distance, as well as the needs of public transport services depended upon by those sectors of society without access to private motor cars.
- A movement network should be able to maintain convenience, safety and multiple-use patterns over time, as the nature of movement demand and network use inevitably changes.
- As mentioned earlier, apart from a limited number of links that accommodate the requirements of fast, longer distance vehicular traffic, a movement network should accommodate a range of movement demands and socio-economic functions.

GUIDELINES ON THE CONFIGURATION OF MOVEMENT NETWORKS (IN GENERAL) TO ACHIEVE THESE QUALITIES

In order for movement networks to perform these roles and have these qualities:

- certain basic relationships need to be created between vehicle-only, mixed-mode, and pedestrian-only links; and
- public right-of-way networks need to be configured in particular generic ways.

The relationship between vehicle-only, mixed-mode, and pedestrian-only links

The purpose of interconnections between vehicle-only and mixed-mode links is essentially to provide higher-speed route alternatives. They enable longer distance, higher-speed traffic to avoid mixed-mode links (or portions of mixed-mode links) that experience relatively high, but lower speed (i.e. "stop-start"), vehicular traffic volumes. In practice, lower levels-of-service (i.e. slower and denser vehicular traffic) will be acceptable on links that have a higher capacity route alternative. Wherever possible (Figure 5.1.2):

- Higher order mixed-mode links should therefore run parallel to high-capacity vehicle-only links. This enables through-traffic to "opt-in" or "opt-out" of travelling along the higher order mixed-mode link, depending on the range of urban activities to which access is required.

- The higher order mixed-mode link and the vehicle-only link should ideally be close enough to make it relatively easy for vehicles to move between the two routes, yet ensure that the fragmentary impact of the higher order facility, particularly if it is a freeway, does not prevent commercial and public facility activities from locating on either side of the mixed-mode link.

- Access interchanges between vehicle-only links and higher order mixed-mode links, as well as system interchanges between vehicle-only links themselves, should be designed to facilitate safe and uniform operating conditions. These interchanges perform a "mobility" function, which precludes locating any activities that require direct frontage access adjacent to the intersection. The spacing of interchanges along vehicle-only freeways should be determined by the need to prevent joining traffic streams from disrupting traffic flow and reducing traffic speed, creating unsafe operating conditions.

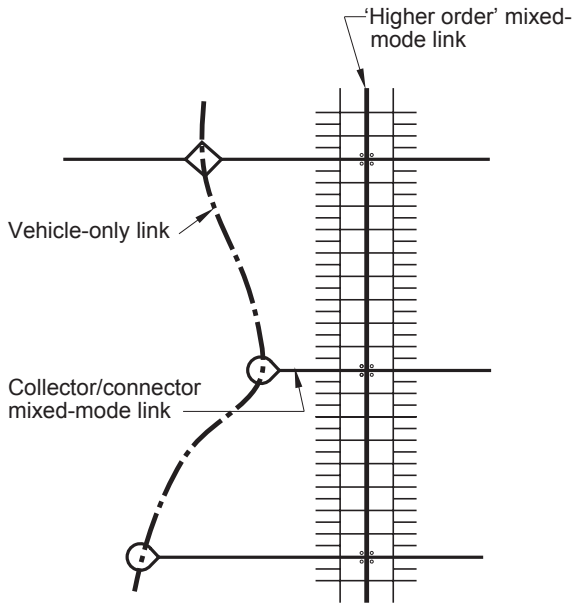

Figure 5.1.2: Diagram illustrating the relationship between vehicle-only and mixed-mode links

On mixed-mode links that accommodate higher traffic volumes, the following should be noted:

- The spacing of intersections should be greater than on links carrying lower traffic loads. In order to avoid excessive disruptions to the traffic stream, greater intersection spacings can be achieved by aligning blocks parallel to - as opposed to perpendicular to - higher order links (and, where required, providing pedestrian-only access through the middle of these blocks).

- Intersections between two mixed-mode links that accommodate larger volumes of traffic are points of greatest accessibility, and are therefore points where commercial opportunities are often largest. The relative accessibility of a particular intersection is determined not only by the type and nature of passing traffic, but by the ability of traffic to stop. Consequently, in order to create trading opportunities, vehicles (including public transport vehicles) should be able to stop and park or offload passengers within a reasonable walking distance from the intersection, and buildings should not be prevented from fronting onto the intersection.

- Taking vehicular access close to the intersection, however, increases the potential for conflict and should be avoided. The volume of traffic on many of these intersections necessitates some form of intersection control which, in turn, through eliminating potential conflict points, enables greater use of four-legged junctions.

On mixed-mode links that accommodate lower traffic volumes, the following should be noted (Figure 5.1.3):

- Intersection spacing should be influenced more by, inter alia, pedestrian circulation, block subdivision and internal utility service reticulation considerations than by traffic circulation considerations. By limiting straight, unbroken stretches of roadway in which vehicles are able to pick up speed, network configurations can be used as traffic calming mechanisms, which enhance the ability of pedestrians to use streets for social and recreational purposes.

- Low traffic volumes do not usually justify investment in intersection control, in the form of traffic signalisation. T-junctions can therefore be used as a way of breaking long stretches of roadway.

- Intersections between two mixed-mode links that accommodate smaller volumes of traffic, are less accessible and therefore provide opportunities for less intensive trade and collective servicing points. Activities should not therefore be prevented from locating close to the intersection.

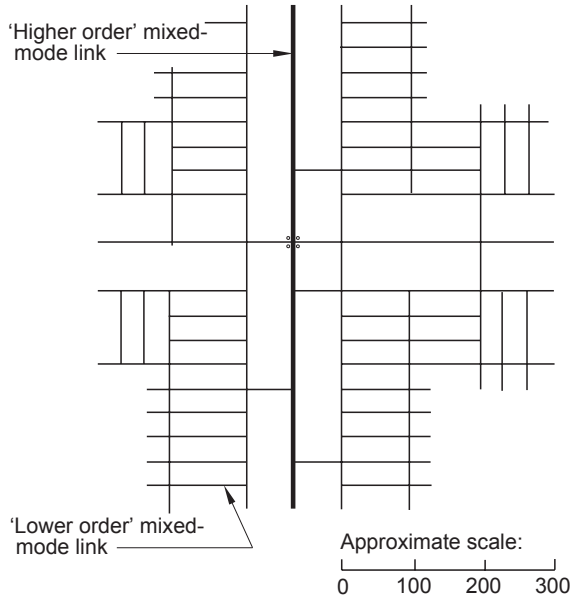

Figure 5.1.3: Diagram illustrating the relationship between higher and lower order mixed-mode links

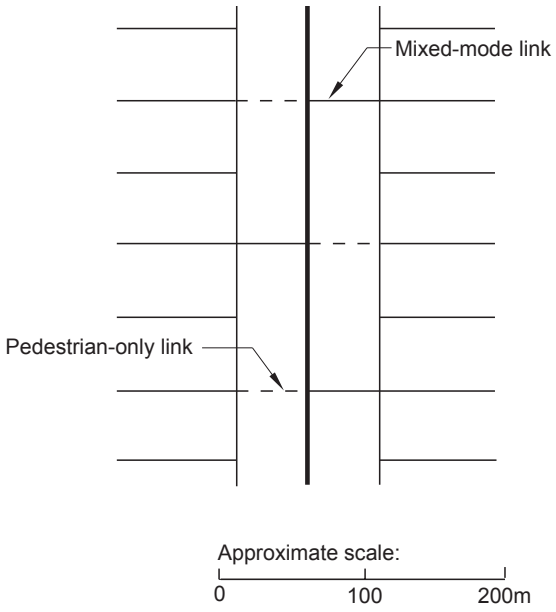

Figure 5.1.4: Diagram illustrating the relationship between pedestrian-only and mixed-mode links

Note: The diagram illustrates public right-of-way links, not roadways. The junction of two right-of-way links does not therefore necessarily imply the intersection of two roadways. See Figures 5.1.8 and 5.1.9 for illustrations of roadway systems that prevent or manage through-traffic on lower order mixed-mode links.

The purpose of interconnections between mixed-mode and pedestrian-only links is essentially to maintain easy multi-directional pedestrian and bicycle access, in situations where the roadway network is discontinuous to prevent large quantities of vehicular through-traffic from using certain routes (Figure 5.1.4). The network of pedestrian footways, crossings, pathways and cycleways should always remain convenient and direct. Intersections between mixed-mode and pedestrian-only routes typically take the form of footways joining with short pathways that run through longer blocks or open spaces.

The configuration of links and junctions into networks

A continuum of basic network-configuration options can be identified on the basis of network connectivity (Figure 5.1.5). On either end of the continuum are closed and open networks. A closed network consists of a hierarchy of links, within which links intersect only with other links equal to - or one below or above - it in the hierarchy. This system establishes clearly defined movement routes between any two points, but offers no equidistant alternatives. An "open" network on the other hand, consists of a system of links of differing hierarchical importance intersecting freely with one another. This system offers a choice of alternative equidistant routes between any two points within the network.

Studies of the impact of open and closed networks on travel behaviour and residents' quality of life, have indicated that different configurations have both advantages and disadvantages. On the one hand, studies have shown that while open networks (in

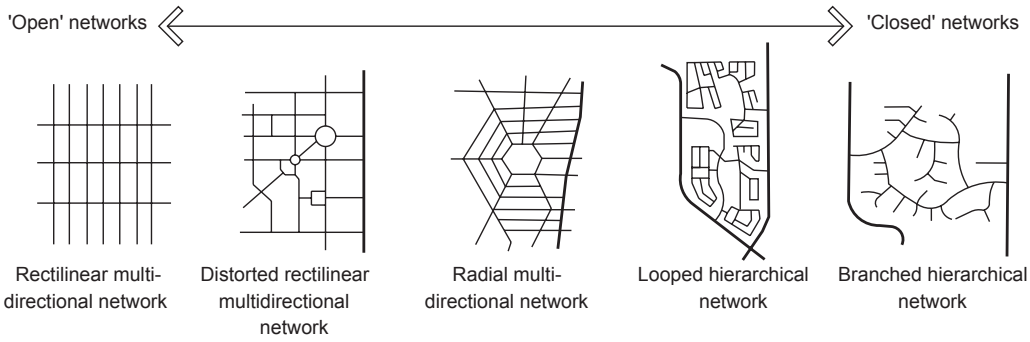

Figure 5.1.5: Generic network configurations

conjunction with mixed land-uses) improve levels of accessibility to local destinations, reduce total vehicle kilometres travelled and increase the walking and public-transport share of the modal split; they can also result in numerous problems associated with the intrusion of fast-moving through-traffic (e.g. safety and noise). On the other hand, studies have shown that, while closed networks manage through-traffic effectively, they can also isolate neighbourhoods and reduce the viability of smaller neighbourhood commercial activities, as well as increase trip lengths for non-motorised modes and necessitate road-based service vehicles to either back-track or frequently accord priority to other vehicles.

Central to the planning approach presented in this sub-chapter is the argument that the configuration of public rights-of-way into networks that are multidirectional, enables different way systems within the movement network to either incorporate or avoid the above-mentioned advantages and disadvantages. It is possible, for instance, for a *multidirectional* movement network to maintain easy and direct pedestrian and bicycle circulation in all directions (through the design of the footway, pathway and cycleway component of the network as an open system), while preventing or limiting the safety and intrusion problems associated with extraneous vehicular traffic (through the design of the roadway component of the network as a closed system - see Figure 5.1.6).

A multidirectional configuration (and the associated patterns of public and private land ownership) further enables the various "way" systems within the movement network to be adapted to become more open or closed as modal split and dynamic land-use development processes alter the nature and pattern of movement demand and the functions of particular links. Network configurations, to a large extent, determine the pattern of land sub-division, which in turn forms the basis for title registration and the allocation of development rights. Given that large-scale expropriation and compensation is required in order to significantly alter patterns of land ownership and development rights, discontinuous or "dendritic" public right-of-way networks are extremely difficult to adapt and are inflexible. A multidirectional movement network is thus able to prioritise the needs of non-motorised modes and public transport users, as well as maintain convenience, safety and multi-use when conditions and movement needs change. It is important to note that a multidirectional movement network is not necessarily an orthogonal grid.

Figures 5.1.7, 5.1.8 and 5.1.9 provide an example of how the individual "way" systems within a hypothetical multidirectional movement network (see Figure 5.1.7) can be configured to manage motorised traffic on lower order mixed-mode links through either volume management measures (see d, e and f of Figure 5.1.8), or speed reduction measures (see Figure 5.1.9), while maintaining direct pedestrian and bicycle circulation in all cases (see a, b and c of Figure 5.1.8). It should be noted that the management of traffic volume and traffic speed is interrelated, and it is not the

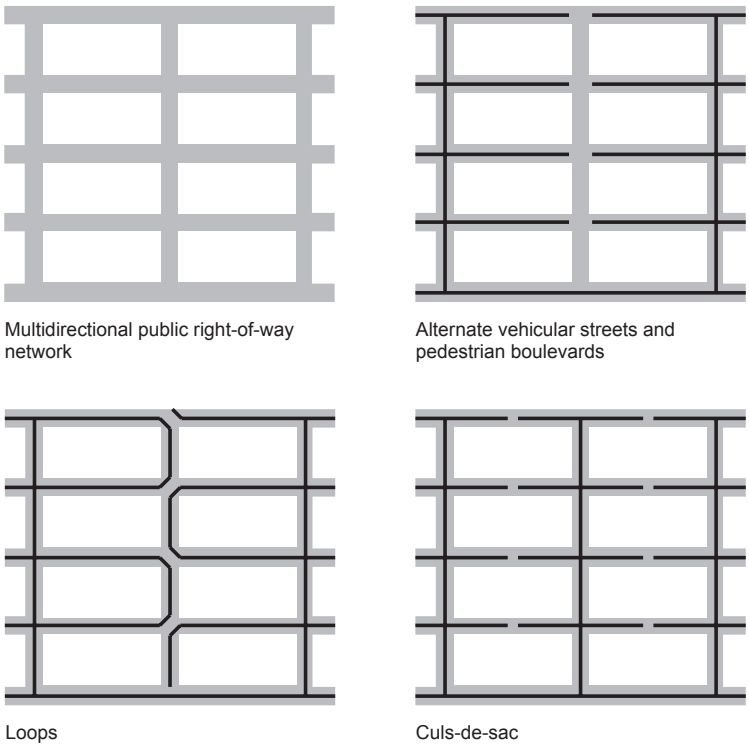

Figure 5.1.6: Conceptual examples of closed roadway system options within a multidirectional public right-of-way network

intention of the figures to suggest that they should be considered independently. Studies on the impact of traffic volume and speed management measures have shown that speed reduction on particular links almost inevitably leads to volume reduction as well. The use of roadway closures and diverters which restrict through-traffic are therefore not regarded as mutually exclusive from the use of measures that reduce speed (e.g. tables, pinch points and chicanes), and vice versa.

It should also be noted that in all the different configurations represented in Figures 5.1.8 and 5.1.9, a continuous footway and pathway network with 18 pedestrian entrance/exit points is maintained. The pathways are also all relatively short and straight, and surrounding properties overlook them. The public transport route is direct, and pedestrian access to the public transport stop is unhindered. In the case of roadway systems, the minimum spacing between T-intersections involving minor arterials and service/collector routes is ± 100 m, the minimum spacing between T-intersections involving collector and local access routes is ± 25 m, and the minimum spacing between cross-intersections involving collector and local access routes is ± 50 m.

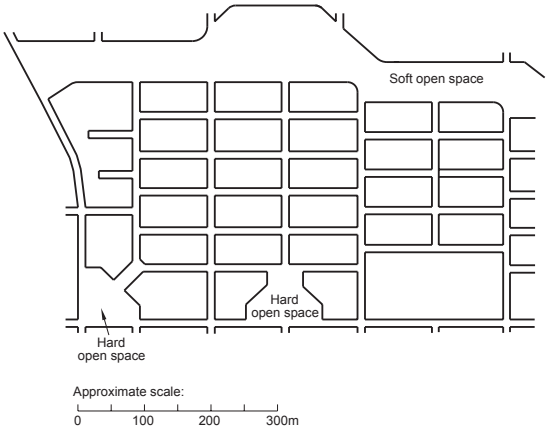

Figure 5.1.7: Hypothetical example of a multi-directional public right-of-way network

The exact configuration of a multidirectional movement network is dependent on context-specific factors like topography, the distribution of traffic-generating activities in surrounding areas, car-ownership levels, and the modal split of the population on the site as well as the surrounding population - these contextual factors are discussed in the following section.

GUIDELINES ON THE CONTEXTUAL FACTORS THAT INFORM THE CONFIGURATION OF A PARTICULAR MOVEMENT NETWORK

An analysis of the pattern and mix of existing and anticipated land-use activity surrounding the particular site, as well as the pattern and mix of higher order land-use development that is to be encouraged within the site, will indicate spatial patterns of movement demand (known as "desire lines") across, into and from the site. In order to identify movement-demand desire lines, it may be useful to establish a map which indicates possible future patterns of movement demand (both motorised and non-motorised) between existing and anticipated areas of land-use activity. This desire-line map essentially consists of bands which represent the major movement flows between appropriately scaled zones - delimited on the basis of a simple grid, or on the basis of clusters of dominant land-use activity. The beginning and end points of the band indicate the origin zone and the destination zone, and the width of the band indicates the relative magnitude of the anticipated movement demand. Such movement desire-line maps can be prepared for different times of the day or week, in order to indicate temporal fluctuations in movement demand. An indication of the nature of these patterns of movement demand can be used to inform

- the need for, and alignment of, higher order movement routes across the site; and
- the need for, and alignment of public transport connections across the site.

An analysis of the pattern and mix of existing and anticipated land use within the site, the demographic and income profile of the existing and "target" population on the site, as well as the biophysical features of the site, will indicate, inter alia, land-access requirements, the nature of movement demands, and topographical constraints on network configuration. In the case of in-situ upgrade projects, the existing pattern of informal movement channels will be a major internal informant of movement-network configuration. An indication of these requirements and constraints can be used to inform

- the modes of movement that will need to receive priority in the configuration of the network;
- local economic development considerations in the configuration of the movement network;
- the land-access requirements associated with the pattern of land subdivision;
- place-making considerations in network configuration; and

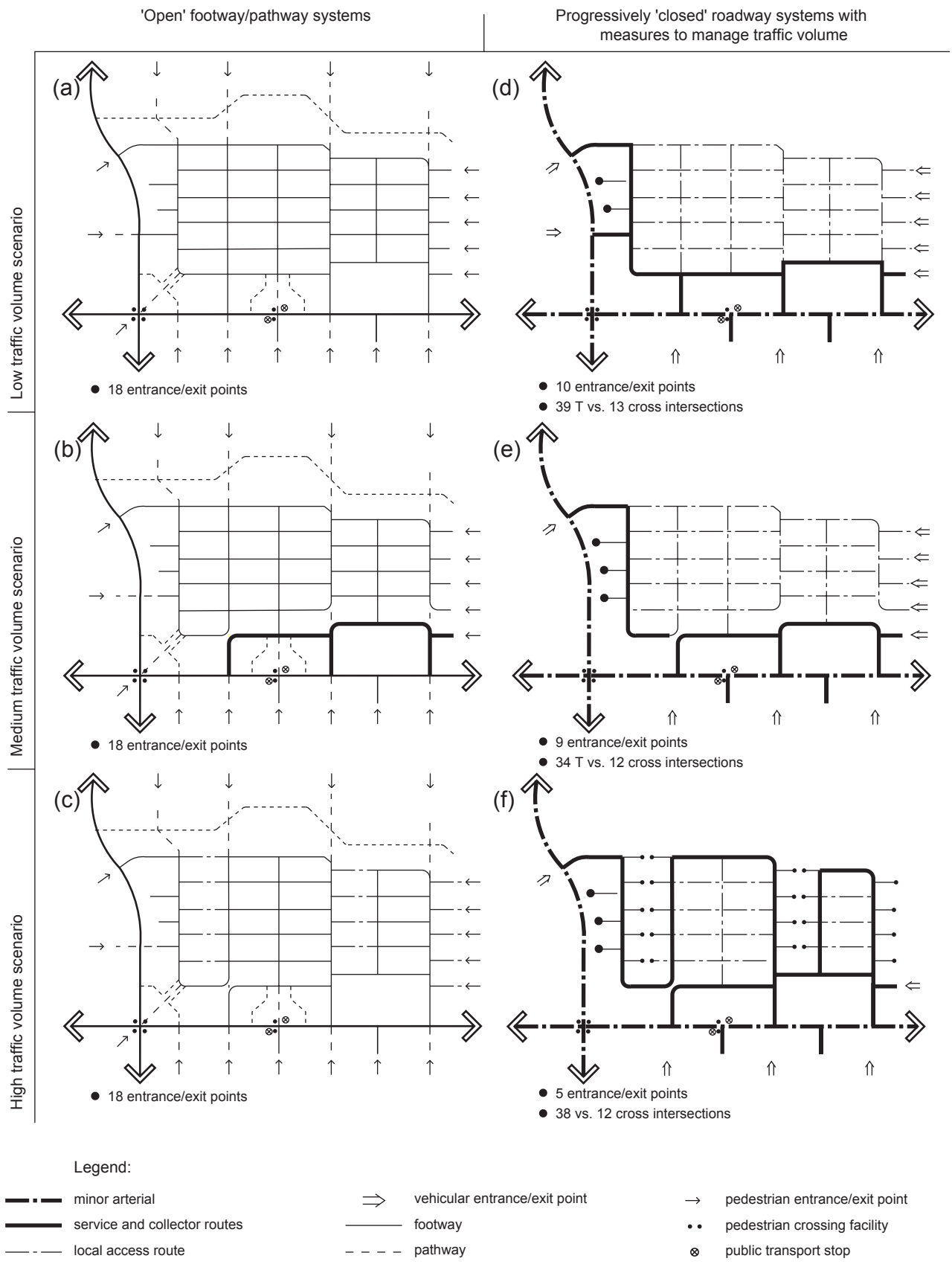

Figure 5.1.8: Possible configurations of foot/pathway and roadway systems within a public right-of-way network that respond to different traffic volume situations

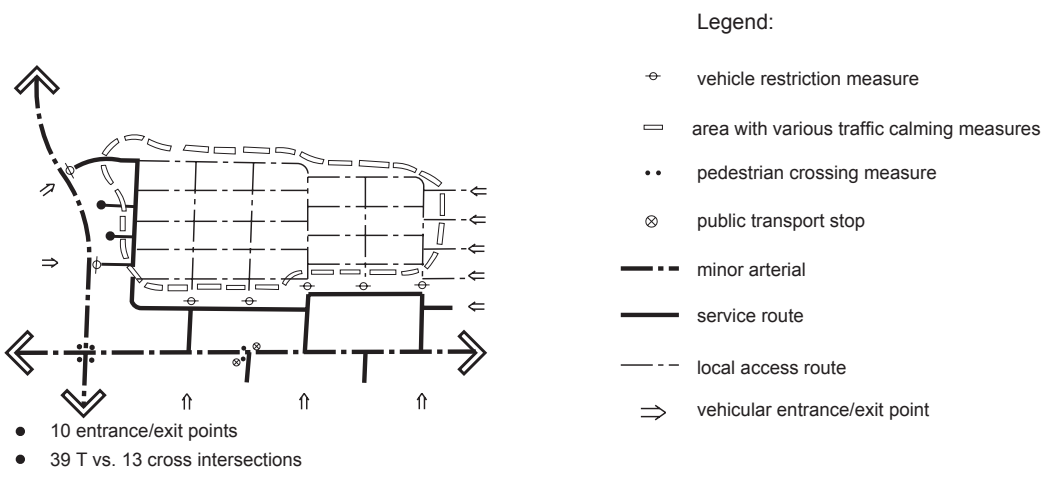

Figure 5.1.9: Possible use of measures in a public right-of-way network's roadway system to manage traffic speed

- the network configuration requirements of internal services reticulation, particularly gravity-based wastewater and stormwater drainage.

Higher order movement route connections

Higher order movement routes, in the form of vehicle-only links or mixed-mode links carrying greater volumes and densities of vehicular traffic, which lead to, across, and out of the site, facilitate longer distance intra-settlement connections. In many cases the need for, and the alignment of, these higher order movement routes across the site will already have been identified in metropolitan or sub-metropolitan plans. In these cases, the proposed higher order routes need to be accommodated within the site, and the planning and design of the local movement network needs to be done in relation to these dedicated alignments. Of particular importance, is the fact that when these higher order routes take the form of vehicle-only links, the opt-in-opt-out relationship between vehicle-only and higher order mixed-mode links, discussed earlier, needs to be considered.

Public transport service connections

Public transport service connections that lead to, across, and out of the site represent an important way of integrating the local environment with the surrounding movement system and land-use pattern. The planning and design of the local network should provide opportunities for increased coverage and penetration of road-based public transport operations, through extending these into and across the site. In order to identify the need for increased public transport coverage and penetration, it may be useful to establish a map which indicates areas that are served and not served. The area served by public transport is delimited on the map as that which is within convenient walking distance of public transport stops. A convenient walking distance is often interpreted as maximum walking time of 5-10 minutes, and a maximum walking distance of that involving 400-500 metres. Such a map illustrates the area of coverage, and suggests where additional service routes and stops might be placed.

Network configuration requirements of vulnerable modes

- Public policies relating to desirable modal split, as well as the existing or anticipated level of car ownership among the site's population (and associated dependence on walking or public transport services), will provide an indication of the relative importance that different modes will need to assume in movement-network design within particular contexts. In order to design networks that are capable of prioritising particular - while effectively accommodating all - modes, it is useful to consider the specific network-configuration requirements of dominant modes (i.e. motor cars, walking, public transport vehicles).

- Motor cars are the most flexible of all movement modes, able to undertake any length of door-to-door trip. It is argued therefore that the configuration of local movement networks should be informed by the needs of more vulnerable, gradient - and distance-sensitive modes, particularly pedestrians.

- Walking trips can only cover relatively short distances (i.e. 1-2 kms), and are often associated with the beginning and end portions of public transport trips. Pedestrian movement is accommodated primarily within footways, pathways and roadways. In order to facilitate efficient pedestrian movement, these "ways" should be configured in the following manner:

  - Footways should be configured into multi-directional networks which enable pedestrians to choose relatively direct and equidistant trip routings, that either avoid or select roads that accommodate greater traffic flows and greater commercial land-use activity, and to orientate

themselves within settlements they do not know well.

- Blocks, within multidirectional network configurations, should be short to medium in length, to enable more intersections where cars must stop and pedestrians can cross, and more direct routing of walking trips. For ease of pedestrian circulation, block lengths should be in the region of 100 m.

- When block lengths are significantly longer than 100 m (in the region of 200-300 m) because of land use or traffic management considerations, short and direct pathways through the centre of the block (known as "pass-throughs") should be provided, in order to maintain the ease of pedestrian circulation.

- When culs-de-sac (or road closures) are incorporated within the movement network because of traffic management considerations, pathways should be provided which connect the end of the cul-de-sac with the nearest foot/roadway, in order to maintain multi-directional pedestrian circulation.

- On mixed-mode links where roadways and footways are separated by kerbs, footways should be provided on both sides of the roadway, and should connect with pathways that cut across large soft open spaces, to facilitate continuous and multidirectional pedestrian circulation.

- Pedestrians tend to choose travel lines of least resistance - cutting corners and keeping their routes as direct as possible. Pedestrian pathways within soft open spaces (that accommodate non-recreational trip functions) should therefore be as direct and short as possible.

- On roadways experiencing relatively high traffic flows, pedestrian crossings should be provided at regular intervals, and should be located at points where pedestrian desire lines cross the roadway, in order to maintain adequate levels of pedestrian safety.

• Public transport vehicle trips typically take the form of shorter feeder, and longer line-haul or express trips. The number and spacing of stops establishes the line-haul or express nature of the public transport service. The network configuration requirements of express public transport vehicles are similar to the requirements of motor cars undertaking longer distance trips. Public transport vehicles are accommodated within roadways and railways. In order to facilitate efficient public transport movement, these "ways" should be configured in the following manner:

- Effective line-haul public transport service operations are quick, frequent and predictable. Roadways carrying road-based bus and light rail services should therefore be as direct as possible, to avoid the delays associated with continuous backtracking, and frequent turning movements where giving priority to other vehicles needs to be accorded. Direct road alignments also make the introduction of dedicated public transport lanes less complex than on circuitous roads, and enable numerous service operations to be routed along the same road for portions of their service length - thus enhancing the frequency of services along the route.

- Parallel road-based feeder public transport service routes should be spaced at maximum intervals of 800 - 1 000 m, to maintain a maximum convenient walking distance to these services of 400 - 500 m.

- At bus service terminals, vehicles may stand for some time and need to turn around. It is preferable to provide a turning area off the roadway, unless there is a suitable nearby roundabout which can be used.

- Where rail lines are an integral part of the movement network, or where a site is being developed adjacent to an existing railway station, every opportunity should be taken to structure a set of road-based public transport routes to interchange or end at the railway station, in order to facilitate inter-modal transfer.

Network configuration impacts on local economic development processes

The spatial organisation of local economies is influenced by a number of complex socio-economic, financial, security and development control factors. It is important that the configuration of the movement network maximises opportunities for small entrepreneurs, and does not disadvantage, or preclude, certain types of entrepreneurs and spatial patterns of economic activity from occurring. Movement networks define the spatial pattern of exposure and access to passing consumers, and therefore influence spatial patterns of economic opportunity (i.e. points of greatest commercial viability that are largely, but not exclusively, dictated by relative levels of exposure and access to passing consumers). Movement networks that create a cellular settlement structure and channel all through-movements onto arterials along which fronting access and on-street parking is not allowed, for instance, tend to create a nodal (as opposed to linear, or randomly scattered) pattern of economic opportunity. Given the limited number of such nodes within a local area, this pattern of economic opportunity frequently

results in commercial activities organising themselves into shopping centres. Small independent entrepreneurs with limited capital are typically unable to meet the relatively high overhead costs associated with trading within shopping centres, and are therefore denied access to most of the viable trading locations created by the network configuration. In order to put in place one of the spatial preconditions necessary to create opportunities for small independent entrepreneurs, movement networks should be configured in the following way:

- The local movement network should be integrated into the surrounding movement system and land-use pattern, so that flexible and complex patterns of intra - and inter-district shopping can develop which enable consumers to move directly and conveniently into, and out of, the local area - thus avoiding monopolistic and oligopolistic trading conditions in which local retailers are able to charge inflated prices to a relatively captive market. Local multidirectional road networks should therefore be stitched into, and form an integral part of, the system of movement in the larger area, and should not be regarded as an independent sub-system.

- The network configuration should incorporate links that enable shorter distance through-traffic to move through local areas, and at the same time ensure that, where necessary, through-traffic has the option of travelling along high-speed vehicle-only routes. Shorter distance through-traffic and local traffic should be concentrated onto continuous integrating main streets that accommodate road-based public transport services, in order to create the passing consumer thresholds that are necessary to support viable, fronting, small-scale commercial activities. Vehicular and pedestrian traffic can be concentrated onto main streets through the alignment of different public transport modes and services along shared routes for a portion of their service length, and the location of movement generators like major public facilities and public transport modal interchanges along the route. While not necessarily dictating the spatial pattern of economic activity within a local area, this network configuration creates a more dispersed, linear pattern of economic opportunity that can accommodate a range of types and sizes of entrepreneurs and commercial investment patterns.

Land-access requirements

A central informant of the planning and design of the site's movement network is the need to ensure that there is adequate access to all erven within the site - typically in the form of a passing roadway and footway to which private pathways and driveways (or private roads, in the case of estates) can connect. What constitutes "adequate" access is subject to debate, however. Conventionally, all erven are provided with vehicular access but, in some instances, due to steep topography or low levels of car ownership (especially in in-situ upgrade developments), "adequate" is interpreted as being a relatively short public pedestrian pathway leading from a public road. The expected nature and mix of land-use activity on the site will, through an iterative process, indicate the width, and in some instances the length, of blocks that need to be incorporated in the network. To facilitate the efficient subdivision and utilisation of land, movement networks should be configured in the following way:

- In the absence of topographical or other constraints (e.g. infrastructure servitudes), local movement networks should be broadly rectangular, to yield the greatest possible number of erven from blocks. Sharply curving road alignments, which result in curved blocks, make the efficient subdivision of land difficult.

- Blocks defined by the configuration of the local roadway network should, wherever possible, be modular in order to enable larger blocks to fit into a pattern of smaller pedestrian-scaled blocks. Land-use activities like schools, shops and parks consume relatively large parcels of land that often do not fit into pedestrian-scaled blocks.

Place-making considerations

The way in which a site's movement network is configured can contribute to the creation of a "sense of place". The concept of a sense of place is complex, crudely referring to the images and feelings associated with the uniqueness of a particular part of a settlement, an entire settlement, or even a collection of settlements, that are embedded in collective memory, and to the way in which individuals respond psychologically, to the way public spaces within settlements are made. It follows therefore that the attainment of a sense of place cannot be achieved through standardised planning and design. Place-making essentially involves recognising the natural and cultural uniqueness of a particular environment and its population, and incorporating - and enhancing - this uniqueness in planning proposals. More specifically, in order to contribute to the creation of a sense of place in settlements, movement networks can be configured in the following way:

- Straight tree-lined avenues or boulevards can be aligned towards, and terminate at, important cultural or symbolic public buildings, public art displays or objects of public remembrance, in order to create vistas (i.e. visual axes) and enhance gateways to public spaces. Road alignments that create vistas can therefore help establish a series of landmarks that make a settlement memorable. By

giving important objects visual dominance in the settlement, they become reference points - thereby reinforcing their symbolic importance.

- Road alignments can, where appropriate, respond to the natural features of the site, and incorporate it visually into the settlement. The alignment of roads can be used as a means to create vistas to natural features like established trees, *koppies*, or distant mountain peaks, and to retain existing landscape features.

Network configuration impacts on internal utility service reticulations

Reticulated utility services, in the form of water supply, sewerage, stormwater drainage, electricity supply and telecommunications are conventionally - either entirely or partially (in the case of mid-block reticulation) - accommodated in road reserves. The configuration of the movement network therefore has an impact on the reticulation of these channels, pipes and cables. The aspects of movement-network configuration that have the greatest impact on efficient service reticulation are: (1) road curvature, and (2) road gradient.

The curvature (or horizontal alignment) of the road reserve has the greatest impact on piped gravity-based services (i.e. sewerage and stormwater drainage), and above-ground electricity and telecommunications cabling. In order to facilitate the efficient reticulation of these services, movements networks should be configured in the following way:

- Notwithstanding the need to follow contours, road reserves accommodating below-ground pipes and above-ground cables, or dictating the pattern of reticulation in the middle of blocks, should generally be as straight as possible to facilitate the shortest relative service line lengths per erf, for straight trenches, and to minimise manhole and poling requirements. Curving road reserves require more sewer and stormwater manholes to provide access to pipes for cleaning (see discussion below), and necessitate extra poles in above-ground public lighting and electricity-supply systems, to ensure cables do not hang over the roadway.

- Notwithstanding the need for larger blocks to accommodate a range of non-residential land uses, blocks should generally be ± 100 m long, to minimise the number of sewer and stormwater manholes. The primary function of sewer or stormwater manholes is to provide access to pipes so as to clear blockages. It is conventional practice to provide manhole access to a gravity pipe at horizontal and vertical changes of direction, junctions between main and branch pipes (but not at junctions with erf connections in the case of sewerage), the head of a reticulation system, and at intervals on straight stretches of pipe. Manhole spacing on straight stretches of pipe is normally restricted to the length of hand-operated cleaning rods (typically 50 m), which are pushed along the pipe. Rods can bend to negotiate curves in a pipe but, if the curve is too tight (with a curve radius of less than 30 m), the rods tend to damage the wall of the pipe. The maximum spacing of manholes on straight stretches of road reserve, where pipes are cleaned with hand-operated rods, is therefore ± 100 m. When blocks are ± 100 m long, manhole access would be required at 100 m or so intervals to accommodate the junctions between main and branch pipes anyway. Limiting the length of blocks to ± 100 m therefore reduces the necessity for manholes on straight stretches of pipe.

The gradient (or vertical alignment) of the road reserve also has a great impact on gravity-based services (i.e. sewerage and stormwater pipes and channels). In order to facilitate the efficient reticulation of these services, movements networks should be configured in the following way:

- T-junctions or culs-de-sac at the down-stream end of steep roads should be avoided, in order to maintain "positive drainage" and avoid flooding.

- Very steep or completely flat road gradients present problems relating to the circulation of larger service vehicles (in the form of congestion), and the self-cleansing flow velocities of gravity-based services (in the form of clogging and road scour). Maximum grades are set by vehicle manoeuvrability requirements (provided the surface runoff velocity that results from the grade is less than 3 m/s), while minimum grades are set by drainage requirements. Maximum grades vary according to the volumes and speed of traffic and the nature of the terrain - generally grades should not exceed 5-6% (or 1:20-1:16) in flat terrain, 10-12% (or 1:10-1:8) in hilly terrain and 12-15% (or 1:8-1:7) in mountainous terrain. Minimum grades of road reserves accommodating pipes should generally not be below 0,4% (or 1:250). In hilly and mountainous terrain, in order to achieve these grades, and avoid deep cuts and high fills, blocks and their associated fronting road reserves should follow contour lines, and traversing roads should intersect roads above and below them at an angle sufficient to maintain an acceptable maximum grade. When blocks are aligned with contours, provided toilets are located close enough to the rear of the erf, mid-block sewer trenches can be dug to ensure that both lines of erven within the block are served by the same sewer.

GUIDELINES ON THE ADAPTATION AND CONVERSION OF MOVEMENT NETWORKS TO ACCOMMODATE CHANGE

As indicated in the previous section, a range of contextual features will inform the configuration of a site's movement network. In particular, with regard to the roadway component of the movement network, the actual and desirable level of car use and associated modal split of the site's (and surrounding) population will inform the degree to which the system is open or closed to through-traffic. This section discusses the anticipation of patterns of movement demand to inform the configuration of roadway systems and the adaptation and conversion of roadway systems to accommodate changing modal split, and changing movement patterns associated with dynamic spatial patterns of land-use activity.

The anticipation of patterns of movement demand within sub-metropolitan and local movement networks

The pattern of movement demand within a sub-metropolitan or local area is directly affected by the nature and form of the movement network. In the case of a closed hierarchical roadway system, it is possible to predict the volume and pattern of traffic (associated with a static spatial pattern of land use and modal split) that will use each road in the system with some degree of certainty, as the system presents no choice of potentially equidistant routes between any two points. While it is not possible, in the case of a more open system, to predict the volume and pattern of traffic with any degree of certainty - due to a greater choice of local and through routes - a more open system is more flexible and integrates the site into its surrounding environment better. There is however a trade-off between flexibility, integration and cost. The ability of more numerous links within a movement network to accommodate a dynamic range of social, recreational, economic and movement functions over time, has capital cost implications - and in many instances greater road reserve width and stronger roadway pavement structure will be required. Every link in a network cannot therefore be designed to accommodate large increases in traffic volumes.

To avoid the excessive road construction costs associated with total flexibility and greater integration, it is necessary, within limits, to predict the possible range of movement demand conditions (or scenarios) a more open road network proposal may be expected to accommodate. More specifically, the need is to identify those links expected, in the short term at least, to accommodate a wider range of functions and greater traffic volumes. Without a reasoned estimate of the traffic load a particular link or intersection will be required to accommodate, it is not possible to make informed decisions relating to the design of appropriate roadway cross-sections and pavements, or the selection of appropriate intersection-control systems. The direction, volume and mode of movement generated and attracted by a proposed development will be influenced by variables like household size and composition, areas of employment, levels of car ownership, and use of public transport services. It is important that an understanding is gained of the extent of change which is realistically possible within these variables, so that the network can be designed to accommodate such changes.

Patterns of movement demand on vehicle-only links, as well as mixed-mode links expected to accommodate larger volumes of traffic, can be predicted through a four-step modelling process, in which future traffic load, at a point in time (typically 15-20 years into the future), is assessed on the basis of a desirable, as well as the existing, land-use pattern. It is important to note that the modelling of future patterns of movement demand is sensitive to transport and land-use policy. Extrapolations of current patterns of movement demand should therefore be tempered by the settlement qualities to be created in a particular environment, and assumptions relating to the ability of the public sector to manage transport-related market forces. The conventional "four-step" modelling process is dealt with in detail in the Department of Transport's TPG 7 and can be broadly summarised as follows:

- estimating the number of trips that will be generated or attracted by each zone (often on the basis of the anticipated population of the zone multiplied by an average trip rate),

- estimating the number of trips that will occur between different zones (often represented in the form of an origin-destination matrix, and a desire-line map),

- estimating the relative proportion of modes through which trips between zones will occur, and assigning the trips moving between different zones, by different modes, to particular routes.

Patterns of movement demand within a particular site can be crudely predicted through the following five-step simulation:

- estimating the number of trips that will be generated or attracted by each erf within the site (often on the basis of assumptions relating to average number of workers per household and per business unit, and the average number of schoolchildren per household);

- estimating how many of these trips are local trips, and how many are into, and out of, the site;

- establishing trip directions on the basis of the location of major movement attractors (e.g. schools, employment and commercial centres) within the site and in the surrounding area;

- estimating the relative proportion of modes through which trips in different directions will occur; and

- assigning the trips moving in different directions, by different modes, to particular routes.

This simulation process can be conducted for peak and off-peak conditions, to establish temporal variations in the nature and pattern of movement demand. The patterns of movement demand identified can then be used to establish link volumes and turning movements.

Given the uncertainty of future predictions of future land-use development patterns and associated movement demand, and the need for movement networks to perform more than simply movement functions, it is important that the modelling processes described above be used to test the likely consequences of movement-network proposals, and not used as the basis for formulating proposals (beyond minor adjustments to network configuration). Demand-driven approaches to movement-network planning and design, based on the traffic load forecast, run the danger of either entrenching existing inefficiencies and inequalities, or of simply basing proposals solely on potentially erroneous predictions of future development patterns.

The management of changing patterns of movement demand within sub-metropolitan and local movement networks

The uncertainty of future predictions of movement-demand patterns also makes it important to monitor change (in terms of variables like traffic volumes, speeds and accidents) over time and, where necessary, to adapt or convert movement networks to accommodate this change. It is important that initial movement-network designs consider and facilitate possible future adaptations. Such adaptations or conversions are essentially aimed (a) at managing or "calming" the increased volumes and speeds of vehicular traffic associated with changing patterns of movement demand - more specifically to prevent large volumes of high-speed, longer distance traffic from cutting through quieter, predominantly residential areas, and to slow traffic on roads that experience a high mix of pedestrian and vehicular traffic, and in doing so, (b) at maintaining the ability of links to accommodate a range of movement and non-movement functions. As mentioned earlier, an advantage of multidirectional movement networks is that a variety of traffic calming interventions can be applied to convert the roadway network into a closed or speed restricted system which controls through-traffic, while maintaining an open footway and cycleway network, and which still enables the roadway network to be converted back to an open system should this be required. The achievement of greater flexibility therefore has implications for the operational capacity of local authorities, in terms of being able to monitor change, as well as for the configuration of movement infrastructure, and cost.

Within local movement networks the ongoing traffic-management objective is essentially to keep the speed of appropriate volumes of traffic low and, in doing so, to make the road as safe as possible for pedestrians. Traffic management, or calming, therefore takes two basic forms. The first is the reduction of speed through adaptations to the cross-section and horizontal and vertical alignment of the roadway. The second is the reduction of traffic volumes on certain roads through converting roadway network connectivity. It is important to note, however, that roadway adaptations can also reduce traffic volumes by making the route less attractive to through-traffic, and connectivity conversions can similarly reduce traffic speed.

The introduction of these traffic management measures are warranted when the monitoring of patterns of movement indicates that certain traffic speeds or volumes along certain routes have increased to levels that are not compatible with the range of social and economic functions the route is required to perform (see TPG 14 on "traffic calming"). Internationally, speed reduction measures on local roads are typically deemed necessary when maximum speeds exceed ± 30 km/h, and on mixed-mode arterials when maximum speeds exceed ± 55 km/h. Typically, volume-reduction measures are deemed necessary on local roads when traffic volumes exceed ± 600 vehicles/h. At slower speeds, drivers have greater opportunity to perceive and react to a situation, thus helping to reduce the number and severity of collisions. Roadway systems can be adapted to manage traffic speed, through the introduction of traffic-calming measures as illustrated in Figure 5.1.10.

Roadway systems can be converted to manage traffic volume, through the introduction of traffic calming measures as illustrated in Figure 5.1.11.

Empirical studies on the effectiveness of traffic management measures indicate that legal speed limits (in the form of "speed zones") have little effect on driver behaviour, and that it is rather the physical or operational characteristics of the road that determine driver behaviour. Traffic management measures should therefore be self-enforcing. Studies suggest that different self-enforcing measures have variable impacts on traffic volume and speed - apart from speed humps and speed tables, "adaptation" measures tend to have a greater impact on traffic speed, than on traffic volume, and "conversion" measures have a significant impact on both speed and volume.

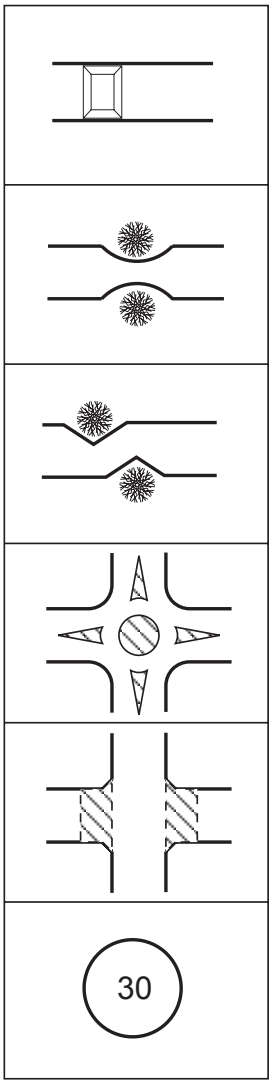

Figure 5.1.10: Roadway adaptations to manage traffic speed.

* The partial of full closure of roadways at the end or middle of the road

* The restriction of traffic movement to selected directions only, in the form of diverters (also known as diagonal road closures) and median closures

* The conversion of two-way roads into one-way roads

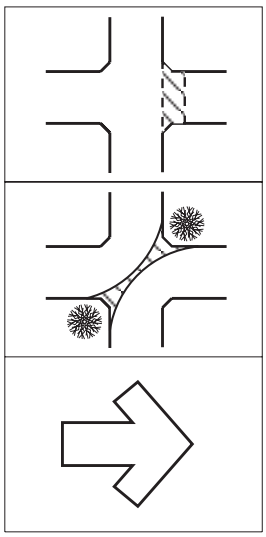

Figure 5.1.11: Roadway adaptations to manage traffic volumes.

The introduction of adaptation and conversion measures requires careful consideration, however. If local area traffic management measures, particularly conversion measures that alter network connectivity, are introduced on an ad hoc or area-specific basis, they can have a negative effect on the performance of the movement network as a whole. For instance, the closure of roadways that accommodate slower speeds, and shorter distance through-movements, increases trip lengths, and can lead to congestion on vehicle-only routes, and can reduce the viability of abutting formal and informal economic activities that depend on exposure to passing non-local consumers. The adaptation of individual roads can simply divert problems to nearby parallel routes, and the introduction of speed humps can have a negative impact on the operation of road-based public transport services and emergency service vehicles. Traffic management measures therefore need to be monitored and applied on an area-wide basis.

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Public transport

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDICES

INTRODUCTION

Public transport policy, strategy, planning, operations and management are all currently in a state of flux in South Africa. In the recent past, in most urban areas the focus of public transport bodies was largely the provision of basic services for low-income communities, whose travel choices do not extend to walking, cycling or driving to their destinations. In most medium- to high-income areas, only rudimentary services exist which can barely be considered an alternative to the motor car. Accordingly, public transport services in South Africa have been designed to serve the perceived need to assemble labour from distant suburbs and satellite low-income dormitories, at centralised workplaces. There were, and still are, very few off-peak services. Public transport to serve non-work trip purposes has also been neglected. In recent years, public transport has come to be dominated by minibus taxis, which do not run to schedule and which have tended to follow the line of least resistance through the townships and settlements, in order to give operators the opportunity of maximising the number of journeys, and thus their profits. Service to customers has not been of primary concern.

The foregoing is the public transport context within which the planners of new settlements will be operating in the short to medium term (the next five to ten years). Settlement planners[1] will, however, be challenged to assist transport authorities[2] in changing direction and building cities and towns which facilitate public transport, and make it more accessible, viable and sustainable. It is, therefore, essential that the planners of settlements in urban areas should understand the current and evolving public transport policies so that they can assist in facilitating settlement which is supportive of public transport. This guide does not deal with settlements in rural areas, although many of the principles and standards are applicable.

The next section provides a summary of relevant documentation about public transport, and gives an indication of the likely directions of change in the coming ten years, to provide settlement planners with an understanding of the context within which settlement planning will be undertaken.

EVOLVING PUBLIC TRANSPORT POLICY AND ITS IMPLICATIONS FOR SETTLEMENT-PLANNING

White Paper on national transport policy

The strategic objectives of the White Paper which are relevant to settlement-planning and which should be incorporated in future settlements are summarised below:

- Public transport travel distances and times for work trips should be limited to about 40 km, or one hour in each direction. This means that new settlements should be located no further than 40 km from the major work destinations. Further, as a general guideline, settlements should rather be located as close as possible to places of work and other urban activities so as to facilitate trips by bicycle or on foot. Where this is not possible, settlements should be located close enough to work destinations to enable public transport vehicles to make two or more trips from the settlement to the work place or school in peak-hour periods.

- An objective has been set to promote the use of public transport over private car travel with an ambitious 4:5 ratio of public to private transport being set as a target. To assist in the achievement of this objective, settlement plans should have circulation systems or movement layouts which make all dwellings accessible to public transport (see Sub-chapter 5.1).

- Within the strategic objectives for improving accessibility, a target has been set of reducing walking distances to public-transport facilities to less than about one kilometre. Most people take about 15 minutes to walk one kilometre, so this objective should be regarded as a minimum. A far more desirable target for settlement-planning will be to place every dwelling within about seven minutes of a public transport boarding point (around 400-500 m).

- A final strategic objective which should be taken into account in settlement-planning is the object of promoting and planning for the use of non-motorised transport. Accordingly, settlements should be planned as places with a variety of urban activities, containing workplaces, schools, shops, recreational and community facilities, and dwellings. They should also have movement networks which permit direct pedestrian access to activities and public transport facilities (see Sub-chapter 5.1).

1 This applies to all professions involved in the planning and design of settlements.

2 Transport authorities are provincial or municipal governments responsible for pubic transport and roads in terms of schedule 4 of the constitution of the Republic of South Africa Act of 1996.

The White Paper also contains a number of policy statements that should be taken into account in settlement planning. These include the following:

- Land-development proposals (which include settlement plans) should be subject to a spatial policy framework within an agreed development-planning process. This means that the settlement plan must be approved in terms of an integrated development plan (IDP), part of which is an integrated transport plan (ITP)[3]. Accordingly, settlement planners will, at the outset, need to consult transport authorities to ensure that the planned settlement will be complementary to the integrated transport plan (ITP), which includes public transport strategies and operations.

- Land-use development at local level (settlements) will be subject to development approval in conformity with integrated development plans.

- The settlement plan should be cognisant of the designated public transport corridors and nodes contained in regional, metropolitan or urban IDPs. Thus, it will be necessary to contextualise the settlement within such a spatial plan. Every new settlement will be either adjacent to, or distant from, a major line-haul public transport corridor (in rare cases the public transport corridor may even bisect a settlement). The form of the settlement should be strongly influenced by its spatial relationship to line-haul public transport corridors, modal interchanges and feeder corridors; in this regard, specific guidelines on planning principles and design standards will be provided in later sections. At this juncture, it is sufficient to note that in terms of the White Paper, settlement plans will need to give effect to the policy of locating employment activities within (or close to) the public transport corridors and nodes (interchanges). Likewise, the settlement plan should facilitate the provision of higher density and mixed land uses adjacent to public transport facilities.

- A high density of development is important for public transport, in that it supports differentiated public-transport provision and enhances operating efficiency.

Legislation

Local government and transport legislation is in the course of preparation and will establish institutions and planning processes and procedures that will give effect to the White Paper's objectives and policies relating to both urban settlement and public transport. It can be expected, however, that local government, land development and land transport legislation will seek to promote integrated planning. This means that settlement plans will be subject to policies set out in integrated development and transport plans, as indicated earlier. Accordingly, in the short term, settlement planners can be guided by the objectives and policies set out in the White Paper which will, in due course, be given effect through the Land Transport Act. An important component of the Act will be the establishment of transport authorities, who will be responsible for planning for public transport. Settlement planners must consult transport authorities as an essential part of the planning process.

Moving South Africa

Moving South Africa (MSA) (South Africa, Department of Transport 1998) was a project of the National Department of Transport, completed in September 1998, which aimed to develop a long-term transport strategy for South Africa. The strategies identified in MSA entitled "Towards a transport strategy for 2020", will impact on settlement-planning. Appendix C to this sub-chapter contains a summary of these strategies. The following are the main features of MSA which are significant to settlement-planning:

- Line-haul, mass public transport will be concentrated into relatively few public transport corridors to provide conditions that will attract high-density mixed land uses. It is expected that most new urban employment activities will be encouraged to locate within such corridors.

- The quality of public transport and the extent of social support for the services will depend on the market segments served in each of the corridors. Settlement planners should thus be aware of the customer segmentation in the settlement, as this will provide an indication of the type of service that can be expected.

- Moving South Africa has developed a broad set of guidelines for determining the type of public transport infrastructure which will be appropriate to each corridor. These are only guidelines because, in due course, transport authorities will examine corridors on their own merits and determine their particular public transport policies. The guidelines will, however, influence settlement-planning. They are as follows:

    - High passenger-volume (also referred to as "ridership") corridors with more than 40 000 passengers per direction per day will probably support a rail - or dedicated public transport road - infrastructure in congested areas. Public transport nodes (stations and interchanges) in these high-ridership corridors will be supported by feeder services rendered by buses or minibus taxis.

[3] An Integrated Transport Plan is defined in guidelines prepared by the Committee of Land Transport Officials (COLTO).

- Moderate-ridership corridors with 10 000 to 40 000 passengers per day per direction are likely to be served by a road infrastructure, with priority or dedicated lanes for public transport over parts of the corridor. The line-haul services in these corridors will largely be provided by buses, supplemented by both buses and taxis at nodal public transport interchanges.

- Low-ridership corridors will characteristically have fewer than about 10 000 passengers per day per direction, and are likely to have some road-based priority schemes. Many of these low-ridership corridors will be feeder corridors. All the roads can be expected to be paved and the line-haul function or feeder function will fall primarily to taxis or small road-based vehicles.

Settlement planners will need to ascertain where the existing public transport corridors are located, relative to the proposed settlement. In planning the settlement it will be necessary to ascertain the type of corridor that will serve the settlement. This means negotiating with transport authorities to identify whether there will be extensions to nearby line-haul services, or whether the settlement will be served by a feeder service. In the case of the latter, the location of existing nodal points and modal interchanges will be an important consideration in the alignment of the low-ridership feeder corridor serving the settlement. Likewise, the location of the corridor or feeder facility within the settlement will need to give cognisance to the accessibility standards discussed earlier.

Figure 5.2.1 shows the urban densification options considered by MSA. MSA notes that high central-city densities will enhance public transport use and sustainability, but in South Africa this solution is problematic due to historic land tenure patterns.

MSA notes that the tendency towards continuing decentralisation of workplace locations is complicating the task of creating "compact cities". While it is argued that some compaction may be achievable as a means of increasing density in some cities, and is not ruled out, it is suggested that the predominant pattern in South Africa should be the "corridor city". MSA argues that the corridor approach fits more easily with existing South African urban land-tenure patterns. The appropriateness of the corridor approach is driven not only by the already decentralised distant townships and the low density of inner-ring suburbs, but also by recognition of the decline in central business district (CBD) vitality and the dispersion of development to satellite nodes. The favoured corridor option recognises the existing vacant land between townships and suburban areas which should be taken into account in settlement planning. These areas, if developed, can build on existing flows on major current corridors.

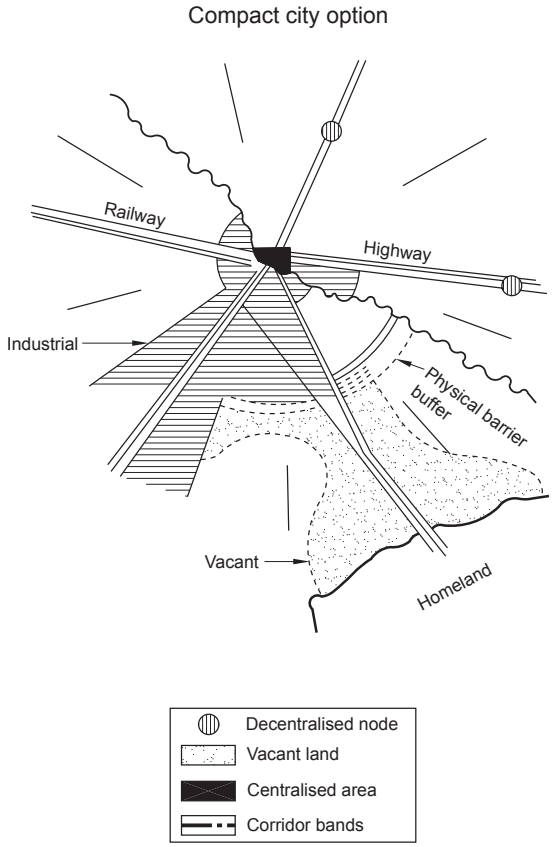


Figure 5.2.1: Urban densification options
Source: South Africa, Department of Transport (1998)

MSA states that corridors already exist to some extent in South African cities and, accordingly, their strategy focuses on densification of existing corridors and the creation of new corridors for future urban settlement-planning. The short-term focus should be on reigning in the centrifugal tendencies in South African cities to

prevent the future dispersion of development. MSA will be looking for strategies to attract decentralising activity towards public transport corridors. This approach should have a strong influence on settlement-planning.

PRINCIPLES TO ACHIEVE THE FUNDAMENTAL RESTRUCTURING OF PUBLIC TRANSPORT

The Department of Transport, through the CSIR, is currently assessing the processes and actions necessary to achieve a fundamental restructuring of urban public transport and create sustainable high-priority public transport systems.

Settlement planners may take it as given that the objectives, policies and strategies outlined in the preceding sections will be pursued through transport policy implementation, which should begin to shape ITPs as part of the process of urban development. The ideal of an interconnected network which serves a variety of destinations and is fully integrated will require a number of interventionist strategies and a supportive land-use structure. Evidence from cities such as Curitiba (Brazil) and Singapore suggests that this can be achieved only through strict adherence to principle and through an approach based on a committed spatial and network form.

The principles for fundamental restructuring are the following:

- *Problem-solving approaches and programmes for restructuring public transport should be incremental, practical and focused on the long-term vision (the corridor form of urban development)*

  Within this principle there are two aspects with a land-use or settlement dimension:

  – Public transport efficiency criteria are the key to the development of land-use. In time to come, transport planning and travel-demand management will impact on spatial patterns in South African cities, helping to make the urban land market more responsive to public transport as a locational determinate.

  – The high-priority public transport network will form the structural component for focused spatial development initiatives. Decentralised, retail and industrial developments and their relation to new settlements should be viewed as key elements in support of bidirectional public transport flows. This will require a review of decentralisation node location, as future design will be geared towards compact decentralisation nodes.

  A public-transport priority network should be developed (a few lines with frequent service are preferable to many lines with infrequent service). This will mean that settlement planners should note that, in most instances, the public transport component of new settlements will be feeder services and transfer nodes, except where the settlement falls within one of the higher-density corridors.

- *Appropriate nodes and technology should be selected to provide cost-effective services at predefined service levels, based on principles of efficiency*

  The public transport corridor and modal hierarchy will be assessed in terms of the length of the corridor, the convergence of routes and the relationship to the surrounding routes. For this reason it will be necessary for settlement planners to consider more than just the nearest point of access to public transport for the settlement. It will be necessary to understand the entire transport network or system when plugging a new settlement into any urban area.

  Settlement planners must be aware that public transport routes may be upgraded from feeder or low-priority routes to high-intensity lines or routes over time, as the urban area grows. Accordingly, the settlement must be designed with some flexibility to facilitate the application of different technologies as the demand at particular nodes and along the corridor grows. Where public transport routes are planned as part of the settlement plan, the demand implications of nodes and the potential for concentrations of land use along the corridor length, should be given attention during the planning of the layout.

- *The potential for transfer between routes should be maximised*

  Modal transfer centres will serve as the focus for the high-priority public transport network. Where such points lie within - or at the edge of - a settlement, they should serve as focal points for the movement network in the settlement. Pedestrian, cycle and public transport feeder roads should converge radially on central transfer points, which should be designed as pedestrian-friendly. To ensure that these points do not become clogged by standing and waiting buses and minibus taxis, separate holding areas should be provided in the settlement. Care must be taken to design the holding areas so that they do not cause unsightly impediments to movement within the settlement. The nodal transfer centres, whether stations or road-based interchanges, should be planned and managed as mixed-use centres, containing retail

facilities, offices, community services, and even some residential activities.

- *Seamless services that contribute to the concept of a centrally operated and controlled public transport system should be developed*

  Seamless services have a uniform and shared fare and ticket system applied to all modes, and customers can transfer between travel modes with a minimum of delay and discomfort. This principle can be supported by settlement planners if they ensure that a public-transport network, or potential network, is provided which is direct and which is physically conducive to comfortable and convenient transfer. In the design of the transport network, every effort should be made to make the route and facilities associated with it highly visible and accessible to the community.

- *Commercial, retail and industrial development activities should be located at appropriate nodes (convergence points on the public transport network), preferably within the priority corridor structure*

  These spatial components of the fundamental restructuring of public transport are illustrated in Figure 5.2.2, which highlights the principles that should be applied to achieve fundamental restructuring of public transport. Settlement planners should be cognisant of the need for public transport nodes to be prioritised in terms of their location relative to the high-priority network, and should be based on meeting certain minimum thresholds of demand. A clearly defined approach to settlement land-use planning is necessary for the support of an efficient, structured public-transport system. Nodes which fall short of the threshold of demand necessary to support a high-frequency public transport service should have further development discouraged within them, both by zoning regulation and the use of incentives and disincentives. This means that settlement planners need to understand at the outset what the public transport thresholds are, and should obtain this information by consulting transport authorities about their standards for public transport in the vicinity.

  Existing townships, particularly dormitory townships, provide a special case in terms of nodal structure. It is important that settlement planners who will be responsible for extensions of townships and infilling should understand that these types of settlement generally lack any kind of economic or activity node. They are, however, powerful

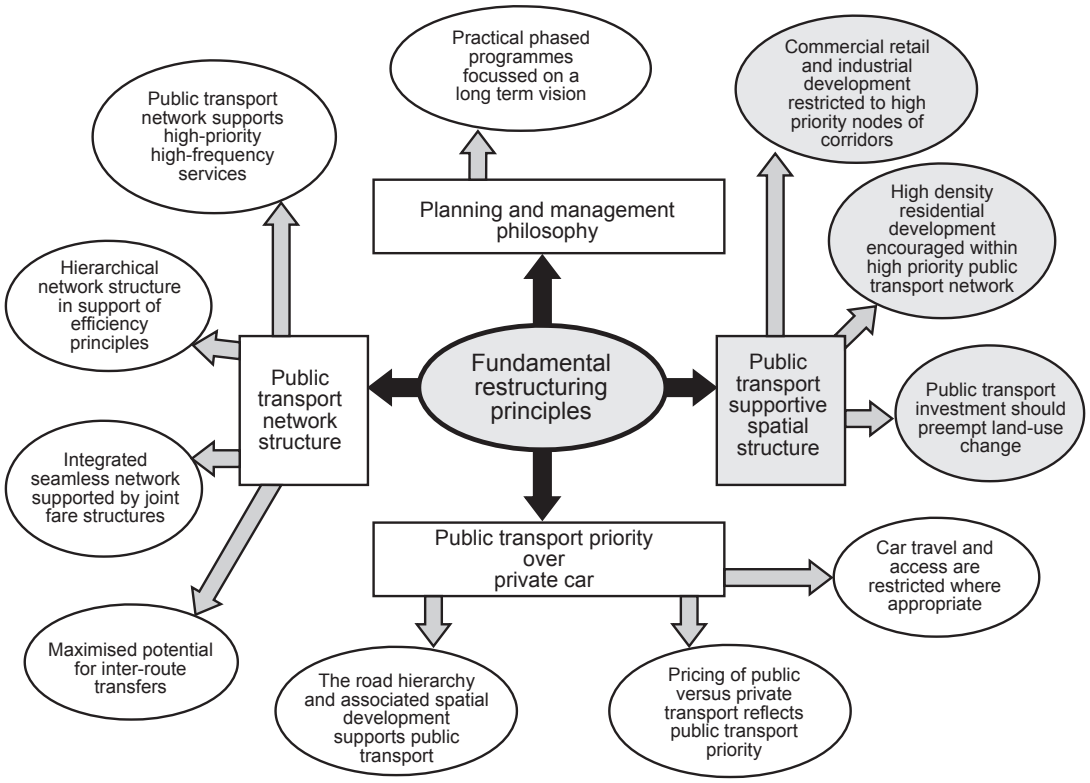


Figure 5.2.2: Principles to achieve the public transport supportive structure necessary for fundamental restructuring
Source: Shaw (1998)

generators of demand for public transport. For this reason it is suggested that potential nodes[4] be identified within or immediately adjacent to township areas. Under ideal circumstances, employment and amenity-related growth should be located at these potential nodes. It must, however, be recognised that developers may be resistant to considering investing in such nodes, thereby constraining the ability to develop efficient bidirectional ridership patterns. The settlement plan should make space available for the relevant nodes to develop, even though there may be resistance to invest at the outset.

- *High-density residential development should be encouraged within the priority high-frequency public transport corridor structure*

  Settlement planners need to understand that higher-density residential development should be encouraged on unused or under-utilised land within the corridor structure of the high-priority public transport network. While it is recognised that the current South African housing delivery process does not encourage high-density development, one of the most significant future challenges to settlement planners will be to find delivery mechanisms and design solutions that promote higher-density residential development as a support mechanism for more efficient public transport. This should apply particularly to the areas adjacent to high-frequency public transport corridors and to nodes within all types of public transport corridor.

- *Public transport priority and infrastructure investment should pre-empt initiatives with respect to land-use*

  In the urban areas of the future, as the primary and feeder public transport route network is developed there will be a need for flexibility in the network within settlements to enable lesser traffic routes to be upgraded as demand increases. This is not to say that large reserves need to be set aside to accommodate possible future public transport, but that the internal circulation or movement system should be designed so that ultimately road-based services can be provided with stops at 800 to 1000 m intervals, with each of the stops having nodality and good access to the surrounding settlement for pedestrians.

- *The road hierarchy, and the association between this hierarchy and spatial development, should support public transport*

  Settlement planners should be cognisant of the negative aspects of creating car-orientated "closed" road networks which are designed to inhibit through-traffic. Provision must be made for the penetration of neighbourhoods by public transport. The road hierarchy should promote direct public transport routing and, where necessary, public transport priority, and encourage suitable pedestrian access to surrounding land uses. Small residential cells may be designed as "closed" networks, providing that cycle and pedestrian through-movement is facilitated (for details see Sub-chapter 5.1).

  In considering the public transport routes through or adjacent to a settlement, settlement planners are reminded to give consideration to the current and proposed future function of the route, whether a primary public transport corridor or a feeder corridor. There is a need to separate the primary public transport route from the private car-based arterial road network, and vice versa. Public transport priority and a public transport supportive road hierarchy are essential to the success of the promotion of high levels of service for public transport. Unfortunately, attempts to give priority to public transport over a considerable portion of the road network are unworkable because of the extensive coverage which would be needed. It would only be possible where there was really significant demand for public transport. However, areas of the network offering the highest accessibility need to be transferred from mixed-traffic conditions to dedicated rights-of-way for public transport.

  If there is to be a priority node and/or corridor within a settlement, the planner should note the need to make a distinction between the core and the frame of the high-priority node. The core should be identified as the area of the greatest pedestrian activity. Parking should be omitted from the core in favour of dedicated pedestrian activities. Parking facilities may be provided within the frame of a node.

  One of the most significant components of settlement planning in support of public transport in the future will be decentralised nodes. The planners of new settlements need to ensure that nodes with large commercial floor space should not be provided in areas not served by public transport.

[4] A potential node is a point in a public transport network where the public transport movement is concentrated and transfers from one travel mode to another take place, providing conditions conducive for local economic development, based on the traffic at the node.

Thus a settlement unconnected to the primary or feeder network through nodes should not be developed as a decentralised activity centre.

- *The pricing of public versus private transport should reflect public transport priority*

  Settlement planners need to recognise that a targeted approach towards the management of both accessibility and the associated form of the public transport is needed. A key element in the future management of accessibility in building South African cities will be to move away from an approach in which infrastructure improvements are commissioned to relieve congestion, irrespective of location. In future, infrastructure improvements should be based on the enhancement of accessibility, particularly by public transport.

- *Restrict car travel and access under appropriate circumstances*

  Settlement planners should restrict motor vehicle access within CBDs and other nodes. Along high-priority public transport routes the access of pedestrians to fronting properties should be promoted, whereas vehicle access should restricted.

The Phase One report of the Department of Transport's fundamental restructuring project contains an assessment of four alternative city forms with associated public transport network structures. The results, highlighted in Figure 5.2.3 provide settlement planners with an overview of the impact of different city forms on passenger-volume conditions, average transfers per trip, trips per capita and the directional mix of traffic. Settlement planners should, therefore, take pains to understand the network to which the settlement is to be attached.

PUBLIC TRANSPORT OBJECTIVES

The following objectives should be applied to give effect to the principles outlined in the preceding section, and to ensure that the settlement is conducive to the provision of efficient and convenient public transport:

- providing for an urban structure of walkable neighbourhoods clustered together to form towns and cities of compatibly mixed uses, in order to reduce car dependence for access to activities;

- ensuring that walkable neighbourhoods and access

Example of four public transport network concepts

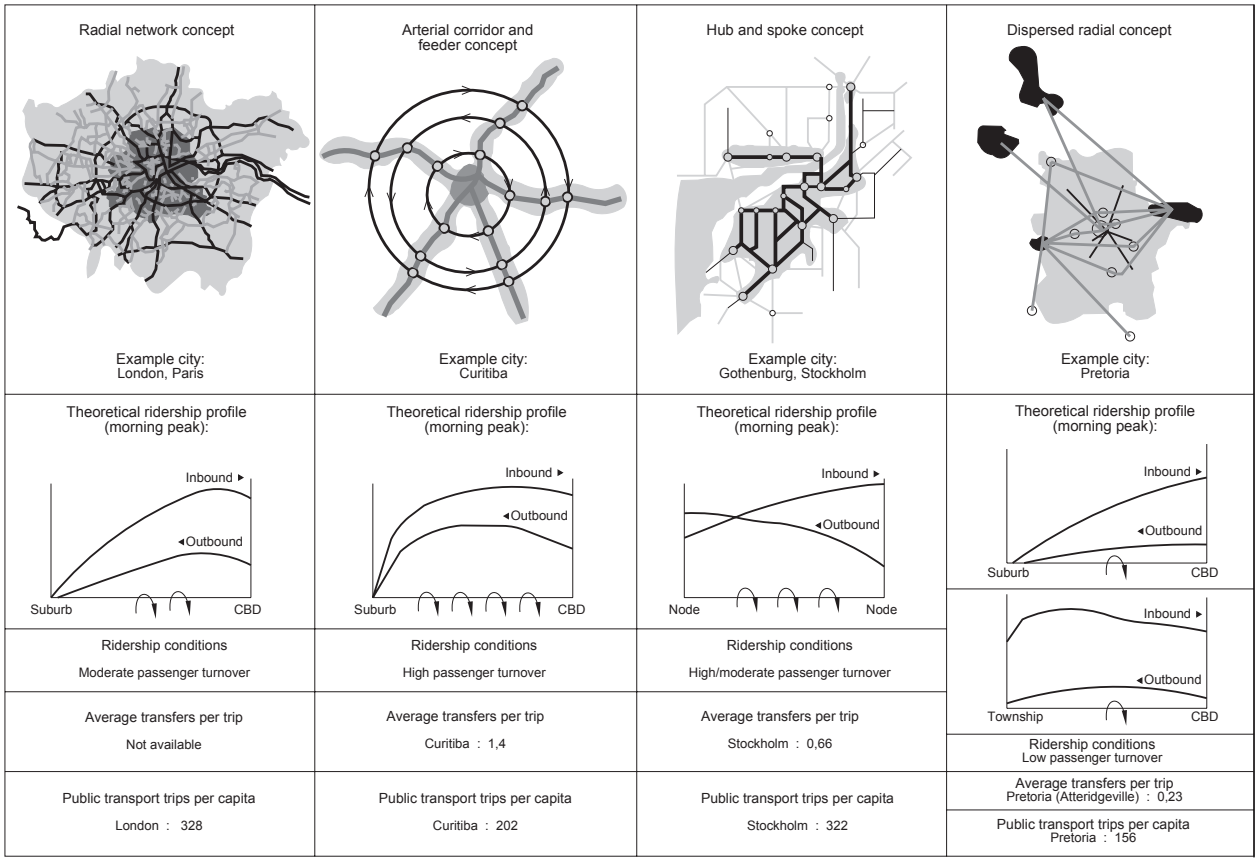


Figure 5.2.3: Example of four public transport network concepts
Source: Shaw (1998)

to services and facilities are designed for all users, including those with disabilities;

- facilitating development that supports the efficiency of public transport systems, with safe and direct access; and

- providing a variety of plot sizes and housing types to cater for the diverse housing needs of urban dwellers at densities that can support the provision of viable public transport.

The design and layout of a settlement can have a profound influence on its sustainability. A number of objectives need to be pursued which will contribute towards creating living environments that are more affordable for residents. The design should

- reduce dependence on cars by encouraging walking, cycling and the use of public transport; and

- give access to facilities for all users of the environment, and provide opportunities for locally based business and employment.

As a global phenomenon, recent neighbourhood design concepts have been given titles such as "transit-oriented design" (TOD), "traditional neighbourhood design" (TND), "green-house neighbourhoods" and "urban villages". In each case the underlying objective is to create neighbourhoods which reduce dependency on private vehicles and are more energy-efficient.

GUIDELINES FOR PUBLIC TRANSPORT SUPPORTIVE SETTLEMENTS

Planning settlements that are accessible to public transport

The process of planning for public transport includes site and contextual analysis, right down to the details of street alignment and form, plot sizes and shapes. The "coat-hanger" around which the settlement should develop is the public transport network. This should be supported by a movement network which should, as a priority, facilitate multi-directional pedestrian movement, focused on a highly accessible public transport system.

In respect of the public transport component of settlement-planning, the planning should take account of and address the following questions:

- How big is the settlement, how will it be developed and at what density?

- Where is the settlement, relative to the main activities in the urban area in which it is situated?

- Where is the settlement located relative to existing public transport, either rail- or road-based?

- How will the settlement be connected to the existing public transport network, whether road or rail or both?

- Will the settlement be sufficiently large for the main public transport line-haul system to be extended through it, or will it be located to one side of the major public transport route, or at some distance from the corridor, requiring a feeder public transport service?

- What will be the likely demand for public transport generated by the settlement?

- Where will the main access to public transport be within the settlement?

- What will be the spacing of public transport stops in the settlement?

- How can the settlement be planned so that the movement system provides the maximum access to public transport?

- What is the relationship between the movement system for the settlement and the proposed public transport services?

Obviously, these and other questions will inform the planner with regard to the integration of the movement and public transport networks. Specific guidelines on the site and contextual analysis, as they relate specifically to public transport, are provided in the following section.

Contextualisation and connection

This should be undertaken at an early stage to identify opportunities and constraints presented by the site. The processes take into account all constraints - such as open space, topography and servitudes - and include an analysis of the regional structure and neighbourhood form in existing surrounding areas. Of relevance to the public transport planning is the following:

On a map (as exemplified in Figure 5.2.4), and where relevant, quantify the following information:

- existing and planned neighbourhoods, towns and regional centres;

- other significant features such as regional parks;

- freeways, arterial roads, public transport routes, bus stops and rail stations; and

- the location of rail stations.

Map, describe and where relevant, analyse, the following information:

- servitudes and street reserves;
- linkage to and from the site;
- distance and direction to public transport infrastructure; and
- distance and direction to local shops and schools.

The foregoing context and site analysis applies only to public transport. Obviously there are other contextual and site-analysis factors which need to be taken into account by settlement planners, including topography, drainage, vegetation, etc.

Figure 5.2.4 exemplifies the concepts of contextualisation and connection. It shows the site and the spatial relationship between the site and existing urban development, indicating the location of the main transport infrastructure, existing and future roads and road reserves and future developments of

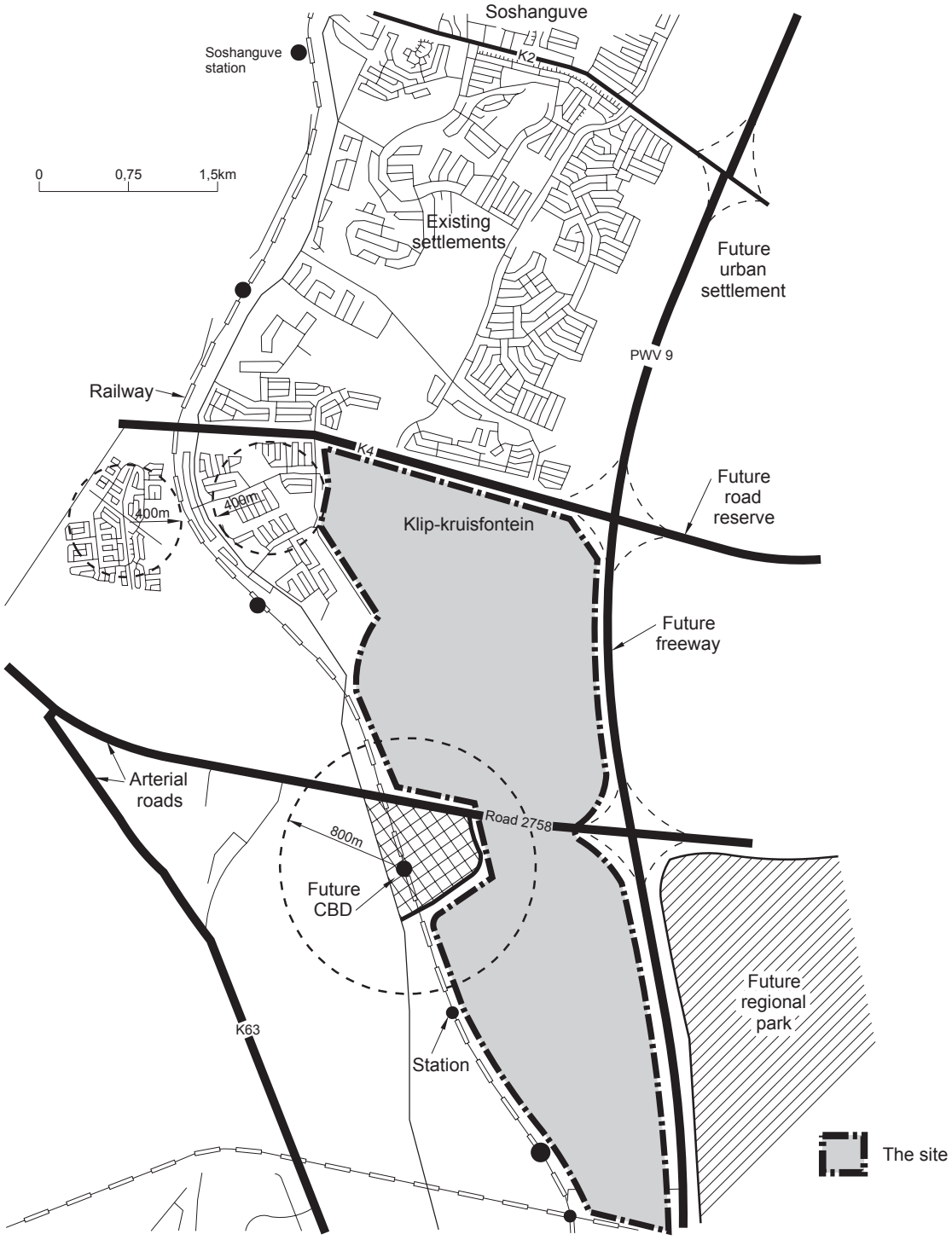


Figure 5.2.4: Context and site analysis map

regional significance, such as a future CBD and rail station and a future regional park. This example is superimposed on an actual settlement, but the elements (such as the proposed future regional park) are hypothetical. The figure illustrates some of the site conditions that will influence the movement and public transport network. Topography and the influence of slope are not shown, but the planner is cautioned to note the importance of topography to the public transport movement system (see Sub-chapter 5.1). It is obvious from this context and site analysis how the site needs to be developed to tie in with the existing settlement and infrastructure. The freeway shown in the figure represents a constraint on the development of the site. This constraint would require settlement planners to negotiate with road and/or transport authorities, to provide measures to eliminate severance and to help minimise the environmental impact of the freeway on the development of the settlement. In this instance, settlement planners should persuade road authorities to provide freeway bridges or underpasses to link the communities on either side of the freeway. In the situation depicted in the figure, the entire layout and settlement plan will be influenced by the number and type of movement connections which the road authority may be willing to provide. Different circumstances will prevail, and there may be cases where the local authority or transport authority will require the site developer to pay for providing linkages. This decision usually hinges on the stage of the planning of the future freeway.

Public transport framework

Planning information requirements should address - but not be limited to - the following matters:

- the contents of the Integrated Transport Plan, including policy statements on the public transport network, rail concessions, bus contracts, minibus initiatives and public transport infrastructure;
- public transport demand (the origins and destinations of trips) the placement of bus routes, proposed bus stop locations (including calculations of walkable catchments served within a 400 metre radius);
- all existing/proposed rail station locations (including calculations of walkable catchments served within an 800 m radius;
- provision for pedestrians and the disabled;
- an actual or potential cycle network plan;
- layouts to facilitate effective traffic management around schools and to facilitate safe access to schools;
- traffic management in and around proposed activity centres;
- measures to control traffic speed; and
- proposed intersection controls, including priority systems signalled by the use of a clear movement hierarchy.

Guidance on the technique to use walkable catchments as the basis for accessibility planning and calculating catchments is listed in Appendix A. Examples of processes for restructuring public transport demand for different settlement types and market segments are provided in Appendix B.

An example of the recommended process for the development of settlements supportive of public transport is illustrated in Figure 5.2.5.

In consulting with transport authorities to ascertain future proposals in respect of road and rail infrastructure, as well as public transport services, the planner is cautioned to note that, in some cases, the settlement should influence and modify planned transport facilities. Some hard-nosed negotiation may be necessary. A hypothetical public transport framework is illustrated in Figure 5.2.5.

It will be noted from Figure 5.2.5 that the main public transport corridor is to be found to the west of the settlement and comprises a commuter railway line, which provides for long distance movement, and a "road-based" activity spine within the corridor, to provide for regional movement between stations and between different districts of the urban area. In this case, the location of the road-based activity spine may be questioned because it duplicates and competes with the rail service. An alternative location further to the east and bisecting the settlement may be preferable, to provide a viable threshold for the road-based public transport service. The regional, road-based "activity spine" needs to be well connected to the rail at interchanges and stations. The figure depicts a future station at the centre of a proposed future central business area. Such a station should be served by feeder road-based public transport in which case there will be a need to plan for a public transport, interchange to facilitate this process. Although not part of the settlement plan, the station and the public transport interchange will exert a strong influence over the road alignments in the settlement, as depicted in the figure. The technique of using 800 m catchments around stations, and 400 m catchments around bus stops, has been used to provide the structuring elements or transport framework for the settlement. The figure shows the activity nodes in the centre of the public transport catchments, which are the focal points on the feeder routes and should be spaced at 800 m intervals. Such a design will provide for flexibility, even if feeder routes are not initially

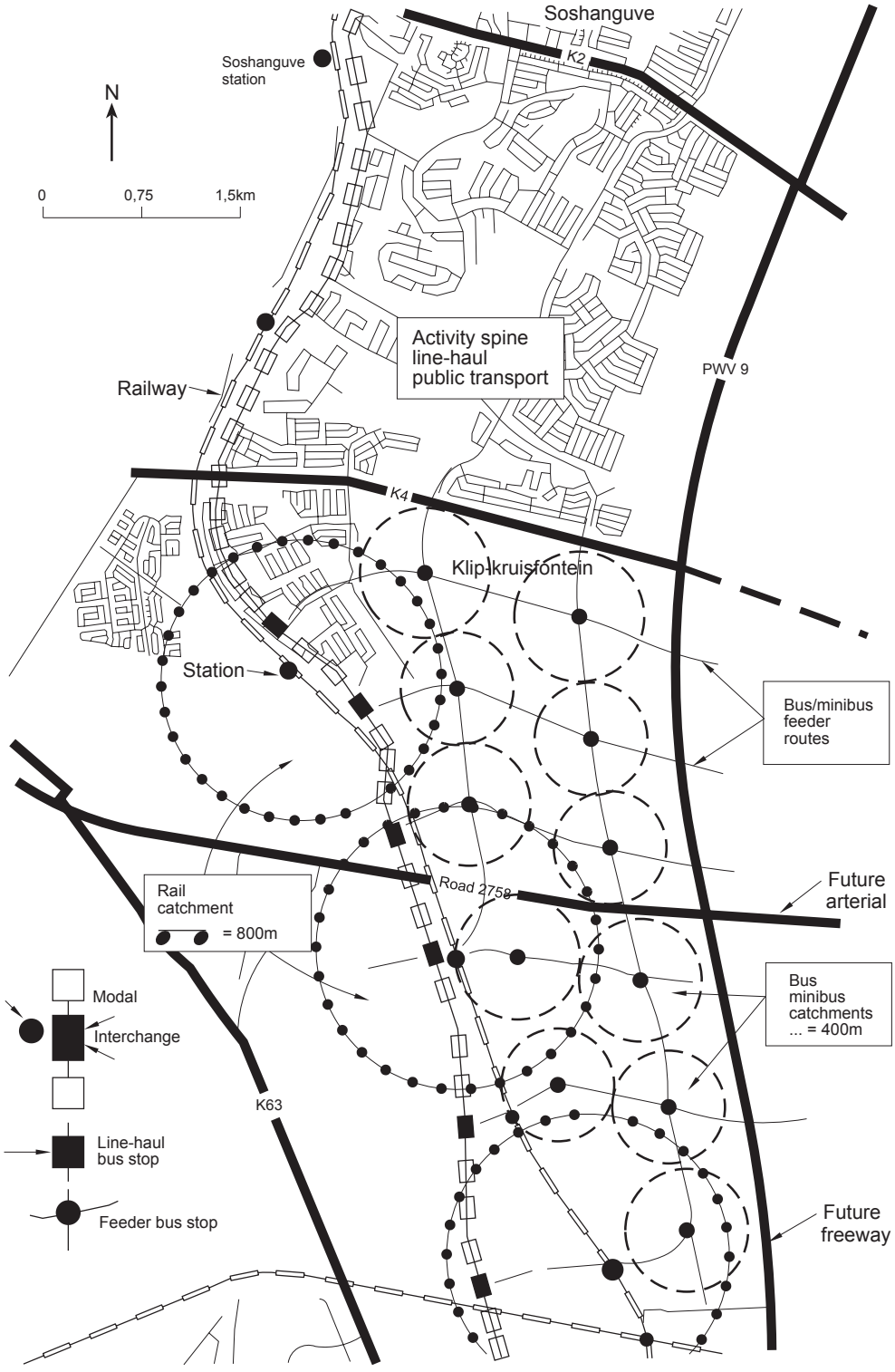


Figure 5.2.5: A transport framework for settlement planning

provided in both directions. For example, the bus stop spacing could initially be lower on the activity spine, with all feeder routes from the settlement feeding into the public transport interchanges, associated with rail stations rather than into stops at 800 m intervals on the activity spine as indicated in the figure.

It is important that flexibility should be provided in the design. It will be noted that the transport framework has made provision for the freeway to be crossed at around one kilometre intervals. This is an important principle and standard which should be adhered to in urban areas in order to minimise severance and the environmental impact of freeways.

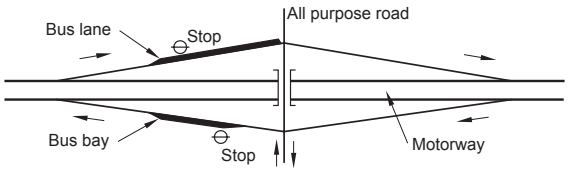
Integration of public transport and movement networks

When designing a movement network in support of the public transport network, the different patterns of movement of buses, freight vehicles, cars, bicycles and pedestrians should be borne in mind (the reader should refer to Sub-chapter 5.1 for guidance on movement networks). Typically, cars and goods vehicles seek to make direct journeys at the highest possible speed. The aim should therefore be to get these vehicles from a neighbourhood to a through-route as quickly as possible. Buses and minibuses, on the other hand, are required to serve passengers and to offer an attractive and convenient alternative to car travel. Buses should be able to proceed directly through the centre of neighbourhoods, picking up and setting down passengers as close as possible to their origins and destinations.

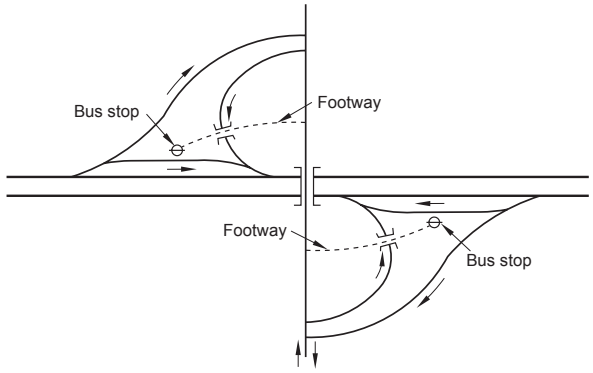
Buses and minibuses normally travel along public roads shared with other traffic. Such roads are usually classified by traffic engineers within a functional road hierarchy. Bus operations can be expected to be found on many of the strata. Accordingly, settlement planners should provide public transport networks on roads on which the traffic functions and characteristics of the road are harmonised with the moderate speed, mixed-traffic and pedestrian-crossing requirements of such a facility. Guidance on public transport in relation to the road hierarchy is provided below:

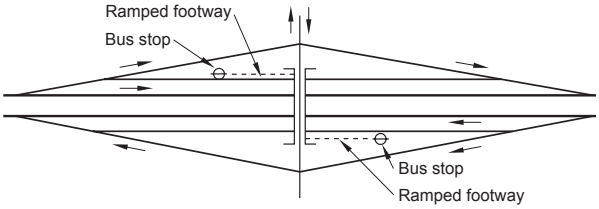
- *Major arterials*. The arterial network in intended to accommodate major traffic movements and to link the major districts of towns and cities. "mobility" routes, which have a limited number of interchanges or intersections and a large degree of access control to fronting properties. Major arterial roads such as urban freeways and dual carriageways are not suitable for bus services and should only be used for limited-stop and express services. In the case of limited stop and express services operating on freeways, stopping places may be provided as indicated in Figure 5.2.6.

- *Minor arterials*. Minor arterials feed traffic from the major arterials into and from the main urban districts and provide the linkage between them. These are generally the ideal roads for line-haul bus and minibus taxi movement. While there are usually some restrictions on frontage access and restraints on street parking on this type of road, particularly during peak hours, the standard of intersection spacing tends to be lower and there is considerable cross-traffic and pedestrian movement, and there are many pedestrian footways at the roadside. The amount of interaction and cross-traffic produces a reduced speed differential between buses and other traffic, meaning that buses can stop at the kerb without causing undue delay or danger for other road users. Bus lay-bys should, however, be provided, and in congested areas on this type of roadway priority lanes should be provided for road-based public transport.

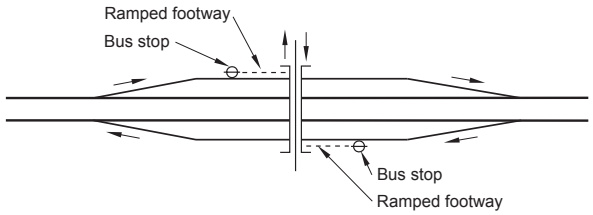


(1) Bus stops on interchange slip roads (for services entering or leaving an urban motorway)





(2) Bus stops for through services at an interchange



(3) Bus slip roads and stops at points between interchange

Figure 5.2.6: Location of bus stops on major arterial roads of freeway standard
Source: Greater Glasgow PTE (1973)

- *Collectors*. Collector roads are the link between the urban main road system (arterials) and neighbourhoods. These should penetrate the neighbourhoods and, together with minor arterials, are the appropriate level in the road hierarchy upon which public transport services, particularly feeder services, should be provided.

  The majority of stopping bus and minibus feeder services will be found along the collector type of

road, which should preferably be at least 7,3 m wide. Widths in excess of this tend to encourage higher speeds which are not desirable on mixed-traffic facilities.

- *Activity streets.* Hitherto, such streets have not formed part of the urban road hierarchy and have not been planned, but have evolved. They are streets that experience mixed traffic and intense fronting land use activity. Many activity streets start life as high-mobility arterials but, because of their high accessibility, become congested and attract commercial land use. Access-seeking traffic begins to predominate over through-traffic. Activity streets are the ideal locus of road-based public transport services. Settlement planners should provide layouts and land-use plans which facilitate the emergence of "activity streets" as the basis of public transport corridors. The scale, geometric characteristics and dimensions of an "activity street" cannot be specified prescriptively. An activity street could vary from collector-road scale, with a narrow cross-section, typical of a European village "high street" to a minor arterial in a generous cross-section. Typically, there should be interaction between one side of the street and the other, with much pedestrian crossing, so the scale of the street should be modest.

- *Local (access) streets.* Public transport should be precluded from using this type of street, which should be designed to facilitate mixed traffic within neighbourhoods in safety and at low speed.

The specifics of the design and layout of the road and movement networks are dealt with in section 5.1.

The following section provides some additional guidelines in respect of the local road and movement networks in relation to public transport. Figure 5.2.7 shows a public transport feeder route bisecting a neighbourhood unit with a radius of 400 m. The centre, or point of highest accessibility, is the point at which public transport services will be provided. It is evident from the layout that, because of the open road network, public transport is highly accessible along the public transport route. The figure also indicates that, ideally, higher-density mixed land-use should be provided adjacent to the route. It also shows that service roads can be provided for access to fronting shops.

Figure 5.2.8 shows a variation of the same network to illustrate the point that intensive neighbourhood activity should be located at the centre or most accessible part of the neighbourhood, whereas more extensive activity, some of which may have an inter-neighbourhood function, may be located further away at the periphery, but will still be accessible on foot, to residents in the neighbourhood. An example of the latter is a primary school.

Figure 5.2.9 shows a "closed" street network which is characteristic of residential networks provided in the recent past. This type of network is a "car-oriented network" in that pedestrian movement is channelled along the streets and the only access to the central

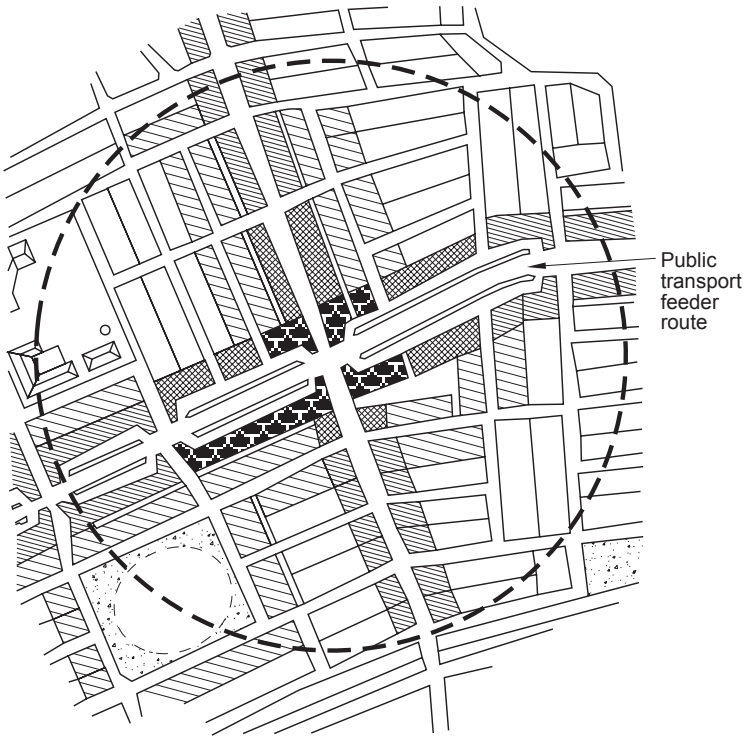


Figure 5.2.7: A public transport feeder route in an open network
Source: WAPC (1997)

"public transport road" is the intersection at the centre of the figure. It is evident that such a layout will be inconvenient to pedestrians, particularly those trying to access the central road from the closed loops.

The "closed" network depicted in Figure 5.2.9 can be modified to facilitate pedestrian access to the central public transport feeder routes at appropriate points, while retaining the closed road network which precludes through traffic (see Figure 5.2.10). This is by means of mid-block pedestrian or cycle gates placed at strategic locations on the facility. The figure also shows bus lay-bys provided in a widened reserve at the most accessible point. Such "closed" street networks may be desired by some communities as an impediment to vehicle-based through traffic, and to preserve the security and or environmental benefits of closed networks. Settlement planners should, however, bear in mind that open networks designed with appropriately scaled reserves and narrow roads tend to inhibit through movement and have greater flexibility. Through traffic tends to be curtailed where space for parking is limited and the streets are designed to facilitate pedestrian movement, street parking and slow vehicle movement.

The foregoing examples provide some guidance as to how the public transport framework interfaces with the neighbourhood movement and street networks.

Figure 5.2.8: A public transport feeder route in relation to neighbourhood activities
Source: WAPC (1997)

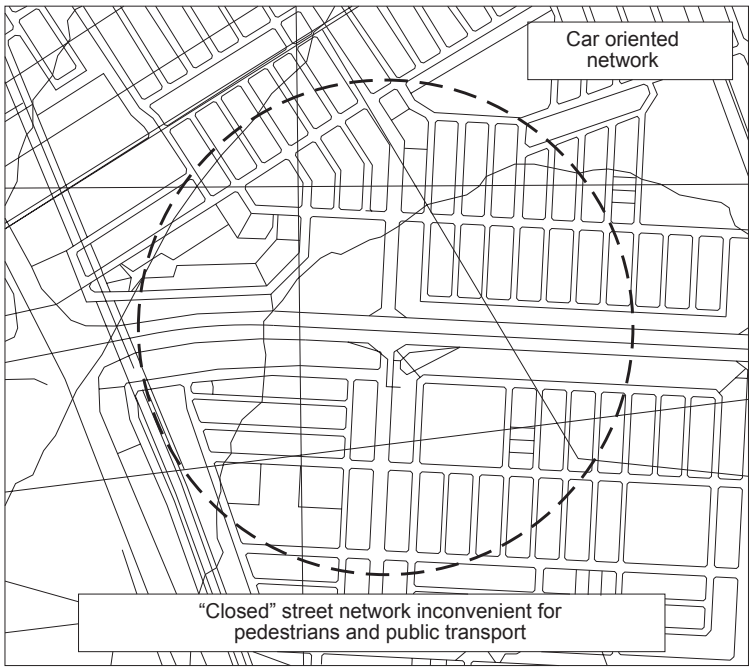


Figure 5.2.9: Car-oriented network

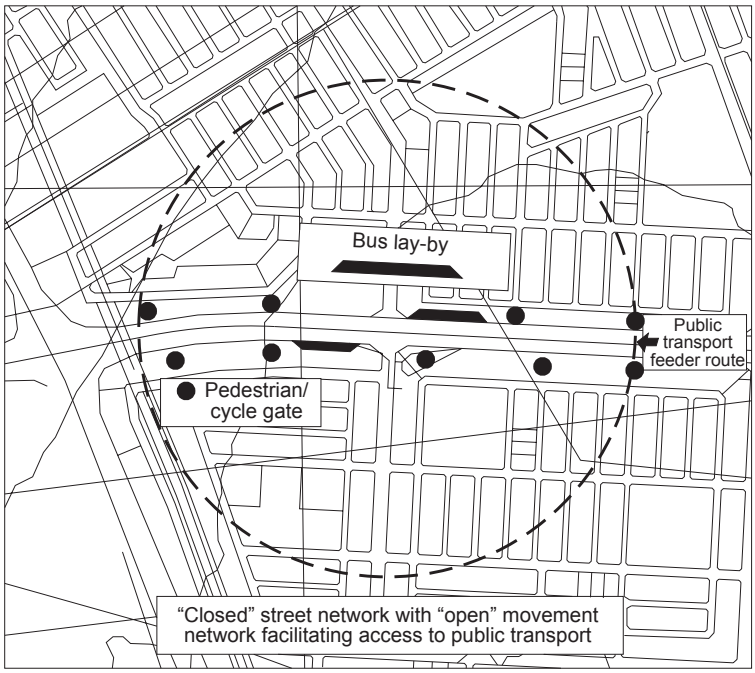


Figure 5.2.10: Modification of a closed road network to provide an open movement network

Integration of land use and public transport

Land-use elements

To attract customers to public transport, planners need to understand the influence of land use and urban design on travel behaviour. As indicated in the previous section, better integration of land use and public transport is possible when public transport considerations are included in settlement planning. Municipalities have the legal authority and regulatory instruments to enforce urban development that is supportive of public transport. In terms of integrated development plans, it is important that development proposals should be reviewed in the light of traffic generation, potential public transport ridership, and ease of operation for public transport. This section of the guidelines describes what public transport-oriented land development means in terms of urban structure, road networks and design standards which are favourable to public transport. Changes to by-laws and regulations governing land development should be contemplated by all municipalities as part of their integrated development plans.

Figure 5.2.11 shows some typical land-use proposals which would be supportive of public transport. At the centre of the public transport catchments are cross-roads on the public transport network. These roads may be mixed-traffic minor arterials and/or collector roads linked to the arterial road system. They are focused on accessible activity nodes at the centre of the neighbourhoods, based on a 400 m walking distance for residents. The activity nodes will largely attract neighbourhood retail and community facilities but will also be the location of bus stops. The figure also shows that, particularly on the most significant public transport route leading to the proposed future central business district, mixed high-density land uses may be planned to support public transport, and in some circumstances, trading activity may be encouraged. The figure shows how the feeder routes converge on the major nodes. The central node should combine central place activity, retail, office and service functions, as well as a modal interchange. It is evident that the central area should be highly accessible by road-based public transport.

It should be noted that the street network within the major public transport corridor is an existing street network, which may be incompatible with the principles being propounded in this guideline. It is inevitable that, as major public transport corridors evolve in urban areas, there may be a need for redevelopment to encourage higher intensity land uses in support of the activity in the corridor. Activity nodes are likely to develop at accessible points in the corridor, as indicated in the figure.

Factors contributing to viable and sustainable public transport

There has been extensive research to demonstrate that the features of public transport-friendly urban design include development density, the land-use mix, the configuration of the urban road network and the design of movement or circulation systems which accommodate both pedestrians and public transport vehicles. Throughout this guide reference has been made to settlement planners, but it is increasingly realised that urban settlements should be the product of multi-disciplinary work involving landscape architects, architects, urban planners and designers as well as traffic and transport engineers. Greater effort is required to design streets from a holistic perspective, as advocated in this guideline, taking account of all forms of movement, including bicycles, pedestrians, cars, and public transport.

It is important to remember that the use of public transport involves pedestrian movements at either end of the public transport trip. An unpleasant pedestrian experience will inhibit growth in public transport patronage. Accordingly, very important factors in promoting public transport are perceived proximity to the boarding point of public transport, walking distance to the final destination, the overall street and site designs, pedestrian facilities, and amenities on the sidewalks.

Development density

The two aspects of settlement density which are important to public transport are the location of dense or less dense settlements, relative to public transport services, and continuous density along a public transport route.

In general, as residential and employment densities increase, so do the number of passengers per kilometre along the route also increase, justifying more frequent or higher levels of public transport service. This helps to make public transport much more attractive.

At metropolitan or city-wide scale, it is important that settlements should be continuous; that is, they should not be permitted to "leap-frog" agricultural land or parkland, as was formerly the case with the lower-income dormitory settlements in South Africa. Municipalities affected by discontinuous developments will experience higher costs per capita for infrastructure such as roads and sewers. This will also apply to public transport services. In settlement planning, the costs of new public

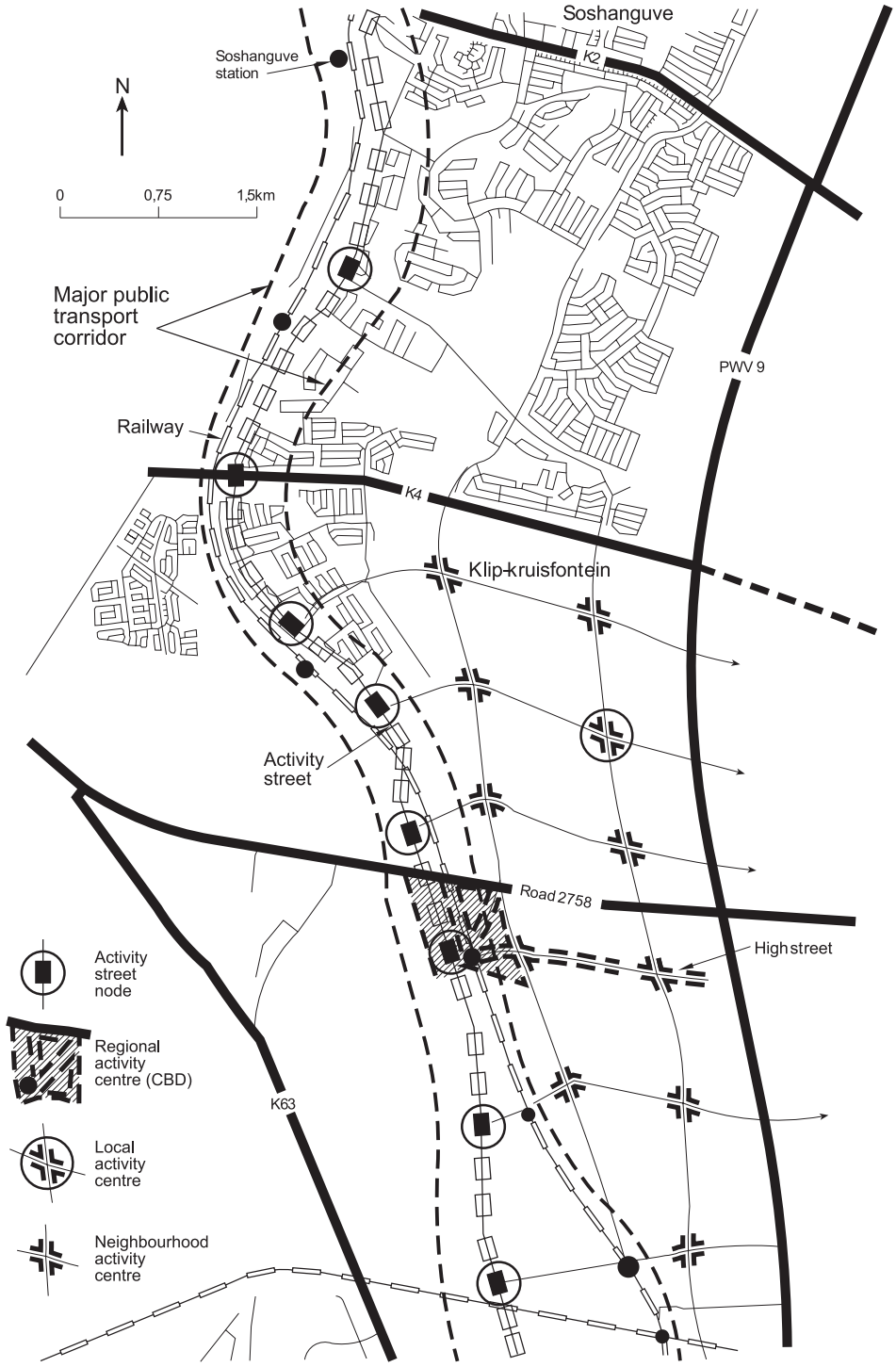


Figure 5.2.11: Land-use elements in relation to the transport framework

transport services should also be factored into the assessment of the municipal infrastructure required for the settlement.

Relationship between density and the location of employment

Future settlement planning should take cognisance of the need to develop balanced communities containing employment activities within the community. The settlement should seek to cluster businesses and employment activities into a few areas of significant development, to help create the critical mass which public transport requires to serve areas cost-effectively. Scattered travel patterns should be avoided so that public transport reflects movement towards a single centre. Empirical research has found that public transport ridership increases markedly when a threshold of one employer per 100 m^2, in a centre with more than 10 000 jobs, is attained. Public transport is therefore heavily influenced by the critical mass of employees, but also by the availability of free parking. Where parking is restricted, public

transport ridership is also enhanced. One of the most serious impediments to the use of public transport in urban areas is the decentralised suburban "business park". Settlement planners must be cognisant of the detrimental effects of such land uses on public transport, and ensure that employment is centred within public transport corridors.

There are two factors that discourage the use of public transport in office or business parks; namely, there is little incentive for employees to consider using public transport when there is free parking, and office parks are usually located some distance from existing public transport services.

Relationship between public transport and residential density

For public transport to be feasible a minimum threshold population is necessary. However, because of the variety of residential market segments in South Africa and the relationship between residential and employment activities, it has not been easy to establish minimum thresholds for residential density. In lieu of clear thresholds and guidelines it is advisable for settlement planners to take note of relationships established abroad. For example, Table 5.2.1 shows public transport services related to residential density as a result of empirical studies in North America. According to Pushkarev and Zupan (1997) the desired threshold for dwelling densities per hectare is around 10 for hourly local bus services, rising to around 40 dwellings per hectare for very frequent public transport services at intervals of less than 10 minutes.

Mixed land use and public transport

Mixing land uses means combining commercial and other uses of various types - for example permitting personal services and restaurants to be located near industry or commerce. Residential settlements should include convenient services within walking distance. The opportunity to walk to and from bus stops and accomplish errands conveniently is a further motivation to use public transport rather than to drive. The central or focal points within any neighbourhood which form part of a settlement should comprise the non-residential land uses such as convenience stores, retail shops, parks, schools and other amenities. The mix of land uses in close proximity to a neighbourhood centre will enable people to accomplish several trip purposes, often by walking. Current zoning often requires strict land-use segregation, resulting in large distances between different activities, increasing single-purpose trips. This can be discouraged by settlement planners who provide conditions conductive to the use of public transport.

Providing for buses, minibuses and bus stops

Alignment of public transport routes

Public transport routes should be planned to follow a reasonably fast and direct itinerary passing as close as possible to the centres of neighbourhoods served by the route. Circular routes should be avoided. Streets used as bus/minibus routes should have a maximum gradient of 1 in 15 (6,7%). Where warranted by demand for public transport, parallel bus routes outside town centres should not be less than about 800 m apart, in order to provide each route with a reasonable catchment area.

Planning to facilitate bus services in new settlements

Settlement planners should take into consideration the fact that areas of intense

Table 5.2.1: The relationship between public transport services and residential density

TYPE OF PUBLIC TRANSPORT SERVICE	GROSS RESIDENTIAL DENSITY (DWELLINGS/ha)
Frequent Service (5-10 minute service intervals)	37
Frequent bus service with some express routes (15 minute intervals)	22
Local bus (daytime 30 minute intervals and extended services at 60 minute intervals)	17
Local bus (daytime 60 minutes intervals)	10

Source: Pushkarev and Zupan (1977)

pedestrian activity such as health clinics, old age homes, schools and bus centres are best located with ready access to the public transport services. As noted elsewhere in this guide, the walking distance to the nearest bus stop should not be more than 400 m from the furthest house. High-density housing developments should be situated closer to the roads along which buses will operate. Development to a depth of at least 200 m on both sides of bus routes is desirable.

Settlement planners should ensure that proper facilities for buses and minibuses are provided from the outset. The following principles need to be borne in mind:

- roads, which may be used as bus or minibus routes, should connect activity centres directly and be suitable as regards width, alignment and construction;
- corner radii should take into account the fact that buses have a large swept turning circle (in the order of 20 to 25 m in diameter);
- bus bays and turning areas should be provided as appropriate (see Figure 5.2.12);
- the minimum width of road for bus operations in new developments should be 7,3 m, or 9 m where there are more than 30 buses per hour using the road; and
- where possible, bus services should have balanced traffic in both directions at peak time. This can be achieved by having employment areas concentrated at nodes along the main bus corridors.

Figure 5.2.13 shows different road layouts, reflecting the history of planning practice. The grid network found in townships that developed before 1950 provided direct pedestrian access to services, shops and public transport.

Sub-divisions over the last 30 years have tended to focus on the internal neighbourhood structure, with roadways designed to reduce travel speeds and discourage through traffic. This type of layout tended to discourage the use of public transport.

This current guide seeks to provide a compromise or a combination that provides the best of both worlds - namely a movement network that caters for direct pedestrian movement in all directions and a road network which inhibits through traffic. These variations are depicted in Figure 5.2.13.

Factors that encourage pedestrian activity and have a direct impact on the attractiveness of walking to bus stops and waiting for buses include

- barrier-free routes, with crosswalks, overpasses and ramps;

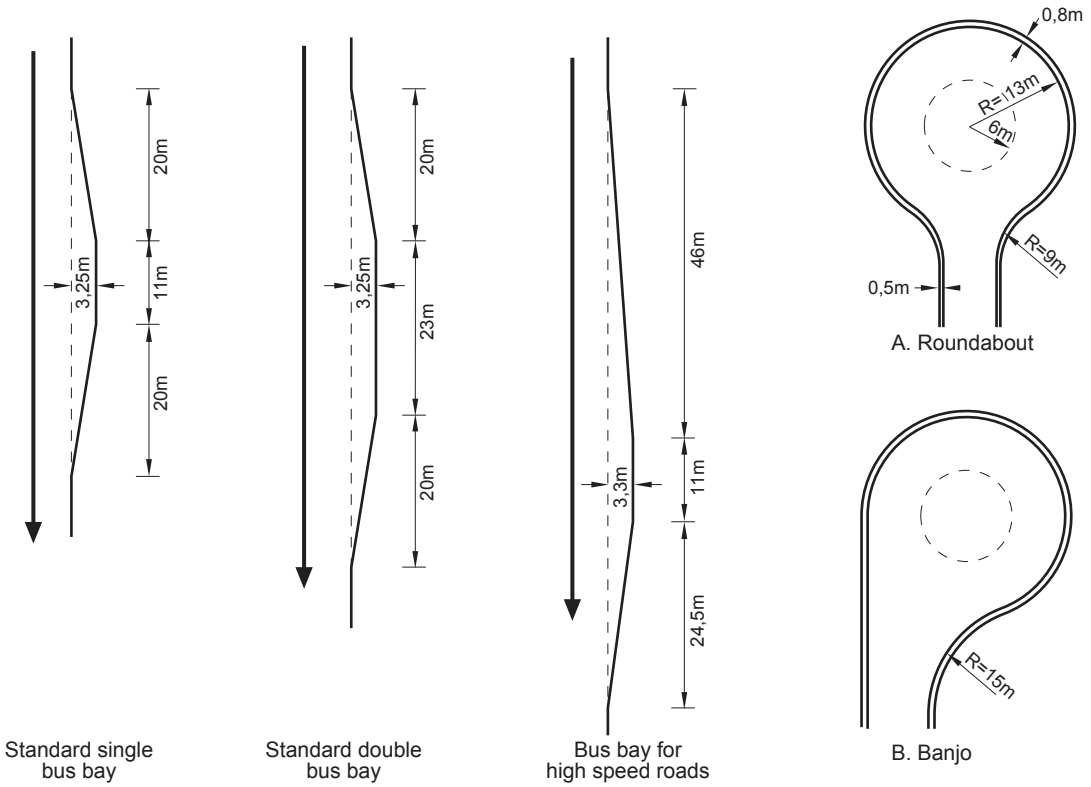


Figure 5.2.12: Dimensions of bus bays and bus turning circles
Source: Greater Glasgow PTE (1973)

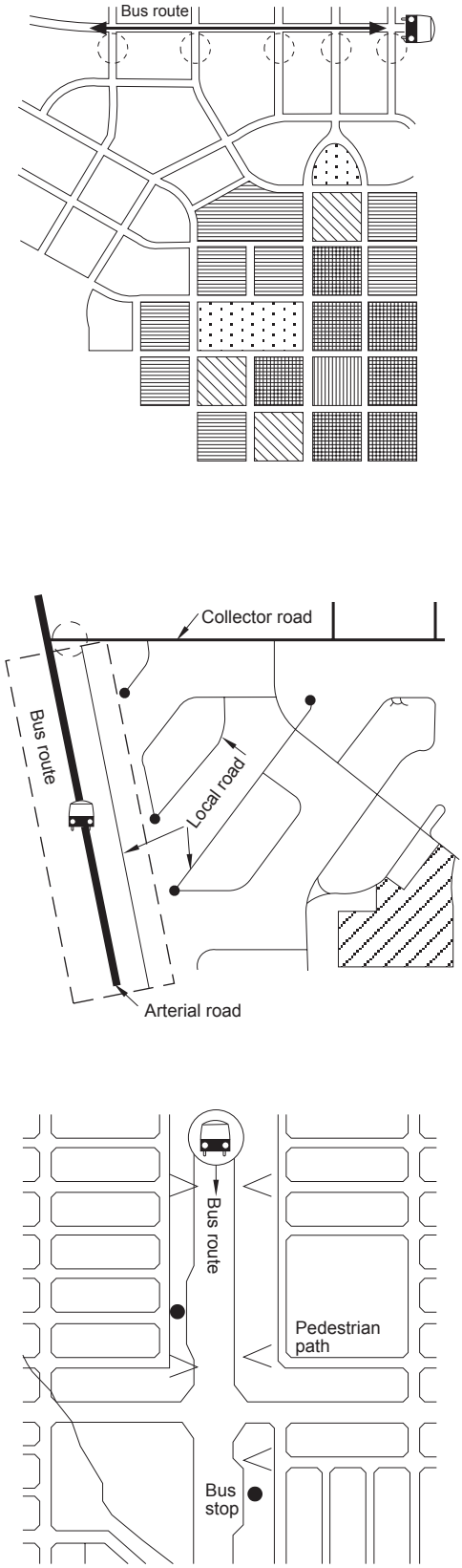


Figure 5.2.13: Road layouts reflecting evolving planning practice
Source: BC Transit (1995)

- good lighting and an environment which is perceived to be safe, because it is overlooked by human activity;
- sidewalks, seating and shelters; and
- pleasant views and other attractions, including landscaping and plantings.

The convenient location of bus stops is significant, and they should be placed relative to building entrances. This aspect is as important to public transport customers as convenient parking is to car users.

Modal choice and relative cost efficiencies for infrastructure and operations

Although this subject is beyond the scope of settlement planners, they should be aware that layout of the movement network and the spatial arrangement of land uses can impact both positively and negatively on public transport. Where modal choice is a consideration, pains should be taken to avoid duplication of public transport infrastructure such as stops and terminals.

The relationship between public transport and commercial sites

Commercial sites in settlements which are supportive of public transport usually face the street and provide easy access for customers approaching by foot rather than by car.

Design features which encourage pedestrian flow include continuous sidewalks, trees and benches, and street furniture that provides a buffer between circulating traffic and the sidewalk. Figure 5.2.14 shows the ideal relationship between a commercial activity site and public transport.

Bus stops

The information that follows applies to both buses and minibuses. The location of bus stops must be planned as part of the movement network at the outset, to achieve the best arrangement. The spacing of bus stops needs to be a compromise between the achievement of as high an operating speed for buses as possible and the placement of stops within an acceptable walking distance of traffic generators, attractors and transfer points. Bus-stop spacing depends on the density of roadside development. Where development is not intense, such as in residential suburbs, stops should be around 800 m apart. In nodal activity centres where there is a high concentration of trip ends, stops should be closer together, with an average separation of around 300 m. If there is more than

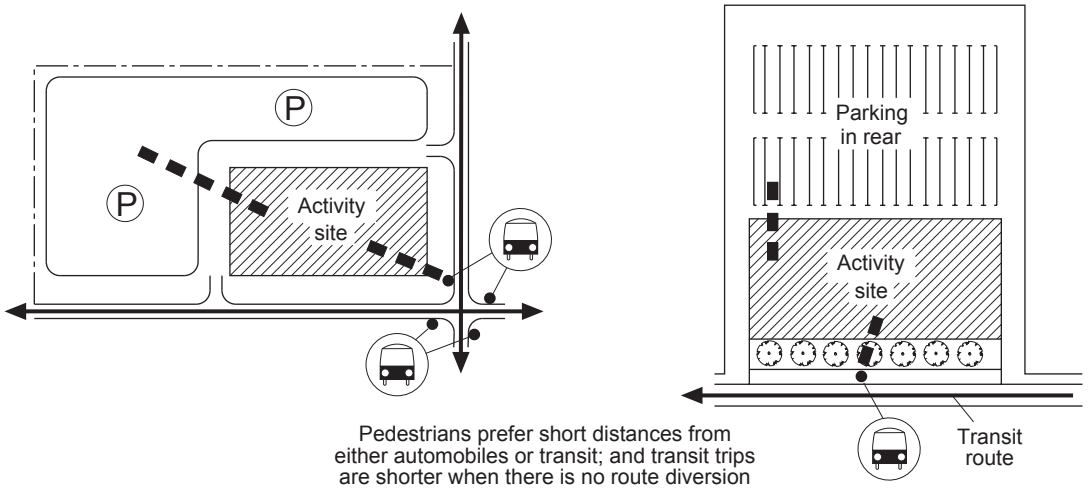


Figure 5.2.14: Relationship between bus stops and a commercial site
Source: BC Transit (1995)

one bus service along a road, transfer is facilitated if all the services use the same stop, providing congestion is avoided.

Bus stops close to railway stations should be arranged to provide the minimum walking distance for transferring passengers. At business centres stops should be sited so that buses deposit passengers at the main frontage of the centres.

For reasons of road safety, bus stops on opposite sides of a single two-way carriageway should be staggered by a least 45 m, so that buses stop tail-to-tail. This dimension may be reduced where lay-bys are provided.

For the convenience of passengers, stops near intersections or junctions should be located as close as possible to the junction consistent with safety. Generally, bus stops should be located at the far side of the junction to minimise interference with left-turning traffic and to maintain traffic-signal efficiency. If public transport is to be promoted, facilities should be provided at bus stops. These include shelters. In siting shelters, care must be taken to maintain adequate sight distance for drivers emerging from side roads. Recommended minimum distances are as follows:

SPEED LIMIT (km/h)	MINIMUM DISTANCE AFTER LEFT TURN (m)
50	23
65	31
80	38

CONCLUSION

If settlement planners are to succeed in providing an environment which is conductive to the use of public transport, the greatest attention to detail should be provided in respect of the development itself and its relationship with surrounding areas. The greatest attention should be provided for pedestrian amenity. Site design features that make public transport more attractive are required but, given the pressures on the road system, it is time to de-emphasise land-use design for the convenience of car users, and refocus towards pedestrian movement and public transport. Public transport-friendly designs can be achieved without detrimental results for car users.

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APPENDIX A

PUBLIC TRANSPORT CATCHMENTS AS THE BASIS FOR NEIGHBOURHOOD PLANNING
Source: Western Australian Planning Commission (1997)

Walkable catchments, when depicted on maps, show the actual area within a five minute walking distance from any centre or bus stop, or ten minutes from any major transport interchange, such as a railway station. The centre should ideally be an activity node for either a neighbourhood or a local community served by public transport. The walkable catchment helps in planning a settlement in such a way that it is easy to evaluate the ability to move through the urban area to access centres.

Walkable catchment calculations are expressed as the actual area within five minutes walking distance, as a percentage of the theoretical area within a five minute walking distance. The theoretical five minute walking distance is shown as a circle with a radius of about 400 metres around a focal points, such as a crossroad. This provides an area of 50 hectares. When calculating a ten minute walking distance, the radius used is about 800 metres, resulting in a circle with an area of 200 hectares (see diagram below). The higher the percentage of actual to theoretical five minute or ten minute walk, the better the "walkability". A good target for a walkable catchment is to have 60 per cent of the area within the stipulated walking distance.

Process for calculating walkable catchments.

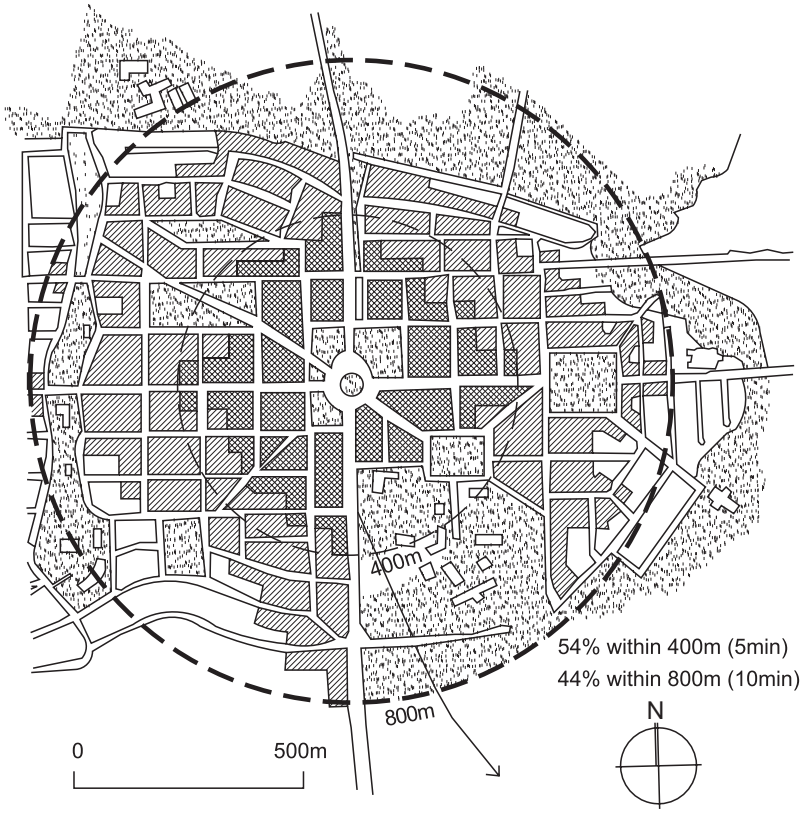
1. On the settlement site map draw circles of 400 metre radius around desired focal points, and 800 metre radius circles around rail stations which are either existing or planned.

2. Starting from the centre, measure along the centre line of all planned streets to a distance of 400 metres.

3. Estimate the boundary of the plots within a 400 metre walk. This will provide the actual area from which the centre can be accessed along the planned streets within a five minutes walk.

4. In the case of stations the same exercise may be completed for a ten minute walking distance using 800 metres as the distance measure. On each circle the result will be a map showing the actual distance within both the five minute walk and the ten minute walk from rail stations.

5. Using a grid of scale hectares, calculate the approximate area and hectares and the land accessible within a five or ten minute walk and express this as a percentage of either the 50 or 200 hectare circles. The percentage will indicate the efficiency of the layout.



Note that the walkable catchment should always count the area of land used for dwellings, but not include public open space contained in the accessible area.

It should be noted that in fine-tuning the calculations, there are practical influences, such as short-cuts through parks or along pedestrian paths. These should only be included where there is a high degree of surveillance from adjoining development and where there is good lighting. Similarly, the walkable catchment may need to be reduced where there is poor surveillance and routes may ultimately be perceived as unsafe.

APPENDIX B

GUIDELINES FOR ESTIMATING PUBLIC TRANSPORT DEMAND AND ASSOCIATED PUBLIC TRANSPORT SYSTEMS IN SETTLEMENTS
Source: South Africa, Department of Transport (1998)

The demand for public transport in any settlement is related to car ownership (affected by household incomes), the form of development (density, proximity to services, etc) and the quality of the services. Settlement planners need to understand public transport demand, in order to size facilities appropriately. In short, in planning a settlement, it is necessary to understand whether the public transport component is scaled to mini-bus taxis or buses or trains. The following examples may be helpful. They are based on differing combinations of the 400 metre radius of "walkable" neighbourhoods.

Conditions

1. A "walkable" public transport catchment of 400 m radius, encircling an area of 50 ha.

2. A "walkable" public transport catchment of 800 m radius for rail, encircling an area of 200 ha.

3. In the dwelling density range which is common in South Africa, of between 5 and 30 dwellings per hectare, around 60 per cent of a neighbourhood can be expected to be developed for residences. Thus in a 50 ha neighbourhood the following may be expected:

   plot sizes of 200 m^2 = 30 du/ha = 1 500 units
   plot sizes of 600 m^2 = 10 du/ha = 500 units
   plot sizes of 1 000 m^2 = 6 du/ha = 300 units

4. Plot sizes usually approximate car ownership and household income, with the smaller plot sizes being associated with lower income and car ownership.

Assumptions

The following assumptions may be applied to public transport demand estimation for a low income settlement based on parameters observed in Cape Town in the current "Moving Ahead" transport study:

1. Size of settlement = 50 ha (400 m walking radius).

2. Income of residents = < R40 000/household/year.

3. Non-residential development
   = 2 ha office/retail
   = 4 ha industrial
   = 4 ha schools and parks
   = 10 ha roads and public spaces.

4. Residential modal split = 85 per cent public transport.

5. Office and retail modal split = 60 per cent public transport.

6. Work trip generation rates for households earning < R40 000 per annum = 1,6 trips to work/day.

7. Average trip length = 14 km/trip.

8. Directional split = 70 per cent from neighbourhood to city centre; 30 per cent from neighbourhood to outer node.

Calculations

Public transport trip productions for a settlement of 30 du/ha (gross):

1. Total number of households = 10 000 m^2 /ha x 0,6 = 1 500 du (200 m^2 stands).

2. Commuter trip generation (TOTAL)
   Residential generation = 1,6 x 1 500 = 2 400
   Office/retail attraction = 2,0 x 250 = 500
   Industrial attraction = 4,0 x 100 = 400.

3. Commuter trip generation (PUBLIC TRANSPORT)
   Residential generation = 2 400 x 0,85 = 2 040
   Non-residential = 900 x 0,6 = 540.

4. Total trips to work = 2 580.

Deductions

1. In the above example the demand for movement out of the settlement in peak work commuter periods amounts to around 1 500 to 1 700 passenger trips (2 040 trips generated, with some having local and others external destinations). There are 540 total neighbourhood trip attractions).

2. Around 1 600 peak period (x 3 hour) commuter trips would approximate a maximum peak hour demand of about 1000 trips per hour.

3. With a road-based public transport supply policy of 5 minute intervals for bus services in the peak, this would translate to a demand of about 12 buses per hour.

4. In a transport corridor comprising five such neighbourhoods on a single route, the capacity to meet such demand (5 000 passenger trips) would amount to 50 buses per hour.

5. In such conditions, a transport authority would need to consider higher capacity public transport options, each of which would impact on traffic movement in the corridor. Such options might include:

   - articulated buses;
   - bus priority and traffic management schemes; and
   - alternative transport nodes modes such as light or heavy rail.

6. In the foregoing circumstances the transport planning authority should be involved in planning the settlement to ensure that conditions on the ground facilitate effective public transport.

7. The above example represents an extreme case of a neighbourhood where residents would be heavily dependent upon public transport.

Forecast

It is not advisable for settlement planners to make long-term forecasts of demand for public transport. As a cross-check, however, the calculations outlined in this Appendix can be used as a consistency check to determine when critical thresholds are likely to be reached in respect of public transport. At that stage, the necessary infrastructure adjustments can be made.

APPENDIX C

THE MOVING SOUTH AFRICA (MSA) STRATEGY WITH REFERENCE TO LAND USE AND LAND MANAGEMENT ISSUES
Source: South African, Department of Transport (1998)

Urban transport focuses on three categories of strategic action:

The first action is the densification of transport corridors. This requires the substantial reversal of apartheid land use planning to halt dispersion, but it is essential to achieve needed economies of scale in the transport system. The strategy will need an aggressive mix of controls and incentives, and will require appropriately integrated coordination of the many institutions with a stake in the urban arena.

Land use patterns are the single greatest driver of the poor performance of the urban transport system in meeting customer needs, and so any solution will require either altering land tenure or working within its existing context. Distance, density, and employment location are all facets of land use that affect the layout of South African cities and, subsequently, the economics and service levels of public transport.

Corridorisation lowers overall system costs - not only for transport but for other infrastructure, too - and also enables lower subsidies, raises travel speeds, and improves frequencies.

Today there is still a tendency towards continuing decentralisation, especially of workplace locations, which further complicates the task of creating compact cities. Some degree of compact city may be achievable in some areas of some cities, and the MSA strategy does not rule out the option in some circumstances. However, the predominant pattern should be the corridor city. The corridor approach fits more easily with the existing South African urban land tenure patterns. Its appropriateness is driven not only by the decentralised distant townships and the low density inner-ring suburbs, but also by a recognition of the decline in CBD vitality and the dispersion of development to satellite nodes. This pattern recognises the existing vacant land occupying the space between most townships and suburban areas, and also builds on existing flows along major current corridors.

Corridors already exist to some extent in South African cities. Therefore, the strategy focuses on densification of existing corridors and creation of new corridors for major new developments. It is essential to prevent the further dispersion of development, and to create incentives for any decentralisation away from the CBD to occur within the corridor context. The major trade-off against the corridor densification strategy is the higher cost of land for new housing projects closer to the CBD. Analysis shows that transport and other utilities generate savings over time which compensate for the increased cost of land.

Housing targets are driving the need to build on cheap, available land, which is causing dispersion. Transport and other utilities have to be provided to serve these dispersed housing developments, bearing increased long-term costs.

Because of the uniquely local nature of land use decisions, the most challenging part of implementing the corridor vision will be the co-ordination across and within government to overcome the obstacles. Some national policies, as in housing, encourage continued dispersion, based on the economics of land acquisition. These policies will need to be harmonised to fit into a paradigm that encompasses the systems cost of all community infrastructure, not just one component like housing or electricity.

The MSA strategy recognises many other obstacles exist to corridor densification, and overcoming these potential pitfalls will require strong co-operation across government. In particular four different public entities will need to act in close co-operation and co-ordination:

- National Government must provide the overall strategic vision for urban development, including transport. It must also create a framework for absorbing systems costs and aligning the incentives for different national departments to follow the framework. Out of this activity will come guidelines for internalising systems costs within land developments.

- Provincial Government must create broad provincial land use strategies that account for full systems cost, within the context of the national government framework. In addition, they will need to orient the subsidy policy to support the corridors, and are responsible for urban roads.

- The Roads Agency will need to align investments in national roads in urban areas with the local corridor strategies developed by local entities.

- Local Government and Metropolitan Transport Authorities will be responsible for developing land use and transport plans, and will now need to be integrated into planning for major commercial and residential developments. The subsidy allocation procedure must be linked into the corridor densification strategy.

The second action works to optimise modal economics and the service mix. Investment in corridors is primarily roads-based, because densities of new corridors are unlikely to support new rail lines. The strategy is one of regulated competition, with integration of modes facilitated. Optimising modal economics requires addressing the use of road space, and the strategy proposes tough road space management to prioritise public transport. A principal lever of the recommended strategy is that of subsidies, which will be targeted and providing affordable access to the stranded and subsidising the most economic mode on each corridor.

The third strategic action entails improving firm-level performance, a task which predominantly falls to private firms. The strategy requires effective regulation of all modes, especially minibus-taxis and the enforcement thereof. It emphasises tendering for subsidised routes and other forms of contract management, with built-in incentives for productivity innovation and reinvestment.

Implementing the strategy will require overcoming some significant obstacles. Changing the nature of land-use planning, road space management, planning and regulation, and subsidy targeting will need agreement on the objectives and strong political will.

Hard open spaces

TABLE OF CONTENTS

LIST OF TABLES

INTRODUCTION

Public space includes almost all land that does not belong to private institutions or individuals. Soft open space (addressed in Sub-chapter 5.4) is the unbuilt or "green space" flowing almost in natural lines through the settlement. Hard open space, on the other hand, is accessible and built public space within the built environment and can be viewed as either semi-public or public hard open space.

Within existing developments, open spaces are usually the result of space-left-over-after-planning. They should, however, be effectively designed from the outset in order to serve as purposeful public spaces. A greenfields development thus poses the opportunity for hard open space to be designed with a purpose in itself. Purposeful spaces should respond to user need, be carefully accommodated and sensitively designed. Then only can they be sustainable spaces that can be effectively used by future generations.

With the renewal or upgrading of existing areas, hard open spaces should be redesigned to better fulfil the public's demand for a quality environment with aesthetic appeal and a functional purpose. During the renewal/upgrading process, existing left-over-spaces between buildings can be redesigned to serve as effective public spaces that only serve as walkthroughs. Through renewal programmes these spaces and their directly linked areas could be given a new lease on life.

AIM OF THIS CHAPTER

In encouraging the effective functioning and urbanity of cities and thus also hard open space, it is important to provide guidelines for development, which is the aim of this chapter. These guidelines illustrate how certain generic forms of public space should be planned to avoid being merely meaningless leftover space.

In using these guidelines it is important to note that the specifics of a situation (the contextual determinants, such as context, site, climate, function and cultural determinants, and the symbolic aspects, such as culture, identity of place, user characteristics) should be considered in the planning and design process. Even though this chapter focuses on a neighbourhood/sub-metropolitan level, the guidelines have to be applied in a broader context within a hierarchy of hard open spaces. Through the interpretation of contextual and cultural determinants, certain distinctive elements of hard open spaces can be derived, evolving towards a unique relationship between the place and the contextual environment in which it functions. It is vital for the reader to bear in mind that the guidelines should merely serve as tools. They provide a means to an end and, to produce successful hard open spaces, they should be combined with the designer's own creativity and ingenuity.

THE ROLE OF HARD OPEN SPACE

In terms of settlement systems, hard open spaces fulfil a crucial role in providing continuity through various other elements of settlements. The public space (hard and soft) between buildings is the heart of the built environment and one of the fundamental form-giving elements of settlements. Through the integration of both the soft and hard open space systems with the built environment, a certain urban structure is created. The quality of public spaces is the result of the planning and development of a settlement. Densification and the reduction in the size of private space make the availability and quality of the public space system of utmost importance to the public realm.

A vital relationship exists between movement networks and hard open space, as the movement network is mostly encompassed by, or accommodated within, public hard open spaces.

According to Rapoport (1977) the relationship between different spaces is as important as the space itself. This relationship is twofold as, on the one hand, it has to do with the continuity and flow of space between different scales or levels of spaces and, on the other, it has to do with flow of space from private to public domains.

This continuity between hard open spaces and soft open spaces is very necessary if the different settings for social, economic and environmental development are to be integrated.

FUNCTIONS OF HARD OPEN SPACE

In order to effectively derive and utilise guidelines for the planning and design of hard open spaces, the point of departure should be the functions taking place, or which ought to be taking place, within hard open spaces. Function should altogether relate to the ability of the open space to foster healthy public living. It has to promote activities as diverse as possible in a multifunctional manner, in order to produce a vibrant environment for people.

In terms of structure there exists a continuum of hard open spaces with different degrees of publicness. These vary from semi-public hard open spaces to public hard open spaces. Based on the degree of publicness, function will vary between these spaces.

For discussion purposes the functions of hard open spaces can be broadly classified on the basis of either active or passive use, encompassing social functions, movement functions, economic functions and political or symbolic functions.

Social functions

- Social functions include activities such as play, sport and recreation. Open spaces are especially used by children for play and recreation. A possibility which has not been adequately capitalised on, yet, is the conversion of open spaces to hard surface playgrounds for games like basketball, etc.

- Cultural entertainment (Moughtin 1992, p 89), such as performing musicians and artists, also forms part of social functions taking place on hard open spaces.

- Another important social activity of hard open spaces is lingering or resting. Public places should function as magnets which draw people to themselves or to the associated public facilities. With the correct mix of surrounding land uses these spaces could become attractions and visitors' destinations.

- Hard open spaces, due to their locality between private spaces and public spaces, are very functional meeting and socialising places (Moughtin 1992, p 89) for business people, shoppers, the unemployed, friends and the elderly during the day, and largely for the young at night. The spaces are particularly important to the least mobile sections of the population as very visible places to meet and enjoy conversation with others.

Economic functions

- The function of street vendors (trading) is an economic activity taking place on hard open spaces that has become a vital part of the South African urban experience. Street vendors are dependent on open spaces such as streets or public transport facilities where there is a flow of pedestrians, and they are in direct contact with their customers.

- Hard open spaces also cater for outdoor markets in designated areas, as well as through the multifunctional and temporary use of parking areas, streets and sidewalks (Rapoport 1977, p 100).

- Hard open spaces are the ideal setting for gatherings like festivals or market places (Moughtin 1992, p 89), which function in parallel with the space as an agent for social interaction.

- Access to facilities such as public services, civic buildings (clinics, libraries, etc.) and shopping spaces are an important function of hard open space (Moughtin 1992, p 89).

Movement functions

- Hard open spaces provide access to public facilities and transport, not only via walkways and sidewalks, but also to places for waiting and intermodal transfer at stops or stations.

- In terms of movement or access, hard open spaces are usually located at points of relatively high accessibility.

- Hard open spaces also encompass spaces such as intersections and traffic junctions.

- Parking is an important activity that takes place in hard open space.

Political or symbolic functions

- Hard open space can provide a venue for ceremonial occasions and parades.

- An important symbolic function of hard open spaces is the provision of suitable, identifiable and accessible settings for civic buildings.

DIFFERENT GENERIC FORMS OF HARD OPEN SPACES

Most of these briefly discussed generic forms of hard open space can and should be used and managed as multifunctionally as possible.

Mixed-mode streets

Mixed-mode streets are streets that contain a mix of motorised and non-motorised users. Although these streets are in part dominated by vehicular movement, they include the hard open space components of sidewalks, bicycle paths and space for the provision of engineering services. Variations and uses of sidewalks and road reserves can be exploited. Road reserves can, for example, be applied to better locate informal traders by making sidewalks wider and catering for sidewalk parking.

Pedestrian-orientated streets

Pedestrian-orientated streets can be regarded as streets set out for the main purpose of pedestrian use, such as the "woonerf" concept and arcades. Variations on use and function are available, including play streets, streets closed (temporarily or permanently) and alleys used for trading, markets, recreation and entertainment.

Squares/plazas

Various forms and uses for squares and plazas exist. The most common uses are as atriums, courtyards, intimate inner-city parks, markets, meeting places, and spaces for entertainment, sport and recreation.

Markets

It is impossible to distinguish between permanent and informal markets, such as informal trading on sidewalks or markets in parking areas or streets. Retailing forms an important part of hard open spaces, and includes convenience and specialist markets.

Parking areas

Parking areas are also considered hard open spaces, but their present use leaves much to be desired. Parking in the street and in front of shopping centres, office blocks, churches and public buildings is most common. Opportunities exist for a variety of uses; especially with regard to different times of night and day and different days of the week.

Public transport stops and stations

Various forms of hard open space relate to stops and stations for public transport, such as bus stops, taxi ranks and bus depots. These spaces can also be used multifunctionally for informal markets and meeting places.

THE INFLUENCE OF USER GROUPS ON THE PLANNING AND DESIGN OF HARD OPEN SPACE

In order to identify various user groups, a hierarchy of activities could be set out (Van Zyl 1997). The first of these sets of activities is "necessary activities". These activities include those that are more or less essential aspects of living - shopping, waiting for a person, running errands. A second category of activities is "optional activities". These are activities participated in if there is opportunity and if time and place make it possible.

Users can be identified by the level of their participation in necessary or voluntary functions, whether static or dynamic. Users can also be identified in terms of their demographic characteristics (age, gender, race, income group, culture, ethnic group, children, teenagers) or in terms of their location-specific activity, in which case activity equals the user, such as the selling of vegetables.

Some of the various user groups that need special mention and attention in the design of hard open spaces, as well as some of their specific needs, are:

- children need formal and informal play areas, and safety;
- elderly people need convenient access, seating, safety and shelter;
- youth need space for activity, safety, multifunctional uses, socialising and lingering;
- disabled people need adequate ramps and access as well as safety;
- traders need public facilities, shelter and public amenities;
- shoppers need public facilities, convenience and access;
- higher income groups need hard open space that provides the setting for private space; and
- lower income groups need to utilise hard open spaces, such as streets, as part of the urban room; incorporating socialising and playing space.

It should, however, be borne in mind that the time at which activities take place can vary between day and night, as well as between weekdays and weekends, and this will influence the user group involved. So a specific hard open space can cater for different groups at different times or simultaneously.

Various cultural and income groups also use hard open spaces differently and have different perceptions regarding open space, urban qualities, environmental quality and cognitive domains of space (Rapoport 1977, pp 24-5).

GUIDELINES FOR THE PLANNING AND DESIGN OF CERTAIN GENERIC FORMS OF HARD OPEN SPACE

General guidelines applicable to hard open space in general are set out first. These are followed by guidelines specific to the following generic forms of hard open space:

- mixed-mode streets;
- pedestrian-orientated streets;
- squares;
- markets;
- parking areas; and
- public transport stops and stations.

For both general and specific categories, qualitative guidelines are defined first, after which quantitative guidelines for each generic form follow. In the case of the specific category, qualitative guidelines refer to:

- location and typologies;
- vertical edges;
- horizontal surfaces;
- public furniture; and
- signage.

Quantitative guidelines for the specific category refer to:

- ratios and thresholds; and
- dimensions and distances.

The guidelines are provided in tabular form and, where applicable, illustrated diagrammatically.

General qualitative guidelines

Table 5.3.1: Integrated hard open space system

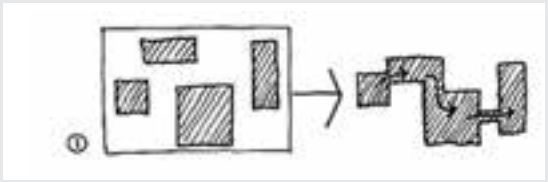
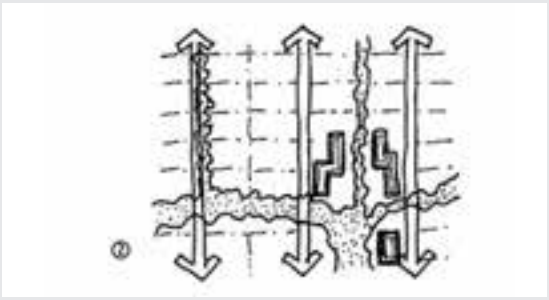
Create an effective hard open space system that integrates the different elements of a settlement to contribute to a meaningful urban structure.	• Provide physical, visible and perceptual connectivity between cluster and linear open spaces. Establish strong and legible linkages between various hard open spaces. [1] • Align the hard open space system and soft open space system with main public buildings, such as community centres or places of worship. [2] • Ensure quality of contextual linkages through the continuation of special activities or functions.[3] • Enhance structural similarity of the street through associational symbolism (personal experience) and cultural symbolism (common areas of understanding in culture) to ensure that as many people as possible can relate to the space. [4]	   

Table 5.3.2: Public facilities

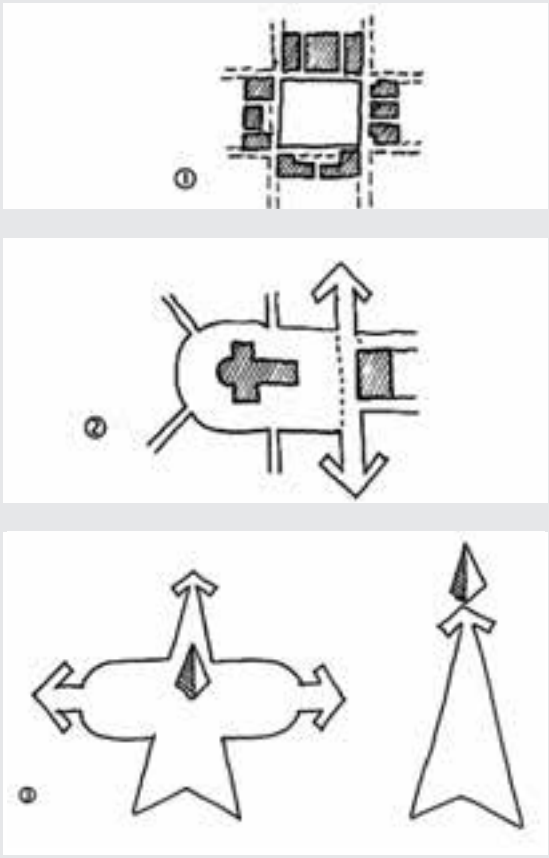
For a meaningful urban structure, link symbolic elements or public facilities to certain hard open spaces in relation to their importance and character.	• Create special public places, as public spaces and public institutions are the focal point of community life. Public furniture should support the desired character of the space. • Concentrate buildings with public facilities, amenities and collective service points adjacent to public spaces. [1] • Locate public buildings in relation to formal public spaces and important movement routes. Hard open space should announce the buildings and accommodate informal activities that respond to these buildings. [2] • Balance the composition of building groups, and place the focal point near the middle of the group (Moughtin 1992, pp 56-7). [3] • Locate symbolic and/or focal points in the middle of a cluster space or at the termination points of a linear space.	

Table 5.3.3: Private and public domains

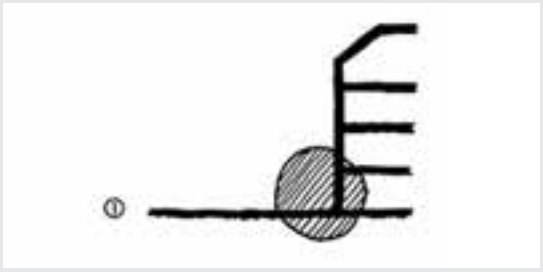
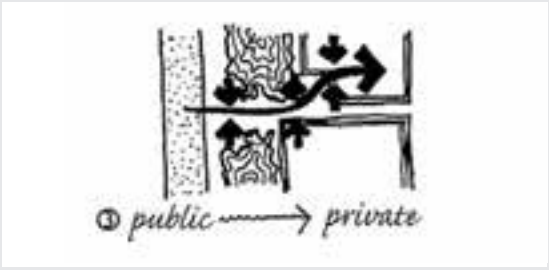
Ensure definition of the public space through effective design of an interface between public and private domains.	• Thresholds should act as shared environments (meeting places) or transitional space between public and private space. [1] • Visual permeability through an interface can enrich the public domain and will affect the way private space is used. It becomes a controlling and enabling constraint. [2] • Enhance the visibility and legibility of the relationship and the transition between private and public domains (Rapoport 1977, p 23). [3]	  

Table 5.3.4: Enclosure

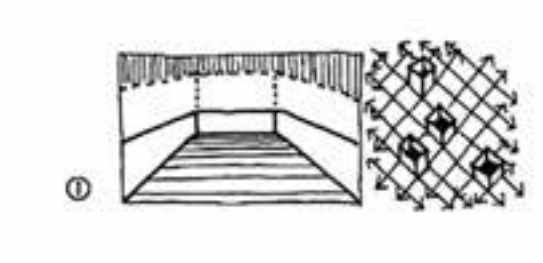
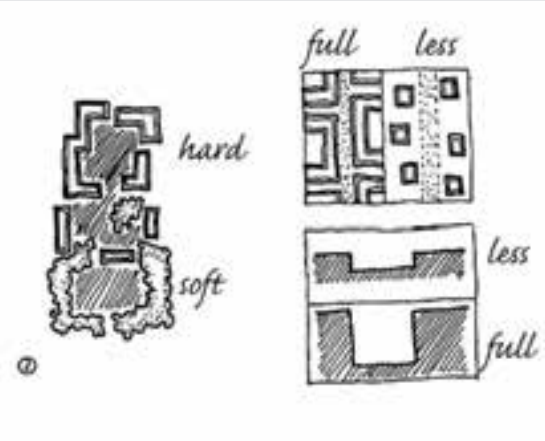
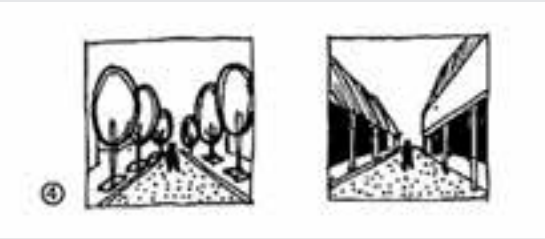
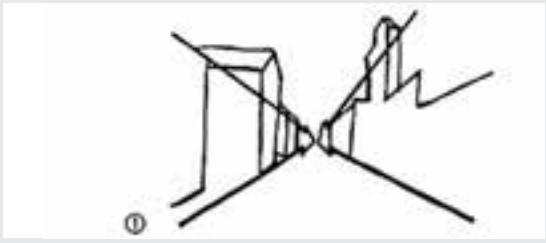
Ensure appropriate sense of enclosure that is on a human scale and fits into the context within which the space is situated.	• Enclosure is needed for the public space to act as an urban room. [1] • The degree of enclosure and nature of enclosing elements determine the character of the space. [2] • Proportion should not be vehicle dominated. Use trees as enclosing elements and to create a human scale. [3] • Define the boundary of the space by means of a unified wall or a series of pavilions linked with landscaping. [4]	   

Table 5.3.5: Continuity and rhythm

Continuity and rhythm of and within spaces should enhance legibility and interest.	• Create rhythmic and spatial progression along a space through the composition of activities or change in land uses (Moughtin 1992, p 58). [1] • Establish a continuation of special activities or functions that exist in the node, within the linkages towards the node. • Perception of hard open spaces is related to the concepts of speed and complexity. Movement relates to complexity and the number of changes that take place within a specific unit of time (Rapoport 1977, p 241), Due to the relative slow movement of pedestrians, a greater degree of complexity and a large number of changes are needed. Faster vehicle movement requires more simplicity and less changes per unit of time. This holds implications for the richness of detail to be provided on buildings. [2]	 

General quantitative guidelines

Table 5.3.6: Scale and proportion

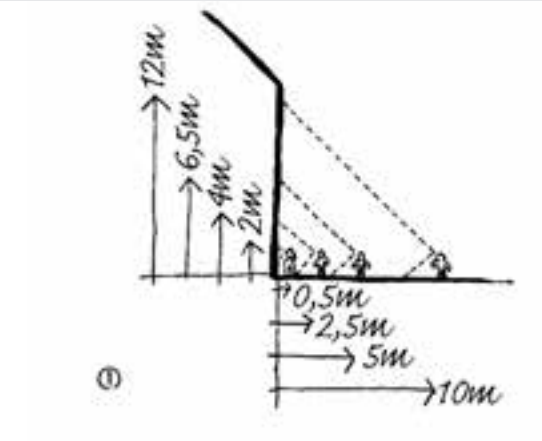
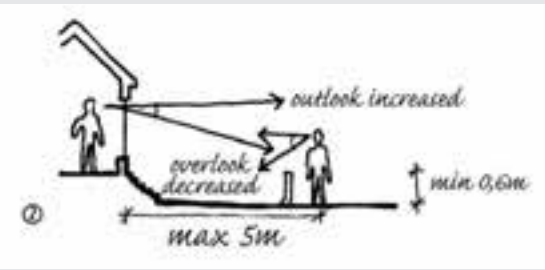
Visual recognition and surveillance.	• Height of detail on buildings that could be appreciated from certain distances away from the facade: - Up to 2 m high to be appreciated from 0,5 m away. - Up to 4 m high to be appreciated from 2,5 m away. - Up to 6,5 m high to be appreciated from 5 m away. - Up to 12 m high to be appreciated from 10 m away. [1] • To maintain contact for safety between pedestrians on street level and people in adjacent buildings, a maximum of 5 m is required. To ensure privacy for inhabitants of buildings at this distance, the street should be at minimum 0,6 m lower than the ground level of the building.[2] • To maintain privacy, a clear distance of at minimum 11 m is needed, otherwise visual obstructing elements, such as trees, should be provided. [3]	  

Table 5.3.6: Scale and proportion (continued)

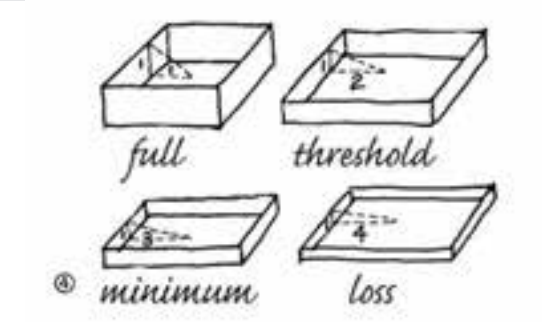
Visual recognition and surveillance (continued).	• Human scale: - Intimate human scale: 12 m (maximum distance to see facial expression); - Normal human scale: 21 to 24 m (25 m at maximum to recognise a face); - Public human scale: 140 m (135 m at maximum to distinguish a human); - Monumental scale: 1 500 m (maximum distance for vista).	
Enclosure.	• Buildings should be seen as a whole from a distance that is twice its height at a 27° angle. • Relationship between radius and height to ensure enclosure (Moughtin 1992, pp 100-1); - Full degree of enclosure is 1:11; - Threshold for enclosure is 1:2 (beyond this proportion space leaks out); - Minimum enclosure is 1:3 (prominent objects are perceived beyond the space); and - Loss of enclosure is >1:3 (space loses its containing function). [4]	

Table 5.3.7: Environmental factors

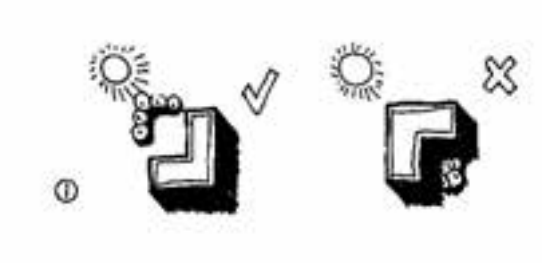
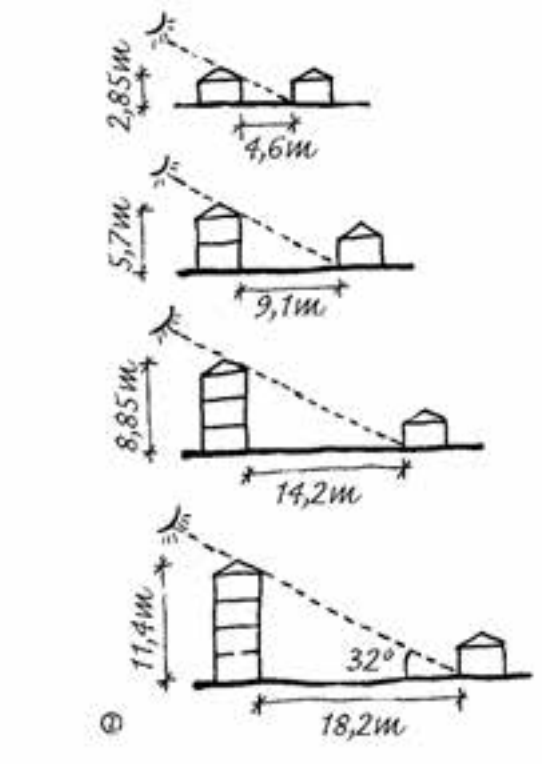
Solar access.	• Locate highest buildings to the southern side of the open space, with lower buildings or trees (as enclosing elements) on the northern side. [1] • To provide adequate solar access to a building, the distance between two buildings should be determined with the following: tan (latitude of the area +10˚) divided by the height of the adjacent building to the north. For example, at Midrand (with a latitude of 22˚) the following is applicable: - If the adjacent building is 2,85 m high (one storey), the distance between the two buildings should be 4,6 m. - If the adjacent building is 5,7 m high (two storeys), the distance between the two buildings should be 9,1 m. - If the adjacent building is 8,85 m high (three storeys), the distance between the two buildings should be 14,2 m.[2]	 

Table 5.3.7: Environmental factors (continued)		
Wind protection.	• An obstruction such as trees can provide the necessary protection against wind. The ground area protected, is generally 10 times the height of the obstruction. [3]	

Specific qualitative guidelines

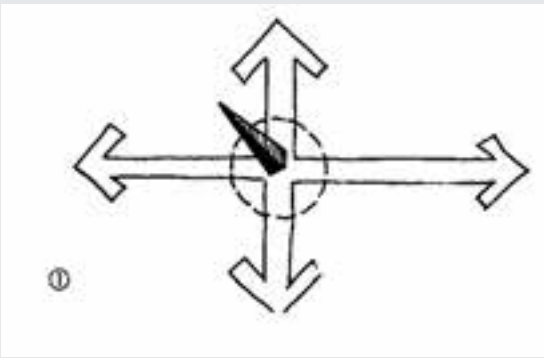
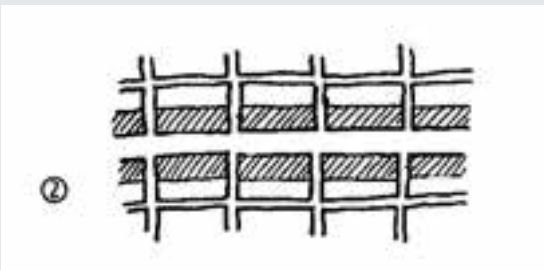
Table 5.3.8: Location and typologies		
Mixed-mode streets		
Ensure a meaningful location in terms of the movement network and urban structure.	• Design the road network to accommodate various and diverse functions. • Meeting of special streets should result in squares and focal points (Moughtin 1992, p 80). [1] • Concentrate intensive activities along continuous vehicle-orientated and public-transport routes. Locate majority of public buildings also along these routes. [2] • Locate buildings close to the street to increase pedestrian activity, reduce resident isolation, and foster pedestrian services such as retail outlets along streets connecting higher density developments.	 

Table 5.3.8: Location and typologies (continued)		
Mixed-mode streets (continued)		
Increase intensity and diversity in the street reserve.	• High information routes are experienced as short, but remembered as long. Ensure complexity and interest along roads and in space along routes (Rapoport 1977, pp 217-220). • Create rhythmic and spatial progression along an axis/street, via composition of activities or change in land uses (Moughtin 1992, p 59). • Block lengths influence access and economic thresholds. Design optimal block lengths to foster diverse activity and economic viability.	

Table 5.3.8: Location and typologies (continued)

Mixed-mode streets (continued)

Increase intensity and diversity in the street reserve.	• Effectively design the whole reserve, including the spaces between the road surface and the building entrances. Design for and make a distinction between the following: - building zone (arcades, canopies, commercial signs, enclosed cafes and sidewalk cafes); - sidewalk zone (sewers, gratings, kerbs, urban art, benches, bicycle racks, hawker stalls, information kiosks, trees, cycle areas, pedestrian areas, newspaper stands, telephone booths, fire hydrants, traffic signs, refuse bins, mail boxes, planters, street lighting, parking meters and bus shelters); and - vehicular zone (banners, manholes, traffic signals, on-street parking, decorative lighting and telephone poles).[3]	

Table 5.3.8: Location and typologies (continued)

Mixed-mode streets (continued)

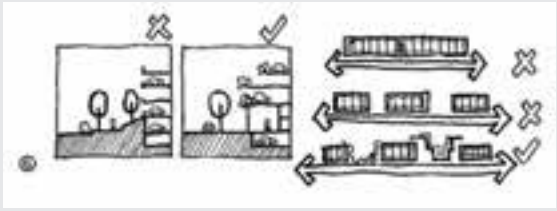
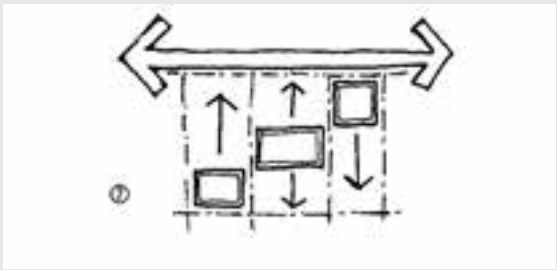
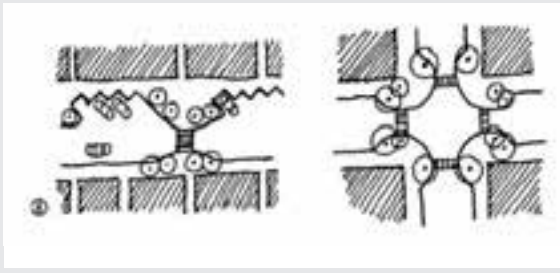
Define the street as a safe and unique public space.	• The general pattern of buildings should help to define the street. [4]	
	• In pavilion-type buildings, use trees to define the street. The streetscape design should incorporate a consistent theme, strengthening the association of unrelated buildings. When a street is not strongly defined at its edges, focal points - at the ends or at regular intervals - could provide a sense of place. [5]	
	• Land uses should enliven the street and ensure surveillance of it. Parking structures should not dominate street frontages. [6]	
	• Distinguish between so-called front-and-back uses and definition, which take place within the street realm, but which differ for various urban users and cultures. [7]	
	• Intersections and road crossings should be designed to be safe for pedestrians and vehicles. This includes the design of sidewalks and crosswalks, traffic signals and other intersection treatment. [8]	

Table 5.3.8: Location and typologies (continued)

Mixed-mode streets (continued)

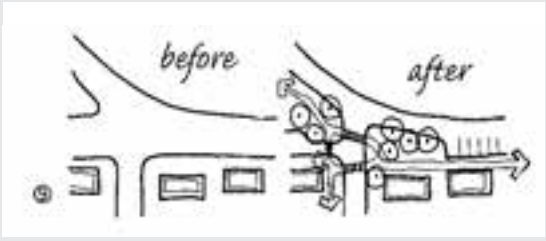
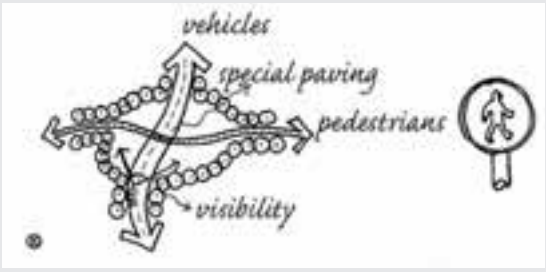
Define the street as a safe and unique public space (continued).	• Modify existing leftover space to accommodate easy pedestrian crossing of streets. [9] • Where pedestrian routes cross streets, ensure visibility through landscaping and signage. [10] • To enhance safety for pedestrians on sidewalks (Untermann 1984, pp 25-28): - minimise conflict with cars; - cater for the disabled; - provide sidewalks; - provide parking, between road and pedestrian; - the busier the street, the broader the sidewalk should be; - place kerb between sidewalk and street; and - design road to discourage speeding.	 

Table 5.3.8: Location and typologies (continued)		
Mixed-mode streets (continued)		
Accommodate a variety of users in the street.	• The effective separation of pedestrian and vehicular movement should be at a scale which encourages activity and pedestrian comfort. • For movement, the street should include a surface for cars, together with bicycle and pedestrian lanes. • Other facilities to be accommodated are those for informal traders, small-scale businesses (such as decorative kiosks for flowers), landscaped strips and spaces of relief and relaxation in bustling areas.	
Pedestrian-orientated streets		
Ensure a meaningful location in terms of the movement network and urban structure.	• Create a symbolic location for a special street through its relative location within a geographical area.	
Increase intensity and diversity in the street.	• In pedestrian arcades, provide spaces of relief and relaxation in bustling areas. • In pedestrian-dominated streets related to residential uses, such as the woonerf street, provision should be made for other uses, such as recreation and socialisation, which are related to the main residential use. • Visitor parking can be provided in the street.	

Table 5.3.8: Location and typologies (continued)		
Pedestrian-orientated streets (continued)		
Define the street as a safe and unique public space.	• Design detail to discourage traffic through the area, and speeding. • Design soft mounds and plant trees separating footpaths and buildings from the road. • Footpaths should preferably be designed adjacent to buildings that overlook them, as opposed to blank walls (Cartwright 1980, p 32).	
Accommodate a variety of users in the street.	• Concentrate public facilities according to functional relationship, to facilitate sharing of resources (halls, playing fields, equipment). • The street as communal area can provide the setting for the integration of collective services in lower-income residential areas.	

Table 5.3.8: Location and typologies (continued)		
Squares		
Ensure a meaningful location in terms of the movement network and urban structure.	• Locate largest and most important buildings in association with largest and most important squares. • Create symbolic location by relative location within a geographical area. • Enhance legibility of the structure (Rapoport 1977, p 116; Lynch and Hack 1984) via the locality of squares at movement-decision points. • Give important squares, dominance in the settlement (Moughtin 1992, pp 56-7) - for example, by letting buildings that surround them, occupy high ground or dominate the skyline. • Provide contrasting hard open spaces with greater or less activity.	
Increase intensity and diversity in the square.	• Integrate indoor and outdoor spaces to make them more useful. Plan spaces to be small and informal in character and quality, so as to be inviting, comfortable and non-oppressive. • Use of the square and activities in the square depend on the activities at the edge, especially on the ground floor. Develop restaurants, small shops and retail stores around the square; exclude large banks, travel agents and offices that attract few pedestrians.	

Table 5.3.8: Location and typologies (continued)		
Squares (continued)		
Increase intensity and diversity in the square (continued).	• Urban squares could be used as markets, with either the central area of the square or the edges as demarcated space for trading.	
Define the square as a safe and unique public space.	• Design identifiable gateways as legible entrance points to the square (Rapoport 1977, p 95). Entry points should be highly visible and linked to major contextual routes (Rapoport 1977, p 383). • Ensure surveillance of the square through its visibility from adjacent buildings. • From a central point one should be able to appreciate all sides of the square.[1] • To enhance memorability, buildings that are simple in geometric shape should be placed together (Moughtin 1992, p 72). One prominent building should dominate the group.	

Table 5.3.8: Location and typologies (continued)

Squares (continued)

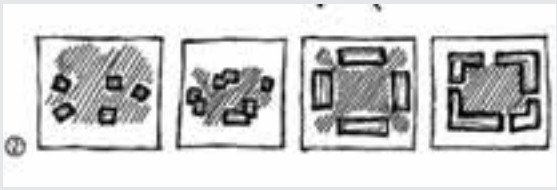
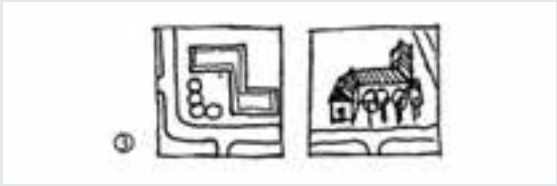
Define the square as a safe and unique public space (continued).	• To contextualise the square and design the correct proportion within the context, take the typology of surrounding buildings into account. Give attention to size, height, unifying elements, theme, shape of space and roof lines. Continuity in height of buildings around a square enhances enclosure. Enclosure is reduced with the degree of difference in building height. • Design for a sense of permanence, through robustness of buildings, which are compatible for a diversity of uses. • Enclosure depends on the way buildings are grouped. Create a sense of enclosure, especially on corners, otherwise space gets fragmented.[2] • One or two sides of a square should be enclosed with buildings. The other sides could be enclosed by something else, such as trees.[3] • If the physical sense of enclosure is less, the sense of place/activity/meaning should be higher.	 

Table 5.3.8: Location and typologies (continued)		
Squares (continued)		
Accommodate a variety of users in the square.	• Enhance the symbolic meaning of city squares. Accommodate symbolic elements and places (statues, objects of remembrance and memorable places) that reflect shared community values and events. • Encourage the use of bandstands, public display areas, outdoor dining space, roller-skating and other features that attract crowds. • Encourage recreational facilities such as theatres, restaurants, cafes, movie houses, and libraries with late-night hours, hotels, and teenage meeting rooms, extending the usage of the square to night-time.	
Markets		
Ensure a meaningful location in terms of the movement network and urban structure.	• Incorporate markets at points of greatest access in the urban structure, such as at modal interchanges and intersections. • Ensure the permeability of, and short cuts through, the market.	

Table 5.3.8: Location and typologies (continued)

Markets (continued)		
Increase intensity and diversity in the market.	• Plan the market to convey a sense of permanence. This should be achieved with compatible buildings that can accommodate changing uses over time. • Create opportunity for formal commercial and informal trading activities. The concentration of activities will encourage interaction and generate economic expansion. • The size of the market will change over time. Expansion and contraction of the market can occur over short periods. The market should, however, be planned in such a way as to retain its intensity at all times. As phased growth takes place, the market should operate as a totality at each stage of its development.	

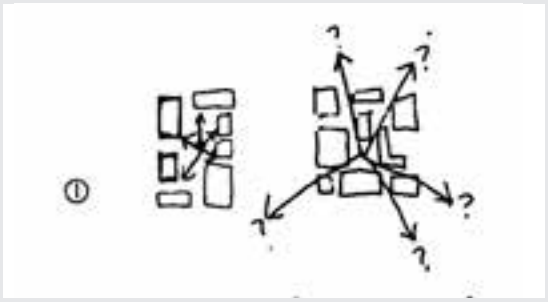
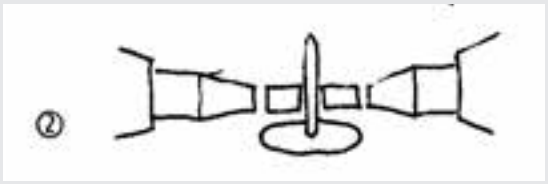
Table 5.3.8: Location and typologies (continued)		
Markets (continued)		
Define the market as a safe and unique public space.	• The gateways to the market place should convey a friendly invitation, where a sense of belonging could be experienced by users. • The market should have an acceptable sense of place that should be defined by means of a primary space, supported by secondary spaces. [1] • The primary space should form the major communal space around which market stalls should be positioned. A vertical element should preferably be placed at its centre. This should form a reference point that will enhance legibility of the market. [2]	 
Accommodate a variety of users in the market.	• Markets with small-scale activities require less formal market infrastructure. Market activity may be intermittent and could take on different forms. The spaces should thus be designed to be as multi-functional as possible.	

Table 5.3.8: Location and typologies (continued)

Parking areas

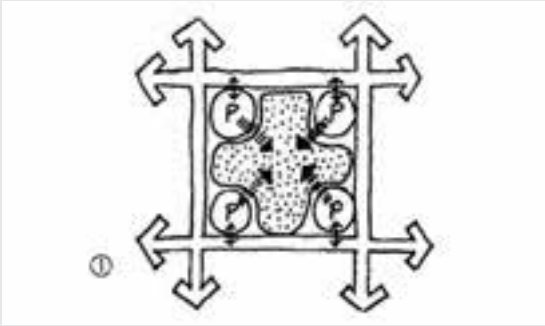
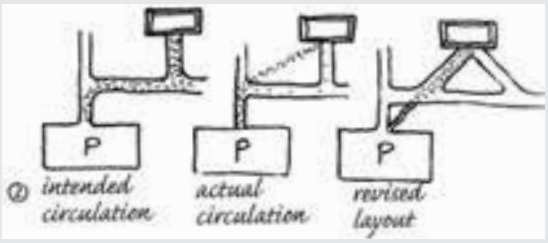
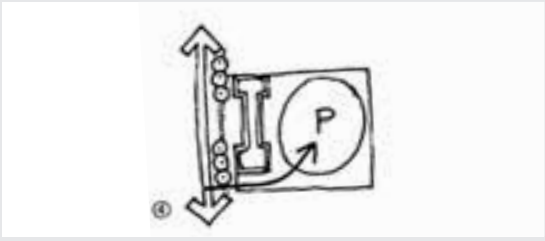
Ensure a meaningful location in terms of the movement network and urban structure.	• Organise parking in small lots around the perimeter of the core of activities and movement. Parking lots should lead to the core and should provide pedestrian access to all streets. [1] • Integrate a parking area with the surrounding area through linking it to natural movement routes and accommodating short cuts. [2] • Parking should be located in smaller areas closer to destinations, especially in higher density development and at local shops. [3] • Parking should preferably be located away from the street at the back of buildings. If parking is provided at the front, a maximum of two rows of parking should be provided. Parking structures should not dominate street frontages. [4]	   

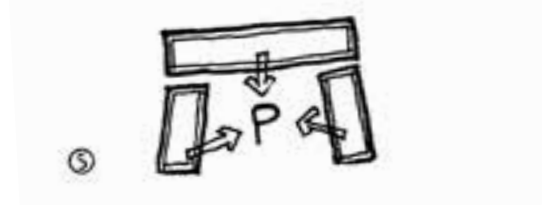
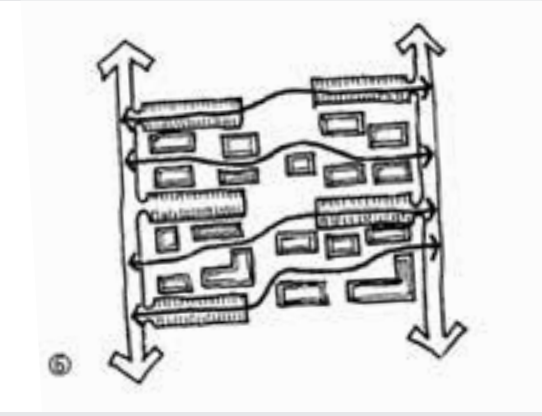
Table 5.3.8: Location and typologies (continued)		
Parking areas (continued)		
Increase intensity and diversity in the parking area.	• Manage activities in parking areas for various uses and effective utilisation of space through different times of the day, such as the closing of parking areas to act as markets in the evening or play areas on weekends. • Type and intensity of uses can vary over time as the demand for parking increases or decreases (differences between day and night, times of the day, days of the week or month). • Accommodate different uses that increase latency and allow for social change without physical change.	
Define the parking area as a safe and unique public space.	• The way buildings are arranged around the parking area should ensure adequate surveillance. [5]	
Accommodate a variety of users in the parking area.	• Allow for informal traders to trade within the parking area in an organised way. • Accommodate multifunctional use of elements within the parking area, such as trees. • Accommodate pedestrian routes through the parking area. [6]	

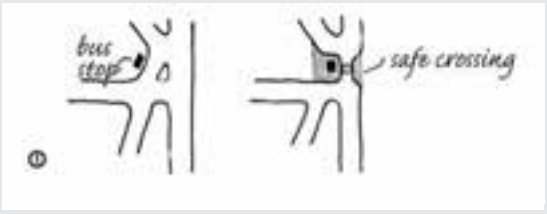
Table 5.3.8: Location and typologies (continued)		
Public transport stops and stations		
Ensure a meaningful location in terms of the movement network and urban structure.	• Locate public transport stops and stations on convenient routes between different land-use activities. • Locate stops or stations at points of highest accessibility. Integrated intermodal transport nodes and change-overs should be promoted to ensure sustainable physical development. • Incorporate stations within their surroundings by means of the effective utilisation and design of existing leftover space. [1] • Stations and stops should be located at more frequent intervals and closer to destinations in higher-density and mixed-use developments.	
Increase intensity and diversity at the stops and stations.	• Organise informal trading around the stop and within the station.	
Define the stops and stations as safe and unique public spaces.	• Attend to the quality of the stops in terms of safety, shelter, character or image and visibility.	
Accommodate a variety of users at the stops and stations.	• Provide adequate space and facilities for informal traders at stops and stations.	

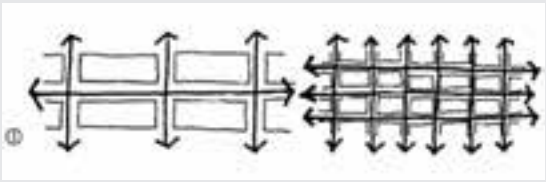
Table 5.3.9: Vertical edges		
Mixed-mode streets		
Create easy access to and from the street.	• Permeability of public space can be enhanced through the provision of maximum alternative routes (Bentley et al 1987, p 10). Small blocks give more choice of routes than large blocks. [1] • Enhance permeability by not absolutely segregating pedestrian and vehicular movement. • Design for permeability and access to occur at visible entrances. • Provide shortcuts to intermediate distance substitutes, such as bus, bicycle and taxi.	
Establish appropriate interfaces.	• The building facade should be linked to human activities along the route to ensure visibility of pedestrians and thus surveillance of the street. Surveillance of the street should also be facilitated from upper storeys. The way this edge is made will also determine the feeling of the upper-storey space. [2] • Arcades provide a defined human space between the building and the street. Arcades should also provide shelter against bad weather.	

Table 5.3.9: Vertical edges (continued)

Mixed-mode streets (continued)

Establish appropriate interfaces (continued).	• Interfaces can ensure coherence and interest, and will provide a visual stimulus to passers-by. Colonnades as interface could provide a coherent simple rhythm on the outside (which relates to fast-moving vehicles) and complexity on the inside (which relates to pedestrians). • Interface between pedestrians and cars should be defined through a row of on-street parking or through landscaping (Untermann 1984, pp 25-28). [3] • Garbage receptacles or unsightly equipment should be screened, especially from pedestrian-movement routes.	
Ensure a unified and interesting edge surface design.	• Unify street design and street frontages of buildings to create a special street with an identifiable character. New buildings should fit into the existing context and attention should be given to similar elements such as roof lines, bay windows and window proportion (Moughtin 1992, p 2, 143). [4] • A number of distinctly identifiable elements along routes should be provided, with continuity of shop fronts (Moughtin 1992, pp 56-57). [5]	 

Table 5.3.9: Vertical edges (continued)

Pedestrian-orientated streets

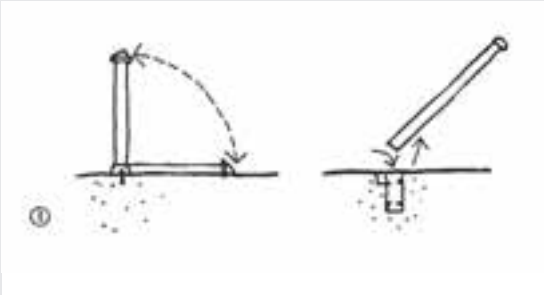
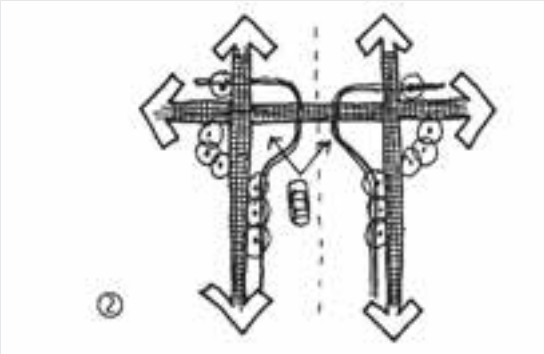
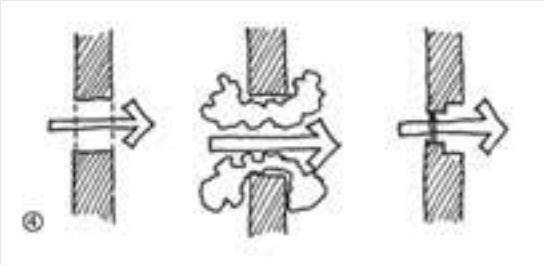
Create easy access to and from the street.	• Access for pedestrians and bicycles should be made easy, while access for vehicles should be more difficult and controlled. Use lockable bollards where applicable. [1] • Access for vehicles must be made difficult. [2]	 
Establish appropriate interfaces.	• In residential developments, it is preferable not to have any fences or walls on the street boundary. However, should fences be put up, it is proposed that palisade fencing that provide maximum visibility, be erected. This should ensure surveillance of the street. [3] • Transition from public to private space should be appropriately made through the provision of perceptual locks. This will contribute to the clear distinction between and definition of public and private spaces. [4]	 

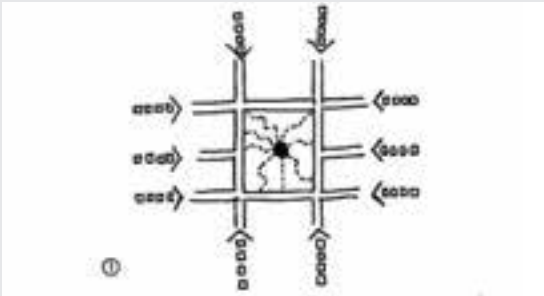
Table 5.3.9: Vertical edges (continued)		
Pedestrian-orientated streets (continued)		
Ensure a unified and interesting edge surface design.	• To organise a unified character, it is proposed that the interface be designed as a single entity.	
Squares		
Create easy access to and from the square.	• Provide direct access to and continued routes through the square.[1] • Design for permeability with as many shortcut routes through the square as possible.[1] • Link the square to major contextual routes.[1]	
Establish appropriate interfaces.	• Establish a boundary which can be a wall, windowed façade or natural features such as trees. Do not design large expanses of blank walls.[2] • The interface should address issues of human comfort, such as shelter from sun, wind and rain and a choice between sun and shade and public lighting.[2]	
Ensure a unified and interesting edge surface design.	• Enhance the sense of enclosure with unity in walls and similar architectural treatment of buildings (Moughtin 1992, p 72). Local styles and materials should be used consistently.[3] • Squares should create discontinuity or interruption in the built form in order to prevent boredom. When approached at an angle, the effect can be dynamic.[3]	

Table 5.3.9: Vertical edges (continued)

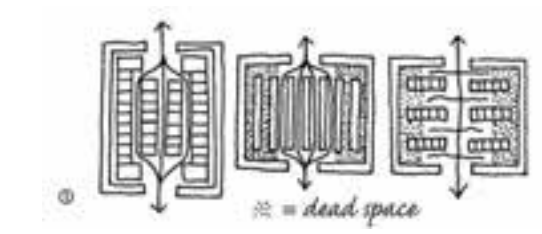
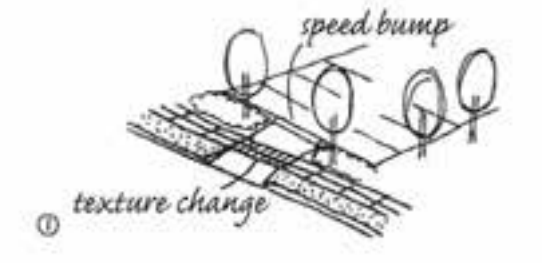
Markets		
Create easy access to and from the market.	• Edges of markets should provide maximum permeability for easy access to and from market activities. [1]	
Parking areas		
Create easy access to and from the parking area.	• Provide adequate stacking space for vehicles waiting to turn into the parking area. • Provide ample dedicated pedestrian routes where pedestrians can access the parking area. • Conflict between pedestrians and automobiles should be reduced through location and design of vehicular and pedestrian access to parking facilities. [1]	
Establish appropriate interfaces.	• Design boundaries as meeting places between different domains. The boundary should act as interface between public space and private space or between inside space and outside space. • Design edges to be used for shelter against wind or rain.	
Ensure a unified and interesting edge surface design.	• Plant shade trees in the parking strip to continue the trees found in surroundings.	

Table 5.3.9: Vertical edges (continued)		
Public transport stops and stations		
Create easy access to and from the stop or station.	• Enhance convenience and safety through provision of the most direct pedestrian access to and from public transport facilities. • Reduce the walk length with short cuts to intensify activity, and to support intermediate distance substitutes, such as bus, bicycle and taxi.	
Establish appropriate interfaces.	• Integrate bus or taxi stops for shelter and safety in the design of the interface of the adjacent building. • Interfaces such as overhangs can provide shelter to informal traders or people waiting for transport.	
Ensure a unified and interesting edge surface design.	• Provide a landscaped setback for ranks, depots and stations from the street.	

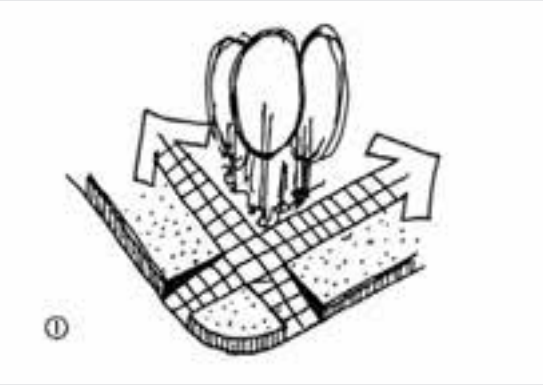
Table 5.3.10: Horizontal surfaces		
Mixed-mode streets		
Ensure accessibility and convenience for different user groups.	• Paving materials should provide safe walking surfaces. • Provide clear markings for pedestrian crossings at intersections. [1] • Walking routes should be provided as level as possible, avoiding unnecessary changes in elevation that can cause accidents.	

Table 5.3.10: Horizontal surfaces (continued)

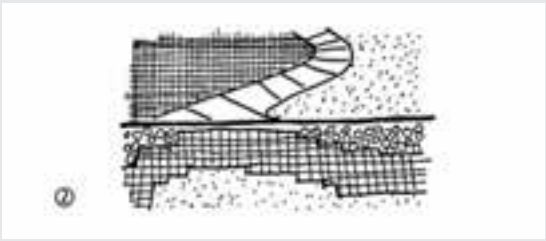
Mixed-mode streets		
Create diversity and interest.	• Pedestrian activity areas should receive special pavement treatment with coordinating materials and patterns to create a specific character for the precinct. [2] • Design simple continuous routes with complex views especially for pedestrian movement (Rapoport 1997, pp 217-8). [3] • Planting and pavement treatment in pedestrian streets should be related to activities and uses in adjacent buildings. • Street landscaping, in particular, should be selected and designed according to a special theme for a given area, providing a sense of place in addition to its other amenities.	 
Consider specific conditions of surfaces.	• Functionality of surfaces in terms of kinaesthetic elements such as change of level, curves with implications for speed of movement and tactile elements such as texture under foot, should be taken into account. • Climatic elements such as air movement and extreme temperatures should be considered. Sun exposure should be considered for early morning and late afternoon.	

Table 5.3.10: Horizontal surfaces (continued)		
Pedestrian-orientated streets		
Ensure accessibility and convenience for different user groups.	• Adequate provision should, for example, be made for paraplegics, elders who want to sit down and youths who want to play.	
Create diversity and interest.	• A combination of soft and hard surfaces should be provided, with certain surfaces being dedicated for a main use such as the carrying of vehicles. However, secondary uses should be promoted and designed for.	
Consider specific conditions of surfaces.	• A variety of surfaces (hard and soft) should be provided to increase maximum choice of use. • Surfaces should be as maintenance-free as possible. • Be aware of the influence of climatic conditions on chosen surfaces. Attention should, for example, be given to stormwater runoff and excessive heating.	

Table 5.3.10: Horizontal surfaces (continued)		
Squares		
Ensure accessibility and convenience for different user groups.	• Avoid sunken squares with difficult access, which make people feel uncomfortable. Keep squares level or just slightly below sidewalk grade. • Ensure easy access for paraplegics to all facilities around the square. • Choose surfaces that will most likely accommodate sports activities such as roller-skating.	
Create diversity and interest.	• Movement spaces as well as resting places should form part of the route. The different kinds of spaces should be reflected in the paving pattern. [1]	
Consider specific conditions of surfaces.	• Sunlight and drainage must be evaluated and appropriately addressed as limitations or potential assets in design.	
Markets		
Ensure accessibility and convenience for different user groups.	• Traders with trolleys should be able to get easy access to the market.	
Create diversity and interest.	• Demarcate position of stalls through different paving patterns.	
Consider specific conditions of surfaces.	• Design surfaces for easy cleaning.	

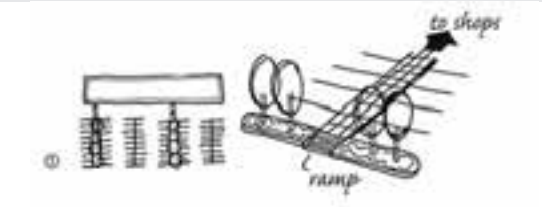
Table 5.3.10: Horizontal surfaces (continued)		
Parking areas		
Ensure accessibility and convenience for different user groups.	• Provide dedicated pedestrian walkways separate from the parking surface, between the building and the parking area. [1]	
Create diversity and interest.	• For 30°, 45° and 60° parking, the triangle in front of each parking bay should be landscaped. [2] • Brick paving, as opposed to concrete blocks or asphalt, should be considered to provide a more interesting surface texture and pattern.	
Consider specific conditions of surfaces.	• Use landscaping and trees to reduce the impact of large areas of asphalt. • Where appropriate, parking surfaces could consist of grass blocks to give a softer, parklike image.	
Public transport stops and stations		
Ensure accessibility and convenience for different user groups.	• Provide for use of stops and stations by wheelchairs and disabled people. • Pedestrian crossings at stops should have clear markings. Take road conditions, traffic intensity and speed into account in the detail design.	
Create diversity and interest.	• The paving pattern should assist in defining the public transport stop as a unique public space.	

Table 5.3.10: Horizontal surfaces (continued)		
Public transport stops and stations (continued)		
Consider specific conditions of surfaces.	• When it rains, surfaces should not gather water or be muddy in order for people not to wait in these conditions and then board public transport.	

Table 5.3.11: Public furniture and signage		
Mixed-mode streets		
Provide functional and aesthetically pleasing public furniture.	• Provide adequate bicycle racks near entries of buildings to prevent vandalism or theft. • Provide adequate seating space. Planters as part of the landscaping can also be designed for this purpose.	
Coordinate signage.	• Street signs and other information signs should be uniform to provide a unique precinct character. • Signs should clearly convey their message but should be located and sized not to block views to and from adjoining buildings. They should also not be excessive in size and number.	

Table 5.3.11: Public furniture and signage (continued)		
Pedestrian-orientated streets		
Provide functional and aesthetically pleasing public furniture.	• Furniture should support the envisaged character of the street. • Furniture could include fountains, litter bins, bus shelters, benches, lighting or basketball rings, depending on the context within which the street is situated.	
Coordinate signage.	• Signage should support the creation of a unified character for the street and convey information to local residents. A notice board could be used for this purpose. [1] • Within a woonerf type of street, signage should mainly convey the message to vehicles that they should drive slowly, due to a number of other users occupying the street for different reasons. • Within an arcade, signage will mainly be geared to pedestrians, indicating where what can be found. [2]	 ①  ②

Table 5.3.11: Public furniture and signage (continued)

Squares

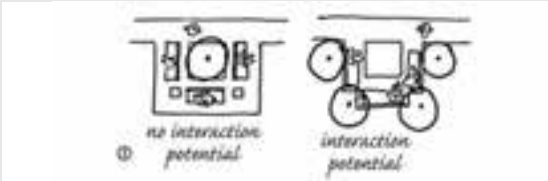
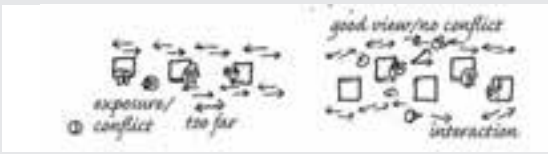
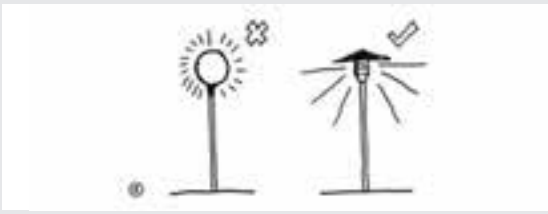
Provide functional and aesthetically pleasing public furniture.	• Some permanent benches should be arranged in order for groups of people to talk to one another.[1] • A choice of seating should be considered, such as movable furniture. Movable chairs make ideal seating because each user can determine the direction he or she wants to face, and move it to gain privacy, sit in or out of the sun or have a better view.[2] • Provide seating in passive areas next to active areas, to encourage people to look towards either side. Design for interaction among people sitting down, and avoid conflict between people walking and sitting.[3] • Appropriate levels of lighting should be used to enhance safety and accent and highlight landscaping. Accent lighting, directed upwards into trees, provides low intensity, but often dramatic illumination of nearby pedestrian areas.[4] • Use sustainable lighting features where light energy is not dispersed into the air. • Regular intervals of lights should be maintained and incorporated into streetscape improvements.	   

Table 5.3.11: Public furniture and signage (continued)		
Squares (continued)		
Provide functional and aesthetically pleasing public furniture (continued).	• Light poles and fixtures should fit into and preserve the historical character of the streetscape.	
Coordinate signage.	• Provide information through signage that is colourful, interesting and theme-based.	
Markets		
Provide functional and aesthetically pleasing public furniture.	• Market facilities and services should be spread evenly in clusters over the market area, to be accessible for all. • Secondary spaces should provide the settings for the location of these clusters of communal services. • Communal services to be provided are standpipes, solid waste bins, public telephones, public toilets, and metered electricity dispensers. These should be integrated. • Electricity will be needed for lighting or manufactured appliances. Water will be needed to clean the market area, also where animals are slaughtered. Water is also needed for laundry or vegetable areas, washing basins, cooking, and general hygiene.	

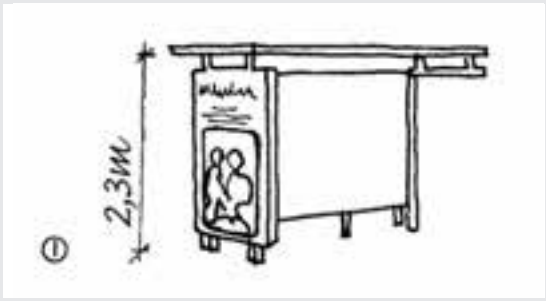
Table 5.3.11: Public furniture and signage (continued)		
Markets (continued)		
Provide functional and aesthetically pleasing public furniture (continued).	• Any extensive public investment in market infrastructure should respond to market development, rather than precede it (Behrens and Watson 1996, p 217).	
Parking areas		
Provide functional and aesthetically pleasing public furniture.	• Where parking areas abut the sidewalk, a landscaped setback should be provided, with adequate furniture such as benches.	
Coordinate signage.	• Signage to parking areas should be coordinated with signage of the building or the street, depending on its direct relationship.	
Public transport stops and stations		
Provide functional and aesthetically pleasing public furniture.	• Provide adequate shelters against rain, sun and wind, if possible. [1] • Provide places for waiting where change in transportation modes take place and at intersections. • Provide space for resting, eating or drinking while waiting for transportation. • Provide benches at bus stops or shelters. Comfortable design and location of street furniture should adhere to the needs of potential users.	

Table 5.3.11: Public furniture and signage (continued)		
Public transport stops and stations (continued)		
Provide functional and aesthetically pleasing public furniture (continued).	• Provide adequate lighting to improve safety. • Provide enough and appropriate litter bins.	
Integrate and coordinate signage.	• Integrate signage with shelters at public transport stops. [2]	

Specific quantitative guidelines

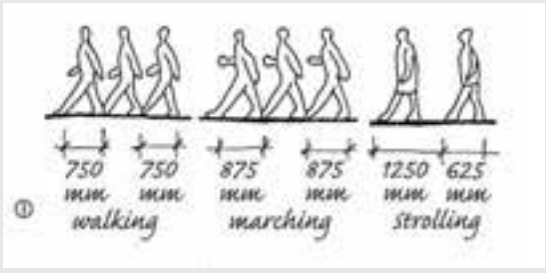
Table 5.3.12: Ratios and thresholds		
Mixed-mode streets		
On-street parking.	• In areas of high car ownership, two visitors' parking spaces should be provided onsite, in addition to on-street parking. • In areas of low car ownership, on-street parking may be sufficient.	
Pedestrian movement.	• 4,5 m per person allows a clear view of the ground ahead, for comfortable adjustment to meet changing conditions. This serves a capacity of 1 000 pedestrians per hour (Untermann 1984, p 54). However, different contexts would allow for different walking spaces. [1] • Stairs reduce walking speed to about one third the speed of level conditions and constrict traffic flows.	

Table 5.3.12: Ratios and thresholds (continued)

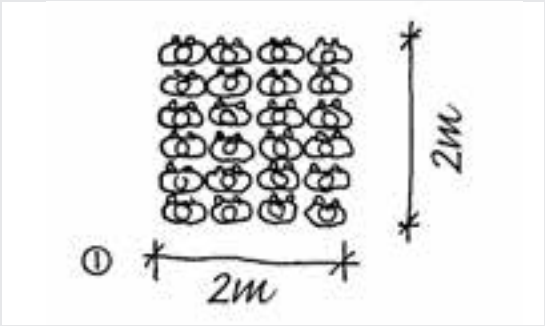
Squares		
Walking space.	• Walking on sidewalks and squares differ. On squares, the crucial spatial dimension is square metres; the more space available to adjust one's route, the faster a pedestrian can walk. Less than 1 m^2 per person can force a pedestrian to stop and less than 0,5 m^2 is totally unacceptable. The greatest density possible per m^2 is 6 people. [1]	
Markets		
Market size.	• Markets that are designed to be small, with no capacity to expand, very often fail as they are too small to attract customers. Markets should accommodate at least 70 operators to be economically viable (Behrens and Watson 1996, p 217).	
Parking areas		
Parking ratio per land use.	• Dwelling unit of 1 habitable room: 1,0 space/unit. • Dwelling unit of 2 habitable rooms: 1,0 space per unit. • Dwelling unit of 3 habitable rooms: 1,25 spaces per unit. • Dwelling unit of 4 habitable rooms: 1,5 spaces per unit. • Visitors: 0,5 space per unit. • Hotels and motels: 1 space per habitable room + 10 spaces per 100 m^2.	

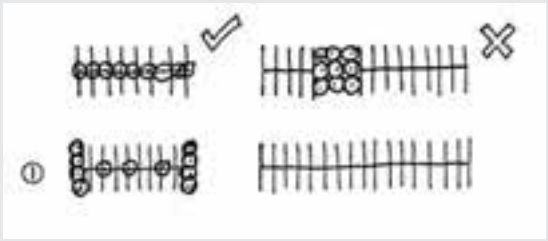
Table 5.3.12: Ratios and thresholds (continued)		
Parking areas (continued)		
Parking ratio per land use (continued).	• Residential hotels, boarding houses, etc: 0,6 spaces per habitable room. • Old-age homes, orphanages, etc: 0,3 spaces per habitable room.	
Landscaping.	• Minimise the impact of parking areas on the living environment through the provision of at least 1 shade tree per 3 parking bays. [1] • 10% of the parking area should be landscaped.	

Table 5.3.13: Dimensions and distances		
Mixed-mode streets		
Travelling distances.	• Design short and narrow residential blocks of ± 100 m x 30 m to ensure permeability and easy pedestrian access. • Shoppers carrying packages or tending to children are more aware of time and distance than people who linger. Keep walking distance and maximum length of a walkway up to a maximum of 140 m. • 20% - 25% of personal trips are under 1,6 km in length. 20% are 1,6 to 3,2 km, with only 12% - 15% being 3,2 to 4,8 km. Thus, almost one half of all urban trips are less than four kilometres long. This has implications for the intensity of information to be provided.	

Table 5.3.13: Dimensions and distances		
Mixed-mode streets (continued)		
Travelling distances.	• Human scale is lost with a linkage longer than 1 500 m (maximum distance to establish vista).	
Ramps and stairs.	• Clear space of ramps should not be narrower than 1,2 m, allowing a person in a wheelchair to pass another person. Ramps should have continuous handrails and should form an integral part of the design of the building, not merely be an add-on.[1] • Ramps can have a slope of between 5% (1:20) and 8% (1:12). • For continuous walkways, cross-slopes of 1:12 should be avoided, with a preferred slope of 1:16. • Stairs should be avoided where large volumes of foot traffic must be accommodated. On stairs, a railing should be provided on at least one side with a height of at least 450 mm (Untermann 1984, pp 29, 41).	

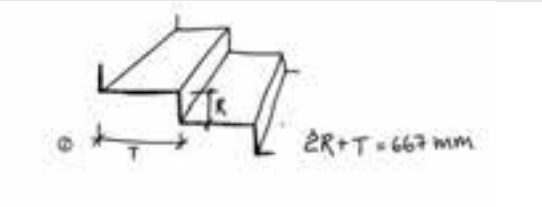
Table 5.3.13: Dimensions and distances (continued)		
Mixed-mode streets (continued)		
Ramps and stairs (continued).	• On stairways, the rise in height should not exceed 165 mm. 1,1 m is recommended as a minimum stairway width to allow passing in the opposite direction. The ideal proportions for outside steps are determined by the indicated formula. [2] For long slopes, a level rest-platform should be installed at a maximum distance of every 20 treads. This platform should be long enough for a person to walk three paces, which is approximately 1,8 m.	
Sidewalk widths.	• With walking on sidewalks, the width is a crucial dimension, since passing is possible only when there is enough width to pass easily (Untermann 1984, pp 25-28). Recommended width for sidewalks in mixed use development is 3,5 m to 4,5 m, clear of any street furniture (Cartwright 1980, p 42).	
Public furniture and landscaping.	• The minimum height for signs over pavements should be no less than 2,1 m (Cartwright 1980, p 99).[3] • Planters, kerbs, rails and other raised surfaces can be used for seating. Any height up to 600 mm will work, with 400 mm being the best. A width of at least 160 mm is appropriate.	

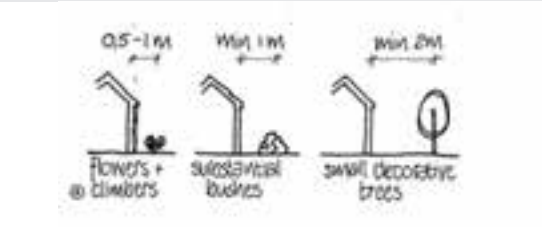
Table 5.3.13: Dimensions and distances (continued)		
Mixed-mode streets (continued)		
Public furniture and landscaping (continued).	• Appropriate distances of plants to be placed from the facade of buildings are the following: - Flowers and climbers: 0,5 m to 1 m away; - Substantial bushes: minimum 1 m away; and - Small decorative trees: minimum 2 m away. • The bigger the ground surface of the plants, the wider the sidewalk should be to ensure safety and ease of movement for pedestrians. [4]	
Pedestrian-orientated streets		
Widths and slopes.	• The maximum gradient of bicycle tracks should be 5% (1:20), with a maximum cross-fall of 2,5% (1:40). • The maximum gradient of footpaths should be 1:12 and the minimum gradient should be 1:200 (for stormwater), with a minimum cross-fall of 1:30 (3,3%). • The minimum width of dedicated pedestrian walkways in these streets is 0,8 m. • When planting slopes with grass, bear in mind that maximum slopes for mowing machines should not exceed 1:1.5, while for tractors they should not exceed 1:3 (Cartright 1980, p 13).	

Table 5.3.13: Dimensions and distances (continued)		
Pedestrian-orientated streets		
Widths and slopes (continued).	• The minimum width of a one-way bicycle track is 2,75 m and for a two-way track it is 3,6 m (Cartwright 1980, p 43). • The maximum width for a dedicated pedestrian walkway is 12 m.	
Distances.	• To maintain coherence and safety, the maximum length of a pedestrian-orientated street should be 140 m, which is the maximum distance for discerning action.	
Public furniture.	• Bollards should not be higher than 800 mm to avoid interference with motorists' sight lines (Cartwright 1980, p 67). • A distance of 1,20 m between bollards will bar any car from access (Cartwright 1980, p 67). [1]