GOALS, OBJECTIVES AND FUNCTIONS OF RESIDENTIAL STREETS

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A goal and objective statement provides direction to the design process. This article uses a sociological review of suburbia, a study of attitudes towards the importance and satisfaction with aspects related to the residential area, and a review of goals and objectives in nineteen design guides to develop a statement of goals and objectives which can be used in the design of residential road networks.

'n Doelwit- en oogmerkuiteensetting verskaf rigting aan die ontwerpproses. Hierdie artikel gebruik 'n sosiologiese oorsig van die voorstede, 'n studie van houdings oor die belangrikheid en tevredenheid met aspekte rakende die woongebied, en 'n oorsig van doelwitte en oogmerke in negentien ontwerpgidse om 'n stelling van oogmerke en doelwitte te ontwikkel wat in die ontwerp van residensiële padnetwerke gebruik kan word.

1. INTRODUCTION

Since planning should focus on people and their needs, this article sets out, in the first section to show, from the literature, how suburbia developed, its sociological needs and its role in the future. In the second section, the findings of a study (included in Cameron, 1984) on attitudes of residents to attributes of the residential area, are summarized. The third section summarises a review of goals and objectives from nineteen references before proposing a goal statement for residential streets.

2. MAN IN SUBURBIA

2.1 The Attraction of the city.

The increase in urban population must indicate that urban living is perceived to have more advantages than rural living. Bird (1977:25) writes that "in the city he (the resident) experiences greater contrasts between intelligence and ignorance, tolerance and prejudice, wealth and poverty, splendour and squalour". It is this contrast that provides the variety of opportunities which continues to attract people to the city.

2.2 Historical development of suburbia.

Unfortunately, this variety also brings with it the negative aspects of the city. These conditions are generally found in the inner suburbs. This has prompted the urban resident who has the means, to try to escape these conditions. He has usually escaped by moving to newer areas on the periphery of the city.

If one traces the emergence and development of suburbia in England, it can be considered to begin with the landed gentry in Victorian times who developed their country estates. They saw these as their home and their city dwellings as necessities of commercial and political life.

With the advent of the railway and the increased income resulting from industrialization, it became possible for more people to seek refuge from the worst aspects of city life by moving to the outskirts of the city. While these homes were not the country estates of the landed gentry, they did allow "the working class to join the exodus from the cities, partly out of choice and partly because they were compelled to do so as their homes crumbled around them and their standards rose" (Glass; 1972:343).

The residents of these early suburbs continued to focus on the existing city centres for their work and social opportunities. As such these suburbs became dormitory towns. To overcome this condition, Ebenezer Howard proposed the "garden cities" concept, whereby suburban cities would be more complete, be heterogeneous in population and providing a full range of work, social and recreational opportunities. Howard's plan did allow for a link between similar cities. This link was limited to a railway line and the size of the individual towns was fixed by walking distance of the stations.

The advent of the motor car freed the suburbs from their dependence on the railway station. Residential development could therefore be located in any location that was served or could be served by a roadway. This new freedom brought with it an explosion in the demand for suburban accommodation. It also brought with it the worst examples of suburbia.

2.3 Criticism of suburbia.

Mumford (1966:533) is very critical of suburbia, which he describes as follows:

> "A multitude of uniform unidentifiable houses lined up inflexibly at uniform distances on uniform roads in a treeless communal waste, inhabited by people of the same class, the same income and the same age group, witnessing the same television, eating the same prefabricated foods from the same refrigerators,

conforming in every inward and outward aspect to the common mould manufactured in the central metropolis".

In an earlier article, Mumford (1948) wrote that a community spirit is essential for the fate of mankind and that "barriers between classes, groups, sects and people of different financial and social status must be broken down". The uniform suburb tends to isolate and insulate social groups.

2.4 Support for suburbia.

Willis (1972:347) also supports the need to develop community spirit and sees this development being achieved through the development of neighbourhoods with a certain degree of uniformity. Glass (1948:77) writes that social integration should have occurred to such an extent that it should be possible to identify the neighbourhood socially and physically.

Soen and Agnon (1980:84) report that "while numerous studies have shown that social mixing is good for community creation, there are an equal number that show it to lead to conflict and unhappiness". From a review of research findings on this issue, they conclude that:

> "On the level of the neighbourhood unit there should be homogeneity in order to establish the following:
> 1. Sufficient consensus among neighbours to prevent conflict.
> 2. Positive relations between neighbours.
> 3. The possibility of establishing friendships among those who wish to do so in their immediate surroundings."

2.5 Suburbia.

Observation of South African cities suggests support for the "uniformity" model for suburbs. This style of residential development is prevalent in other cities as well. Thorns (1977:227), Burnett (1978:313) and Rapoport (1980:126) report that suburbia is a way of life aspired to by many; not only in cities in Australia and the United States which can be considered to have developed after the motor car, but also in England, Israel, France, Germany and Japan. Suburbia is aspired to by both those who can afford it as well as those who cannot.

Four reasons can be put forward for the continued development of suburbia; namely:

1. Suburbia is perceived to have a better environment than the inner city and provides a greater opportunity for a healthy life for the family. It also has an implied better status.
2. Industrialization has resulted in more women working. Thus families have fewer children and do not depend on the extended family for support. Since land costs are lower on the outskirts of the city, the costs of a dwelling are also lower there. Therefore the young family will for economic reasons establish itself in the newer suburbs on the outskirts of the city.
3. A family will tend to locate among other residents which they consider to be their social peers. In choosing a place to stay, families will be influenced by what they perceive will be the social status of existing and potential residents.
4. The form of suburbia with its detached house on its own piece of land provides the opportunity for the family to enjoy activities impossible in other forms of housing. One argument for suburbia traces the D.I.Y. activity in suburbia to the lack of job satisfaction which has resulted from mass production in industry. In an attempt to regain the satisfaction inherent in the work ethic of the Western Protestant Culture, suburban man becomes involved in D.I.Y. projects around the home. (Thorns, 1977:109).

Suburbia is therefore exemplified by an area almost totally devoted to residential purposes, in which the dwellings are generally ground related. The development of suburbia is based on a choice of residential location and the financial ability to own one's own property. This is accompanied by the ownership of a motor car (or more), which the density of suburbia necessitates. One must remember that the emergence of suburbia as we know it today is based on the family having access to a motor vehicle. This raises two issues:

1. The "suburbia" model cannot be applied directly to residential areas for lower income, non-car-owning families.
2. The motor car has become the dominant factor not only in the design but also in the environmental conditions experienced in the residential area (Northamptonshire, 1978:27).

2.6 The social role of the street in suburbia.

Soen and Agnon (1980) found in their study that there is a need for opportunities to establish friendships among those who wish to. Social contacts cannot be made from a motor car. They require personal pedestrian approaches. One could argue that the affluence of suburban residents permits them to develop friendships and social contacts from a wider spatial range than the immediate vicinity of the dwelling. But as Soen and Agnon suggest, this need for social contact also exists within the neighbourhood as well.

This need is even greater among children, adolescents and the aged who are not as mobile as the middle aged, since they do not have easy access to the motor car.

Safdie (1970:160) gives as one of the criteria for housing that "a child of this age (3-6) should be able to leave the family and wander a minimum distance of 150 feet (50 meters), meet at least 10 friends of his age and find a safe place to play". Mead (1972:246) writes "Although parents will tend to restrict the child's social interaction as a way of protecting the child, the child also needs a variety of experiences if he is to grow up into an adult able to face the world". Concerning the older child, Mead also writes (1972:249) "every neighbourhood should have places where older children can move freely away from familiarity with confidence to learn to trust strangers and the strange".

With the concern which parents have for the well being of their children, the local street outside the dwelling should be an ideal venue for the social interaction and development of children. In this location:

1. Parents can supervise their children at play.
2. Children will meet other children and adults who have gained the approval of their parents; either tacitly since parents in choosing a place of residence have chosen to live among

their peers; or directly due to parents knowing their neighbours.

3. A knowledge of who the neighbours are, would allow parents to recognise strangers and give them the confidence that adequate and timely action could be taken to protect their children.

2.7 Conclusion.

The local street appears to be an ideal location for the social development of the child, as well as the place where neighbouring contacts could begin and develop; but vehicular traffic could be such that it could prevent these social exchanges taking place. The two aspects of vehicular traffic which will determine whether the local street can be used as a venue for social contact are vehicular speed and vehicular volume. These two factors also affect the degree of danger, noise and pollution which may inhibit social interaction.

3. A SURVEY OF ATTITUDES AND CHOICES

Cameron (1984) discusses the findings of an interviewer assisted self-administered questionnaire which covered the following three areas:

1. Trip-making patterns within the residential area.
2. Attitudes to the residential area.
3. Socio-economic data.

3.1 The study.

The attitudinal study had the following two objectives:

"1. To determine the overall and relative importance of dwelling, street environment and accessibility attributes in the choice of dwelling places.
2. To assess the residents' satisfaction with road related qualities of the environment, notably traffic noise, safety, vehicle speed and the appearance of the street."

A survey was made during March 1981 of 690 households in eight residential areas in South Africa. The name, size and sample size of the eight residential areas are given in Table 1. The eight study areas were selected "to give the study breadth and to accommodate attitudes to widely differing environments and standards". The data collected for Queensborough was found to be inaccurate and incomplete and as such was not analysed. Six of the remaining seven study areas housed members of the White population group, and Mitchell's Plain provided housing for Coloureds.

TABLE 1. SAMPLE SIZE OF STUDY AREAS

	Number of households in study area	Sample size	Sampling fraction (%)
Wingate Park	643	100	15,6
Danville	1 131	85	7,5
Kensington B	424	69	16,3
Queensborough	1 551	50	3,2
Durban North	537	100	18,6
Plumstead	1 408	80	5,7
Edgemead	1 095	100	9,1
Mitchells Plain	381	106	27,8
Total	7 170	690	9,6

As a result of the pilot testing, an interviewer assisted self-administered questionnaire was selected as the most appropriate survey method.

3.2 The questionnaire.

The attitudinal section of the questionnaire addressed three issues:

1. How residents rated the importance of 27 attributes in choosing a home.
2. Which of these attributes influenced them in choosing the dwelling in which they were living.
3. How satisfied residents were with 21 attributes of their residential area.

The 27 attributes which residents were asked to rate as extremely important, very important, somewhat important, of little importance and of no importance, were:

1. Nearness to schools
2. Nearness to a particular school
3. Nearness to husband's place of work
4. Nearness to wife's place of work
5. Nearness to family or friends
6. Nearness to church
7. Nearness to shops
8. Nearness to a bus route
9. Nearness to another activity to be specified by the respondent
10. The price or rent of the dwelling
11. The size of the dwelling
12. The appearance of the dwelling
13. The kitchen
14. The number of bathrooms
15. The number of bedrooms
16. The dwelling is on a main road
17. The dwelling is on a quiet road
18. The dwelling faces north
19. The stand faces north
20. The garden is attractive
21. There is a secluded garden
22. There is a swimming pool
23. The dwelling is set well back from the road
24. The suburb has status
25. The streets are wide
26. The streets have trees
27. Other attributes to be specified by the respondent.

The attributes can be grouped as follows:

Attributes 1 to 9 are attributes associated with proximity or accessibility.

Attributes 10 - 15 are attributes associated with the dwelling and value for money.

Attributes 18 - 23 are attributes associated with the property.

Attributes 16, 17, 25, 26 are attributes associated with the road.

Attribute 24 is an attribute associated with the suburb.

In the second question, respondents were asked to indicate which of these 27 attributes influenced them in choosing the home in which they were living.

The third question of the home interview survey requested respondents to indicate their satisfaction, on a scale of being very satisfied, quite satisfied, neutral, somewhat dissatisfied and very dissatisfied, with respect to the following 21 attributes:

1. The level of noise from neighbouring property
2. The level of noise from the road during the early morning
3. The level of noise from the road during the day
4. The level of noise from the road in the early evening
5. The level of noise from the road in the evening
6. The level of noise from the road during the night
7. The safety of the road outside their homes for strolling with children and pets
8. The level of safety of the road outside their home for children (6-12) walking to school.
9. The level of safety of the road outside their home for children (13-17) walking to school
10. The level of safety of the road outside their home for children (6-12) cycling to school
11. The level of safety of the road outside their home for children (13-17) cycling to school
12. The level of safety of the road outside their home for children (6-12) playing on the verge
13. The level of safety of the road outside their home for children (13-17) playing on the verge
14. The level of safety of the road outside their home for children (6-12) playing in the roadway
15. The level of safety of the road outside their home for children (13-17) playing in the roadway
16. The speed of vehicles in the street
17. The volume of vehicles in the street
18. The time to get to a specified location
19. The ease with which the driver could exit his driveway
20. The appearance of the street
21. Overall satisfaction.

These attributes could be grouped as follows:

1. Noise from the neighbours.
2. Noise from the roadway.
3. The safety of children using the roadway.
4. Vehicular conflict in terms of speed, volume and ease of entry into the traffic from the properties.
5. The appearance of the street.
6. The overall satisfaction.

3.3 Importance of attributes.

These data were analysed using a categorical judgement analysis package developed by the NITRR. The categorical judgement analysis technique is a uni-dimensional scaling method which can be used to measure psychological attributes. The method transfers the properties of the number of times a particular attribute was judged greater than another, into distances on a scale. The position of the attribute relative to the attribute category indicates that the population as a whole is likely to rate the attribute as shown on that scale.

Table 2 shows the order of importance of the attributes which were adjudicated very and extremely important by respondents.

TABLE 2. SUMMARY OF IMPORTANCE RATINGS OF ATTRIBUTES

	W.P.	D.	K.B.	D.N.	P.	E.	M.P.	ALL
Appearance	1	6	6	6	4	3	5	4
North facing	2		7					
Size	3	3	3	2	2	2	2	2
Quiet Street	4	5	2	4	6	6	9	5
Number of bedrooms	5	4	4	3	3	4	3	3
Price	6	1	1	1	1	1	1	1
Number of bathrooms	7	9						
Status of suburb	8			6		5	7	7
Near bus route		2					4	8
Near shops		7	5	5	5		6	6
Near church		8						
Near schools				7			8	9
Secluded garden						7		
Attractive garden						8		10

The values in the table represent the ranking of the importance of the attribute. Only attributes ranked as very or extremely important are ranked.

W.P.	Wingate Park	D.N.	Durban North	M.P.	Mitchell's Plain
D.	Danville	P.	Plumstead	ALL	All study areas
K.B.	Kensington B	E.	Edgemead		

If one examines the report by Cameron (1984) and Table 2, the following aspects can be deduced:

1. Due to the quality of the responses received, four attributes were omitted from the analysis. These were the kitchen, being on a main road, the specified proximity attribute and the "other" attribute.
2. Five attributes were considered extremely or very important by the respondents of seven study areas; namely:
   a) Price of the dwelling
   b) Size of the dwelling
   c) The number of bedrooms
   d) The appearance of the dwelling
   e) The dwelling is on a quiet street.
3. Attributes which were also considered very important for the survey area as a whole were (The number of suburbs in which they were considered very important is given in brackets):
   a) Near Shops (5)
   b) The suburb has status (4)
   c) The dwelling is near a bus route (2)
   d) The dwelling is near schools (2)
   e) The dwelling has an attractive garden (1)

3.4 Factors influencing choice of the present dwelling.

Table 3 summarizes the replies of the respondents to the question about which of the 27 attributes influenced the choice of the dwelling in which they were living at present. (Once again the four attributes of the kitchen, living on a main road, the proximity to a specified location and a request for other attributes have been omitted from this analysis.) From this table it can be seen that:

1. The price of the dwelling was the only attribute to influence the choice of dwelling of more than 40% of the respondents in all of the study areas.
2. The size of dwelling influenced the choice of dwelling of more than 40% of the respondents in six of the study areas.
3. Appearance of the dwelling influenced the choice of dwelling of more than 40% of the respondents in six of the study areas.
4. The number of bedrooms and the proximity to shops influenced more than 40% of the respondents on the selection of their dwelling in three of the study areas.
5. Proximity to schools influenced more than 40% of the respondents in the choice of their dwelling in two of the study areas.
6. The fact that the dwelling face north, that it was on a quiet street, that the suburb had status and that the dwelling was close to a bus route influenced more that 40% of the respondents in the choice of their dwelling, in one study area.
7. When all the study areas are considered together, the factors which influenced the choice of dwelling were:
   a) Price of dwelling
   b) Size of dwelling
   c) Appearance of dwelling
   d) Proximity to schools
   e) The number of bedrooms
   f) The dwelling is on a quiet street
   g) The proximity to shops.

The last two attributes were considered to have influenced 30% of the respondents' choice of dwelling.

A comparison between the findings discussed in Sections 3.3 and 3.4 is shown diagrammatically in Figure 1. From this figure it can be seen that all the attributes were considered to be more important at the time of the survey than at the time when the dwelling was chosen. This could be due to a change in perception as to what is considered important. This change could have resulted from experiences gained through actually living in the dwelling or because some attributes may have been underestimated at the time the dwelling was selected.

Another important aspect to emerge from this comparison, for road planning purposes is the importance given to "quiet street" which was rated fifth in importance although only rated seventh in relation to the attribute that influenced the choice of the present dwelling. This can be taken to imply that the need for a quiet street is not adequately rated at the time that the dwelling is selected.

3.5 Satisfaction with attributes.

Since there was a considerable amount of missing data in the responses to this question, the five road noise factors were grouped into a single factor "street noise, and the nine safety factors were grouped into two safety factors. The first factor "safety functional" is related to the satisfaction of the safety of walking and cycling and "safety for play" is the second factor, which is related to the satisfaction with the safety of children of both age groups "playing in the street".

The values on the rating scales for satisfaction have been summarized in Table 4.

From the report by Cameron (1984) and Table 4, the following are noted:

1. Residents in all seven study areas were very or quite satisfied with the overall home environment, the noise from the neighbours, the noise from the street and the ease with which they could exit their driveways.
2. Residents in six of the study areas were quite satisfied with the appearance of the street.
3. Residents in five of the study areas were quite satisfied with the amount of traffic.

TABLE 3. DWELLING CHOICE FACTORS

Stimulus	Percentage who choose dwelling for this factor							
	Win. Park	Dan-ville	Ken. B	Durban North	Plum-stead	Edge-mead	Mitch. Plain	All Suburbs
Nearness to schools	21	33	23	47	38	20	64	37
Nearness to a particular school	2	13	17	16	11	2	3	9
Nearness to husband's work	18	17	15	23	11	17	3	15
Nearness to wife's work	2	2	9	7	1	1	1	3
Nearness to family	8	6	20	14	25	10	4	11
Nearness to church	5	10	9	13	14	2	19	11
Nearness to shops	8	15	29	56	44	6	49	30
Nearness to a bus route	15	23	17	37	29	5	40	23
Price of dwelling	57	80	59	59	84	82	70	69
Size of dwelling	54	19	42	56	78	60	52	51
Appearance of dwelling	45	11	30	42	60	54	36	40
Number of bathrooms	36	5	15	20	8	4	2	13
Number of bedrooms	40	13	29	38	55	25	46	35
Dwelling is on a quiet road	45	13	39	39	30	23	21	30
Dwelling faces north	46	1	36	12	14	19	2	17
Stand faces north	14	0	7	2	5	4	0	5
Attractive garden	9	0	22	18	19	10	1	11
Secluded garden	10	0	20	28	11	22	0	13
Swimming pool	5	0	16	7	8	5	1	6
Dwelling is set back from road	7	0	10	14	11	7	5	8
Suburb has status	28	3	9	44	21	33	34	25
Streets are wide	6	0	6	9	5	8	10	6
Streets have trees	3	1	9	15	5	7	1	6

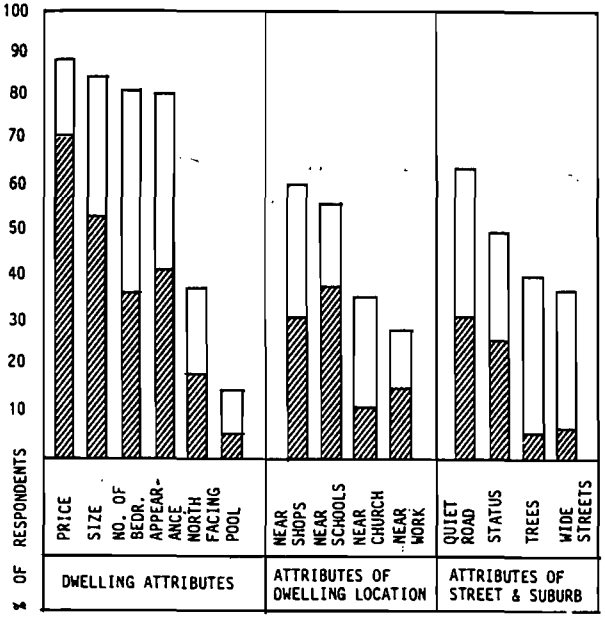


FIGURE 1:

IMPORTANCE OF FACTORS IN DWELLING CHOICE.

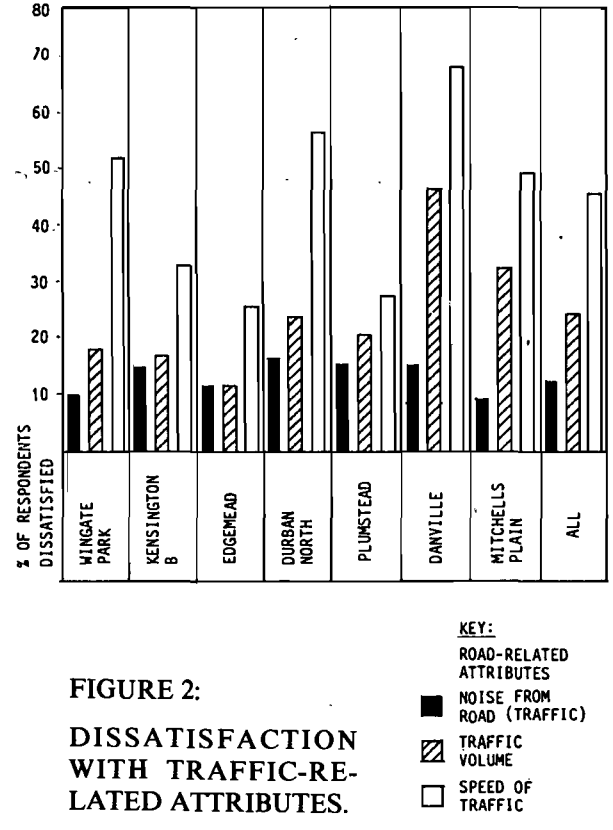


FIGURE 2:

DISSATISFACTION WITH TRAFFIC-RELATED ATTRIBUTES.

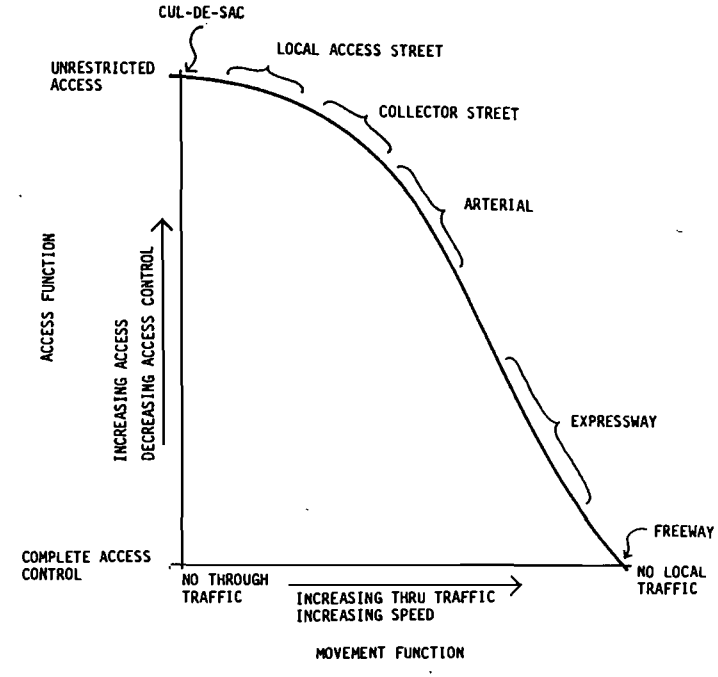


FIGURE 3: ACCESS AND MOBILITY. (AFTER ITE; 1967)

4. Residents in two of the study areas were quite satisfied with vehicle speeds and "safety functional".
5. Respondents in five of the study areas were somewhat dissatisfied with the attribute "safety play".
6. Respondents in three of the study areas were somewhat dissatisfied with vehicle speeds and "safety functional".
7. Respondents in one study area were somewhat dissatisfied with the amount of traffic.
8. When the study areas were considered as a whole the respondents replied that they were somewhat dissatisfied with "safety play".

Three aspects are of particular relevance to the design of residential streets; namely:

1. Traffic noise
2. Traffic volume
3. Traffic speed.

The percentage respondents reporting dissatisfaction with these three variables is shown diagrammatically in Figure 2. The diagram suggests that respondents in Wingate Park, Durban North, Danville, Mitchell's Plain and the seven study areas taken as a whole, were dissatisfied with the vehicular speeds and those of Danville were also dissatisfied with vehicular volume.

3.6 Conclusions on the survey of attitudes.

The study of the attitudes of residents to the importance of and satisfaction with attributes in the residential area provides a factual foundation for describing the needs of residents in residential areas:

1. There is a need for a quiet street. The road network designer has some control over this attribute which is considered as one of the most important. The price of the dwelling can only be marginally affected by the planner; while he has absolutely no influence over the appearance of the dwelling or the number of bedrooms.
2. The residents showed dissatisfaction with the use of the street by children and with vehicular speeds.
3. Since the importance with which residents rate the attribute "quiet street" increased significantly from the time of choice to the time of survey; one must presume an increasing degree of dissatisfaction with this variable. Since the residents were all satisfied with the attribute. noise, it must be deduced that "quiet street" has a broader meaning to the respondents than simply that of a noise related attribute. It is suggested that the attributes such as safety play, vehicular speed, safety functional and vehicle volume all form part of the "quiet street" attribute.
4. The residents in most suburbs were not satisfied with the attribute safety play and vehicular speed on the roads fronting their dwellings.

TABLE 4. SUMMARY OF SATISFACTION RATINGS OF ATTRIBUTES

	W.P.	D.	K.B.	D.N.	P.	E.	M.P.	ALL
DISSATISFACTION								
Safety Play	1	1	1	1	1	1	1	1
Vehicle speed	2	7		2				
Safety functional	3	3		3				
Amount of traffic		4						
SATISFACTION								
Overall	1	1	2	1	1	1	1	1
Exitting from driveway	2	3	1	5	1	1	5	4
Street noise	3	4	3	3	4	3	1	3
Appearance of street	5		4	4	5	5	4	5
Amount of traffic	6		6		6	6	5	6
Neighbours' noise	4	2	5	2	3	4	2	2
Vehicle speed					7	7		
Safety functional					8	8		

The values in the table represent the ranking of the satisfaction or dissatisfaction with the attribute. Only attributes ranked as very or slightly dissatisfied and very or quite satisfied were ranked.

W.P.	Wingate Park	D.N.	Durban North	M.P.	Mitchell's Plain
D.	Danville	P.	Plumstead	ALL	All study areas
K.B.	Kensington B	E.	Edgemead		

4. A SUMMARY OF GOALS AND OBJECTIVES.

4.1 Preamble.

Goals are defined as "statements of idealized end-states of the total environment towards which planners strive when they plan a system or some part of it". (NITRR, 1979). Objectives are "desired factual states which are expressed in such a way to allow measurement of the degree to which they have been achieved." (NITRR, 1979).

A review (Del Mistro, 1987) of 19 references is shown in Table 5. An examination of the aspects listed in this table shows that many of them are interrelated. Nevertheless, an attempt has been made to group the aspects into the following three categories, in relation to the scale of planning on which the aspects focus:

1. The residential area.
2. The residential road network.
3. The residential street.

4.2 The residential area.

The word 'livability' is not defined precisely in any of the references. Nevertheless, it must be assumed to include the opportunity for social activity. This would involve person to person contact which can only be achieved as pedestrians. Also included in the notion of livability are personal safety, privacy, and an appropriate environment, free from noise and air pollution and with an aesthetic quality congruent with perceptions.

The economy of the development is also related to the residential area as a whole. This aspect will be composed of the capital cost of servicing the residential area, the cost of maintaining these services and minimizing the use of scarce resources, the amount of land allocated for circulation and the length of roads. These costs together with the operating costs could also have been considered to

be related to the residential road network.

Two aspects which are considered to be in conflict with one another are design guidelines which are used as such and not in practice applied as rigid standards, and the application of standards rigidly to expedite the approval of plans by the bureaucracy. Using the guidelines as guidelines result in designs which are an amalgam or prescriptive of design standards and techniques. The design guideline approach should result in a residential environment which attempts to maximize livability. This would be physically evident from the variety of street forms. It is important that the guidelines should therefore not become standards, and that agencies responsible for approval or implementation apply objectives rather than standards. The fear that an approach without standards will lead to unrealistic costs is not valid since one of the objectives is precisely that of minimising costs.

From a land use planning point of view, the location of major generators of pedestrian, cycle and vehicular traffic, must be planned to achieve convenience and accessibility with a minimum of side effects. The street system to a large extent dictates the shapes and sizes of the residential erven. These shapes should not unduly inhibit the way in which the erf can be developed. Generally, in residential areas this is only a problem where erf sizes are small. Here care should be taken to ensure that the resulting erven can be developed economically.

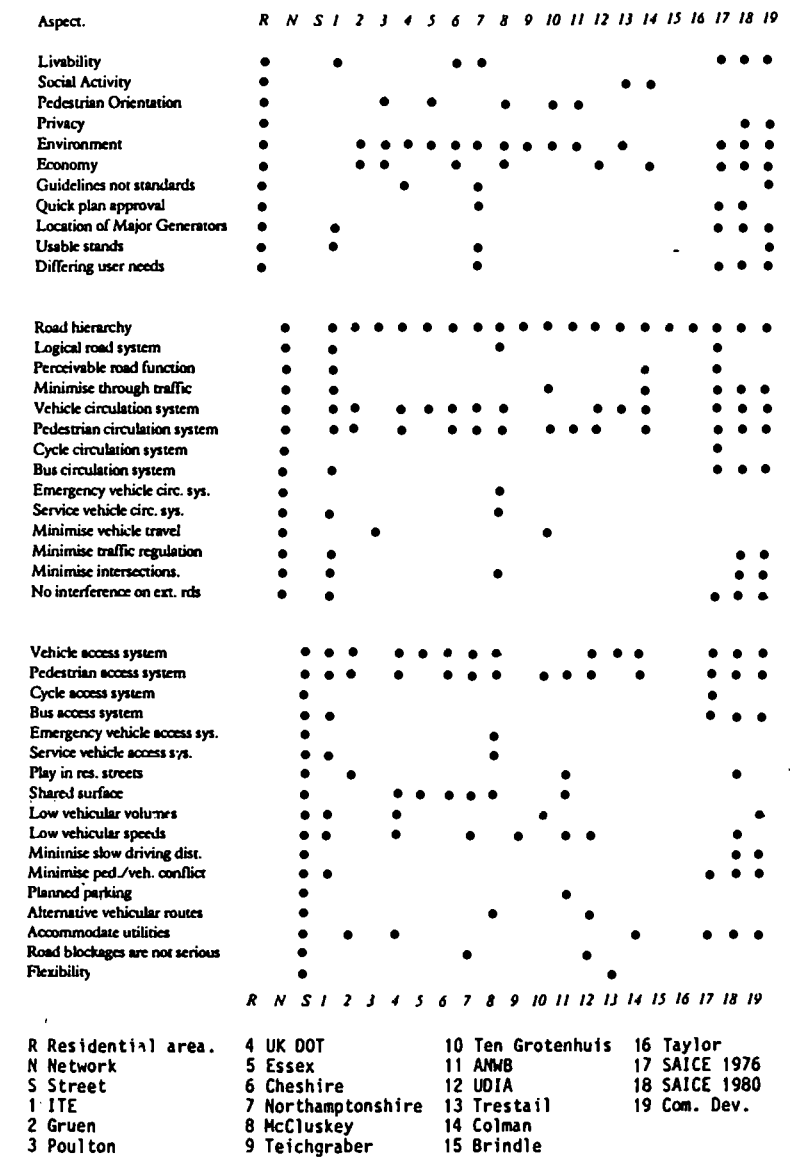
The final aspect related to the residential area is the need to consider the requirements of all the road users. Thus the residential area should cater for pedestrians, cyclists, motorists as well as buses and emergency and service vehicles. Not only will the needs of these different users be different from one another, but they will also differ for each user depending on the location whithin the residential area.

4.3 The residential road network.

An aspect referred to by all the references was that of the road hierarchy. ITE (1967) shows the relationship between mobility and access (Figure 3), but Brindle (1979) suggests that this relationship is not as perfect in practice as would be expected from a tributary system.

TABLE 5

SUMMARY OF THE REVIEW OF GOALS FOR RESIDENTIAL STREET DESIGN



The implementation of such a road hierarchy would result in a logical road system in which the function of each road could easily be perceived by the road user. If this is the case the amount of through traffic using the residential road network would be minimized.

The amount of travel on the residential road network would be minimised if the network provided an adequate, convenient and safe circulation system. The literature seems to direct its attention in this regard towards the motor vehicle. The needs of all road users must be considered in designing the circulation system.

Four other aspects related to the road network referred to in the literature are:

1. The need to make the residential road network self regulating external enforcement of safe motorist behaviour in residential streets is impossible. It is expected that an hierarchical road system would result in this requirement being fulfilled.
2. The need to minimize the number of intersections, so that the number of conflict situations between vehicles is reduced. One should also note that a reduction in the number of intersections will be accompanied by a reduction in the length of roadway.

3. The traffic from the internal road network should not interfere with the traffic operation of the major roads bordering on the residential area.
4. UDIA (1978) mentions the need for the road to endure harsh weather conditions. While this might be taken to refer to the structural strength of the roadway it can also be taken to refer to conditions when the road is totally or partially blocked, for which McCluskey (1979) suggests that alternative routes must be available. McCluskey mentions that the consequences of such blockages must not be serious. Therefore the more important a route is, the more certain one should be that the route will always be open to traffic. Teichgraber supports the need for alternative traffic routes as a general condition.

4.4 The residential street.

Each dwelling requires an adequate, convenient and safe access system. To fulfil the social activity it is necessary to permit playing in the street. This will require that vehicles and pedestrians share the roadway. To make this possible vehicular volumes will have to be kept low and vehicle speeds controlled. Motorists cannot be expected to voluntarily travel at slow speeds indefinitely. This also suggests the need for two types of road; i.e. one for access and another for movement. Pedestrian/vehicular conflicts must be minimized. This refers not only to the number of conflicts but also to their severity. This would be achieved if access streets are perceived to have a pedestrian orientation, while specific pedestrian facilities are provided to accommodate pedestrian needs in roads having a movement function.

Because pedestrians may dart between parked cars parked vehicles are reported in the literature as contributing to pedestrian accidents. The literature debates whether parked vehicles should or should not be permitted in residential streets, and if they are permitted should they be restricted to specific parking bays as required in the 'woonerf' approach (ANWB;1980). Since the streets in the residential area are in public ownership they provide a suitable corridor for the location of engineering services.

Finally, one should consider the need specified by Trestail (1978) that residential streets should be flexible in terms of their vehicle carrying capacity. He suggests that a 20 meter road reserve can accommodate a 6 metre roadway or 13 metre roadway. This approach is considered to contradict many of the aspects mentioned earlier; such as the need for a variety of street forms, the need to clearly indicate the function of each street element; the need to ensure that traffic volumes in residential streets are kept very low, to ensure pedestrian orientation and in terms of 'livability' the need for an environment free of noise and air pollution.

5. THE STATEMENT OF GOALS AND OBJECTIVES.

5.1 Preamble.

In the formulation of a statement of goals and objectives for the design of residential streets it should be noted that the review also provides direction on three aspects. Firstly, there are three levels of planning for which goals should be developed; namely, the residential area, the residential road network, and the residential street. The street can be considered in one of two forms, either for access or for movement. Secondly, the words used in the discussion suggest that the goals and objectives could be grouped in terms of environment, safety, cost efficiency and convenience. Finally, while most of the discussion leads towards objectives dealing with the quality of the residential road network it also identifies the following four functions for the residential street:

1. The provision of access to abutting properties.
2. The facilitation of social activity.
3. The movement of vehicles.
4. The accommodation of engineering services.

5.2 Goals and objectives for residential areas.

5.2.1 The goal for the residential area is as follows:

"To maximize the utility and livability of the residential area while minimizing the cost of its development, maintenance and operation."

5.2.2 The objectives in support of this goal are:

a) To maximize the number of erven with the size and dimensions appropriate to the needs of the residents.
b) To locate non-residential activities within the residential area so that internal convenience is maximized and externally generated traffic is minimized.
c) To minimize the amount of land used for circulation.
d) To minimize the total cost of servicing the residential area.

5.2.3 The success of the design of a residential area in meeting the first objective may be measured by the number of erven that have the appropriate dimensions, while the success of the design in achieving the remaining objectives may be measured in terms of the road network and residential street goal and objectives statements.

5.3 Goals and objectives for the residential road network.

5.3.1 The goal for the residential road network is:

"To structure the residential area so that the residents can enjoy maximum livability and convenience at minimum cost."

5.3.2 The objectives which support this goal are:

a) The road network should not result in the invasion of the privacy of the individual properties from vehicles on major roads.
b) The safety of vehicular traffic should be promoted by minimizing the number of intersections and a network structure which does not expect motorists to travel at slow speeds for an excessive amount of time.
c) External traffic must be prevented from travelling through the residential area.
d) The internal road network should not result in interference with the flow of traffic on the external major road network.
e) The road network should regulate the behaviour of vehicular traffic.
f) The length of the road network should be minimized.
g) The length of roadway carrying heavy vehicles should be minimized to reduce the cost of road construction.
h) Since the road network will influence the location of the engineering

services; its design must aim at minimizing the total cost of engineering services.

i) The amount of internal travel must be minimized.

j) The convenience in gaining access to the non-residential activities by residents must be maximized.

k) The network must accommodate a bus system which is convenient to the resident.

l) The network should provide the means to minimize the effects of road blockages on the residents and especially on emergency vehicles.

5.3.3 The achievement of these objectives can be measured as follows (addressed in the same order as the objectives):

a) This aspect can only be measured by the residents themselves; although the planner must take this aspect of the design into account.

b) The number of intersections in the design can be counted. The length of roadway over which motorists are expected to travel slowly for longer than a specified period can also be measured.

c) The travel time on the shortest route through the residential area can be compared with the travel time using routes external to the residential area. Trip assignment techniques could be used to calculate the through traffic.

d) The number, location and traffic volumes of the access points onto the major road system can be studied to determine the traffic conditions resulting from the access facilities.

e) The use of Tee-junctions results in the self-regulation of traffic. Roundabouts can also be used to this end. Since four leg intersections do not achieve this, their number can be taken as a measure of failure to achieve this objective.

f,g) The length of roadway can be measured. The measurement can be made more accurate by considering the construction costs of specific sections of road; taking into account the width and structure of the road section.

h) The total costs of providing engineering services for alternative designs can be compared.

i) The amount of internal travel needed to satisfy the requirements of residents to participate in urban activities can be estimated.

j) The measure of (i) would also be a good indicator of the accessibility of non-residential activities.

k) The proportion of the population which resides beyond the acceptable walking distance from a bus stop can be estimated.

l) A policy can be determined to specify how close emergency vehicles must get to a dwelling. The proportion of dwellings which are located within this specified value, for a range of road blockage conditions, can be estimated to ascertain the achievement of this objective.

5.4 Goals and objectives for residential streets for access.

5.4.1 The goal for a residential street for access is:

To create a place from which dwellings can gain access and in which social activity can occur in safety while at the same time minimizing the cost of this component of the circulation system.

5.4.2 The objectives in support of this goal are:

a) The access street should be designed as an urban place.

b) The design of the roadway should not be uniform or standardized.

c) The noise levels should not exceed acceptable levels.

d) Air pollution should be kept within acceptable limits.

e) Vehicular volumes should not exceed acceptable volumes.

f) The pedestrian should be considered to have priority.

g) Vehicular speeds should not exceed acceptable speeds.

h) The length of roads should be short enough for motorists to accept low speed driving conditions.

i) Provision should be made for parked vehicles.

j) The amount of land used for roads for movement should be minimized.

k) The cost of engineering services, including road construction should be minimized.

l) The road reserve can act as a corridor for engineering services.

5.4.3 The achievement of these objectives can be measured as follows:

a,b) While the measurement of the aesthetics of the access street can only be measured when the street has been fully developed; aspects of urban design can be incorporated in the planning of the street.

b,c) The volume of vehicular traffic can be estimated.

d,e) This measure can be used to estimate noise levels, air pollution levels and whether the volumes are appropriate for an urban place in which social activity is being facilitated. The proportion of dwellings abutting sections of the roadway with unacceptable traffic conditions can be calculated.

f,g) The maximum speed which is considered to permit the sharing of the road space by both pedestrians and vehicles can be determined. An estimate can be made of the vehicular speeds on the road. The proportion of erven facing sections of road on which speeds can be attained which are incompatible with the safety of the shared roadway can be calculated.

h) Having defined the length of road over which motorists would accept low speed driving, the length of roads on which dwellings abut which exceed this length, can be measured.

i) The aesthetic treatment of the provision of parking facilities must be considered in terms of creating an urban place.

j,k) The amount of land used for circulation could be calculated in the assessment of the achievement of the network related objectives; as could the cost of road construction and the installation of engineering services.

5.5 Goals and objectives for residential streets for movement.

5.5.1 The goal for residential streets which facilitate the movement of vehicles is:

The provision of a safe and convenient corridor for the movement of vehicles at a minimum cost.

5.5.2 The objectives in support of this goal are:

a) To provide a road alignment which is environmentally pleasant.

b) To locate the roads for movement so that they do not reduce the privacy of residents.

c) To ensure that noise levels emanating from vehicles using these roads do not become unacceptable.
d) To ensure the safety of all road users by applying the appropriate geometric standards for the anticipated vehicular speeds and volumes.
e) To provide the appropriate pedestrian and cycle facilities; considering safety and minimizing conflict with moving vehicles.
f) To minimize the amount of land used for this facility.
g) To minimize the cost of road construction.
h) The road reserve can act as a corridor for engineering services.
i) Land use activities abutting this type of road should not create conditions which reduce the ability of the roadway to facilitate the movement of vehicular traffic

5.5.3 The achievement of these objectives can be measured as follows:

a,b) The visual experience when travelling along roads for movement must be considered as part of the geometric design. While this aspect, as well as that of not intruding on the privacy of the residents, cannot be quantified, it must be considered in the design.
c) Noise levels can be estimated. The cost of noise attenuation devices can be included in the total cost of the development. Alternatively, the proportion of erven blighted by noise can be calculated to measure the failure of the design to meet this objective.
d) Geometric standards must be applied to the design of the road to ensure a safe and smooth flow of traffic.
e) The cost of providing adequate and safe pedestrian and cycle facilities must be included in the total cost of developing the residential area.
f,g) The amount of land used for roads and the cost of
h) constructing roads can be calculated.
i) The proportion of dwellings gaining access from this type of roadway will be an indication of the failure to meet this objective. The traffic generated by abutting non-residential land uses can also be estimated.

6. CONCLUSIONS.

The literature suggests that suburbia is a housing form which has considerable attraction. The study of attitudes of residents in suburbia indicates that a quiet street and personal safety are very important aspects; as well as the general aspects of economy, efficiency and environmental quality. From the discussion the following four goals, each related to a different level of the residential road network are presented:

- To maximize the utility and livability of the residential area while minimizing the cost of its development, maintenance and operation.
- To structure the residential area so that the residents can enjoy maximum livability and convenience at minimum cost.
- To create a place from which dwellings can gain access and in which social activity can occur in safety while at the same time minimizing the cost of this component of the circulation system.
- The provision of a safe and convenient corridor for the movement of vehicles at a minimum cost.

Furthermore it is held that:

a. The success of a residential road network can be determined in quantitative terms by estimating:

- The area of land used for circulation.
- The cost of engineering services, the cost of the roadway or the length of roadway.
- The cost, distance or time of internal travel.
- The proportion of dwellings facing roadways which have unacceptable traffic volumes, vehicular speeds or vehicular noise levels.

b. The qualitative aspects of the residential road network relate to:

- The ability of the street for access to be an urban place. This aspect can be assessed in terms of the ease with which social interaction can occur.
- The aesthetic quality of the access street.
- The aesthetic quality of the network as a whole.

c. Each segment of the road network must fulfil one or more of the following functions:

- The provision of access to abutting properties.
- The facilitation of social activity.
- The movement of vehicles.
- The accommodation of engineering services.

Since each segment of the road network will fulfil each of these functions to varying degrees, its shape and form will vary accordingly.
It is important to recognise and accept that the achievement of design quality is enhanced by the adoption of flexible attitudes towards the application of design guidelines and is negated by the inflexible application or rigid design standards.

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