

Three Bedroomed House.

	Living room	Kit- chen.	Bed- room 1	Bed- room 2	Bed- room 3	Store	Stoop	Bath- room	Total*
Averages prior to 1947.	146	65	120	115	101	19	47	22	765
NE51/13	125	105	125	94	94	-	-	30	760

The comparison of these figures shows that the minimum standards of accommodation have not increased the area of the houses, and, therefore, have not affected the costs. The main points of note are:

- (a) The kitchen has been increased to allow preparation of food and dining in an area separated from the living room.
- (b) Second and third bedrooms are reduced in size but the main bedroom is increased.
- (c) Stoops are completely abolished.
- (d) The living room area has been reduced, as the function of dining is now catered for in the kitchen.
- (e) Living room and dining-kitchen areas increase with number of bedrooms.

HOUSE DESIGN.

House design can be defined as the organisation of space in such a manner as to provide for the domestic needs of present day society in the most economical and efficient way. This space, although often referred to as an area, is a three dimensional space, the basic function of which is to provide shelter against the elements and to satisfy the society for whom it is planned.

The designer of houses has to consider many factors in arriving at a satisfactory solution to design problems, but today he is assisted in his task by the scientist. The designer can look to the scientist for guidance in climate control, new constructional methods and materials, and building economies which were unknown in the last century. It is, however, essential that a common language and understanding exist between designer and scientist if the best results are to be achieved.

In studying the approach to the design of Native housing in South Africa the principle of teamwork is already present, but as so many factors must be considered by the designer there still remains much ground to be covered. This state of affairs calls for even greater co-operation between designer and scientist.

SOCIAL ASPECTS OF DESIGN.

In the same way as man has changed the method for supplying his needs from individual production to mechanization, so he demands more than just shelter from his dwelling. Society is, in fact, constantly changing and / ..

* It must be realised that these totals, being based on average figures, cannot correspond to the average room sizes based on the figures prior to 1947. The standard type plans have an allowance for toilet where these are not shown in the plan.

and design must keep abreast of man's changing requirements if progress is to be maintained.

The designer is, therefore, faced with the problem of knowing man before he can plan. In the quest to understand society, the sociologist can assist the designer in reaching a stage of enlightenment from which decisions can be made. In planning any housing scheme, social scientists must be able to answer the questions posed by the designer; viz. family size, family income, distribution of family sizes and single persons, and future trends in population structure. In addition he must be able to say what the social effects of a design will be, and not just what must be avoided. In regard to social effects, such questions as living habits, grouping of houses and household possessions all require investigation by the social scientist.

In Native housing, house design faces numerous unknowns, and it is only by using social research as a basis that the designer can approach his task with any degree of confidence. Design of Native housing cannot be successful when based upon prejudices, opinions and isolated personal experiences.

The social survey undertaken by H.J.J. van Beinum in respect of the design of the new Native township of Kwa-Thema, Springs, demonstrates the manner in which information on family size and distribution in relation to ability to pay rents, presented the house designer with a completely new problem. This was the provision of a range of differing sizes of houses which had to meet three varying economic classes of persons, viz: the economic, sub-economic and sub-sub-economic.* The problem, in so far as the economic and sub-economic groups are concerned, can be met by the house types, Figures 14 to 21, but in the case of the sub-sub-economic class the designer is faced with a virtually insurmountable task. Technically, the best solution lies in the production of the cheapest form of construction possible within known limits. This would call for the closest co-operation between scientist and designer.

SPACE ORGANISATION IN DESIGN.

The first point to determine in house design is how much space is required to allow for the proper functions of family living. The minimum standards of accommodation, as previously discussed, laid down a basis for planning, but it must be pointed out that minimum standards tend to become maxima when reviewed by unsympathetic administration. As the minimum standards were developed from studies of furniture arrangements and functions of family living, it is doubted whether planning to these standards is not limiting the designer's initiative. It is a matter of research, for example, to determine whether the functions of eating and cooking in one room, and sleeping and living in a second, are preferable to a living-dining-kitchen room with a second room as a bedroom, which may provide the family with more privacy for sleeping. The important point in laying down standards is to review them constantly and to ask the basic question: "Are the standards socially valid - do they allow satisfactory family life?"

The designer must then organise the minimum spaces into one composite design in such a manner as to provide an efficient working plan free of accident or collision points, with a minimum of circulation space, and arranged to allow the easy and smooth function demanded by the occupants. The influence of furniture and storage space has been noted

and / ...

Economic group, persons who can afford an economic rent.

Sub-Economic group, persons who can afford to pay some rent but require some form of subsidy.

Sub-sub-economic group, persons who cannot afford any rental at all.

and should form an integral factor in design; the designer must, however, know what household possessions must be allowed for in his design for a particular group of persons. In low income housing, furniture is often second hand and not designed as compactly as the house, and clumsy household utensils requiring large storage areas demand special attention from the designer.

In addition, the degree of privacy will vary and the designer, faced with minimum space considerations, may not attain as high a level of seclusion as the inhabitants desire.

However, minimum standards of accommodation, when backed up by social surveys, will not result in rigid uniformity, as houses will have to be built for differing economic and social groups, as well as for differing family sizes. All these points indicate the importance of research in house design.

PROTECTION AGAINST THE ELEMENTS.

Architects throughout history, when designing houses, have had to accept the forces of nature - cold, heat, wind, dust, rain, snow, frost, light and darkness, and the attacks of insects and disease. These factors are limitations to design but the designer, through understanding or through scientific investigations, is gradually overcoming many of these difficulties.

Once a structure which conforms to the areas determined by the minimum standards of accommodation has been erected on the site, it has to withstand the elements. Bad orientation may result in excessive heat or sunlight in a room, disregard of climatic factors may provide doors unprotected from driving rain, and lack of suitable materials may cause extreme cold within the structure.

In considering problems of low-cost housing in South Africa, the National Building Research Institute is at present investigating the thermal conditions of houses built of various materials and by differing constructional methods, but this work, searching for minimum standards of heat and cold within a structure in order to provide possible economies, can only be considered in true perspective if adequate definitions of environments and their relationship to health and comfort are available. The designer, in similar manner, when discussing economies may ask himself how thin a wall can be made before uncomfortable or even unhealthy conditions result within a house. The problems of defining these limits of comfort and health are unknown factors requiring a lead from health authorities.

The application of efficient daylighting standards to Native housing is shown in Figure 13, and in the standard type houses adequate natural ventilation has been planned upon a basis of scientific findings. Further studies in the laboratories are developing efficient artificial lighting and acoustic and climatic control.

The findings in all the above fields of research are vitally important to the house designer and it is necessary for him to follow carefully each new scientific development in order to improve the function and efficiency of the plan. A warning note should be sounded here, however, to the effect that if the designer is not willing to co-operate with the scientist, or the scientist is not aware of the practical limitations

of his findings, no progressive work will result. The scientist must endeavour to frame his findings in terms known to and understood by the designer, and the designer must carefully study these findings so that they are applied in the correct manner. If this understanding is not forthcoming, then legislation in terms of by-laws dealing with health, building and safety, will be imposed upon the designer, thus limiting his freedom. Ordinances are a limitation not from the point of view of their purpose but because of their rigid application. If the scientist and designer can work together, then these standards can be translated in terms of function and design which can be readily applied.

CONSIDERATIONS OF MATERIALS, METHODS OF CONSTRUCTION, STANDARDISATION AND PREFABRICATION IN RELATION TO DESIGN.

Science is continually developing new materials and improving existing ones, and for this reason the designer must keep abreast of the latest developments. As new materials are developed, sympathetic understanding in the use and limitations of each must bring about its most economic and efficient application. The engineer is developing new methods of construction which require the constant attention of the designer in considering the limitations of his designs in relation to new processes.

In this respect, he must be able to appreciate the limitations of, say, prefabricated wall panels made up of lightweight materials, and must arrange a plan in such a simple manner as to bring about maximum economics.

A clear picture can be given if we inspect the various methods of building from the point of view of a critical analysis, each stage, of course, giving the designer a new set of conditions and limitations.

Type of building method.	Gains	Losses.
Traditional building methods.	Flexible designs to meet individual requirements.	High costs due to inefficiency and bad organisation of labour.
Traditional building methods with standard plans.	Labour economy and watering down of skilled workers.	Design is limited but efficiency of plan should be increased.
Mass producing on site to standard plans, with factory produced prefabricated parts only.	Economy derived from volume of production, bulk buying, repetition of operations and simple control of work.	Design now faces monotony of individual unit and must find an outlet in grouping of units.
Prefabrication. (Total factory produced unit).	Mass production on assembly line principle, giving maximum economy.	The demand must be such to maintain full production at all times. Designer faces the problem of creating new demands by producing articles of greater public appeal. High transportation costs in Africa owing to long distances.

It is beyond the scope of this work to state emphatically which method of building is the best, but whatever circumstances present themselves in any particular place, resulting in an emphasis upon one of the four methods, the designer must be able to fulfil his role and realise the limitations under which he has to work. The final stage, i.e. total prefabrication, has to overcome many difficulties, especially in respect of a country such as South Africa, but the prefabrication of parts of a house rather than the whole is already developing. This will call for the standardisation of parts of a house, viz. doors, windows, roof sheets, wall panels and so forth. The result may be compared to a box of blocks, which the designer has to arrange to form buildings of varying size and appearance.

The standard type plans have also assisted greatly in the cost and density studies being undertaken by the National Building Research Institute. The construction of houses to some of these type plans in Witbank, Springs, Vereeniging and Pretoria has demonstrated their success in so far as design is concerned and also the application of different constructional methods in accordance with the original designs.

In addition to the standard type plans, it has become apparent that a pool of house designs is necessary for selection by those Natives who are in a good financial position and can afford more than the minimum house. The South African Institute of Architects has been approached in this connection and it is hoped that a pool of house designs slightly above the minimum standards will be produced.

PSYCHOLOGICAL ASPECTS OF HOUSE DESIGN.

Psychological aspects are noted here because, in providing housing for Natives, the designer is not altogether aware of what is taking place inside the occupants' minds. The Native may be a newcomer to the urban area or he may have lived there all his life. If he has recently come to the town, he faces a new environment of speed, noise, individualism and so forth. The designer, in planning a home for this rural man, does not really know what he is imposing upon this new town-dweller. Will the home provided help to satisfy him and assist him in overcoming his new-found loneliness or will its new form disturb him to such an extent that his frustration is even more exaggerated?

In this respect the designer may in his design be unconsciously creating an environment of such changed values that harm rather than good may result. Within the dwelling such factors as privacy, expression of the individual, nervous irritation and numerous other aspects will lead the designer to realise that an understanding of the psychological implications of man's adaptability is an essential of good planning.

AESTHETIC AND LANDSCAPE CONSIDERATIONS.

Standardisation has been discussed but it was noted that the designer had his part to play in this approach owing to the resultant monotony associated with repetition. The designer has at his disposal form, space, line, mass, texture, light and shade, colour and arrangement in his task of creating a satisfactory aesthetic expression. However, it must at the same time be pointed out that a successful composition may not necessarily result from a set of rules and conscious objectives but rather from a creative act which satisfies human needs and emotions.

In addition, in considering housing, the designer must be aware of the fact that he is basically creating two spaces; that within the walls of the dwelling and that defined by the external walls of the dwelling (external space). The relation between internal and external space is a contribution of contemporary American landscape designers and architects. In planning low income housing, landscape design has a great contribution to make, but the planned landscape is not a foil to the houses, but an organisation of space beyond the dwelling. This space organisation is based primarily upon the materials of nature. In the housing layout, the external space must be as economically planned to meet the needs of man as the internal space.

"A garden is a useful place; a place in which to rest, to entertain, to exercise, to play" JOSEPH HUDNUT in "Architecture and the Spirit of Man",

The minimum house, considered in terms of Hudnut's remarks, can be extended outwards to embrace the whole external space defined by the boundaries of the plot.

"The minimum garden is, in fact, an extension of the house: an out-of-door living room....."

CHRISTOPHER TUNNARD in "Gardens in the Modern Landscape".

That the designer has so much at his disposal in creating low income housing layouts, is not readily appreciated from an inspection of Native housing schemes in South Africa. This statement must not, however, be considered as a fault entirely due to designers; there are other considerations.

Firstly, designs are often prepared without the services of a skilled designer; secondly, administration often dictates to such an extent that the designer is not given a free hand; and thirdly, in a world of specialisation the designer is often not a housing specialist.

The solution would appear to lie in the following:

The design of a housing scheme demands:

- (i) A designer who possesses specialised knowledge.
- (ii) A sympathetic administration, that can appreciate the value of a small expenditure in the right direction against large wasteful expenditure at a later date. (Small expenditures upon the planting of a few trees, can assist greatly in creating a contented community).
- (iii) Co-operation between designer and administrators.
- (iv) Design of the house ought not to stop at the external walls of the dwelling, but must extend out to embrace the external space.

ECONOMIC CONSIDERATIONS.

It is best at the outset to note the two main advantages of economics upon design. Firstly, they prevent unnecessary ornamentation of the dwelling and force the selection of good materials which require

little maintenance, and secondly, they tend towards efficient design in terms of function and construction. In the former case the designer is forced to arrive at a simple aesthetic expression free of any form of applied ornamentation, whereas in the second case the structure is designed to meet the needs of the occupants and the dwelling within the most efficient limits. (A single storey building is designed to meet the forces and loads associated with a single storey structure).

The next limitation of which the designer must be fully aware is that of the ability of the persons housed to pay the rental resulting from the capital expenditure of the house planned. In certain cases this limitation may be so severe that it is beyond the ability of the designer. Walter Gropius, however, sees this aspect as follows: "Subsidies do not lead to a real solution of the housing problem. They are to be considered only as a measure of transition until means and ways are found for solving the housing problem economically".

In addition to design, material selection, methods of construction and structural considerations, thought must be given to the question of labour. One method of overcoming labour costs is the introduction of "owner-builder" or "self-help" systems whereby man builds his own home with his own hands. This system will once again impose upon the designer a new set of circumstances and problems which will demand his attention. Schemes of this nature can very easily get out of control and result in chaotic and unorganised layouts. The system of owner-building will demand co-operation and understanding between designer, technician and administrator in every stage of house planning.

FUTURE TRENDS.

The last challenge to the designer is the provision of a flexible plan which will suit the needs of man today, but at the same time is capable of satisfying the changing demands of the next generation.

CONCLUSIONS.

Design is dependent upon so many factors that it is often impossible to satisfy all requirements and it is left to the imagination and judgement of the designer to produce the best compromise. The important aspects of house design include the following requirements:

- (1) There must be co-operation between scientist, technician and administrator.
- (2) The designer must understand the persons he has to house.
- (3) Designers must produce simple designs suitable to adaptation by a variety of materials and methods of construction and allowing a simple yet sufficient form of living.
- (4) Housing specialists must emerge if satisfactory housing is to be achieved.
- (5) Flexibility must be allowed either within the designs or by other means. In South African standard designed Native houses, it is suggested that by changing the occupancy rate of the units, viz. by reducing the number of inhabitants from 7 to 5 persons in a two bedroomed unit, greater flexibility can be achieved.

- (6) Although standard type plans have been drawn up there is no reason to accept these plans as the only solutions, and freedom to submit alternative designs must be maintained. The principle of standard designs is, however, a matter of economy which cannot be overlooked.
- (7) The designer must keep abreast of new developments in the form of new materials and methods of construction.
- (8) In low-cost housing, the important contribution of landscape design must be more generally considered in the future than has been the case in the past.

COMPARISON OF MINIMUM STANDARDS OF HOUSING ACCOMMODATION FOR NATIVES WITH STANDARDS OF OTHER TERRITORIES IN AFRICA.

Standards are relative and personal, and it is dangerously easy to criticise any new venture on the grounds that it departs from 'standards'. It is important, therefore, that the reason for setting standards is fully understood. If a family is to be housed as a unit which will produce good citizens in the future generation, then two main points arise. The parents must be given the privacy of an isolated bedroom and children of different sexes must be separated at an early age. Many investigations have been carried out overseas on this particular problem, but looking closer at the tribal housing arrangement of the Native people such separation is immediately found. The huts of a family form a group and the accommodation is so arranged that the man of the group has one hut, one is provided for each wife with her infants and small children, one for growing boys and another for the girls. These huts numbering from four in a small family to six in larger families are grouped round a courtyard or interconnected courtyards.

The first requirements of standards are thus seen as the proper separation of sexes and the provision of privacy. The actual room sizes will depend upon such health considerations as ventilation, overcrowding and proper shelter. The urban Native has, however, certain possessions and furniture so it is important that storage and furniture arrangement are possible within the provisions of the minimum standards.

At a later date the standards must allow for convenience and comfort in addition to the minimum provision of spaces for general living, preparation of food, eating and sleeping. This stage will be dependent upon the ability of the occupants to afford these provisions.

The basis of the South African minimum standards has been to concentrate upon provision for proper family life but to reduce the fittings and equipment to an absolute minimum. The emphasis has, therefore, been upon separation of sexes for sleeping purposes and the separation of dining and food preparation areas from other space.

In comparing the South African standards with those laid down in the other countries of Africa, great difficulties are at once encountered. The majority of countries lay down standards but have completely overlooked the occupancy of the houses built to predetermined space standards.

As an example of this statement the report prepared by Professor L.W. Thornton-White for the colony of Mauritius is of interest. ("Report

on the Housing of Sugar Estate Workers") He commences by stating:

"The establishment of a minimum standard is essential as a first step in any housing programme, particularly in Mauritius, where the economic difficulties are acute." The Standards then laid down are:

The first two rooms should be 15 ft. by 10 ft. the other rooms are 10 ft. by 10 ft. In addition it is recommended that a separate bathroom, containing W.C., and kitchen are desirable; the recommended ceiling height is 8'-6".

The occupancy and function of the rooms are not laid down, yet these units are for family occupancy.

In the report "Village Housing in the Tropics" prepared by Jane B. Drew and E. Maxwell Fry which has considered the problem of housing in West Africa, the main theme of the work was completely confused by tribal customs and religious taboo, and as such has given no indication of housing standards. The report does appreciate the value of family housing but could not lay down definite proposals owing to purdah regulations of the strict Mohammedan and other difficulties.

In the "Nairobi Master Plan for a Colonial Capital", prepared by Professor L.W. Thornton-White, L. Silberman and P.R. Anderson, pages 35 to 36, the problems of Native housing in Kenya's capital are discussed. The problem is definitely one of the change from migratory labour being housed temporarily in single quarters to the development of a permanent urban Native population. The story of 'KARIAKORI', which was the first Native public housing scheme, is of interest, as it was only when the primitive dormitories were partitioned off into smaller rooms or cubicles that the scheme became fully occupied. The desire for a house suitable for family occupation was greater than the provision of a healthy, well-constructed vermin-free, single quarter.

The Native housing standards of Nairobi are very close to the South African Slums Act provision; the dwelling standards call for a separate kitchen, food store, bicycle or pram shelter and a small front or back verandah where possible. A superficial sleeping area of 40 square feet per adult inhabitant must be provided.

In Africa outside of the Union of South Africa, only the Belgian Congo has paid attention to the family housing of urban Native people. The Congo realised the value of a stabilised labour force in providing greater efficiency and production in her industries and has developed a system of housing which is most important. The clerical and administrative Natives are provided with houses very similar in size and construction to the European housing built by the National Housing and Planning Commission of South Africa from 1945 until 1950. The next range of housing for better paid workers, is very similar to the houses built by South African local authorities for Natives prior to 1947; i.e. houses with steep and little rooms, about 100 to 120 sq. ft., each leading out of a main living-kitchen room. It is of note, however, that one room is usually provided with a mud and wattle ceiling below a rather steeply pitched roof, thus giving protection against the heat. Lastly, the housing of rural plantation and farm workers is on a reduced scale, usually two or three rooms with an area of 150 sq. ft. per room. Occupancy standards do not appear to be laid down but the standard of housing is good and well designed in many of the Belgian Congo examples.

It is of note to remember the cause of South Africa's urban Native housing problem; urbanisation and industrialisation have played a major role in creating the difficulties encountered. If we are to compare our solutions to the problem with solutions put forward by other countries, we must limit the comparison to countries with similar industrial expansion. In the continent of Africa at the present time this is not possible.

C H A P T E R II.

CHAPTER II.

NEIGHBOURHOOD PLANNING AND DENSITY RESEARCH.

ABSTRACT:

Cost studies in Native housing cover both the cost of the house itself and the development and service costs demanded by the complete layout. It is in the field of development and service costs that density research can play such an important part.

The importance of site selection for low cost housing estates is discussed with reference to cost reduction and to the creation of a satisfactory environment. The provision of sufficient residential land and space for communal facilities is most important if the housing layout is to function properly. The economics of a layout are very dependent upon the density achieved and this is governed by the dwelling types. In arriving at higher densities it is undesirable to reduce space allocated to open spaces and communal facilities.

A good plan is the balance of economics and the creation of a good environment.

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Before proceeding with the details of neighbourhood planning it is as well to discuss briefly the objects of Native housing research in so far as the technical aspects are concerned. In the introduction, the problem and the magnitude of South Africa's urban Native housing problem was discussed; in overcoming this housing shortfall four essentials must be given full consideration.

- 1) Good will and determination to overcome the problem must exist.
- 2) The supply of essential building materials must be guaranteed.

In 1945 supply of building materials was a great problem but today, 1953, the position is greatly improved. The National Building Research Institute has carried out exhaustive enquiries and, in the case of the most scarce building material, found in 1952 that in order to produce 35,000 Native houses per annum less than 10% of available supplies would be needed.

- 3) Sufficient labour must be available. This condition has been greatly improved by the passing of the Native Building Workers Act, as it is now possible to find a new potential of building operators among the Natives themselves.
- 4) Monies must be available. In respect of the financial aspects of housing, research work can render great assistance in reducing costs, thus allowing a greater number of dwellings to be constructed for a given sum of money. In addition, cheaper dwellings mean lower rentals.

Two main approaches are open in considering the reduction of costs in housing schemes: (a) the studies involved in the cost structure

of the house itself and (b) the development and service costs. Studies of the cost structure of houses are being carried out at the National Building Research Institute by Mr. A.L. Glen, guided by a committee under the chairmanship of Mr. T.H. Louw, President of the Institute of Architects. The work is directly financed by the National Housing and Planning Commission, and will be discussed later in this thesis. Reduction of development and service costs was undertaken by the author and it is from this point of view that this work was produced.

Certain tentative standards had been laid down by the Research Committee on Minimum Standards of Accommodation in their interim report on 'Estate Planning', but these were hardly prompted by detailed economical considerations. In the work undertaken by the author the procedure adopted was to investigate why development costs were high, and then to lay down certain criteria for site selection with a bearing upon future costs. Next, the implications of higher densities had to be considered, but it was realised that certain minimum standards must be observed if a good environment were to be retained for a housing scheme. This work called for the study of space beyond the dwelling, in a manner very similar to the investigations of the minimum standards of housing accommodation. These studies then led to certain definite conclusions, which have been applied to the practical cases of the Witbank new Native Township and Kwa-Thema, at Springs.

The problem started with the finding that in the Transvaal one large housing scheme begun in 1944 resulted in a dwelling unit cost of £472 and an average cost of £379 to service each unit. The service costs involved the provision of roads, stormwater, street lighting, sewerage and water, and were on a reduced scale when compared with those services supplied to European residential areas. This meant a capital expenditure of £851 per dwelling unit for house and development costs. The density of these layouts was about 4 dwellings/gross acre. An inspection of the areas developed showed that the siting was responsible for much of the expenditure, as the township was located on a rock outcrop which meant expensive excavations for all services and foundations.

SITE SELECTION.

It was, therefore, essential that certain principles should be observed in selecting sites for Native townships in order to reduce costs to a minimum. The selection of a site for development in a low-cost housing estate layout can have a direct bearing on the development costs, and also on the type of environment established on completion of the scheme. It is obvious that the factors affecting the selection of a site are so numerous and varied that no site will meet all requirements but, by careful consideration of each site, the advantages and disadvantages of one can be compared with those of another, resulting in the best selection. It should be added that the selection of a site is important in that it may make or mar an entire project.

It is the purpose of this section to deal with some of the more important aspects of site selection in order that economies may result.

1. Zoning.

(a) The importance of legislation cannot be overstressed and reference is made to the following:

- (i) Slums Act No. 53 of 1934.
- (ii) The Housing Act No. 35 of 1920 as amended, the Housing (Emergencies Powers) Act No. 45 of 1945.
- (iii) The Natal Housing Ordinance of 1945.
- (iv) The Native (Urban Areas) Consolidation Act, 1945 (No. 25 of 1945 as amended).
- (v) The Group Areas Act, 1950 (No. 41 of 1950)

(b) In considering a site for a housing layout it is necessary to ascertain that the zoning of the area is suitable for non-European residential purposes and that the surrounding areas in no way interfere with such development. In considering a town which already has a Master Plan and/or Town Planning Scheme, the zoning will be fixed but, in the case of a town not possessing such a plan, provisions should be made to safeguard the newly-selected residential zone against further misuse. In both cases it must be remembered that, in South Africa, careful scrutiny of the "Title Deeds" relating to that portion of land will save much time and money at a later stage when unknown servitudes, outspans, mineral rights, etc. might subsequently be disclosed, and must either be removed or the site abandoned.

2. Health.

When considering health aspects, the site and the surrounding area must be taken into account; if a neighbouring site contains a factory belching smoke and fumes into the atmosphere, so that the polluted air will be constantly inhaled by persons living on the site under consideration, then either the site must be avoided or control sought in order to prevent such discharge. In the field of health consideration, one must consider noise, fumes, odour, vibrations, smoke, polluted and stagnant water, made-up ground consisting of materials detrimental to good health, etc. In this connection, the medical officer of health will have the final say.

3. Location of Site in Relation to (a) Transportation. (b) Services.

(a) In considering this aspect, sound judgment rather than any given rule will determine the best selection. The most important points to be considered are:

- (i) relation to place of work;
- (ii) relation to town centre.

In the case of the low income groups, the journey to and from work has to be carefully considered in terms of expenditure in relation to income, and efficiency loss in the case of workers who have to travel unnecessarily long distances to and from work. In locating a Native residential area it is very important to trace out the journey from home to work in order to see what is involved. Will the workers have to traverse the whole town every day, is there transport to move them, how long will their journey to work take, and how much will transport cost? These points seem obvious enough, but are very seldom considered.

(b) The next considerations deal directly with the local authority and involve the services within the site. Of prime importance in this field are the utility services - the provision of drinking water, sanitation, waste removal services, roads, stormwater drains and electricity. Further considerations are police protection and administration of the area.

4. Topography and Soil Conditions.

Dealing first with topography, we find that it influences both cost and livability of a site, e.g. a steep slope may be expensive to develop, but the view, light and air circulation may be ideal. Too flat a site, on the other hand, may lead to difficulties in sewerage, surface drainage and stormwater drains. The all-year round conditions of a site must be considered, as flood levels and collection of pans of water can be easily overlooked during a survey in a dry season. The ideal site would be undulating, with gentle hillsides sloping away to the North, although in areas in South Africa, a slope towards the South, if not too steep (not greater than 1:15) would be quite suitable.

Soils and subsoil conditions have an important bearing on costs; an area consisting of made-up ground may involve such high additional costs in building as to render it completely useless as a site for low-cost housing development. Besides the considerations of building foundations, the soil must be suitable for cultivation. If the houses in the layout are being given private gardens and the depth of the top soil is such that cultivation is impossible, the provision of too large a garden space may be unnecessary except for providing good sunlight and ventilation.

These aspects of topography and soil should be considered by experienced technical officers, who are in a position to interpret the ground formation when considering costs of development.

5. Social Survey.

A social survey for housing layouts may not really form a part of the site selection but is noted here, as it does become an indirect condition. The number of persons to be housed, for instance, bears directly upon density if the size of site is limited or alternatively, if density is fixed, the size of site is affected. An authority ought therefore, to know the number of families to be housed, the number of persons besides family to be housed, their rent paying capacity, family size and composition and, lastly, their living habits, which are either national or racial in origin.

6. Area and Shape of Site.

In the preceding section, the area of land required was discussed, but care must be taken, in considering the area of a site, to note how much of that area is actually suitable for development. Many cases can be quoted where large areas of ground, when properly surveyed and inspected, provided for development to take place on a very small portion, due to the presence of swamps, unstable soil conditions, etc.

The shape of a small piece of ground may, if the angles formed by the boundaries are sharp, result in inconvenient as well as wasteful planning.

At all times the area of a site must be considered in terms of

density of population to be accommodated - a given population and a predetermined gross* density will indicate the area of site required.

7. Cost of Land.

When considering sites for purchase, foresight and good planning can save unnecessary expenditure. The selection of a site must obviously have a direct bearing on the cost of land, but cheap land, expensive in development costs, may be an unsound investment. Further, when a site is selected, future development must not be overlooked, and the immediate purchase of adjoining areas may result in a good longterm investment.

8. General.

(a) The site must meet the conditions for which it is to be used, namely non-European residential purposes, etc.

(b) Contours of the site can control the technical decisions of the planner.

(c) A suggested check list, which may be of value to a local authority when selecting a site for an estate layout, is given in the Appendix. The use of such a table would mean firstly, that each point for consideration would be listed and secondly, that a complete record would be conveniently compiled. In cases where one site is compared with another, these check lists would be invaluable.

(d) If the best economics of a site are to be studied, it may be necessary to prepare rough layout schemes so that estimates can be prepared and the development costs compared.

APPENDIX.

Suggested Check List for Site Selection of an Estate Layout.

Name of Site

Municipality of

Date of Survey

Points to Consider.	Remarks.
1. Does the title deed reflect that the site is free of encumbrances?	
2. Does the Master Plan and/or Town Planning Scheme, show this site free for development as a residential area?	
3. /	

* Gross Density is defined as the number of persons or dwellings per acre of the total estate (purchased or required for the purpose of development) and including all residential land, streets, and land used for recreation, shopping, schools, parks, green buffer strips and community purposes.

Points to Consider	Remarks.
3. Has the Native Affairs Department or the Land Tenure Advisory Board been approached in connection with racial zoning?	
4. Does the zoning of neighbouring sites as shown in the Master Plan and/or Town Planning Scheme influence the selection of this site under consideration?	
5. Will the Council or controlling authority approve of the development of this site for	
(a) immediate requirements?	
(b) future extensions?	
6. Has the Medical Officer of Health expressed his opinion as to whether or not this site is healthy for development as an Estate layout?	
(a) Is the area low-lying in relation to the surrounding country?	
(b) Is the ground reasonably porous?	
(c) What is the aspect of the site? (Gentle slope to north, etc.)	
(d) Are any low-lying areas present in the vicinity of site? (Malarial areas)	
(e) Is the site particularly exposed to high winds?	
7. Are any hazards present in the form of	
(a) Main traffic routes?	
(b) Railway lines?	
(c) Possibility of flooding area?	
(d) Fast-flowing rivers?	
8. Are there any sources of nuisance present, e.g. factory fumes, noise, dust from mine dump, vibration, odour, etc.?	

Points to Consider	Remarks.
9. What are the forms of public transport, how frequent is it, and will the capacity serve the new development?	
10. How long does transport take to places of work, and what does it cost?	
11. How long does transport take to the town centre and what does it cost?	
12. Is there any source of employment within	
(a) walking distance (1 mile)?	
(b) cycling distance (5 miles on easy gradients)?	
13. In extensions to existing schemes,	
(a) are there any existing parks, sports areas etc. within walking distance?	
(b) Any schools or shops within walking distance?	
14. Are the following services available on the site?	
(a) Drinking water?	
(b) Sanitation (stating what type)?	
(c) Rubbish removals?	
(d) Electricity?	
(e) Fire Protection?	
(f) Any other municipal services such as street lighting etc.?	
(g) Will police protection be available?	
(h) What administration is required? (Location superintendent, etc.)	
15. Topography in general; is the site advantageous to development as a residential area?	
16. How much land is to be wasted (for swamps, acute angles etc.) expressed as a percentage of the whole?	
17. (a) Have trial holes been dug on site?	
(b) Is soil suitable for foundations of dwellings?	

Points to Consider	Remarks.
(c) Is soil suitable for cultivation?	
(d) Are there any existing trees worth preserving?	
(e) What are the conditions of any existing roads on site?	
(f) What are the conditions of any existing buildings on site?	
(g) Is slope of site suitable to orientation of buildings?	
(h) Is slope of site suitable to sewerage, stormwater drains and run off?	
18. (a) Do you know how many families are to be housed?	
(b) What size are these families?	
(c) Are any single persons to be housed?	
(d) What density of housing do you wish to achieve?	
19. (a) What area of non-dwelling sites is being allowed?	
(b) Does area of site meet these needs - that is, housing and amenities?	
(c) Is site a good shape for development and is it free of intersecting main traffic routes and railway lines etc.?	
20. What is the cost of land?	
21. What effect will the development of this site have on surrounding area?	
22. Has the site in question been inspected and approved by the relative Government approving bodies?	
(a) Health Department.	
(b) Native Affairs Department.	
(c) National Housing and Planning Commission.	
(d) Land Tenure Advisory Board.	
(e) Provincial Administration.	
23. General comments.	

THE PLANNING OF NEIGHBOURHOOD OR RESIDENTIAL AREAS FOR LOW COST HOUSING IN SOUTH AFRICA.

The work in this section is the record of three and a half years of research by the author. The approach has been to establish certain space standards in relation to the requirements of a neighbourhood and to make use of such data to study the resulting effect upon development costs. It is obvious that the determination of a density is only one factor in the planning of a residential estate and other factors play an equally important part in the creation of a good and healthy environment.

DEFINITIONS.

Before any discussions are led it is important to know what form of measurement is to be employed and the terms used are defined as follows:

A HOUSING SCHEME is an area in which persons are housed in surroundings which create an environment conducive to a full life. In order to meet these conditions, full amenities, conveniently positioned in relation to all dwelling units, should be provided. These amenities may include all or some of the following facilities within or adjoining the area under consideration: educational, recreational, health, religious, administrative, commercial and industrial.

GROSS ESTATE DENSITY is defined as the number of persons or dwellings per acre of the total estate (purchased, or required for the purpose of development), including all residential land, streets, and land used for recreation, shopping, schools, parks, green buffer strips and community purposes.

GROSS DEVELOPMENT DENSITY is defined as the number of persons or dwellings per acre for the useful area of development. It is calculated by dividing the estimated total population or number of dwellings by the area suitable for development, which excludes all woodlands, swamps, water reserves, or any other land considered to be unsuitable for building, due to health or economic reasons, only when these rejected areas are not utilised for parks or definable open space forming part of the layout.

NET DENSITY is defined as the number of persons or dwellings per acre of building land, excluding all non-residential building sites and roads but including building sites, private or directly connected communal gardens which may be found in the cases of row houses and flats, and any access ways laid out on building sites.

The problem of overcrowding within the dwelling units themselves is not fully covered by these definitions. In laying out an area, it is assumed that each dwelling will house one family unit and, to assess the density in terms of persons per acre, the average family size is frequently multiplied by the number of dwellings per acre. For example, a net density of 6 dwellings per acre is planned in a particular area where the average family size is 5 persons; the resulting net density in persons per acre is $6 \times 5 = 30$ persons per acre. Immediately any overcrowding takes place, or the house types provided are in such proportions that the various family sizes are not properly accommodated in terms of the Revised Standards of Accommodation, then the net density figure, based upon an average family size, is incorrect. There is, then, a need for some measurement which will be determined by the number of habitable rooms

within the dwelling units; and this unit of measurement can then be tested by applying the occupancy* rate of any particular area. The occupancy rate of the Revised Standards of Accommodation** would be slightly greater than 2.

Spatial requirements in the house.

No. of persons accommodated	Type of dwelling	Room areas in sq.ft.				Average occupancy rate
		Main bed-room	Bedrooms	Dining Kitchen	Living Sleeping	
2	Aged couple unit	-	-	70	110	2
2 - 3	1 room unit	-	-	70	118	2 to 3
4 - 5	2 room unit	118	-	80	115	2 to 2.5
6 - 7	3 room unit	118	94	90	120	2 to 2.33
8 - 9	4 room unit	118	94	100	125	2 to 2.25
10-11	5 room unit	118	94	110	130	2 to 2.2

To illustrate the advantages of having a further detailed unit of measurement, viz. something below gross and net densities, the following cases are quoted. Considering a population of 5,000 persons to be housed, the following methods can be followed:

Case (a) Average family size of 5 persons would give 1,000 houses, which in accordance with the Revised Minimum Standards of Accommodation, require to be two-roomed dwellings.

Case (b) Housing the same population, in accordance with the findings of a social survey conducted in an existing area where overcrowding is to be relieved by the new houses provided, the following data are obtained:-

59 single-persons to be housed in hostels.
 275 families requiring a one-roomed house.
 284 families requiring a two-roomed house.
 208 families requiring a three-roomed house.
 104 families requiring a four-roomed house.
70 families requiring more than four-roomed house.
 941 houses required.

Case (a) / ...

* Occupancy rate is the number of persons occupying a habitable room for purposes of sleeping and is calculated by dividing the total number of persons housed by the total number of habitable rooms.

** Revised Minimum Standards of Accommodation as accepted by the National Housing and Planning Commission.

Case (a)	Case (b)
1000 houses required.	941 houses required and accommodation for 59 single persons.
2000 habitable rooms required (habitable rooms include bedrooms and living room only).	2233 habitable rooms required by Revised Minimum Standards of Accommodation allowing further hostel accommodation for 59 single persons.
284 families or 28.4% are correctly housed in accordance with family size. 334 families or 33.4% will be overhoused and 382 families or 38.2% will be underhoused or overcrowded.	All families housed in accordance with family sizes and flexibility allowed as minimum accommodation has not been provided in every case.*

Case (c) If, as can happen in practice, the smaller sized families, viz. less than 4 persons, are not moved to a new housing scheme, then the following would happen:-

Case (a) would break itself up as the figures of case (b) indicate, i.e. 666 families would be housed in the new area. The new area, being designed to give a net density of 6 dwellings per acre, could then not possibly give a figure of 30 persons per acre net. In terms of habitable rooms the 666 families would require $(284 \times 2) + (208 \times 3) + (104 \times 4) + (70 \times 5) = 1958$ habitable rooms. The total number of persons to be housed is $(284 \times 4.5) + (208 \times 6.5) + (104 \times 8.5) + (70 \times 10.5) = 4253$ persons. This would result in an occupancy rate of 2.172.

The net density of 6 dwellings per acre means that 111 net acres are required to house the population. At the rate of one family per dwelling, this results in a net density figure of persons per acre of $\frac{4253}{111} = 38.7$ or $\frac{38.7}{2.172} = 17.8$ habitable rooms per net acre. The figure of 2.172 dwellings per acre, based incorrectly on average family size, would give $6 \times 2 = 12$ habitable rooms, and this in actual fact would give an occupancy rate of 3.225 which is far above the Revised Minimum Standards of Accommodation.

In addition to the above example such a system of measurement can be easily appreciated from the point of view of overcrowding. Consider

an / ...

* A one-roomed house accommodates a family of 2 or 3 persons.

A two-roomed house accommodates a family of 4 or 5 persons etc.

an overcrowded township, containing only houses of 4 habitable rooms each, and which has been designed for a density of 6 dwellings per acre; if a sample survey of the area reveals an occupancy rate of 4, then it can immediately be determined that the net density is $6 \times 4 \times 4 = 96$ persons per acre. The occupancy rate of the Revised Minimum Standards of Accommodation is about 2.18 which would give $6 \times 4 \times 2.18 = 52.32$ persons per acre as desirable. To prevent overcrowding then;

(a) $\frac{96-52.32}{2.18} = 20.36$ additional habitable rooms per acre are required,
or

(b) for purposes of re-development, the figures give $\frac{96}{2.18} = 44.036$ habitable rooms per net acre, as being required to house satisfactorily the same population on the same area of site, within the occupancy rates of the Revised Minimum Standards of Accommodation.

From these discussions it is obvious that further research work along the lines of determining a measure of density in terms of habitable rooms and occupancy rates is desirable.

CASES FOR AND AGAINST HIGHER DENSITIES.

The term 'density' can cover a wide range of considerations but in this case it is to be limited to Native housing only. Even within these narrow confines, a great number of approaches have to be considered and balanced one against the other in order to arrive at successful conclusions.

Housing densities are simply a measure of the intensity with which land is used for housing purposes. This use should not be so great as to cause congestion of buildings or preclude the amenities necessary for good housing.

In England, the limited quantity of agricultural land has caused much attention to be devoted to the problem of obtaining higher densities, but in South Africa higher densities have been studied from the points of view of development costs and suburban sprawl. Cost reductions are, however, not the only considerations which will determine suitable densities in housing layouts. A given density will affect the following:-

- (a) The type of dwellings, i.e. detached houses, semi-detached houses, terraced houses or flats.
- (b) The occupancy of persons within the dwelling units.
- (c) The spacing of dwellings which must be arranged to give sufficient light, air, sunshine and open space directly adjacent to the dwellings.
- (d) The facilities such as shops, schools, parks etc. which are necessary in creating a good environment within a housing layout.
- (e) The circulation or access within the scheme.

These points vitally affect the living conditions of the people to be housed and give rise to the most important factor in all density studies, i.e. that of striking a balance between economic considerations and social requirements.

THE CASE FOR HIGH DENSITIES.

The need for higher densities, has developed as land costs have risen steeply in South African urban centres since 1934, and owners demand the maximum floor area for any building erected upon their land. In the case of low income housing, however, there is the need to curb the great suburban sprawl at present taking place, and to prevent low income families having to pay higher rents resulting from high development costs; in addition, persons living in far reaching suburbs have to pay for and endure longer journeys from home to place of work.

THE CASE FOR LOW DENSITIES.

The arguments here are based upon the fact that South Africa possesses large tracts of undeveloped land and that land costs on the perimeter of large towns are sometimes low. It is also argued that the individualistic character of South Africans tends to encourage the desire for individual houses set in their own grounds.

ANALYSIS.

As these two points of view are obviously in conflict, it is necessary to define the objects of each clearly. The case for higher densities is based upon the economic aspects of development, whereas the case for low densities depends upon the individual's preferences. Housing density research must, however, balance economic considerations against the social aspects of the persons housed.

Before coming to any definite conclusions on the above arguments, it is necessary to establish what space demands must be made in planning residential areas, bearing in mind the provision of full amenities of family living. Generally speaking, the densities that can be laid down in a housing scheme depend upon the occupancy of the horizontal surface of the land available. If, then, each item that is required for a residential area is considered in terms of land area or coverage the resulting densities can be obtained. Basically, the approach to Native housing is upon family groups, and the studies will, therefore, commence from this point of view.

PLANNING RESIDENTIAL ESTATES.

Residential Estates are made up of the following facilities:-

1. Housing.
2. Schooling and education.
3. Outdoor recreation.
4. Indoor social and cultural amenities.
5. Shopping and commercial buildings.
6. Health provisions.
7. Roads and access ways.

These facilities constitute the variables in problems of estate layouts, in so far as densities are considered, but at the same time they are the factors, which, if well planned, constitute a system of good living. Considering each of these in turn gives a guide as to their needs and sizes, and in turn assists with the determination of densities in non-European housing layouts.

1. Housing.

In Native housing, the most common forms of dwellings currently constructed are single storey detached and semi-detached units, but it is advisable to consider all forms of single and multi-family units both single storey and multi-storey in order to arrive at final conclusions.

SPACE REQUIREMENTS OF HOUSING. SINGLE STOREY ON PRIVATE PLOT.

Space requirements of a garden or a landscape depend upon the activities of man. As society changes, the individual demands will vary also. The investigation of space in this work will not be suitable for the society of yesterday, and can only be a guide to the demands of tomorrow.

This investigation will explore the demands of man to-day, translate these demands into space requirements, and finally, by selected examples, observe how this space can be planned within the contemporary ideals and limitations. In dealing with the domestic garden the demands are very dependent upon the individual requirements - upon the likes and dislikes of the individual - whereas in community gardens the demands are more general. The planned private plot must, in the same manner as the house it encloses, reflect the living habits of its owner.

Peter Shepheard in a paper "The small private garden" appearing in the Journal of Landscape Architecture, March 1951, describes what the average family wants from its garden. He states that these wants may include a green setting, in which can be seen the seasons' change, and views of plants and trees, preferably with a view of something other than the neighbouring house or street. It may include a place for entertaining friends or strolling in the open air, a place for sitting in privacy out of doors such as an outdoor living room, a place where children can play in safety, a place to cultivate plants for recreation, or a place to keep pets. In addition, an area for hanging out washing may be required. This list can be interpreted in numerous ways - provision for entertainment can be in the form of a terrace where teas or sundowners are taken, a tennis court with tennis shelter, a swimming bath with its accompanying terrace or an open lawn with croquet, putting green or badminton laid out upon it.

As in the dwelling, the requirements of man in the garden are limited by space, and by what he can afford. The rich man can afford a large dwelling containing large rooms, but the middle income and low income groups are set the task of meeting their housing requirements on the basis of the smallest structure which can be planned to meet their needs.

The same happens in the garden, where we find lots varying from 5 acres to $\frac{1}{8}$ th acres in certain suburbs, and in others to less than $\frac{1}{10}$ th acre. Investigations have been carried out in respect of low cost housing producing minimum standards of accommodation, but no such standards are ever produced in dealing with the out-of-doors areas, except in very general terms.

If then an approach to garden requirements were made similar to that dealing with house planning, some positive recommendations might result. A minimum standard of accommodation for the private and communal open space is sought, and, bearing in mind the Native housing problem, these standards

are / ...

are most important. The requirements of the out-of-doors differ from the dwelling in that usually they occupy a horizontal plane. Dwellings can be single, double or multi-storey, but the garden is limited to the surface of the land in its most economical form (roof gardens being a luxury item as yet).

The demands of a private plot must be known in exactly the same manner as one accepts that facilities for eating, food preparation, seclusion, sleeping and entertainment are basically the requirements of a dwelling. The plot must accommodate the dwelling in such a manner that fresh air and sunlight are sufficient to ensure good health and the house must be positioned as to allow the maximum use of the garden space. So often the house is merely dropped into the centre of the plot without any thought being given to the developed garden, which in the case of minimum gardens sets the owner an impossible task laying out a useful outdoor area.

The minimum residential plot must then provide for the following general requirements:-

- (A) Privacy.
- (B) Services - laundry, clothes drying, dustbin and storage area.
- (C) Children's play space.
- (D) Adult entertainment and leisure area.
- (E) Area of ground for cultivation.
- (F) Sufficient overall area to obtain fresh air and uninterrupted sunlight within the limits of good planning.

(A) PRIVACY.

Just as the dwelling demands seclusion for adults and children, the private plot demands privacy from neighbouring gardens, and from passing vehicles and pedestrians on the street.

"And this restriction works both ways: for as children draw on towards maturity, they need no less than their parents, inviolate apartments in which their hot discussions, their high confidences, their first essays in courtship, may take place. For lack of such space in America, a whole generation of girls and boys has grown up, cramped in the vulgar promiscuities of the automobile, from which they are too often graduated proudly into the no less shabby intimacies of the roadhouse or the overnight cabin: carrying into their erotic life the taint of something that is harried, esthetically embarrassing and emotionally disintegrating. The house, the garden, the park, must be planned for lovers and for love-making: that is an essential aspect of an environment designed for human growth. Everything from the distribution of open spaces to the heights of windows is affected by this programme: and the sooner the architect and the planner faces the facts of contemporary life and evaluates them intelligently, the quicker will he throw off the clichés of old-fashioned design, and the sooner will he realise that a great many of the economies in plan that have recently been affected have been purchased at too high a price".

LEWIS MUMFORD.¹⁾

In the above argument Lewis Mumford attacks the lack of understanding of one aspect / ...

1) Lewis Mumford in 'The Culture of Cities'.

aspect of contemporary society by the planner, he appeals for a return to fundamentals, since, by providing for these in design, good planning will result. Fundamentally, all individuals want privacy within and without their dwellings, but if too much seclusion results, the individual begins to feel he has lost the society he belongs to. A contradiction is always present in man, and the planner is not set an easy task in discovering the fundamentals and planning about them - the fundamentals in many cases will contradict one another, and it is a difficult task to develop a plan which will provide for all requirements within the final composition. It is interesting to note human nature when planning such a simple item. A family complaining of being overlooked by their neighbours decided to enclose their garden within a high wall. After the wall was constructed they settled down to complain bitterly that now they were completely cut off and could never see any movement in the world outside - 'I wonder who Mrs. J. had visiting her to-day?' The planner must be able to see ahead and warn man of the implications resulting from his plans, or the design must be flexible enough to overcome the contradictions of human nature. Lewis Mumford has the ability to seek out the weakness of our society, he can quickly discover the limitations of the planner, but it is not to be believed that his solutions will result in a Utopia - even Mumford is apt to be confused.

The above is noted as it is impossible to define a limit or degree of privacy acceptable to all individuals. Some individuals derive great pleasure from watching movements in the street, others dislike the noise and inquisitiveness of the passers-by. The investigations can only allow for the worst cases but in no way are they intended to be the 'musts' of a planned outdoor area.

Privacy can be obtained by the provision of sufficient space which would allow for the dwelling to be removed well away from its site boundaries; secondly walls and special fences can give insulation against interference, or, thirdly, the garden can be so developed that the planting of hedges, trees and shrubs can produce the required conditions. In the first case, that of providing sufficient space, if the purpose is the investigation of minimum space, then this approach must be discounted. The second case is the most extreme and will give the best results for a minimum stand demanding privacy; it has, however, the disadvantage of being a costly procedure, and in the case of low income groups must be used sparingly. The third method, that of plantings, is the method which is possibly the best suited to low income groups; it must however, be remembered that the area occupied by plants has to be provided for in any layout.

(B) SERVICES.

Laundry and clothes drying area for an average family of 5 persons, requires a length of 75'-0" of washing line, and a space of about 60 square foot for washing. If the washing line is provided in two lengths then a steel galvanised stranded line is necessary; if in three lengths then a rope would be sufficient. Allowing an 18" space between lines and a 3'-0" clear pathway on one side for approach this gives an area 37'-6" x 6'-0" for the steel line and 25' x 7'-6" for rope lines. The washing can also be done in this space.

The dustbin needs an area 3'-0" x 5'-0" for housing the garbage can and allowing for an enclosing wall. The garden usually collects some offcasts of the dwelling, and there are usually garden tools to be housed.

These items may demand a storage unit which although inexpensive must be allowed for in arriving at the space requirements. A store 5' x 5' with an outward opening door is ideal for the small private plot.

In America, incinerators are common in gardens, but South Africa has not as yet developed this system of disposing trash. The humus pit is, however, a common sight in South Africa and must be provided for if the cultivation of the small garden is to be successful. On inspection of domestic garbage containers such useful garden material can be found. Fruit and vegetable peelings excess food and other organic matter is often thrown away instead of being returned to the denuded soil. Quantities of wood ash are discarded instead of being used to nourish the soil. In general then, this tendency is wasteful in two respects. Firstly, valuable organic materials are lost to a place that most needs them - the domestic garden - and secondly, the cartage and disposal of refuse is increased. Modern society is very wasteful: in many cases it does not matter, but when the low income groups begin to waste, then action is necessary. By education, the Native can be taught to conserve organic matter, form humus pits, and so add to the soil compost that will retain the scarce water or rain falling on the surface of the soil. The result will be a productive garden where before a hard sunbaked semi-desert existed.

(C) CHILDREN'S PLAY AREA.

In a private residential area the provision of children's play is most important. The family with small children is attracted to a dwelling set in its own plot. The reason is that a feeling of security and freedom is sought. All parents prefer to see their small children playing in the open within the safety of the residential plot. The provision of play areas can, however, be taken to extremes, as it is only when children are between the ages of 2 and 3 years that they are satisfied with small play areas. It is during these ages that parents are most worried about their children, especially as regards traffic hazards. In the case of minimum sized plots (say 45' x 70') once the child is older than 5 years it views the garden as something known and seeks adventure further afield. If trained by the parents the child can then move to play areas beyond the private plot.

The provision of children's play areas is only necessary for the very young, if proper facilities for older children exist near the dwelling. The ideal area in any garden should be an area which can be seen easily from the room most used by the mother during the day. The child will use the whole garden, but a special area of 100 square feet for a sand pit or open space, where the child can play in the sun, or out of it, and at the same time be easily supervised from the dwelling, is necessary. The older children require bigger areas where ball games and organised play can be provided, but these areas are too large for most private gardens. They must be planned close to the dwellings and along routes not frequented by dangerous, fast-moving traffic. As those areas are beyond the limits of the individual plot, they will be discussed later.

(D) ADULT ENTERTAINMENT AND LEISURE AREA.

This area forms the external living room and ought to be planned to meet the needs of the particular owner. In general, it is an area where one can sit in the sun on cold days, and relax in the shade during warm weather. Its location will depend upon the orientation of the dwelling, and the use demanded of it. Privacy for the area will depend

in like manner upon the purpose it has to fulfil. Considering the area as one for leisure and entertainment, the minimum space provision would be 500 square feet. This figure is not an arbitrary area selected to give a preconceived total space allocation, but is one resulting from planned areas and trial tape-defined spaces, set out on an open piece of ground. The area allowed would provide for a small croquet lawn, a putting green, miniature bowls or games of this nature, as well as providing space for relaxation when the games were over. As an outdoor room its space taken as 15'-0" x 33'-4" would allow a 15 foot square, in the shade and possibly secluded, where teas could be served or sewing done, and a sunny terrace 15' x 18'-4" for sun bathing and general relaxation. The most useful shapes were found to be 20'-0" x 25'-0" and 15'-0" x 33'-4". If however the area is divided into two or three areas, endless variation of uses and sizes can be found.

(E) CULTIVATION.

The greater the area allowed for cultivation of flowers and vegetables, the greater will be the return to the family. The point worth remembering, however, is that in sub-economic housing, especially for Natives, gardening in any form is an expense. Flowers are in the luxury class, while many Native families do not eat green vegetables to the same extent as Europeans do. Provision of space for cultivation should not be overlooked on this account, and the need for a vegetable patch will develop with education. To enable a family to produce all the vegetables they need from cultivation, would require more space than that area which the worker can develop during his leisure hours. Consider a Native who leaves home early in the morning and returns late at night, his free time being thus very limited. In order to know exactly what would be expected of a low income worker the author set up an experimental vegetable patch in Pretoria. It was found that the taped out mock-up layouts which determined the areas of the other functions in the garden, were not satisfactory in determining the area necessary for cultivation. Details of the experiment are summarised as follows:*

"The seeds planted and the tools used were listed against the vegetables produced. A limited amount of manure was used - one bag - and with this a humus pit was established; water for the first year was carried by hose pipe. The plot, some 400 square feet in extent, cost £2.7.6 (including water) to develop and produced the following items priced at market prices in one year:

Beans / ...

* D.M. Calderwood "An Investigation into the Functional and Aesthetic Aspects of Garden Architecture". A thesis submitted to the University of the Witwatersrand, 1952.

Beans	81 lbs. @ 6d. per lb.	£2. 0. 6
Peas	7 $\frac{3}{4}$ lbs. @ 6d. per lb.	3.10
Tomatoes	31 $\frac{1}{2}$ lbs. @ 9d. per lb.	1. 3. 7
Lettuce	31 @ 3d. each	7. 9
Radish	80 bundles @ 3d. each.	1. 0. 0
Carrots	67 bundles @ 3d. each	16. 9
Cauliflower	15 @ 3d. each	3. 9
Soup Greens	30 bundles @ 3d. each.	7. 6
Strawberries	27 trays @ 2/- per tray	2.14. 0
Mulberries	9 trays @ 1/- per tray	9. 0
Cabbages	22 @ 3d. each	5. 6
Onions	3 $\frac{1}{2}$ lbs. @ 6d. per lb.	1. 9
Beetroot	6 $\frac{1}{2}$ lbs. @ 3d. per lb.	1. 6
		<u>£9.15. 5</u>

This led to the conclusion that an area of 400 square feet is considered a suitable minimum area for cultivation in a private residential plot.

The experiment was repeated over a second year but this time half the area was watered from a bucket filled at a standpipe 100' - 0" distant from the bed and the other half of the plot was not watered at all. The year was rather dry (Bronkhorstspuit district was declared a drought area and this adjoined the Pretoria area where the tests were undertaken), but the results were very marked. The area watered by bucket produced the normal return but carrying water was found to be a trying business, whereas the unwatered area produced nothing.

These results are interesting when considering the criticism of Native housing estates where often no gardens are found: without water it is most difficult to produce a garden in certain areas of South Africa.

CONCLUSIONS FROM EXPERIMENT.

- (1) An area of 400 square feet is considered a suitable minimum area for cultivation in a private residential plot.
- (2) Without water, as is often the case in Native townships, the climate of Pretoria is too severe for the cultivation of vegetables".

PROVISION OF FRESH AIR AND SUNLIGHT.

In this case, much will depend upon the space between dwelling units and the resulting plot size. The author has taped out various small plots and the points that are overlooked in calculations of this nature are the provision of circulation space, and space absorbed when planting out boundary hedges and shrub screens. When considering circulation, the average space may be taken as 10% of all useful garden space, which would exclude the area occupied by the dwelling. In adding all the space provisions made, the following results were obtained:-

Laundry / ...