

PRACTICAL AND ECONOMIC ASPECTS
OF LOW-COST HOUSING
IN THE WESTERN CAPE

Thesis submitted in ^{part} completion
of the Degree of Master of
Science to the Faculty of
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Cape Town.

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(A) In the context of this thesis "Housing" is taken to mean urban and peri-urban dwelling places of adequate standards to safeguard the health, decency and welfare of the occupants, whether the dwellings be single or semi-detached houses, maisonettes or flats.

Township services which are regarded as basic for the attainment of such standards included the provision of :

1. Potable water,
2. Efficient sewage disposal,
3. Hardened roads,
4. Stormwater drainage,
5. Street lighting,
6. Refuse removal

Ancillary services allowed for in township layouts include :

1. School and church sites
2. Clinic
3. Creche
4. Shopping centre
5. Civic centre)
6. Library) Local authority office
7. Playing fields and open spaces
8. Postal and police services
9. Old Aged Homes
10. In addition to the above, day hospitals are now being established in some townships, their distribution being calculated to give an even spread of medical services in the region according to population density.

(B) "Conventional" building methods for dwellings in South Africa has come to denote buildings with the superstructure built of burnt clay brick or concrete blocks; timber housing, so common in North America, is "unconventional" in South Africa, partly due to its exclusion from many Building Regulations.

(C) "High-rise" buildings are limited to three to four storeys in the context of low-cost housing; higher buildings would require lifts and the additional expense would not be covered by Housing Code requirements.

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P A R T I

LOW-COST HOUSING

IN GENERAL.

1.0 THE NEED

1.1 Industrialisation.

* The swing of the country's economy from a mainly agricultural and mining basis towards a more highly industrialised level was accelerated by the needs of the 1939 - 1945 war.

The labour demanded by increased industrialisation in turn caused the movement of a large number of largely undeveloped and unskilled workers towards urban areas. Such workers have only a limited earning capacity initially, and are unable to afford more than minimum standards of accommodation until acquired skills enable them to increase their earning capacity.

1.2 Slum Clearance.

Following the slow-down of housing construction during the war a critical shortage of housing arose, with rentals rising as demand outstripped supply. Amongst the lowest income groups such conditions led to overcrowding of existing houses and the creation of slum conditions, and the unauthorised erection of shanty towns on the outskirts of large towns and cities. (1)

Whereas rural life can allow relatively primitive housing and sanitation, the higher population densities of urban and peri-urban living demand higher standards for the maintenance of public health and decency; consequently the building of crude shacks without adequate fresh water supplies or sanitary facilities could not be allowed to proceed unchecked.

1.3 Population Growth.

In addition to the demand for housing due to population migration towards industrial centres, natural population growth has imposed its burden; such growth is always greatest amongst the lowest income groups. Slater (2) has remarked that population growth has been exceptionally high amongst the Coloured people of the Western Cape.

* These industries have traditionally housed their unskilled employees and imposed no housing demand on Central or local government.

1.4 The Group Areas Act.

A further source of housing demand has been the requirement of Government policy after 1948 of the residential separation of different races. This has taken the form of the declaration of physically separated "Group Areas" for the various racial groups; White, Coloured, Asian and Bantu. "Disqualified persons" are designated as those found to be living in a Group Area to which they do not belong by reason of race classification at such time as the Group Area boundaries are gazetted; they are required to be rehoused in a Group Area appropriate to their race classification within a specified time.

The need for low-cost housing having been established, it is now necessary to frame the requirements for minimum standards of accommodation and structural performance, and maximum limits beyond which the housing ceases to be defined as "low-cost."

2.1 Minimum standards of accommodation.

Calderwood and Connell (3) have described the minimum standards of accommodation for the housing of non-Whites, and compared the South African standard with similar standards in other countries.

Fig. 1 gives a comparison of the "useful net area per person" as laid down minima in various countries. This area is defined as the interior space of the dwelling excluding circulation, bathroom and lavatory areas. In 81% of the European cases illustrated the occupancy is four, and in the remainder three persons.

The South African space requirements are very low; due partly to a high occupancy rate (seven) allowed in order to relieve the pressure of providing shelter; at the same time the minimum load upon the purses of local authorities and the rent-paying occupants has been aimed at. Small living-room space is justified by the better climate and longer hours of sunshine in South Africa as compared to most countries of Europe where children are mainly confined indoors in the depths of winter and thus need additional recreation space.

The South African minimum standard quoted above is based upon the type NE 51/9 house, one of a number of type plans prepared by the National Housing Commission to assist local authorities; see Fig. 2.

2.2 Minimum standards of performance.

Minimum standards of accommodation having set the size of dwelling, it is also necessary to define the minimum quality of building; the aim is to ensure that public money is wisely spent by erecting buildings which conform to certain standards of

- 2.2.1 structural stability,
- 2.2.2 rain resistance,
- 2.2.3 acceptable thermal environment and ventilation,
- 2.2.4 durability,
- 2.2.5 resistance to vermin infestation.

2.2.1/.....

2.2.1

Structural stability denotes the ability of the building to withstand the normal forces and stresses which it may be expected to encounter during its lifetime e.g. wind pressure and suction due to a gale of 112 km/hr.; the weight of a 90 kg man working on the roof; an impact simulating a heavy bump by furniture being moved.

In addition, local conditions may be such as require special precautions to withstand hailstorms, foundation movement, or earth tremors.

The NBRI has devised full-scale tests to assess the behaviour of roofs under heavy hailstorms, and further tests for walls subjected to foundation movement and high winds. In the latter case satisfactory anchorage of the roof down into the brickwork has been proved essential. Further tests simulate the combined effect of possible live and dead loads on floors.

2.2.2

Rain resistance is a quality the importance of which is related to the locality concerned; in summer rainfall areas occasional dampness which becomes visible not more than three times annually, and disappears in less than a fortnight, is said to be acceptable in low-cost housing. By contrast, in the winter rainfall region no visible dampness can be accepted and precautions must be taken to avoid any rain penetration of outer walls.

The NBRI has developed an artificial rain test, which consists of spraying an excess of water on one side of a wall and observing the time taken for moisture to penetrate. This test has been applied to walls of actual buildings in various parts of the country and tables are available showing how various types of construction behave under test.

2.2.3

The thermal environment inside a dwelling is produced by the effect of the outside climate as modified by the building's ventilation and particular type of construction.

In studying this aspect, it is usual to consider Corrected Effective Temperature (C.E.T.) to measure the environment. This measurement embraces air temperature, humidity, air movement and the mean radiant temperature of surrounding surfaces.

The "comfort zones" usually accepted in South Africa lie between 17° - 23° C (C.E.T.) in the winter and 18° - 26° C (C.E.T.) in summer; however it is found in practice that only high-quality air-conditioned buildings conform to these limits. Jennings (4,5) suggests a "health zone" which lies beyond the limits of the comfort zone and indicates outer limits beyond which there will be impairment to health.

From medical records of heat-waves and heat-stroke the upper limit is set at 30° C. The lower limit has not proved easy to fix, and has been arbitrarily decided upon as lying roughly halfway between the behaviour of superior-class construction (11-inch cavity wall with fibreboard ceiling and iron roof) and that of an unlined iron hut in the neighbourhood considered.

- 2.2.4 Durability is a measure of the lasting qualities inherent in the materials and workmanship of the dwelling. This affects maintenance costs and the building's economic life; in general the amortization period should not exceed 75% of the expected economic life.

Particular note should be taken of local climatic conditions; the harsh corrosive atmosphere common in coastal and industrial areas will not be encountered in remoter inland areas, and the destructive termite of sub-tropical climates is not found in winter rainfall areas. Assessment based on experience and scientific testing will form a guide in conventional building, while for unconventional building methods the Agrément Board will give technical certificates covering their assessment of tests on a full-scale prototype. The NBRI also performs accelerated ageing tests which indicate resistance to shrinking, cracking and warping of components, and tests of resistance to fire hazard and vermin infestation.

In general, the engineer has to strike a balance between what is available at reasonable prices and what the maintenance costs will be; a cheap quality glass window is easily replaced if broken, but a cheap sewer pipe laid 6m deep under a concrete roadway could cost hundreds of rands to repair and replace if it failed, not to mention the health hazards which might be involved.

- 2.2.5 Resistance to vermin infestation is tested mainly in regard to the possibility of rodents (particularly rats and mice) gnawing through a wall lining and gaining access to cavities where they might nest.

2.3 Housing Code Classifications.

The Housing Code (6) divides low-cost housing schemes into

- (1) Economic letting and selling schemes;
- (2) Sub-economic letting schemes;

(3)/.....

- (3) Housing for persons in the very lowest income groups; these are single persons and families who earn "exceptionally low incomes" and are unable to pay the rent of even the cheapest sub-economic accommodation.

The general basis to be used throughout is that the rental must not exceed one-fifth of the tenant's monthly income. To prevent abuses of sub-economic housing funds, every tenant in a sub-economic scheme is required to submit a certificate annually "to the local authority from his employer indicating his income for the year ended." A system of graduated rentals enables a tenant whose income has risen above the sub-economic level to pay increased rent "up to a maximum equivalent to the full economic rental of the dwelling."

To be housed in a dwelling erected from sub-economic funds, the applicant should (a) be married or have dependants residing permanently with him; (b) have a monthly income not exceeding

White	R. 100
Coloured and Indian	R. 60
Bantu	R. 30

2.4 Land Acquisition and Use.

2.4.1 Introduction.

The old concept of having ample space in South Africa in which to spread unchecked has been curtailed by proper town planning, and by escalating costs of land, township services and transport services. Suburban sprawl has often been caused by the building of predominantly single-storey dwellings on over-large plots, whereas high-rise buildings could make more economical use of the available land.

2.4.2 Acquisition of Land.

Chapter VII of the Housing Code ⁽⁶⁾ deals with "Acquisition of Land by a Local Authority with Housing Funds and the Alienation thereof."

In general, land may be acquired by negotiation or expropriation either in terms of section 66 of the Housing Act or section 18 of the Slums Act. Such land may be situated inside or outside an approved township; in the latter case its suitability for township purposes must be approved by the Department of Community Development.

In purchasing land outside an approved township, the local authority must submit two sworn valuations to show that the purchase price is reasonable and in agreement with current market prices when applying for an advance from Housing funds; the local authority "should not enter into a final deed of sale with the owner until it has been informed that ministerial approval for the acquisition of the land has been granted."

2.4.3 Removal of servitudes.

Restrictive conditions, such as servitudes which may be registered against sub-divisions or farms making up the consolidated township, may be removed or modified under section 40 of the Housing Act. Where servitudes of passage or stormwater drainage are concerned, it is often sufficient for the local authority to indicate that the proposed township layout of streets and stormwater drainage serves the purposes sought by the servitude(s) and thus removes the necessity for such servitude(s) remaining in force.

2.4.4 Graves.

In the case of agricultural land it has often been the practice in the past to establish family burial grounds on a portion of the farm. Once such a farm is purchased for township purposes it will be necessary for the local authority, unless a cemetery is to be established to include the existing graves, to make arrangements for the exhumation and reburial of the remains.

2.4.5 Alienation of Land.

Alienation of vacant land purchased with Housing funds is not permitted without the prior approval of the Minister of Community Development. Exception can be made for municipal purposes, crèches, and churches; where business sites are provided in the township plan the land may be offered for sale in the order of preference :

- " (i) To the Community Development Board at cost to the local authority if the Community Development Board itself intends erecting business premises thereon, and at market value if the sites are to be utilised for resale by the said Board;
- (ii) to the Coloured Development Corporation at market value (only applicable to land situated in a Group Area for Coloureds);
- (iii) to the public by tender (not auction)." (6)

2.4.6 Land Use.

Land use in a township is usually divided into the following main categories :

<u>Category</u>	<u>Typical percentage</u>
Roads	21,0
Public open space	12,0
Residential (all types)	50,0
Schools (primary & secondary)	10,0
Crèche	0,5
Churches (incl. mosques)	1,5
Local authority	0,5
Minor business	1,0
Miscellaneous	3,5
<hr/>	
Total	100,0
<hr/>	

Under "Miscellaneous" various townships may include some uses such as sewage pumping station, electricity sub-station, Old Aged Home, clinic, day hospital, library, post office, and police station. The library and post office may sometimes be conveniently housed in the shopping centre, or otherwise in conjunction with the local authority offices. Crèches are usually sited adjacent to playlots or open spaces. Police stations are distributed according to population density and available staff.

The Department of Community Development ⁽⁷⁾ insists upon the provision of an absolute minimum of 1,2 morgen (1,03 ha) per 1,000 population of open space, which may be divided into parks, sports fields and playlots. The parks and playing fields should be located adjacent to school sites where possible.

Special items such as sewage treatment works would normally require special siting, and would not be within a residential township.

2.5 Family Sizes.

In the estimating of size requirements for low-cost housing units, cognisance must be taken of the average family size for initial planning purposes.

For Coloureds a statistical analysis of census figures gives an overall average of 6,1 persons per family.

Amongst/.....

Amongst this section of the population it is usual for ageing parents to be taken into the home of the children; similarly young married couples may live temporarily with one set of parents. The net result is that few non-White families consist of only two members.

For Whites requiring low-cost housing a figure of 3,6 persons per family is usually taken.

3.0 THE METHODS.3.1 Preamble.

Although private capital had done much for the development of commercial buildings and urban and suburban housing, it was soon realised that the return on capital was not sufficient in the case of low-cost housing to tempt investment in such development. It was necessary to have non-profit organisations engaged in the establishment and administration of low-cost housing; to this end the Housing Act enjoins local authorities "to provide housing for the inhabitants of their areas of jurisdiction...", and the National Housing Commission assists by the provision of housing funds.

Advances for the construction of housing schemes are repayable over a period of 30 years for economic schemes and 40 years for sub-economic schemes; the rates of interest are 8% (at present) for economic and $\frac{3}{4}$ % for sub-economic schemes.

In addition to the Housing Act, the Slums Act requires local authorities to prevent housing nuisances or remedy such nuisances in their areas of jurisdiction.

3.2 The Low-cost Approach.3.2.1 Increased Housing Density.

Jennings (4,5) has discussed the method of economising by increasing the number of buildings per gross hectare, i.e. the total number of dwellings divided by the total township area including streets and open spaces. Whereas the density of the average (Bantu) township in 1954 was only 10 dwellings per gross hectare, it was not considered desirable to increase housing densities suddenly, but rather to allow a gradual increase over the years. This has in fact taken place and we can now (in 1972) find Coloured townships under construction having a planned density exceeding 20 dwellings per gross hectare. Much of this increase has been due to the inclusion of high-rise development in portions of new townships.

3.2.2 Repetition of Designs.

One of the most fundamental methods of introducing economies into mass housing is to limit the number of building designs to be used.

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The NBRI has investigated the provision of low-cost urban Bantu housing in detail (8) taking for its study the NE.51/9 type house upon which our minimum standard is based. Most of their findings are also applicable to all other classes of housing.

Although in the past the use of only a few standard designs has resulted in a "barracks-like" appearance in some townships, there is no reason why, with the exercise of some imagination, low-rise and high-rise buildings might not be interspersed to vary the roofline. The use of different wall colours, different roof coverings and pitches, and variation of the set-back from the plot boundaries can also introduce a better finished appearance to a township.

3.2.3 Bulk Buying.

Where a large housing programme is planned, bulk buying can also prove economical: the buyer of several thousand doors and frames, windows, lock sets, baths and lavatory suites can obviously command preferential discounts over the ordinary purchaser. Examples of preferential prices for large orders have been building sand at 80c. per cubic metre instead of R. 1-10, and cement at 75c. per sack instead of the usual 90c. Bulk cement delivered by tanker to a silo is even cheaper, as long as a good watch is kept at the user end to prevent wastage.

3.2.4 Use of Stock Items.

The general use of stock items throughout without any "specials" being called for is recommended; in particular stock windows with fewer opening sections are cheaper. Suppliers may offer slow-moving items from time to time at a discount, and these may be substituted for the standard items as long as they are equally durable and do not lower the standard of building.

3.2.5 Roof Simplification.

One great economy lies in simplification of the roof as far as possible, avoiding complicated hips and valleys and aiming at simple gable ends to a rectangular plan. When the roof covering is asbestos-cement sheet, trusses and purlins need only be spaced at 1,5m centres; this may be compared to the heavier roof having trusses at 0,8m centres to carry the more expensive tiles or slates. The higher pitch of the latter also calls for additional timber.

3.2.6/.....

3.2.6 Cheaper Floors.

For floors, vinyl-asbestos or asphalt tiles are to be preferred to woodblocks in single houses. Whereas the tiles may be laid in one day on the prepared screed, woodblocks require the three processes of laying, sanding, and polishing, each of a day's duration.

3.2.7 Simplified Wiring.

To economise in the electrical layout, the distribution board may be located above the stove-point and back-to-back with the meter-box on the outside wall. This ensures that the costly connection of heavy-duty cable serving the stove is kept to a minimum. Further economies are made by limiting the number of plug outlets and having such outlets as well as wall switches back-to-back where possible.

3.2.8 Simplified Drainage.

The drainage layout may be simplified wherever possible and plastic piping used for house connections. P.V.C. piping is supplied in 6 metre lengths, weighs only 3 kg per metre, and is jointed with a push-together coupling. Rapidity of work saves money in this instance.

3.2.9 Stain instead of Paint.

Doors and skirtings may be stained instead of painted. This is a single operation as opposed to the two minimum operations of priming and painting for a painted finish.

3.2.10 Housing Code Requirements.

The Housing Code ⁽⁶⁾ lays down certain maximum standards of construction of housing services, as follows :

" (a) Streets.

- (i) Streets with a gradient of less than 1 in 50 are graded to a width of 18 feet and rounded up. If the quality of the soil is unsuitable for road building purposes, e.g. as a result of turf which renders roads impassable during heavy rains, selected gravel may be brought in and compacted.

(ii)/.....

(ii) Streets which are steeper than 1 in 50 but flatter than 1 in 25 are graded to a width of 18 feet rounded up and compacted to sub-grade standard. Selected gravel may be brought in if the quality of the soil is unsuitable for road building purposes, kerbing and channelling or packed stone being recommended on the lower side of the street. The cross fall of the street must extend in the direction opposite to the natural fall.

(iii) Streets with a steeper gradient than 1 in 25 are built 18 feet wide and tarred if necessary. The road is designed to carry a wheel load of 5000 lb. Kerbing, preferably of the slanting type, and channelling are provided on the lower side of the street in a direction opposite to the natural slope of the site.

(iv) Streets carrying bus transport may be 24 feet wide and able to carry a wheel load of 9000 lb.

(b) Stormwater drainage.

As far as possible use should be made of open ditches alongside the streets for the draining of stormwater. Stormwater drains may be provided only if the flow of water is expected to be so strong that washways may result.

(c) Provision of Water.

(i) The minimum daily water consumption in sub-economic schemes provided with sewerage but not with bathing facilities is considered to be 20 gallons per person with a peak factor of at least 3 and a minimum pressure during peak periods of 25 ft. head. In respect of schemes where pail latrines are used, the minimum daily consumption is considered to be 12 gallons per person.

(ii) Waterpipes may be laid either alongside the rear boundaries of the building plots or inside the road reserve.

(iii)/.....

(iii) In schemes for very low-paid non-Whites, water is provided by means of street taps which are positioned in such a manner that no dwelling is more than 500 feet from a tap. The average daily water consumption in such schemes is 8 gallons per person. The installation of an outside tap on the plot is, however, also permissible, in which case the average daily consumption is 10 gallons per person.

(d) Sewerage.

- (i) The usual engineering standards in regard to main sewers and sewerage reticulation are applicable. The flow is based on the water consumption per person allowed for in the planning of the system.
- (ii) The inner block sewerage system is strongly recommended in cases where it will result in a saving. In the case of very steep sites even the provision of sewerage right across the building plot and passing near the dwelling and latrine is recommended.

(e) Street Lighting.

Overhead wiring is preferred to underground cables in view of the cost.

11. If as a result of special circumstances, e.g. uneven sites or exceptionally high rainfall intensity it is considered necessary to provide services of a standard higher than the aforementioned, proposals for the application of a higher standard may be submitted, giving the reasons therefor."

(Extracted from Chapter IX of the Housing Code.)

3.2.11 Maximum House Prices.

The Housing Code also lays down maximum total erection costs for single houses in selling schemes. The maximum was increased on 19th July, 1972, from R.6500 to R.7200.

3.2.12 Mechanisation. (9)

During the building boom years when labour supply proved difficult, local authorities were forced to mechanise their work wherever possible :

In trench excavation, the building of new townships on virgin ground devoid of any underground services makes it possible to excavate in "open cut", allowing the trench sides to be sloped to the natural angle of repose of the soil. Since more soil has to be moved, it is advisable to use a large machine - it is false economy to "send a boy to do a man's job." The slow and costly timbered trench is to be avoided wherever possible; the additional time taken and consequent high costs more than outweigh the saving in quantity of excavated material.

Further mechanisation may be provided by hoists when working on multi-storied buildings, and the ubiquitous motor "dumper" which can convey all classes of building material farther and faster than labourers pushing wheelbarrows and does not become fatigued.

3.3. Conventional Building Materials.

3.3.1 Introduction.

In ancient times, the burnt clay brick was found to be a cheap and durable building material, suited in size and weight to a man's hand. In later years attempts were made to replace bricks by "blocks" of varying sizes and shapes. Many of these were rejected as being unwieldy to handle, and awkward to lay accurately and bring to line; some sophisticated alternatives have been too expensive to warrant further development.

3.3.2 Types of burnt brick.

Before the metric system was introduced into South Africa, the imperial system brick in common use had the nominal dimensions 9 in. x 4½ in. x 3 in. thick (228,6 mm x 114,3 mm x 76,2 mm thick). These bricks were usually laid flat in stretcher bond; for low-cost housing projects economies in quantity and labour costs were often effected by laying the bricks "on edge", i.e. with the 4½ in. (114,3 mm) dimension vertical, giving a 3 in. (76,2 mm) thick internal wall or 8 in. (203,2 mm) cavity wall. This method used less brick courses with less horizontal jointing mortar for a given height of wall.

A "lightweight"/.....

A "lightweight" brick has been on the market for some time; this is of the dimensions given above and is pierced with three holes through the thickness of the brick. The presence of the holes prevents the bricks from being laid "on edge".

The various types of common stock brick, smooth face-brick and rustic face-brick are too familiar to require description. In general, wire-cut bricks are cheaper than pressed bricks.

3.3.3 The Metric Brick.

With the introduction of metrication, a metric brick of reduced dimensions (215 mm x 102,5 mm x 65 mm) has been proposed and produced in small quantities by some brickfields. This smaller brick has met considerable opposition from building contractors and local authorities who have found that extra labour and mortar are needed in building walls. If a 10 mm joint is assumed it can be calculated that for a 1,2m height of wall we require 16 courses of metric bricks as compared with 14 courses of imperial bricks. Thus for a wall of average height 3,6m the use of metric bricks will require 6 extra courses over the whole building. It is possible that the size of the metric brick will be reconsidered in the light of the practical disadvantages found; the additional cost of metric brickwork is said to be 15% above the normal cost.

3.3.4 The Calcium Sillicate Brick.

The shortage of burnt clay bricks resulting from the building boom has encouraged the development of alternative materials. One such is the pressed brick made by compacting a mixture of hydrated lime and fine silica sand, and hardening the material in an autoclave. This produces a brick which can have a minimum crushing strength of up to 5 000 lbf/ in² (34,5 MPa). The calcium silicate brick must be laid with a certain degree of care to ensure a proper mortar bond. Bricks must on no account be saturated as in the case of burnt clay bricks; suction of the bricks must be controlled by the use of as little water as possible. Mortars should not be very strong, a good mix has the proportions 1 part cement to 2 parts lime to 8 or 9 parts of dry sand.

Calcium silicate bricks have the following advantages over burnt clay bricks :

- (a) Being a pressed brick, the calcium silicate brick has accurate and uniform dimensions;

(b) /.....

- (b) The burnt clay brick can vary in hardness over a consignment, or be bent out of true;
- (c) Breakages in calcium silicate brick are said to be as low as 5 per 1000, compared to perhaps 50 per 1000 for burnt bricks;
- (d) Since the calcium silicate bricks are no more expensive than burnt bricks, all the foregoing advantages lead to labour and materials savings on the part of the contractor.

The calcium silicate brick has recently been produced in an "oversize" form, having the dimensions 230 mm x 104 mm x 90 mm thick. The extra size is most easily seen in the thickness. If we assume a mortar joint of 10 mm as before, a wall 1,2 m high requires only 12 courses of the oversize brick. In this case, for a wall of average height 3,6 m there will be a saving of 6 courses of brickwork over the whole building, as compared to the normal (imperial) size of brick. The price is R.2 per 1000 more than for imperial size.

3.3.5

The Clinker brick.

These have been made in imperial dimensions from waste power-station ash with cement admixture pressed into a mould and allowed to dry. The material is cohesive by nature and makes a brick often laid as a nailing course for cornices and skirtings and sometimes used for interior partition walls.

3.3.6

Terracotta Hollow Blocks.

These blocks may be described as being of "egg-crate" construction; H 12 blocks have the dimensions 12 inches (304,8 mm) long by 6½ inches (165,1 mm) high. This height is equivalent to two courses of imperial size brickwork, but the weight of the H 12 hollow block is sufficiently close to that of a stock brick to avoid overtiring the bricklayer during the day.

Tests were carried out on 12 blocks by the Materials Testing Laboratory of the Dept. of Civil Engineering, at the University of Cape Town, for the manufacturers, in accordance with B.S.S.No. 1190 of 1951. The average crushing strength was found to be 1290 p.s.i. (8,89 MPa) and the water absorption by weight averaged 6,3%.

The City Engineer's Department, Cape Town, is prepared to accept such blocks for building provided that their average crushing strength is not below 700 p.s.i (4,83 MPa) and the water absorption by weight does not exceed 10%.

3.4 Unconventional Building Materials.

3.4.1 Introduction.

As a generalisation, the prime target for innovators in building has most often been attempts to eliminate the "wet" trades of bricklaying and plastering. Numerous attempts have been made to fabricate whole wall panels in a finished condition, requiring no further treatment than painting and no delays to dry out.

When the S.A. building boom of the 1960's caused a grave shortage of bricks, and an accompanying shortage of bricklayers, thoughts were turned towards alternative methods of building. These methods have sometimes been oriented towards alternative materials, and sometimes towards less labour-intensive methods of construction.

3.4.2 Variety of Systems. (10, 11)

In Europe and the Americas many industrialised building systems have been developed; there are at least 55 different "heavy" systems for all types of building, and 30 "lightweight" systems for single-storey buildings. Not all of these systems will give low-cost buildings to the degree which we seek, but all must necessarily be financially competitive in their own areas of operation.

One great advantage of nearly all types of industrialised building is the rapidity of erection of the outer shell, roof timbers and roof covering. This allows all the other trades to work independently of weather conditions. A consequent advantage is the possibility of earlier completion of the building and earlier occupation.

3.4.3 Agrément Board.

The Agrément Board (12) of South Africa was appointed by the Minister for Community Development and Public Works in July, 1969, in order to investigate and evaluate "innovations in the Building and Construction Industries".

While/.....

While existing building regulations cover the use of traditional materials and methods of construction, local authorities rarely have the specialised knowledge of facilities required to test and assess unconventional components or systems.

Agrément Board certificates are limited to technical aspects of a product or system, and cover :-

"structural safety; resistance to impact damage; behaviour in fire; thermal performance; resistance of the walls to; rain penetration, sound transmission, rodent attack; durability in regard to: dimensional stability of materials, and corrosion; extent and ease of maintenance."

Agrément Board certificates contain drawings and specifications sufficient for the contractor's client to detect any non-compliance with certificate requirements, but do not disclose any confidential information.

The NBRI is the evaluating agency of the Agrément Board, carrying out all the tests and investigations required.

3.4.4 On-site Fabrication.

Several methods have been used whereby complete wall panels have been fabricated at the building site and then erected in position on the foundation slab. One such method casts successive concrete panels one above the other with releasing oil painted on the panels between successive pours. This can lead to damaged panels if the releasing agent is not efficient.

3.4.5 Off-site Fabrication.

All building methods which fabricate complete panels or whole rooms, e.g. bathrooms, away from the actual building site have the following advantages :-

- (a) By working under cover there is no lost time due to adverse weather conditions;
- (b) Workers have a fixed work site instead of having to change sites every few weeks, thus absenteeism is reduced;
- (c) In the case of precast concrete components, sophisticated mixing, batching and steam-curing plant may be properly housed and under close control for both running and maintenance;

(d) /.....

- (d) Suppliers have a fixed address for deliveries, thus control of quantity output is improved;
- (e) Quality control is more easily enforced;
- (f) By eliminating wet trades such as plastering more rapid drying of the components is achieved and the possibility of moisture being trapped in the structure is virtually eliminated;
- (g) Wasteful processes such as chasing and cutting holes for plumbing and conduits are eliminated by having these preformed or cast into the panels.
- (h) There is less wastage of time and materials; on conventional building sites, nails, screws and small tools may be trodden into the soil and pilferage of small components such as door lock sets is common.
- (j) On multi-storey buildings, window frames may be obtained which can be glazed from the inside, thus avoiding the necessity for scaffolding.

3.4.6 No-fines Concrete.

No-fines concrete is used extensively in Great Britain as a wall building material, being placed in shutters erected on site. Shutters may be lighter than those usually used for conventional concrete, since no-fines concrete does not behave as a fluid and consequently does not exert the same hydrostatic pressures on the shuttering; a typical light shutter using a formboard face has 75 mm x 50 mm studs at 600 mm centres spanning 2m.

Further Advantages are :

- (a) There is no "bleeding" from shutters;
- (b) The material is easier to transport and place, weighing only 2000 kg per cu. metre instead of 2400 kg per cu. metre.
- (c) The finished wall may be chased for pipework as easily as brick-work.

Note that any patching that is required must only be done with no-fines concrete - the use of conventional concrete will lead to the transmission of moisture right through the thickness of the wall.

Normally/.....

Normally the inclusion of numerous unconnected air voids in no-fines concrete prevents any transmission of moisture in this way.

In British practice internal walls take the form of partitions to avoid having a multiplicity of different shutters for various wall sizes.

3.4.7 Timber Houses.

Timber houses have been used throughout North America and in parts of Europe where timber is plentiful. Visser (13) has compiled a report on the construction of 50 timber houses at Thaba Nchu, built by Bantu labour for Bantu occupation. At the time timber was in over-supply and its use for housing was partly an experiment to see whether this type of building would be an outlet for its use. One point which was noted was that the thermal behaviour of the type of house built at Thaba Nchu was sub-standard; for reason of economy there was only a single "skin" of covering timber (without any insulation) on the framework.

The Thaba Nchu houses have been found superior to brick-walled houses which suffer from cracks due to the poor foundations obtaining in that area. Timber houses would probably perform better than brick-walled houses in areas subject to earth tremors or earthquakes.

Dobson (14) has reported that the general "feeling among regulatory authorities is that timber housing is not suited to low-income groups", one of the main reasons being the risk of fire emanating from the use of candles, oil lamps, and paraffin stoves.

Since the start of the building boom in this country, timber has been in short supply at times and certainly not a cheap material in spite of Government price control.

(15,16)

3.4.8 Pisé de Terre.

This is literally a "rammed earth" method of constructing walls, in which "moist selected earth is rammed between moveable forms without the addition of straw or other material." The ramming renders the compacted material sufficiently self-supporting to allow the forms to be removed as soon as filling and ramming are completed.

For protection, as well as improvement of the appearance, it is usually necessary to apply an external protective treatment.

The best/

The best and cheapest material for this has been found to be a mud plaster (of similar material to the walls) stabilised by adding 10% of Portland cement by volume. Alternatively, stabilisation of the plaster may be achieved by adding asphalt emulsion at the rate of 1 litre to 10 kg of dry plaster mixture. A final finish of limewash adds to the waterproofing.

The acute postwar shortage of housing in Rhodesia, aggravated by a shortage of building artisans, led to the promulgation of the Building Act of November, 1946. The National Building and Housing Board, then created, had as its main object alleviation of the housing shortage "in any way possible." Over a thousand pisé de terre houses were built in the suburbs of the main cities of Rhodesia at this time, making use of mainly unskilled labour.

These were regarded as temporary dwellings with a life not exceeding 15 years and an amortization period of 10 years, although many such houses lasted far longer when given adequate maintenance.

Pisé de terre construction has not been approved for State-financed housing schemes in South Africa.

P A R T I I

LOW-COST HOUSING

IN THE

WESTERN CAPE.



Photograph by courtesy of the Divisional Council of the Cape

4.0 THE O1 REGION.4.1 Limits of the Region.

The region designated O1 includes the magisterial districts of Cape, Wynberg, Simonstown, and Bellville. See Fig. 3.

This is the largest metropolitan complex in the Cape Province and the most densely populated part of the Western Cape, comprising the core city of Cape Town together with its suburbs and the adjoining larger municipalities. According to the 1970 census (17) the population of this region was then made up of

White	378 505
Coloured	598 952
Asian	11 263
Bantu	107 877
TOTAL	<u>1 096 597</u>

4.2 Population Growth.

Projections have been made of the population growth of the O1 Region up to the year 2000.

According to the Cape Provincial Administration Report on Population (1968) (18) : "It has been found totally impossible to calculate with any accuracy the future Bantu population, whilst the numbers of Asiatics are too small to worry about."

Considering the White and Coloured population as contributing the bulk of the increase therefore, the following table has been compiled :-

Year	Total	White	Coloured
1975	1 085 023	381 369	703 654
1980	1 244 986	407 868	837 118
1985	1 431 287	435 264	996 023
1990	1 647 907	463 377	1 184 530
1995	1 901 652	492 211	1 409 441
2000	2 201 664	522 635	1 679 029

From this table, and figures published by the Bureau of Statistics, the recorded and projected population growth is assembled and shown graphically in Fig. 4.

The/....

The projection for 1970 (which was made in 1968) is about 5% low when compared with the actual census figures recorded in 1970; an extrapolated line from the 1970 figure to the point X at the year 2000 gives a possible maximum. The actual population in the year 2000 probably lies between the two points shown. It appears that planning for future housing should regard the lower (projected) figure as a minimum.

4.3 Population Policy.

Although Government policy has been frequently stated to be oriented towards the removal of Bantu from the Western Cape, the number of Bantu enumerated in successive census counts in 1960 and 1970 shows an increase approximating 30 000, or roughly 40%. Due to the increased demand for labour over the period considered, it is probable that a large proportion of the increase is made up by men on "contract" from the Bantu homelands who are not permanently settled with their families in the Ol region. Under the contract system an employer who has made application to the Department of Labour for Coloured workers and has satisfied the Department that suitable workers are not available to fill his requirements, may obtain a permit to recruit a specified number of Bantu male workers in one of the homelands. Recruiting is done through a Native Commissioner's office, and the employer is responsible for transporting the contract labour to the Western Cape and back to the homeland on expiry of the contract period. The employer must also arrange for accommodation for the workers in premises licensed by the Department of Bantu Affairs. In times of shortage of Government funds, employers are permitted to erect single men's accommodation in the established Bantu townships.

Wives and families are not permitted to accompany the men who are thus recruited for contract work; wives may obtain permits for visits of limited duration, on condition that they are not in a state of pregnancy sufficiently advanced to make it likely that a child could be born during the visit. In the event of such a birth taking place, the mother would have a legitimate excuse for prolonging the visit by at least a week, and the child might have a claim to having been born in the Western Cape; both these eventualities the central Government wishes to avoid.

4.4 Bantu Housing Requirements.

Since migrant labour is regarded as transient and is limited by law to a high preponderance of males, the State has laid down certain housing designs in recent years.

As shown in Fig. 5, "hostel" blocks are designed to accommodate 20 Bantu men in two sections, but can be converted as required into two Coloured dwelling units.

4.5 Joint Town Planning Scheme.

The Joint Town Planning Committee, which was constituted in terms of Section 34 of the Townships Ordinance No. 33 of 1934, has prepared a Master Plan for the Cape Flats. This committee has for its members the Divisional Councils of the Cape and Stellenbosch, and the municipalities of Cape Town, Goodwood, Milnerton, Strand, Somerset West, Parow, Bellville, Kuilsrivier, Pinelands and Stellenbosch.

The Master Plan covers such aspects as road and rail transport, future housing and schools as related to population projections, cemetery sites, and industrial uses such as the utilisation of agricultural and silica sand areas. The provisional plan shown in Fig. 6 is not inflexible, but forms a basis for the formulation of planning decisions from time to time.

4.6 Group Areas Requirements.

When funds for housing schemes are approved by the Department of Community Development, the local authority is notified of what proportion of the proposed number of dwellings will be required for re-settlement of persons to be rehoused in terms of the Group Areas Act. This has been as high as 75% in certain cases. Fig. 7 shows the location of some Group Areas in the region.

5.0 CLIMATE.

5.1 The Winter Rainfall Area.

At the south-western tip of the African continent, Cape Town's latitude of 34° South of the equator gives it a Mediterranean type of climate with a less extreme range of annual temperatures than either San Francisco or the Mediterranean cities of Europe. (19) The summers are hot and dry, while winters are cold and wet; Fig. 8 shows graphically how the main rainfall months of June and July are also the coldest months with least hours of sunshine.

5.2 Building for the climate.

When prolonged falls of rain are combined with a driving north-west wind, building construction must be adequate to prevent rain penetration of weather walls. Unlike the highveld summer rainfall areas, once an exterior wall suffers rain penetration to the inner surface there is little likelihood of effective drying taking place for a considerable time. Experience has proved that in conventional construction using burnt clay bricks a "cavity" wall is the most waterproof. This usually takes the form of two 4½-inch (113 mm) brick skins separated by a 2-inch (51 mm) cavity. Any water which may penetrate the outer skin drops down the cavity and passes out through slits left in the vertical jointing at damp-proof course level. Provided care has been taken to keep the cavity clean during bricklaying, and to prevent "bridging" due to mortar lodging on wire ties between the skins, the inner skin should remain dry at all times.

Whether exterior walls are rendered or finished in "fair-face" brickwork, painting improves waterproofing.

✓ It does not drip! It forms a wet surface on the inside leaf which evaporates. Hence cavity walls should have copper vents as well.

D.C.B.

Int. En.

6.0 HISTORICAL BACKGROUND.

Historically the first part of South Africa to be settled by European colonisers, the Western Province of the Cape had grown in 300 years to contain elements of all racial groups in a relatively mixed residential pattern.

The town which "just grew" from the small settlement established by the Dutch East India Company to provide fresh vegetables and water for their trading vessels, went through various stages of "growth" and "ageing" during which former high-class residential areas became less popular as the more affluent moved out to the suburban areas. Over the years, suburbs which had non-White settlements on their outskirts found that by a natural process of expansion they had become contiguous with the adjoining suburb and White and non-White had become neighbours.

6.1 District Six.

In the case of Cape Town the old Kanaladorp, which had housed the freed slaves, Malay tailors and fruit and vegetable hawkers of the mid-nineteenth century, expanded to become the District Six of the present day. In many parts of this non-White district overcrowding and lack of building maintenance had led to the development of slum conditions; the population density reached a mean of 279 persons per hectare, with less than minimal recreational facilities, narrow streets being the legacy of the days of horse-drawn traffic, streets where only priests or uniformed nurses could walk alone but policemen went in pairs.

The Government decision in February, 1966, to declare part of District Six a White Group Area has been mainly a slum clearance project; approximately 33 000 people were to be removed and rehoused from this area.

Fig. 9 illustrates a slum dwelling photographed in District Six during winter, 1972. The probability is that this building has been grossly overcrowded for years.

6.2 Windermere.

A very different type of slum was once to be found to the east of Maitland in an area which some cynic had seen fit to name "Windermere", having doubtless visited it during the winter rains when the ground became a series of lakes and pools.

Here/

Here members of the lowest income groups had erected a sprawling shanty town of crude shacks knocked together of wood and iron, cardboard, packing cases, and any cheap or discarded materials which came to hand. The rehabilitation of this depressed area was undertaken by the City of Cape Town in a programme covering the years from 1946 to 1968, and comprises the full provision of potable water, sewers and hardened roads with electric lighting and stormwater drainage to accompany the building of adequate housing.

The transformation is partially indicated by the photographs of Fig. 10; having provided clinic, creche and library facilities and set aside land for schools, churches, and playing fields, a swimming pool was built. The final touch was to discard the name "Windermere" and replace it by "Kensington". Windermere no longer exists.

6.3 City Council Housing. (20, 21)

In 1913 a number of small municipalities, stretching along the railway line from Sea Point to Muizenberg, amalgamated with the City of Cape Town.

The first low-cost housing by the enlarged municipality was the erection of 122 cottages for municipal employees at Maitland Garden Village in 1917, at a cost of one shilling per square foot (R.1-08 per sq. metre).

In 1922 the Government first made loans for housing schemes available to municipalities; both wood and iron dwellings and concrete block houses were erected. In 1929 the Citizen's Housing League was inaugurated; between this date and 1963 the League "provided 1174 homes in the City itself as well as some 4000 homes in adjacent municipalities". Group Areas legislation now prohibits the League from building in non-White residential areas.

In 1953 a special housing section was set up in the City Engineer's Building and Production Branch. The tempo of building has increased considerably since the Building Unit was established; from 4260 lettings at the end of 1952, there were 30 846 lettings at the end of 1971, plus 2002 home-ownership dwellings. Fig. 11 shows graphically the progress made between 1962 and 1971 by local authorities in the Ol Region.

6.4 Cape Divisional Council Housing.

Establishment of the Housing Development Section was decided upon by the Divisional Council of the Cape in 1965, in order to expedite the provision of dwellings in those areas of the Cape Division which lay outside the municipalities.

By/

By the end of 1966 the first 132 sub-economic homes had been built for the Housing Development Section in Grassy Park; by the end of 1971 the housing stock totalled approximately 5 200 dwelling units.

6.4.1 Elsies River Redevelopment.

On 1 April, 1970, the depressed area known as Elsie's River was taken over from Goodwood Municipality by the Divisional Council of the Cape. This area of 739 hectares contains both Indian (Cravenby Township) and Coloured Group Areas.

A survey of the existing housing stock revealed that out of 13 000 families some 11 000 were housed in inferior buildings of which 9 600 were makeshift shacks ("pondoks"). Out of roughly 50 hectares zoned for open space less than 2 hectares were developed. Basic services were lacking, community facilities were non-existent, and the bus services feeding suburban railways were functional, though less than satisfactory. 70% of the household heads were found to earn less than R.60/month, the upper limit for sub-economic housing.

The survey of housing also revealed that in 317 hectares the entire area needed replanning, in 99 hectares partial replanning was required, and in 323 hectares little or no replanning was needed; see Fig. 12. In order to replan the affected area the Cape Divisional Council must acquire the land by negotiation with the owners; this is a time-consuming process and, if negotiations fail, it may become necessary to resort to expropriation. By the end of April, 1972, land had been bought or negotiations entered into to the extent of 105 hectares at an estimated purchase price of R3,168 million; expropriation had not been necessary in any of these transactions.

The Elsie's River Planning Report No. 1 (22) gives a preliminary estimate of redevelopment over a 10-year period as R.42 million, to provide housing and appropriate services and amenities for 115 000 persons.

In Goodwood Extension 10 (Uitsig Township) a contract for 1008 sub-economic dwellings was in progress when the Divisional Council of the Cape took over; this was completed in 1971 and 400 selling scheme houses have also been built, while blocks of flats comprising 288 lettings are under construction. The School Board has had a primary school built in Uitsig.

Major services, particularly stormwater drainage to relieve the annual winter flooding, are under construction.

6.5 Bellville Municipality Housing.

6.5.1 The Past.

Low-cost housing for Coloured residents of the Bellville municipal area commenced in 1947 with the building of 100 sub-economic dwellings, ; over the years these have been upgraded, first to economic lettings and then to a selling scheme. After a lapse of almost 14 years, a series of concrete block dwellings was erected during the period 1961 - 1962, 236 of these were for the sub-economic group and the remaining 117 were economic lettings. In 1964 a further 124 sub-economic lettings were built using brick-on-edge construction.

6.5.2 The Present.

A contract for both services and buildings is under construction at present at a cost of R2,9 million. The 916 dwellings units will comprise :

333 sub-economic lettings;

415 economic lettings;

168 sub-economic lettings for municipal staff. The municipal staff dwellings are financed from municipal funds and the balance from National Housing funds. In this scheme the gross density of occupation is 22,8 dwelling units per hectare.

6.5.3 The Future.

A low-cost housing scheme for Whites has been prepared and comprises both low-rise and high-rise buildings; the 372 dwellings are planned to give a gross density of 14,2 units per hectare.

6.6 Parow Municipality Housing.

Parow Municipality has a somewhat unusual problem in that there is no available vacant land at present for the required low-cost housing.

As regards the Coloured group private development south of the main railway line has for many years been in a township sub-divided into half acre (0,2 hectare) plots. Owing to the high cost of developing such a sprawling layout, only the minimum services could be provided. Absentee landlords have often accepted ground rent from three or four families who were then allowed to erect their own accommodation, often of crude shacks.

The services per half acre have usually been limited to one standpipe for fresh water and one or two bucket latrines.

By invoking the Slum Act the municipality has been able to acquire large areas of land for replanning with smaller plots, followed by the demolition of shacks and the erection of adequate housing. This is a continuing process; consideration has also been given to the building of a number of "transfer" blocks of flats which could provide temporary accommodation for families in the process of being rehoused from shacks to proper dwellings.

Year Built	No. of Units	Class	Costs (R)			Scheme Area ha	Gross Density D.U./ha
			Buildings	Services	Total		
1961-2	100	S/E	81 166	12 440	93 606	4,46	22,4
"	229	Ec.	201 399	28 280	229 679	10,90	21,0
1964	148	"	154 133	21 155	175 288	7,63	19,4
1969	161	"	345 789	63 679	409 468	9,91	16,2
*1970-1	326	"	546 608	88 698	635 306	18,34	17,8
*1972	207	"	496 275	94 475	590 750	13,88	14,9
1971	30	"	42 505	-	42 505	0,94	31,9

* Slum Clearance.

6.7

Milnerton Municipality Housing.

The whole of Milnerton is designated as a White Group Area.

Some years ago the Department of Community Development purchased Bosmansdam Farm, and the township of Bothasig was planned. Low-cost housing has been constructed under the supervision of the Department, and 806 single dwellings were built between 1965 and 1970. A few residential stands were also sold to individual purchasers and to date 171 single houses have been built privately. Although a number of stands are zoned for flats, no flats have been built yet.

At present 330 single houses are under construction by contract in Bothasig Extension 1, and 12 houses are being built by private enterprise in this section.

7.0 LAND ASSEMBLY.

In a free-enterprise economy those who can afford the most desirable building plots will acquire them by outright purchase, or by hire-purchase or building society loan. Once the most sought-after land has been used for residential, commercial, and industrial development, some of the balance may become available for low-cost housing. Low-cost land may initially be used for farming; once the spread of urban development reaches the borders of agricultural land the farmer may find land prices rising faster than the value of his produce. In many cases such marginal land has been offered to local authorities for housing.

7.1 Physical Suitability of Land for Housing.

This parameter is relative to the urgency with which housing is required in a particular locality. For example, in Hangberg Township (adjoining Hout Bay harbour) it was necessary to house the families of men engaged in the fishing industry; wives and daughters are also employed in processing factories close to the harbour. Although much of the site available was sand-dunes and mountainside, and the cost of services consequently high, there was no alternative site both near to the harbour and zoned for Coloured housing.

By contrast, land in the Bokramspruit valley (adjoining Ocean View) and near Durbanville has been rejected for present development due to its undulating or mountainous nature and the lesser urgency of providing housing in these areas.

7.2 Constraints.

Two types of constraint encountered in land assembly in the Western Cape have been :-

1. Restrictions
2. Prohibitions.

7.2.1 Restrictions.

These have taken the form of :

- (a) Land lying in the flight-paths of military airfields (Ysterplaat and Phesantekraal) or commercial airfields (D.F. Malan Airport), on which building height restrictions are imposed;

(b) /....

- (b) Land abutting freeways and national roads, upon which only limited road access is permitted (e.g. Nooitgedacht);
- (c) Land subject to servitude restrictions - these may be removed as discussed in paragraph 2.4.3.

7.2.2 Prohibitions.

The State has entirely prohibited the use of land for housing for the following reasons :

- (a) Proximity of a proposed nuclear power station;
- (b) Land reserved for agricultural uses;
- (c) Presence of kaolin (china clay) in commercially valuable quantities (Ocean View and Sun Valley);
- (d) Presence of silica sand in commercially valuable quantities (abutting Hein Road).

7.3 Land Prices.

According to its former zoning prior to being offered to local authorities, the price of land has shown some variation and has increased over the years.

Former agricultural land was bought for R1 000 per morgen (R1 168 per hectare) in December, 1969; between December, 1970 and April, 1971, similar land was bought for R1 500 per morgen (R1 751 per hectare).

Land zoned as residential for many years is currently (1972) being acquired by the Cape Divisional Council at Elsie's River at an average price of R15 800 per hectare, in consultation with a valuator of the Department of Community Development; indications are that land prices are rising steadily in this area, following the general pattern seen throughout the country.

8.0 SERVICES.

As shown in Fig. 13 (and discussed later in paragraph 12.4) the cost of services is one of the smaller items in housing costs, and is limited by the maxima laid down in the Housing Code.

8.1 Cape Flats Sewers.

On the Cape Flats, where the ruling gradient in a township may be as flat as 1 in 300, the laying of a long 150 mm sewer at the limiting grade of 1 in 178 would involve excavation at excessive depths below the (shallow) water table. Two remedies are available to the designer :

- (a) Lay a larger sewer - say 225 mm at a limiting grade of 1 in 305 for at least part of the required distance, or
- (b) Install a minor pump station to raise the sewage to a higher level.

The first of these alternatives is usually cheaper and involves least maintenance.

8.2 Amended Sewer Standards.

Marais (23) has described the use of a "self-topping aqua privy system" in Zambian low-cost schemes; in this system all household waste water is discharged into the aqua privy tank, thereby retaining the water seal around the chute and preventing odours. The tank acts as a sedimentation tank and elementary anaerobic digester, and only fluids overflow into the collecting sewer. Since the sewer does not have to transport any solids, it may be laid at gradients flatter than those usually adopted to give a minimum flow velocity of 1 metre per second; a flow of 0,3 metres per second has been found adequate.

The advantage of this system is the possibility of laying sewers at very flat grades and economising in depth of excavation. Marais quotes the use of grades of 1 in 300 for 100 mm sewers.

A disadvantage is the necessity for physically removing accumulated solids from the aqua privy tanks at regular intervals of several years.

To the author's knowledge this system has not yet been tried in the Western Cape; the State's allowance of full engineering standards for sewerage has no doubt discouraged local authorities from experimenting.

8.3 Modified Housing Code Requirements.

The requirements laid down for summer rainfall areas of passing stormwater flows in open earth ditches in gravelly or stony ground have been modified for the winter rainfall area. Open ditches are not suitable in the sandy conditions of the Cape Flats, and the flat gradients could lead to mosquito breeding in ponding areas. Piped stormwater drainage has been allowed, to cope with the more prolonged periods of rain experienced in the Western Cape.

Similarly, roads could not simply be formed by grading and rounding up the existing soil formation; in the cohesionless often wind-blown sands of the Cape Flats only four-wheel drive vehicles could use such tracks.

Concrete roads of 4 metres width with a 1 metre gravel shoulder are allowed by the Housing Commission.

9.0 BUILDING.

It has been found that few contractors will tender for the construction of sub-economic dwellings - there is little profit to be made in building at unit rates between R.18 and R.22 per square metre, unless the contract is sufficiently large. An exception has been the construction of 1008 lettings at Uitsig (Elsies River) by Messrs. L.T.A. Construction (Cape) Ltd. In general, therefore, local authorities have been obliged to erect sub-economic housing themselves.

9.1 Conventional Building.

All sub-economic building in the Western Cape has made use of conventional materials, such as stock bricks or cement blocks.

9.1.1 Cement Blocks.

The 1008 sub-economic lettings mentioned above were built with mainly unskilled labour, using a patented jig to keep corners square and plumb and to align block courses. This "CONJIG" system allowed the use of the minimum number of skilled operatives who were able to supervise several unskilled gangs at once, thus allowing the contractor to cut costs.

9.1.2 Stock Brick on Edge.

Both the Cape Divisional Council and the Cape Town City Council have built sub-economic and economic lettings using stock brick laid on edge; the external walls have two such brick "skins" separated by a 2-inch (51 mm) cavity to give an 8-inch (203 mm) wall. The outer faces of the walls are usually laid in "fair face", and the interior faces and partition walls are bagged instead of plastered.

A typical building is shown in Fig. 14.

9.1.3 Stock brick laid flat.

This is the conventional method, and numerous selling houses have been built in this way, both for White and non-White occupation. The Old Aged Home illustrated in Fig. 15 was built with a "fair face" exterior finish; Sun Valley houses shown in Fig. 16 are plastered over conventional brick cavity wall construction.

A range of buildings built by conventional methods is shown in Fig. 17.

9.1.4 Terracotta Hollow Blocks.

Messrs. Porter's Cape Construction (Pty.) Ltd. has carried out several housing contracts for the Cape Town City Council and the Cape Divisional Council using burnt clay hollow blocks for both interior and exterior walls.

The contractor achieves economy in this case by building walls faster; in addition to the main walls of terracotta block, the foundation walls are laid in stock brick "on edge".

9.2 Unconventional Building.

9.2.1 Contractors using unconventional building methods, even though these may have been evaluated by the Agrément Board, are required to give a "guarantee against rain penetration for three years, supported by an approved security."

9.2.2 The "Must" System. (Figs. 18-22 inclusive)

Precast concrete wall sections are used in the "MUST" system of industrialised building developed by Messrs. Murray and Stewart. The firm has established a factory near Philippi on the Cape Flats, in a situation designed to be centrally placed to serve an area having a maximum radius of 48 km. This represents approximately an hour's run from factory to site.

The installation comprises two batteries of vertical steel moulds onto which doorframes and ducts can be bolted so that they occupy the desired positions in the finished internal walls. The steel leaves of the batteries are clamped together by hydraulic presses prior to casting; the rear of each leaf comprises one face of the adjacent panel and is capable of giving a finish sufficiently smooth to allow painting after erection without any further treatment. Steam curing of the concrete in the battery allows a strength of 5,5 MPa to be attained after three hours, and the moulds can then be stripped.

External wall panels are cast on horizontal tables which can be tilted for stripping when the concrete has attained a strength of 6,2 MPa after 18 hours. The outer faces of these walls are "dragged" with canvas in order to give a textured appearance.

Wall/....

Wall panels are all provided with lifting hooks cast in place, and are removed from the batteries or tables by an overhead gantry crane (capable of lifting 10 tonnes) and stacked in a yard which has storage capacity for 80 complete houses, or approximately 1600 panels. Although the use of lightweight aggregate in the concrete would make handling easier, such aggregates are not available in the Western Province and would have to be brought from the Transvaal at the prohibitive cost of approximately R.8-00 per cubic metre.

Wall panels are conveyed to the building site on "toast-rack" trailers, and erected by crane onto previously cast foundation slabs. Each panel has projecting steel loops at the vertical ends, which overlap similar loops on the adjoining panel; a locking pin is then dropped down the vertical joint cavity and the whole is grouted. See Fig. 22. The external and internal walls for two complete houses can be erected on site in one day. The order of erection is only restricted by the crane operator's vision of the process, and normally proceeds from the rear walls through the interior to the front of the building. See Fig. 21.

Once the walls are erected, the "gangnail" roof trusses immediately follow, purlins are placed and the roof is covered by asbestos-cement sheets. There are no wall-plates, the trusses being dropped into preformed slots in the wall panels and fastened to hoop-irons embedded in the wall panels. Since all gable ends for a given house type should be identical in this system it is not as simple to have varying roof pitches within one house type as in conventional building.

Once the roof is covered the carpenter, plumber, electrician and other trades follow and the completed house can be handed over for occupation 15 working days after the foundation slab has been cast. This represents a great saving in time (which is money) over conventional methods which can take four times as long.

Of the 400 single houses comprising the Uitsig (Elsies River) contract, Messrs. Murray & Stewart erected all 400 superstructures in 220 working days, and handed over 360 houses as complete in that time. The contract comprised 11 different house types; in this system the minimum economic number of buildings in a contract must be 50, and in such case the number of house types must not exceed two.

The Cape Divisional Council has also awarded Messrs. Murray & Stewart a contract for 516 economic flats to be constructed by the "MUST" system in 3-storey and 4-storey blocks. In this case intermediate floors are also formed of precast slabs. The buildings are designed to avoid "progressive collapse" should any single panel be damaged or destroyed.

The success of this capital-intensive venture is demonstrated by the ratio of skilled to unskilled workers being \pm 1:10 instead of 1:4,6 in conventional construction.

A comparison of the labour required to build two house shells per day by conventional or by the "MUST" industrialised method is given hereunder; building operations common to both systems are omitted.

Operation	Labour Required					
	Leading hands		Artisans		Labourers	
	Conv.	Ind.	Conv.	Ind.	Conv.	Ind.
Foundations	Nil	Nil	Nil	0,5	65	12,5
Brickwork in foundations	1,5	Nil	14	0,5	30	12,5
Brickwork in superstructure	7,25	Nil	74	5	148	70
Plastering and floor screeding	5,25	Nil	54	5	82	20
TOTALS	14	Nil	142	11	322	115

Totalling all the labour, it is seen that industrialised building only needs 126 men where conventional building needs 478 to build two house shells; this is hypothetical for the sake of drawing a comparison, 239 men trying to build one small house in a day would be falling over each other.

The important point is that industrialised methods save the use of artisans; particularly in boom periods when artisans are scarce and expensive this means savings which can be passed on to the customer and may win contracts. Fig. 23 shows that the industrialised system here described has produced the most economical prices on offer at the present time.

9.2.3 The Longtill System.

The Longtill system is usually an on-site one, utilising patented hollow cement blocks which are extruded by the conventional "egg-laying" travelling block machine onto a concrete casting floor. The cement/sand mix is designed to give a test strength of 3,45 MPa at 28 days.

The standard block is 495 mm long and 150 mm thick for external walls, or 112 mm thick for internal walls; the height of the block may be varied between 250 mm and 275 mm according to the number of block courses required to build a standard height of wall for a given project without cutting any blocks.

As shown in Fig. 24 the mortar bed between courses is usually 9 mm thick, but is only placed at the ends of blocks as a temporary fixing until the concrete intermediate "columns" are cast at 500 mm intervals. Exterior walls are weatherproofed by a 12 mm cement rendering; any moisture which may penetrate drops down the continuous vertical cavity and does not penetrate to the interior.

In order to fit in with windows and doorframes a longer block of 588 mm may be laid in conjunction with the normal blocks.

Precision-made steel jigs are used to maintain line and verticality during laying of the blocks; door and window frames are not set in position during block laying but slid into the spaces left in the building shell when laying is complete.

This form of construction uses less tradesmen for construction of the shell than conventional methods; one bricklayer sets out and lines up the jigs and watches the maintenance of course levels on 2 or 3 houses simultaneously.

Each house requires 4 semi-skilled block layers and 10 labourers, plus the services of a carpenter to erect shuttering for the corner columns. The shell for a house of approximately 63 square metres floor area can be erected in 8 working hours. See also Fig. 25.

Messrs. Longtill Limited are constructing 220 houses for the Department of Community Development in Bothasig, a portion of Milnerton Municipality, using the system as described above. These houses are for occupation by the White group.

9.2.4 The Fibrelock System.

This is a new system covered by world-wide patents; the developer intends to promote construction using this method by established building contractors who would pay royalties to the patentees. At the time of writing the system is under evaluation by the Agrément Board.

In brief, the system is based upon a frame of box-section steel bents fastened at 4'4" (1,32m) centres to foundation sole plates which rest upon a concrete foundation slab. The bents are flanged to receive 8' x 4' x 3" thick panels (2,44m x 1,22m x 76mm thick) which form both walls and roof covering and are held against the steel flanges by locking plates. (See Fig. 26) Due to the stiffness of the portal-frame construction no roof trusses or interior supports are required. The panels are formed in a "sandwich" to a finished thickness of 3 inches (76mm), composed of an inner thickness of expanded polystyrene sheet between outer layers of 3/16-inch (4,76mm) unpressed asbestos cement sheet.

Bonding/

Bonding between the layers is effected by an epoxy glue.

After erection of the bents and panels, the bents are covered externally by square-section asbestos-cement gutter, the gutter edges being sealed to the panels with epoxy glue. All exterior joints are then sealed with 8" (200mm) wide fibre-glass strip and polyester resin before painting.

A house built using the Fibrelock system was erected at Elsie's River and presented to the Cape Divisional Council by the developer; it is occupied by a Divisional Council employee.

9.2.5 No-fines concrete houses.

The Cape Divisional Council recently let a contract for 82 single houses at Ocean View Township. The successful tenderer was Messrs. W.J.M. Construction Co. (Pty) Ltd. who had elected to build in no-fines concrete.

Since there were to be 10 different house types in this comparatively small contract, it was not considered feasible to build the many and varied internal walls in no-fines concrete; internal walls were built instead of terracotta hollow blocks and no-fines concrete was used for the external walls and gables only.

A complete external "shell", with galvanised steel windows and doorframes, was poured every second day; on intervening days the contractor would strip shuttering from the previous day's pour and re-erect them on the next foundation slab ready for the following day's pour.

Site equipment included a bulk cement silo, a batching plant for mixing and dumpers for transporting the no-fines concrete; the dumpers were fitted with detachable skips so that a lorry-mounted crane at the pouring site could raise the concrete to the top of the shuttering. The mix was 9 parts of $\frac{3}{4}$ -inch (19mm) stone to 1 part of Portland Cement; the water-cement ratio was decided upon "by feel" so as to give the desired workability (in Britain it is apparently sufficient to use wet aggregate).

The contractor has commented that plastering was expensive due to the high proportion of voids on the surface of the no-fines concrete. See Figs. 27 and 28.

10.0 ECONOMIC ASPECTS.

Various economic aspects of low-cost housing have been examined :

- 10.1 Comparison of the cost of land, services and buildings in selected schemes.
- 10.2 Comparison of the prime costs of selling scheme houses (i.e. single dwellings.)
- 10.3 Stratification of building costs - an attempt to illustrate the differing cost limits for sub-economic, economic, and selling schemes.
- 10.4 The trend towards lower services costs with increased housing density.
- 10.5 A comparison of cost indices.

10.1 Comparison of the cost of land, services and buildings.

Some representative examples have been selected to illustrate a range of housing types; four of the bar graphs of Fig. 13 refer to Coloured housing schemes, and the last to a White scheme - the first 110 houses to be built in Sun Valley. The length of each bar represents 100% of the cost of the total scheme, and it can readily be seen how small a part of the whole the cost of the land and services represents; only in the case of sub-economic housing does the land and services proportion together exceed 14%. For economic selling schemes therefore, it appears that we might well be prepared to pay somewhat more for land if the services and buildings promise to be economical to construct.

10.2 Prime Costs of Selling Scheme Houses.

Fig. 23 shows how the prices of various house types, each of which has been repeated many times, have varied with the passing of time and with the distance from the base of operations. The two most distant jobs, both at Ocean View (near Kommetjie), were the most expensive. On the basis of prices obtained for 400 houses at Uitsig, industrialised building could prove the cheapest. To obtain the selling price to the buyer, the local authority may add to the prime cost a pro-rata share of the costs of land, services, legal and survey fees to a maximum of R.2 000 per plot.

10.3 Stratification of Building Costs.

Fig. 29 illustrates the relationship between the classification of buildings into sub-economic and economic lettings and selling houses, and the "strata" formed by limits between which unit building costs are found to lie for each class.

As a contrast the unit costs are shown for buildings constructed for the private sector outside the low-cost limits, in the usual client-architect-contractor arrangement wherein the building contractor works to a tendered or negotiated price on which he expects to make a profit.

It is evident that any contractor, who wishes to enter the field of low-cost housing and tender successfully, must be able to keep his costs within the limits of the class for which he aims to build. Should contractors be unable to tender competitively in a given class, the local authority will have to build departmentally.

10.4 Lower Services Costs by Increased Housing Density.

Fig. 30 illustrates the trend towards lower services cost per dwelling which can be achieved by increasing the occupation density of the township. With the cost of land and buildings rising continuously over the years, increased housing density will be one way of reducing overall costs.

10.5 A Comparison of Cost Indices.

Fig. 31 shows that in spite of the steady increase exhibited by total building costs (i.e. the whole building industry) and the consumer price index, it has been possible to hold down costs in respect of low-cost housing; the house types selected for this comparison were the 9/5 and 9/6 Community Development plans.

11.0 FORWARD PLANNING.

The most pressing housing needs in the Western Cape are those of the Coloured group who suffer from a combination of low average incomes and the highest birth-rate in the country. (25) Lipman has also shown that a high degree of overcrowding already exists in comparatively new Coloured townships - sub-economic units in Bonteheuwel are overcrowded to the extent of 62,3%.

11.1 Future Housing.

On a basis of projected population for 1980, Lipman has shown that approximately 62 000 additional dwelling units will be needed between 1970 and 1980. It may be assumed that the bulk of these, say 55 000, will have to be subsidised from State funds. The split between the main local authorities will be of the order of 15 000 built by the Cape Divisional Council (26) and 40 000 by the Cape Town City Council. The projection takes account of the existing backlog of housing, as well as population growth and in-migration to the O1 region; it is assumed that all migrants will require subsidised housing.

11.2 Land Demand.

On the assumption that existing townships cannot absorb any further population increase, more land must be acquired for housing purposes. If we design for gross densities of 22 dwelling units per hectare for subsidised housing and 15 dwelling units per hectare for privately-financed housing, land requirements will be 2 500 hectares and 465 hectares respectively.

11.3 Mitchell's Plain.

This large area of some 2 100 hectares on the south-east Cape Flats is the last remaining large project in the O1 Region for the Coloured group. Due to its relatively remote situation with respect to major work areas, cheap transport will be a high priority; a railway link extended from the existing Nyanga line has already been proposed. A road network linked with major freeways of the Joint Town Planning Scheme has also been outlined, as indicated on Fig. 6. Detailed planning has hardly started.

Following /

Following the evolution of an overall plan, development of this township is to be divided between the Divisional Council of the Cape and the Cape Town City Council in the approximate proportions of 220 ha and 1880 ha respectively. The ultimate township will probably accommodate a population of 250 000 persons, and planning will have to provide for the full range of necessities and amenities.

11.4 Where Next?

After Mitchell's Plain, it appears from a report which appeared in the Argus of 11 July, 1972, that the Department of Planning considers the only suitable close area to the metropolitan complex to be "the Mamre and Darling area." Since very little more of the Cape Flats is to be made available, the balance being either reserved for agriculture or for silica sand, it seems that future development will have to be northwards. The Mamre site has been stated to be capable of accommodating a population of 800 000.

12.0 CONCLUSIONS.

		Thesis Reference
12.1	<u>Repetition need not mean monotony.</u> Imaginative planning of grouping and adequate landscaping can prevent monotonous rows or "army barracks" appearance.	3.2.2
12.3	<u>Higher densities of site occupation will give economies in the cost of township services.</u> As shown graphically in Fig. 30, increased density of housing reduces the cost of services by reducing the spread of the streets required to give access to the buildings, and consequently reduces the sprawl of watermains, sewers and stormwater drains.	Fig. 30
12.3	<u>Increased housing density should be achieved by the use of more high-rise buildings.</u> As a corollary to paragraph 12.2, it should be noted that higher densities should be achieved not only by reducing single plots to minimum sizes, but by such devices as the use of group housing, maisonettes, and blocks of flats. The proposed use of group housing in a portion of Sun Valley Township would increase the occupation density from a mean value of 11,4 dwellings per gross hectare to 16,4 dwellings per gross hectare. Although the Department of Community Development will accept single plots as small as 320 square metres, it is found in practice that 360 square metres is a better minimum to aim at in order to allow for the later erection of a car-port or garage. As previously discussed, the use of both low-rise and high-rise buildings will also improve the township's appearance.	3.2.2
12.4	<u>Housing Scheme economies are most effectively directed towards savings in building costs.</u> Fig. 13 shows how the cost of buildings can total up to 90% of a scheme's cost, land and services together forming the minor proportion of expenses.	Fig. 13

The cost of services being to a large extent prescribed by the maxima laid down in the Housing Code, it is obvious that any attempt at lowering or holding down costs must primarily be directed at the largest item in the budget, namely the cost of dwellings. (Only in the case of Hangberg, where services had to be constructed under steep mountainside and dune sand conditions, do we find the building costs comparatively lower; most buildings were for sub-economic occupation and in the case of Grassy Park "B" it may also be seen how the cheaper sub-economic dwellings form a smaller proportion of the total cost.)

3.2.10

12.5

In metrication the size of common bricks should be increased rather than decreased.

As already discussed, the proposed metric brick of 65 mm thickness has met widespread opposition and is shown to be uneconomical in use.

3.3.3

Concrete and terracotta blocks of all types have always tended to be larger rather than smaller than the stock brick; in the face of this trend towards increased size it is difficult to visualise why the smaller metric brick was proposed.

Better dimensions would probably be those adopted for the calcium silicate "thick" brick of 90 mm thickness, where a saving of approximately six courses of brickwork over an entire house can be obtained. Moreover, it appears from actual bricklaying experience that an artisan who has a rate of X bricks per day of standard size will still lay X of the thicker bricks per day. The additional weight of the thicker brick is not so great as to cause a drop in production.

3.3.4

12.6

Tender procedures could be altered.

In general, it appears from an inspection of the labour required and contract prices obtained for industrialised building, that such methods can effect real economies where mass housing is needed. Instead of being labour-intensive, industrialised methods are essentially capital-intensive.

9.2.2
Fig. 23

Such/....

Such being the case, it cannot be expected of the contractor that he should lay out large capital sums on the pure speculation that contracts will be forthcoming; here the system of calling for competitive tenders in the open market (which system local authorities are compelled to adopt) can lead to the contractor using industrialised methods being "squeezed" out by a lower tender.* Should the State allow local authorities to negotiate tenders from a panel of approved contractors (as in the Orange River Scheme) who would be brought into the planning picture at a fairly early stage, such contractors would be able to plan and organise their work sooner and have some guarantees of assured work. In the largest schemes the formation of a consortium might be appropriate. Negotiated tenders could be strictly supervised by the State to obviate any suspicion of favouritism or corrupt practices entering into the tender procedures. No doubt the smaller contractors would complain if they were excluded from the approved panel, but where the rapid provision of adequate low-cost housing takes on proportions approaching a national emergency, the country's best interests should be allowed to take precedence. Small contractors using conventional methods are better suited to carry out schemes of smaller magnitude and more diverse designs.

*See 12.7

12.7 The lowest tender is not always the best tender.

This has often been said before, and needs repetition here in the light of some firms having grown with mushroom-like rapidity during times of a building boom and extending themselves beyond their capabilities by tendering for work (a) too far from their usual base of operations for adequate supervision, or (b) at a price cut to the bone and leaving no margin for error, or (c) on a time schedule too impossibly tight for completion by the due date, leading to the imposition of penalties.

When the boom slackens, a struggling firm may cut its tender price to a "no profit" basis, merely to avoid paying off specialist staff which it may need later and to win a contract which it may then have to battle to fulfil.

On/....

On more than one occasion the lowest tenderer has gone into liquidation before completing a contract, and the local authority has then had to call up the guarantees and endeavour to have the contract fulfilled, invariably at increased cost.

Where the lowest tenderer is a firm of established reputation, known to have the resources and experience to carry through a contract to successful completion, no such difficulty arises; it is amongst the unknowns and "mushroom" enterprises that the local authority has to tread warily if it is not possible to justify the acceptance of a tender other than the lowest offered.

12.8 Continuity of Housing Funds.

One of the practical difficulties with which local authorities have had to contend has been a "stop-start" allocation of Housing Funds, in which the amount of money available has varied annually in a manner rendering long-term planning almost impossible. For example, funds have been cut in 1972 to the extent that the City of Cape Town has had to pay off hundreds of building trade workers; although a nucleus of the best workers is retained in such circumstances, the local authority will have to make a slow start in the ensuing year while building up staff strength to take advantage of such additional funds as may then become available.

Of course the Government has to balance its budget, but it appears highly desirable that such a fundamental item as the proper housing of the population should receive priority to the extent that an independent fund might be set up free from the fluctuations of annual budgeting. Local authorities would then be able to plan several years ahead and have funds allocated to approved schemes, with the assurance that funds would be obtainable as and when construction was put in hand.

APPENDIX

EXTRACT FROM THE HOUSING CODE, CHAPTER IX.

The Department of Community Development has designed a range of building plans to provide suitable dwellings at prices within the means of the appropriate income groups :-

"6. Plans available - The following plans are available :-

Abbreviations.

L	=	Living room (Lounge)
DK	=	Combined diningroom and kitchen
B	=	Bedroom
LB	=	Combined living-room and bedroom
L/D	=	Combined living-room and diningroom
D	=	Diningroom
K	=	Kitchen
BR	=	Bathroom
T	=	Toilet
S	=	Storeroom
C	=	Carport
ST	=	Servant's toilet
G	=	Garage

NOTE - Where a separate toilet is not indicated on the plan, the toilet is provided in the bathroom, or separate latrine is built outside.

(A) Dwellings for Whites, Coloureds and Indians who fall under the Higher Economic Income Group.

<u>Plan No.</u>	<u>Description.</u>	<u>Floor Space.</u>	
		ft. ²	m ²
E.S. -			
6/2	L, 2B, K, BR	618	57,47
7/5	L, 3B, K, BR	766	71,24
8/1	L, 3B, K, BR, T	830	77,19
8/4	L, 3B, K, BR, T, S, C	876	81,47
8/6	L, 3B, K, BR	830	77,19
8/7	L, DK, 3B, K, BR	815	75,79
9/1	L, 3B, K, BR, T	900	83,70
9/3	L, 3B, K, BR, T, S, C	998	92,81
9/5 & 9/6	L, 3B, K, BR, S	966	89,84
9/7 & 9/8	L, DK, 3B, K, BR, T	920	85,56
9/9 & 9/10	L, 3B, K, BR, T	900	83,70
10/1 & 10/8	L, 3B, K, BR, T, S, C	1,000	93,00
10/2	L, 3B, L, BR, T, S, C	1,054	98,02
10/7	L, 3B, K, BR, T, S, C	1,014	94,30
10/9	L, 3B, K, BR, T, S, C	1,016	94,49
10/10	L, 4B, K, BR, T, S	1,057	98,30
10/11	L, 3B, K, BR, T, S, C	1,010	93,93
11/1	L, DK, 3B, K, BR, T	1,102	102,48
11/2	L, DK, 3B, K, BR, T	1,113	103,51
11/3	L, 3B, K, BR, S, C	992	92,26
9/5/66	L, 3B, K, BR, T, ST, S	954	88,72
9/19/66	L, 3B, K, BR, T, ST, S, C	958	89,09
9/21/66	L, 3B, K, BR, T, ST, S, C	954	88,72

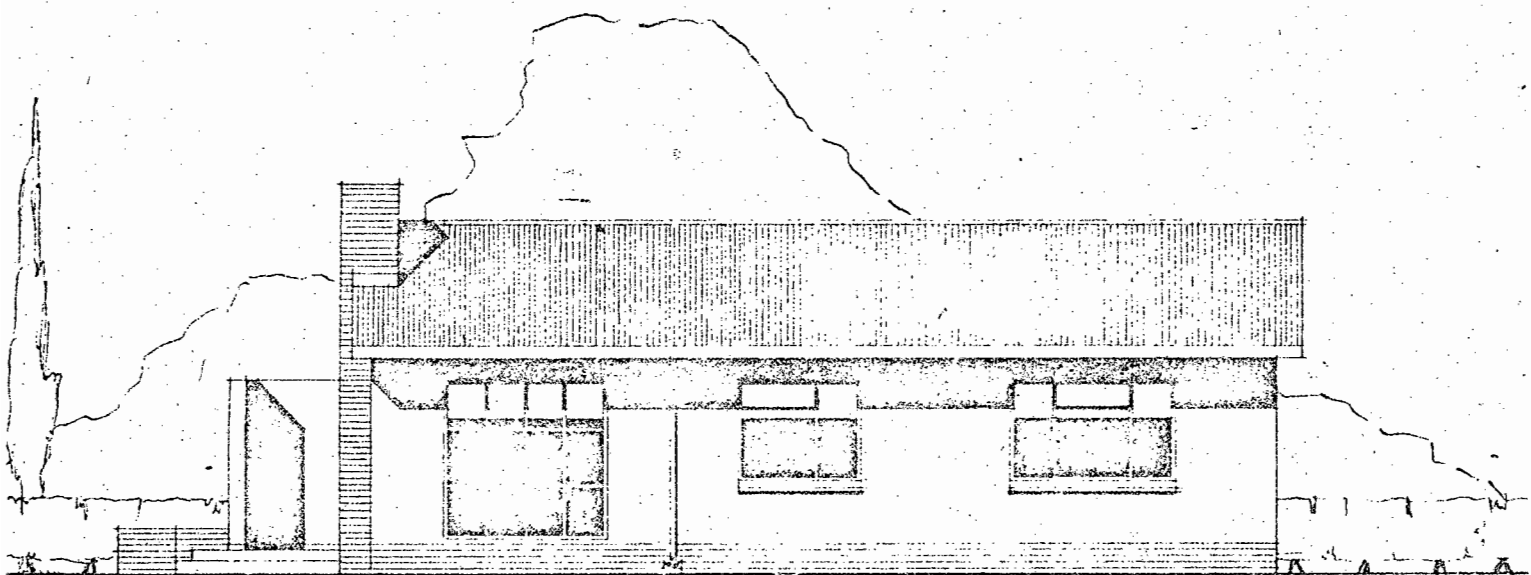
9/22/66 /.....

9/22/66	L/D, 3B, K, BR, T, ST, S, C	984	91,51
9/23/66	L/D, 3B, K, BR, T, ST, S, C	983	91,42
9/24/66	L, 3B, D, K, BR, T, ST, S, C	998	92,81
9/25/66	L/D, 3B, K, BR, T, ST, G	940	87,42
9/27/66	L/D, 3B, K, BR, T, ST, G	955	88,82
10/10/66	L/D, 4B, K, BR, T, ST, S	1,092	101,55
10/25/66	L, 3B, K, BR, T, ST, S, C	1,053	97,93
10/26/66	L, 3B, K, BR, T, ST, S, C	1,003	93,28
10/27/66	L/D, 3B, K, BR, T, ST, S, G	1,040	96,72

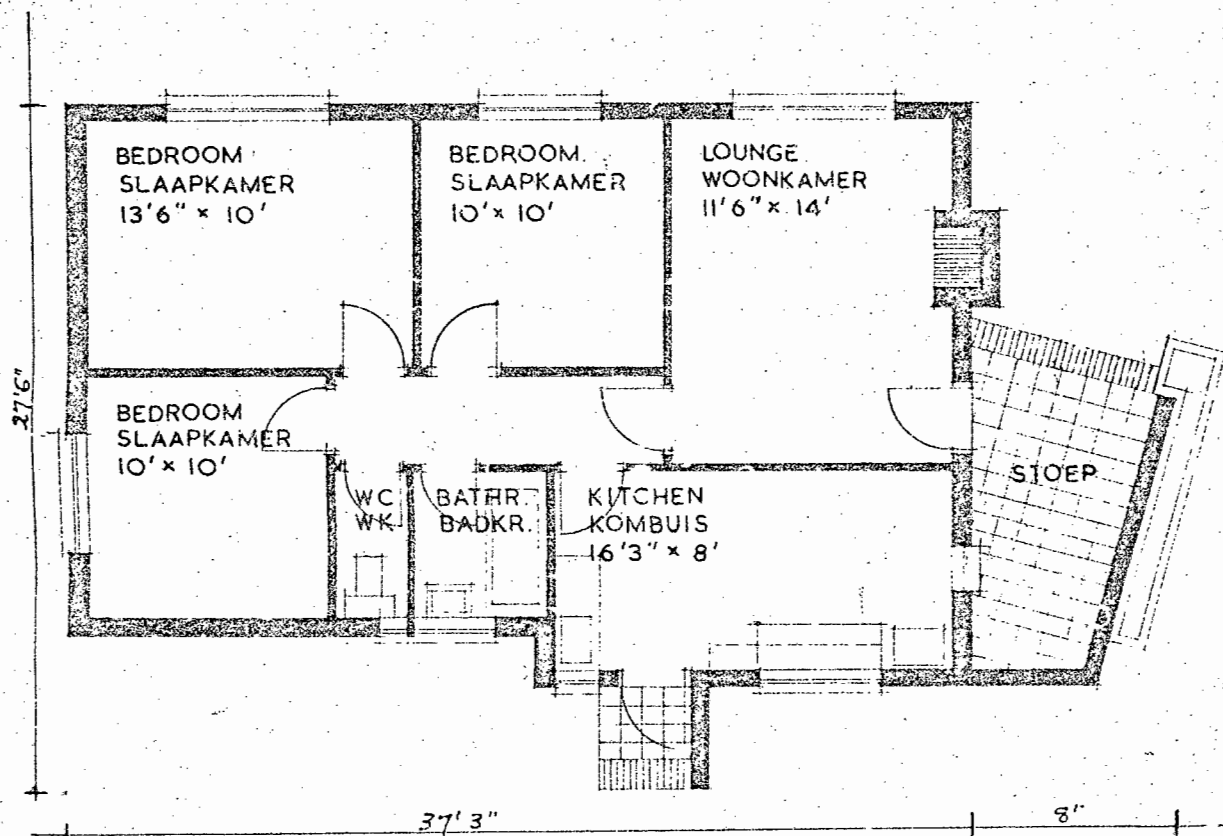
(B) Dwellings for Whites who fall within the Sub-Economic Income Group.

<u>Plan No.</u>	<u>Description.</u>	<u>Floor Space.</u>	
		ft. ²	m ²
E.S. -			
6/3	L, 2B, K, BR	647	60,17
6/4	L, 2B, K, BR	687	63,89
7/4	L, 3B, K, BR	782	72,73
7/6	L, 3B, K, BR	752	69,94
7/7	L, 3B, K, BR	766	71,24
8/8	L, 4B, K, BR	815	75,79

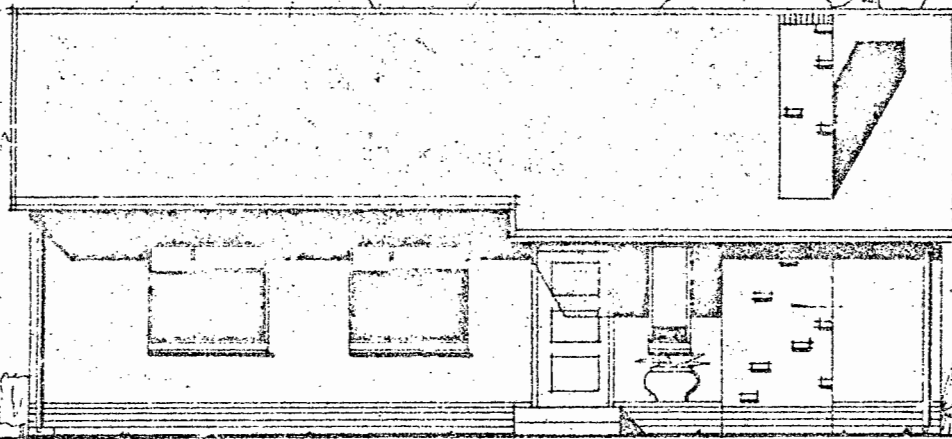
Plans of the 8/1 and 9/5 houses follow this Appendix.



ELEVATION.
AANSIG.

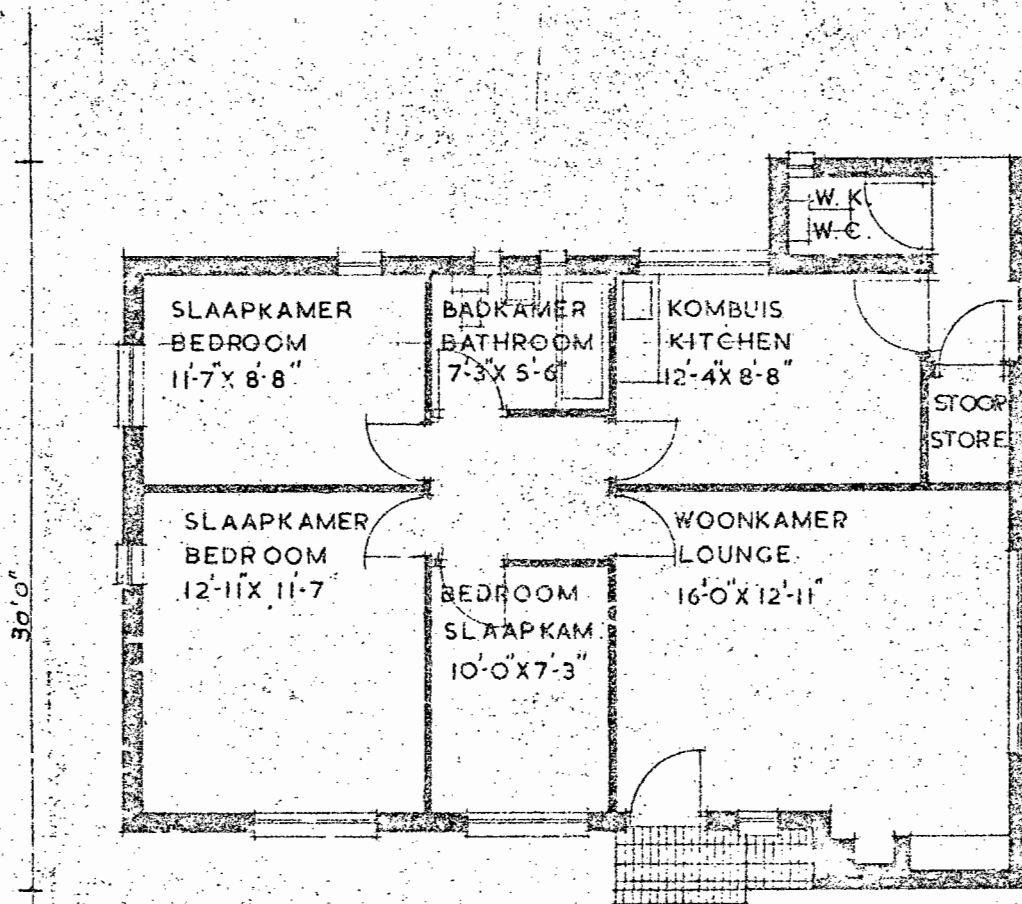


PLAN.



AANSIG
ELEVATION

9/5



PLAN

37'-0"

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Fibrelock Homes (Pty) Ltd.

W.J.M. Construction Co. (Pty) Ltd.

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Officials of the Local Government Branch, Cape Provincial Administration.

Photographs and Diagrams :

Unless otherwise acknowledged in the text, all photographs and diagrams in this thesis are the author's original work.

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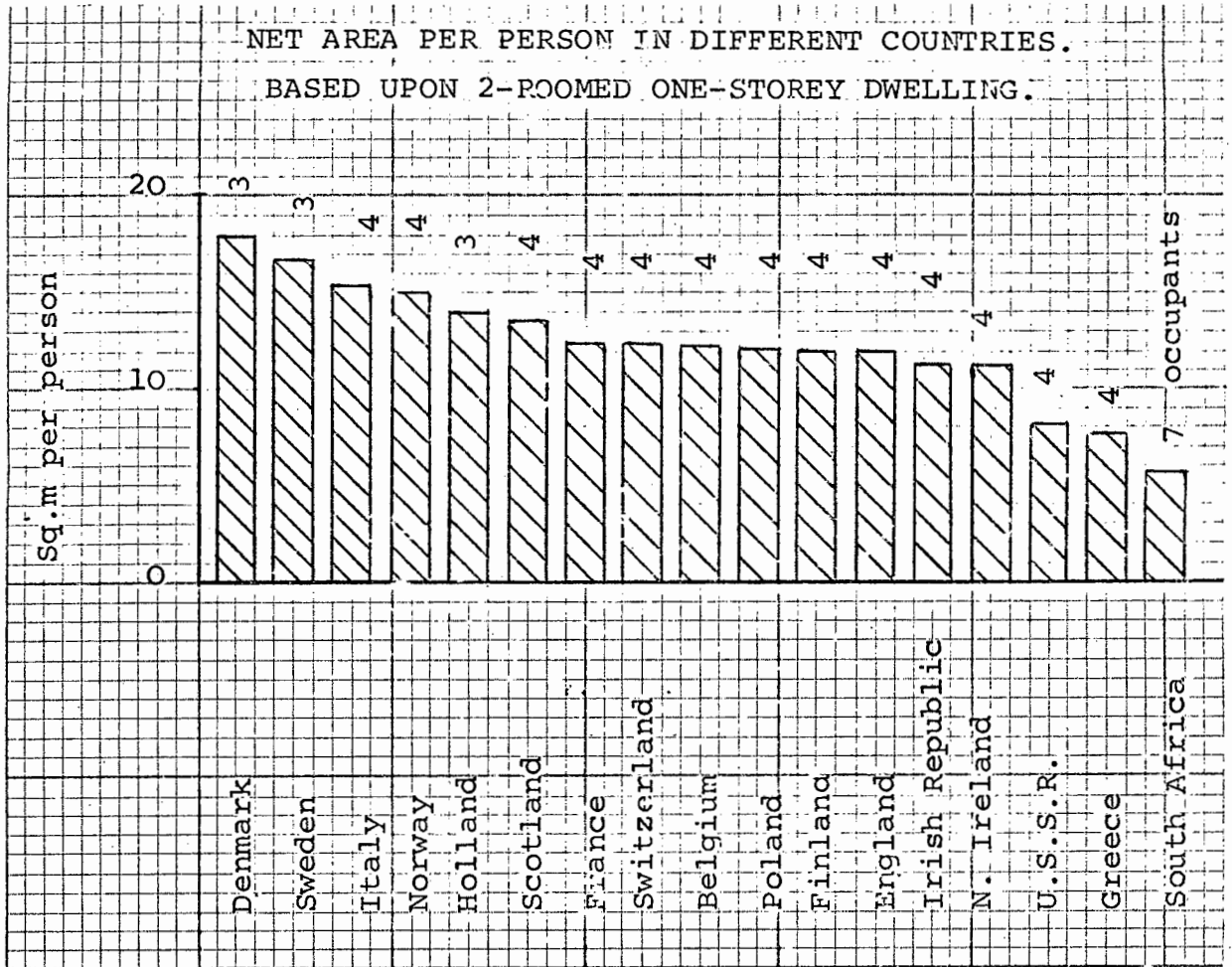
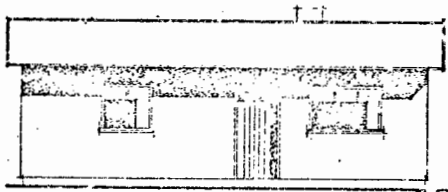
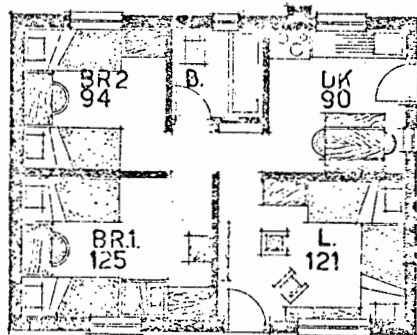


FIG. 1



ELEVATION

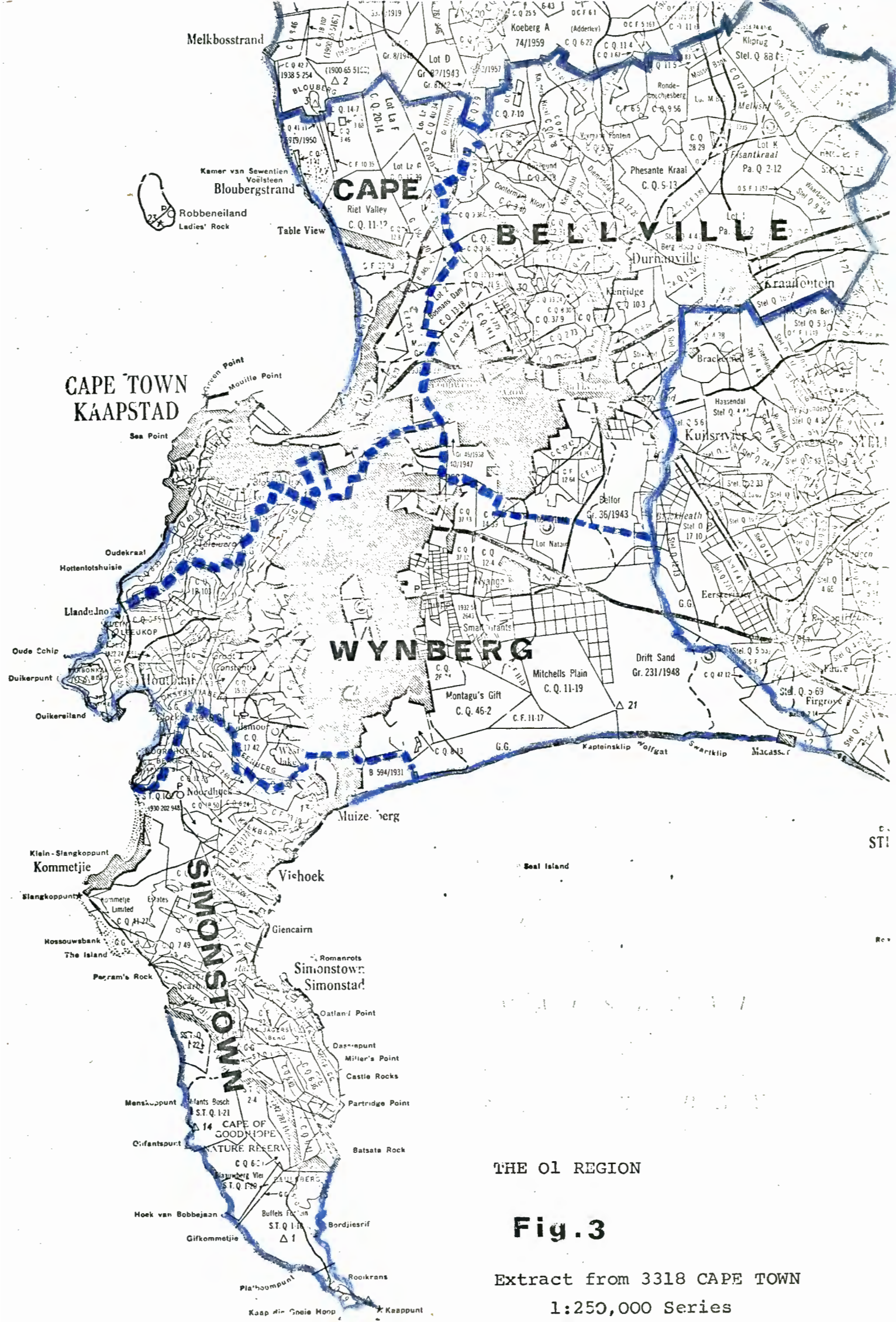


PLAN

0 5 10 15 20
SCALE IN FEET.

FIG. 2

The NE 51/9 house



CAPE BELLVILLE

WYNBERG

NMOLSTOWN

THE OLIFANTS RIVER REGION

Fig. 3

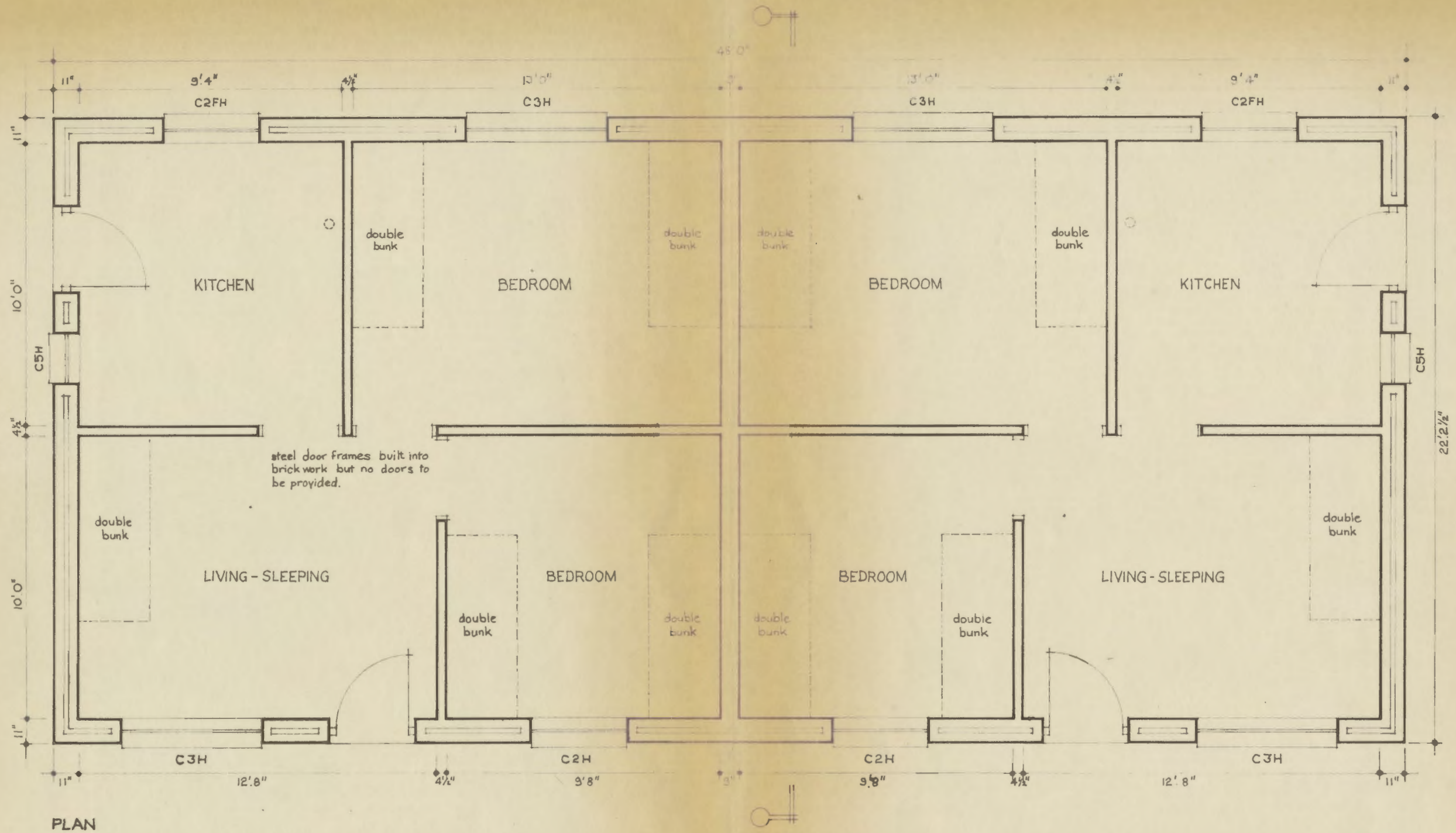
Extract from 3318 CAPE TOWN

1:250,000 Series



POPULATION OF THE O1 REGION

Fig. 4



PLAN

DRAWN
A. BEKKER.

J.W. COETZEE.
HOUSING
ENGINEER.

M.K. BOTHA.
CHIEF
ENGINEER.

THE DIVISIONAL COUNCIL OF THE CAPE
HOUSING SECTION.

FIG. 5

SAMENTLIKE DORPSAANLEGSKEMA · KARRSE VLAKTE G.P.B.

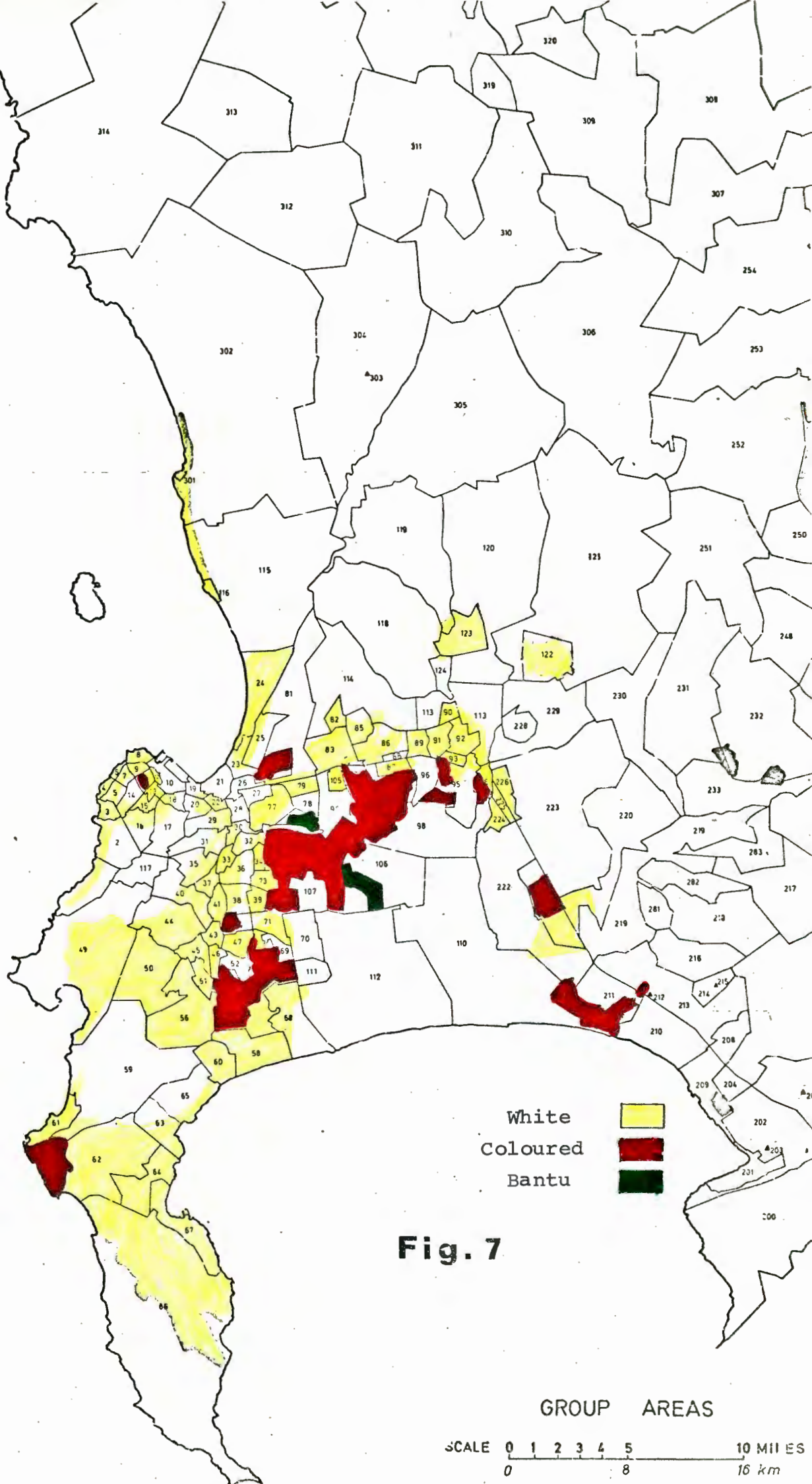


VERALGEMEENDE PLAN

Fig. 6

TP CF-19
D-T DRAWER N° 4

- | | | |
|--|---|--|
| <ul style="list-style-type: none"> ■ BOUTHANS WAGHABELE KESSE KLEDFINES ■ GEFILLETTERDE WAGHABELE SWARDE ■ RESIDENTIELE KASSES ■ WAGHABELE ■ SLENGKANTORIE WAGHABELE SWARDE ■ WAGHABELE SWARDE | <ul style="list-style-type: none"> ■ DOP SWARDE ■ WAGHABELE ■ WAGHABELE ■ RESIDENTIELE SWARDE, SWARDE ■ WAGHABELE SWARDE | <ul style="list-style-type: none"> ■ WAGHABELE SWARDE ■ WAGHABELE SWARDE ■ WAGHABELE SWARDE ■ WAGHABELE SWARDE ■ WAGHABELE SWARDE |
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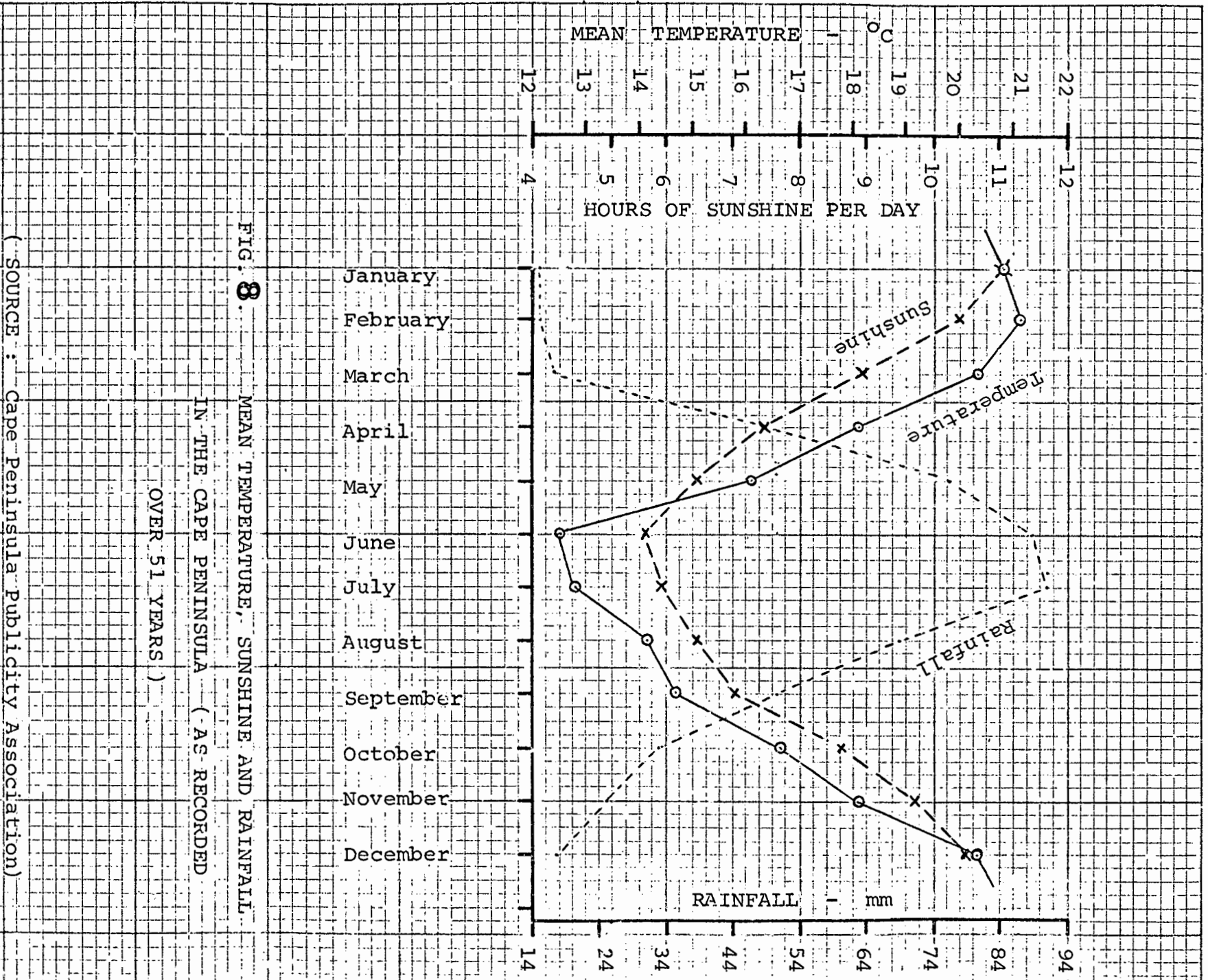


FIG. 8. MEAN TEMPERATURE, SUNSHINE AND RAINFALL IN THE CAPE PENINSULA (AS RECORDED OVER 51 YEARS)

(SOURCE : Cape Peninsula Publicity Association)



DISTRICT SIX -- A typical slum dwelling; some adjoining buildings have already been demolished after their occupants were rehoused.

FIG. 9



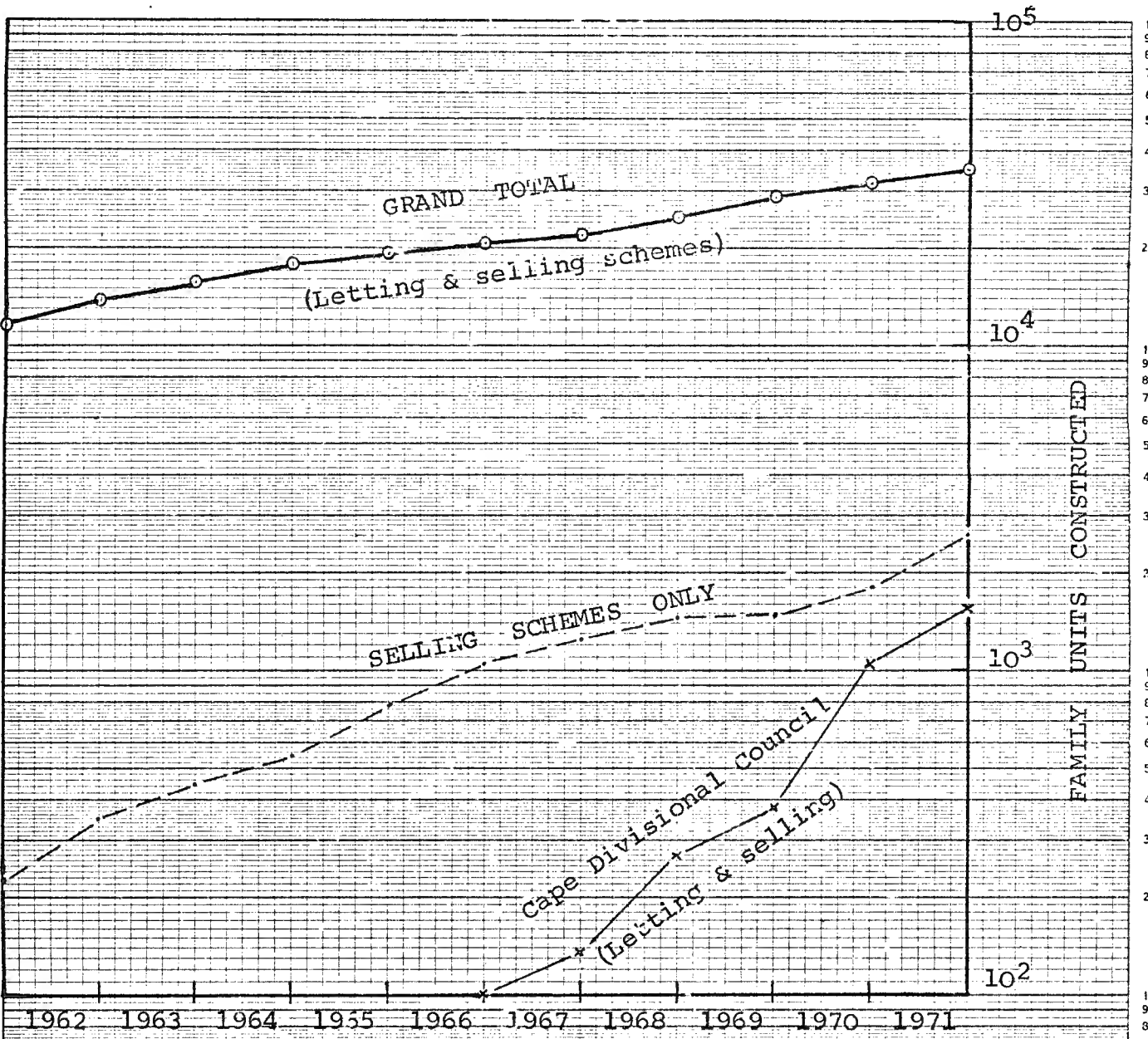
THE PAST - Windermere shacks in a
typical Western Cape winter.

(Photo : Cape Times)



THE PRESENT - Home-ownership houses
in Kensington (the same suburb).

Winter, 1972

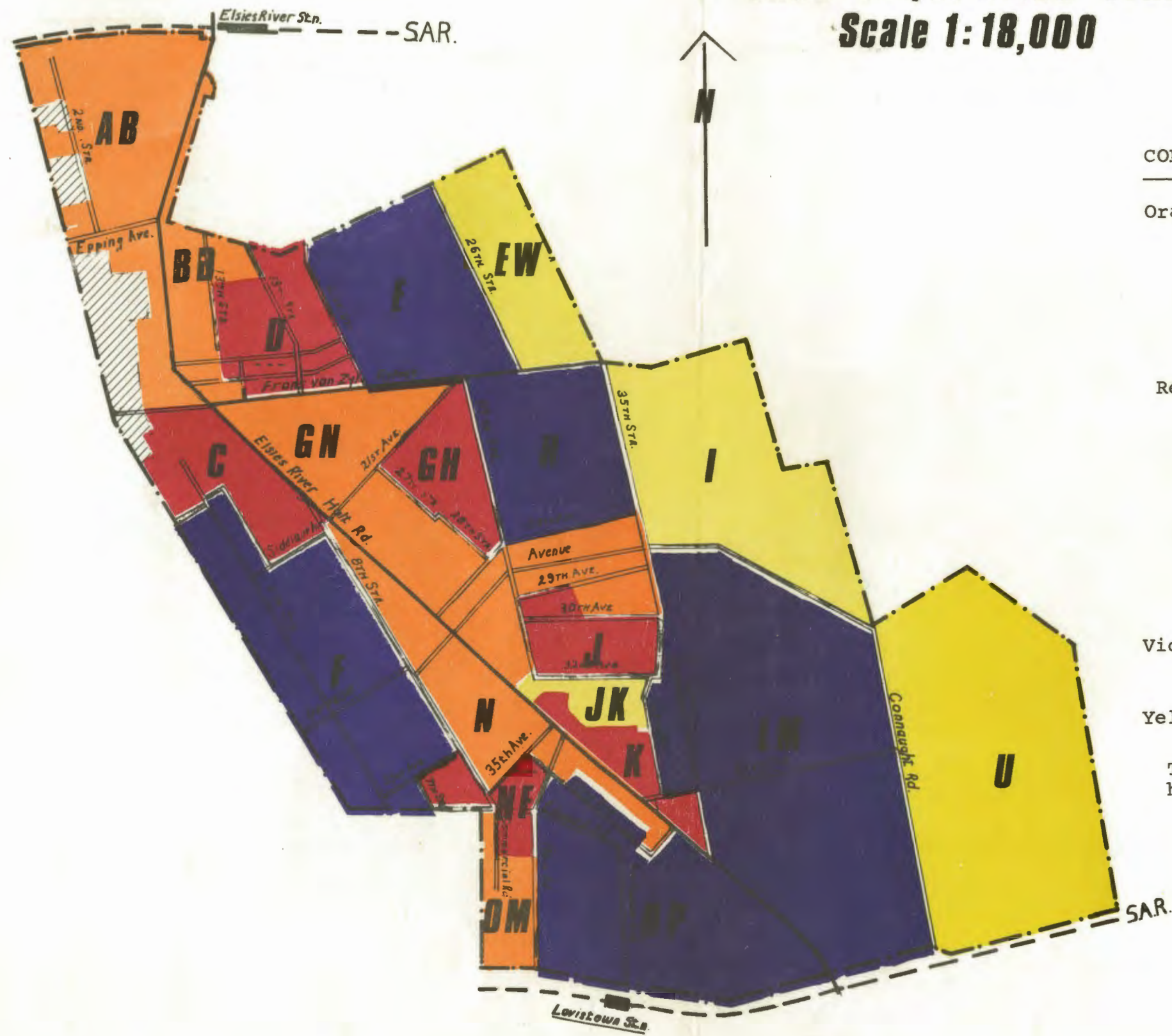


TEN YEARS OF HOUSING PROGRESS.

Low-cost construction by local authorities in the Ol Region.

Fig. 11

Figure 12
LAND ACQUISITION STRATEGY
Scale 1:18,000



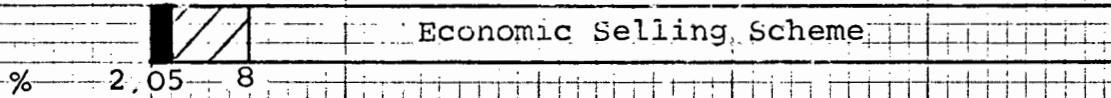
COLOUR	REMARKS
Orange	Areas where, in general, 50% or more of residential erven have good or fair brick houses on them. Minor remodelling of streets and provision of land for community services is necessary.
Red	Areas where, in general, 40-50% of the residential erven have good or fair brick houses on them. Group housing and an increase in population densities are envisaged and all owners will be given opportunity to sell if they wish. Potentially good housing will be retained wherever possible.
Violet	Generally less than 40% good buildings. Entire replanning needed.
Yellow	No replanning contemplated

The Buffer Strip shown hatched has been excluded.

COLOURED HOUSING

Families

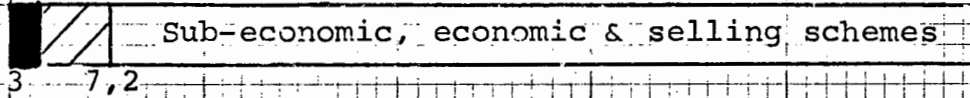
Grassy Park Extn. 9



Economic Selling Scheme

60

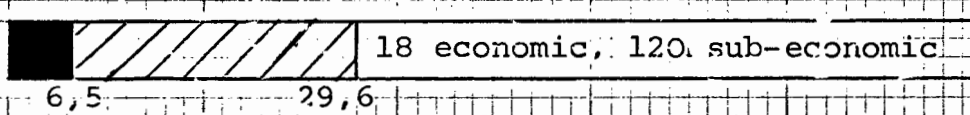
Ocean View



Sub-economic, economic & selling schemes

956

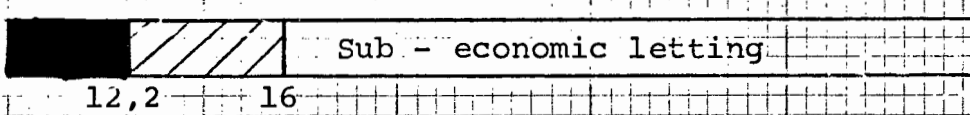
Hangberg (Hout Bay)



18 economic, 120 sub-economic

138

Grassy Park "B"



Sub - economic letting

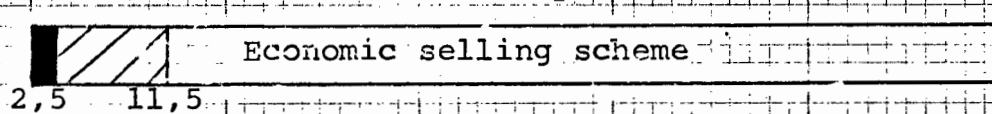
741

Land Services

Buildings

WHITE HOUSING

Sun Valley



Economic selling scheme

110

FIG. 13 COMPARISON OF THE COST OF LAND, SERVICES, AND BUILDINGS IN SOME CAPE DIVISIONAL COUNCIL HOUSING SCHEMES.



FIG.14 LOTUS RIVER - Economic
semi-detached house (2 lettings)



FIG.15 LOTUS RIVER - Old Aged
Home for the Indigent.

(Building by the Housing Development Section of
the Divisional Council of the Cape.)



Some of the first houses, built departmentally.



New houses under construction, 1972 ;
part of a 179-house contract.

FIG.16 SUN VALLEY
(A Cape Divisional Council Housing Scheme)



GRASSY PARK EXTENSION 10 - From left to right, single house (selling scheme), 3-storey block of flats (letting), double-storey maisonettes (letting). All contract built.



HANGBERG (HOUT BAY) - Sub-economic flats. External staircases save space under cover, discourage loitering and clandestine drinking. Built by Cape Divisional Council Housing Development Section.



"MUST" SYSTEM - (a) Inside the Philippi factory, showing casting tables & the overhead gantry.



"MUST" SYSTEM - (b) Steel door and window-frames and reinforcing steel in position ready for casting an exterior wall panel.



"MUST" SYSTEM - (c) Concrete being placed in the wall panel on the horizontal table. Door and window frames are temporarily masked.



"MUST" SYSTEM - (d) Vibrating screed finishing

FIG.19

(Photographs by courtesy of Messrs. Murray & Stewart.)



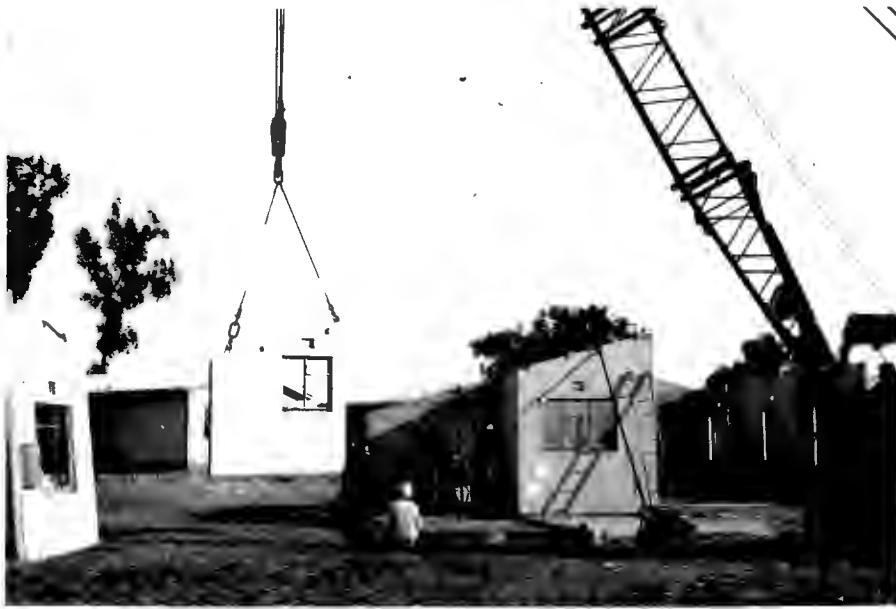
"MUST" SYSTEM -
(e) Casting table
tilted to near vertical
and panel being lifted
clear.



"MUST" System - (f) Wall panels on the
"toastrack" trailer.

FIG. 20

(Photographs by courtesy of Messrs. Murray & Stewart.)



"MUST" SYSTEM - (g) Wall panels being erected by crane on previously cast foundation slab.



"MUST" SYSTEM - (h) Erection of walls completed; temporary props in position while tee joints are made & roof trusses positioned in the slots shown.

FIG.21



"MUST" SYSTEM - (i) The assembly of interior wall panels showing lifting hooks, tee joints and electrical conduit cast into the walls.



"MUST" SYSTEM - (j) Blocks of flats, showing precast panels erected to four storeys.

FIG.22

(Photographs by courtesy of Messrs. Murray & Stewart.)

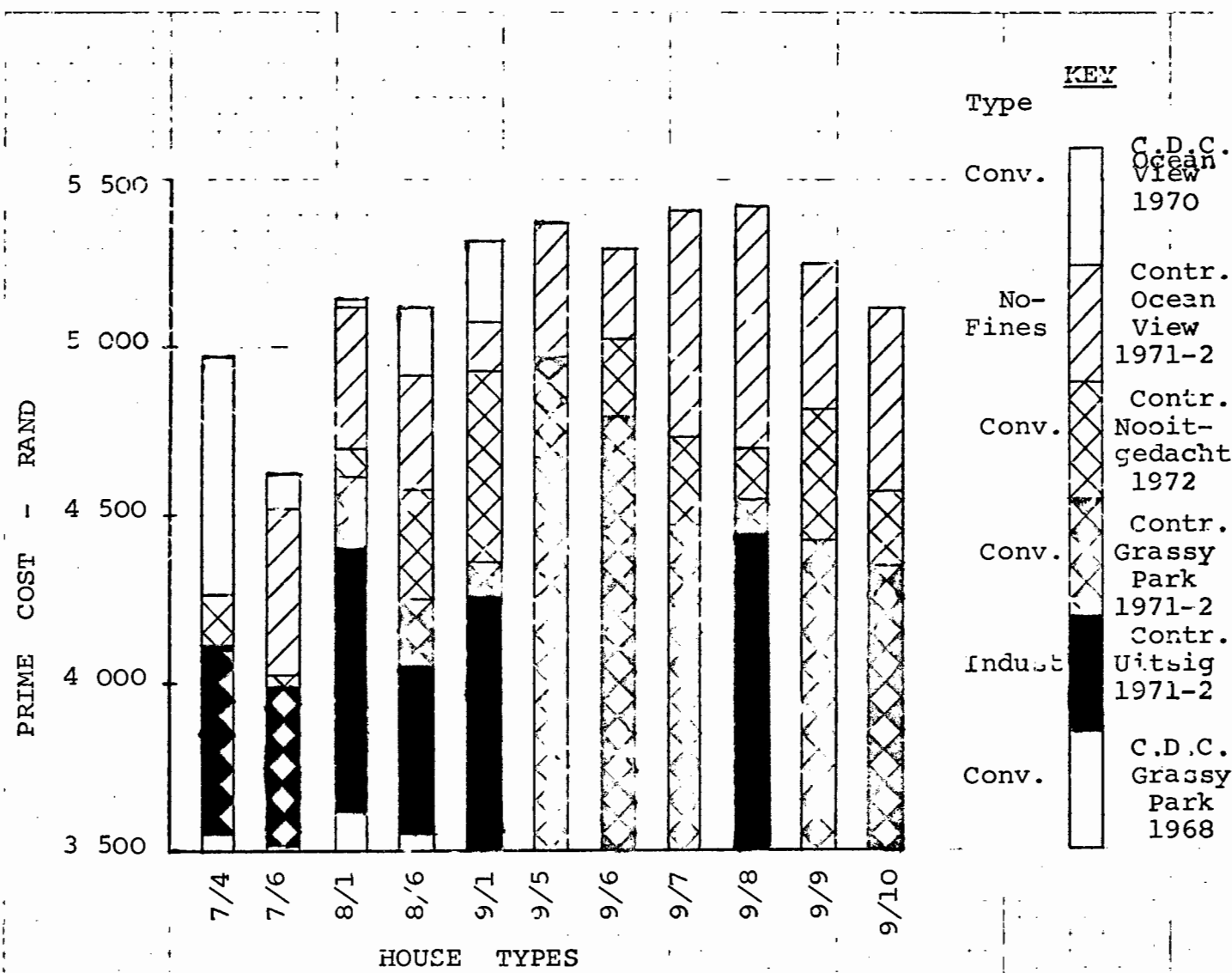


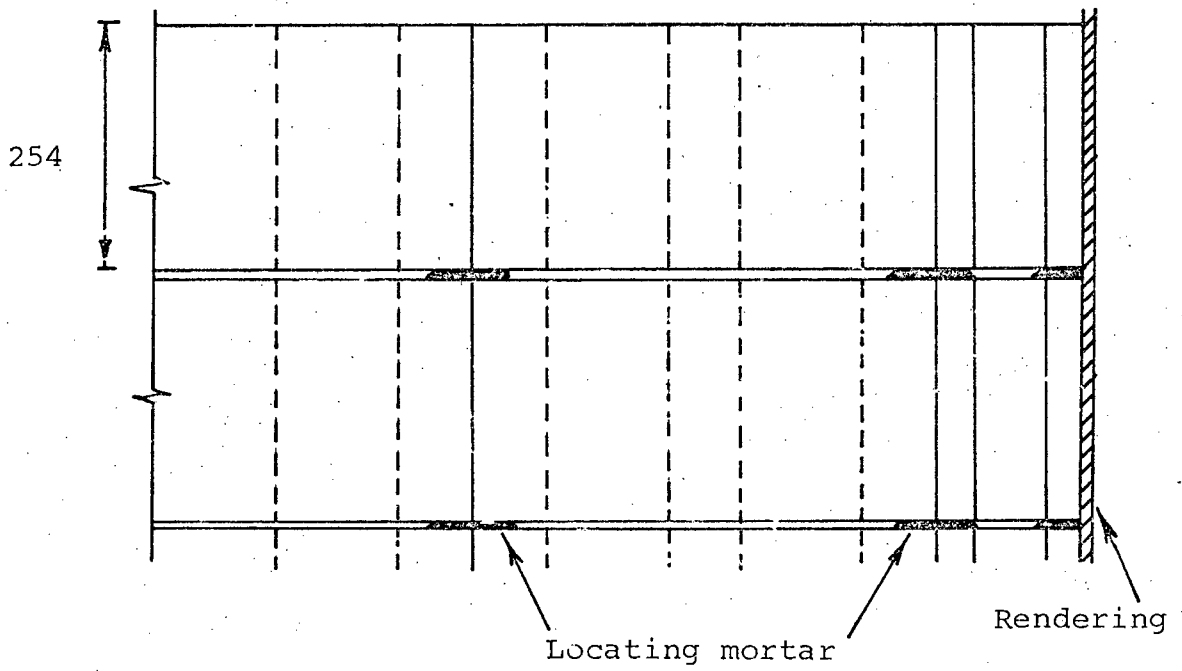
FIG. 23 - COMPARISON OF PRIME COSTS OF SELLING SCHEME HOUSES BUILT FOR THE CAPE DIVISIONAL COUNCIL

Note : In the case of houses built departmentally by the Cape Divisional Council, the difference is illustrated between building close to the Housing Development Office in Grassy Park in 1963 and building at Ocean View 48 km away in 1970. This difference is due not only to the rise in wages and cost of materials over two years, but to the cost of transporting workmen to the site and paying for travelling time when no productive work was done. Had Council not been prepared to condone these expenses the work could not have been done, as workmen were assured in the building boom then prevailing of alternative jobs.

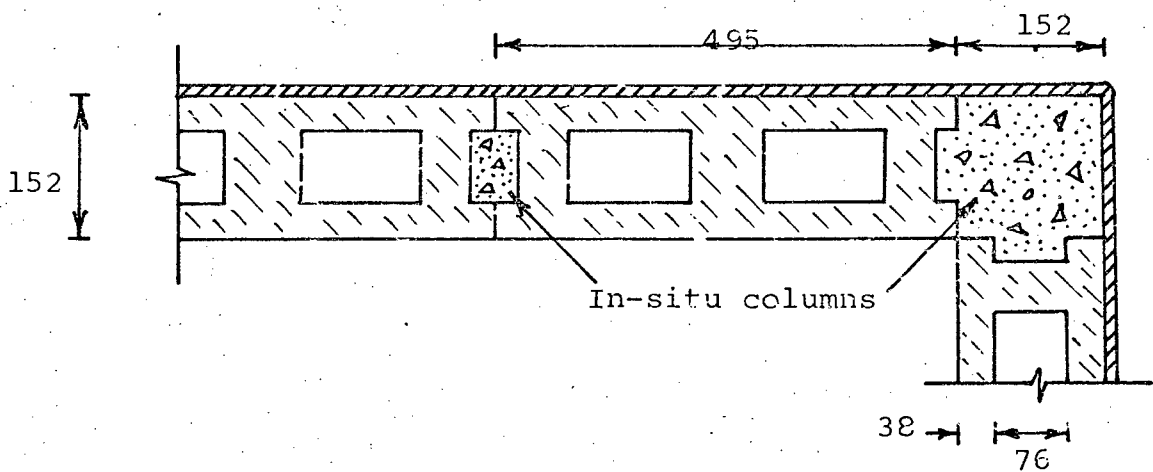
ABBREVIATIONS :

C.D.C.	Cape Divisional Council
Contr.	Contractor
Conv.	Conventional building methods
Indust.	Industrial " "

(Data from Housing Development files, Cape Divisional Council.)



PART ELEVATION



PLAN

FIG. 24 THE LONGTILL SYSTEM



Scale : 1/8 Full Size



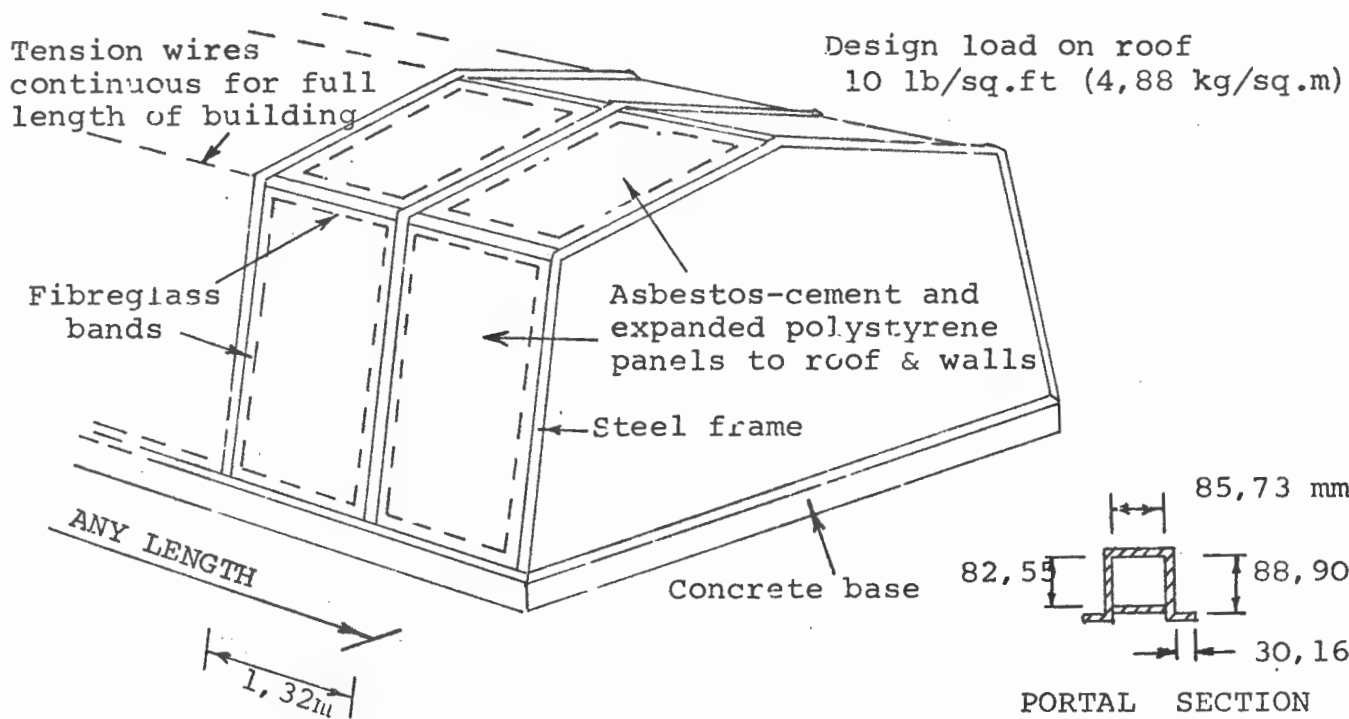
BOTHASIG - NEW SCHEME

Longtill system houses
under construction; the
vertical "columns" and
corner "columns" shown.



BOTHASIG - OLD SCHEME

Wooden houses alternate
with brick houses to
reduce the fire hazard.



ASSEMBLY OF BENTS AND PANELS.

(Tunnel construction does not depend on end walls for stability.)



COMPLETED HOUSE AT CONNAUGHT ROAD, ELSIES RIVER.

(Presented to the Divisional Council.)



Removing the internal jig bracing prior to stripping formwork; the light construction of the formwork can be seen.



An interior corner showing no-fines concrete on the exterior wall and terracotta blocks on the interior wall; electrical conduit tubing is visible.

OCEAN VIEW - NO-FINES CONCRETE I.

FIG.27



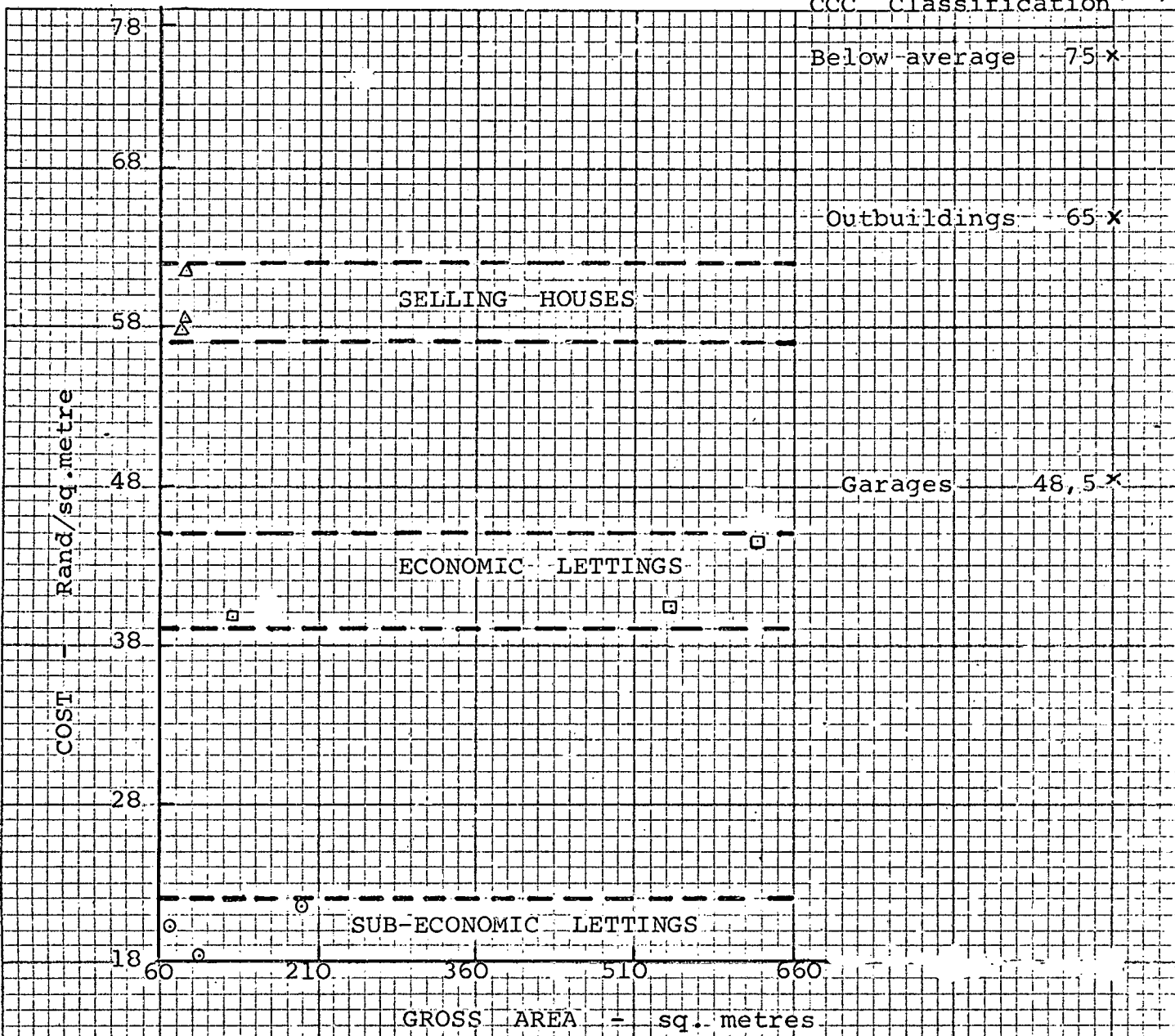
An exterior wall showing window frames cast in position; the open texture of the concrete can be clearly seen.

(Photograph by courtesy of W.J.M.Construction Co.)



A street of no-fines houses after completion of the 82-house contract.

OCEAN VIEW - NO-FINES CONCRETE II.



STRATIFICATION OF UNIT BUILDING COSTS.

Dwelling units built under contract
for the Divisional Council of the Cape.

Fig. 29

(Data from Housing Development files, Cape Divisional Council.)

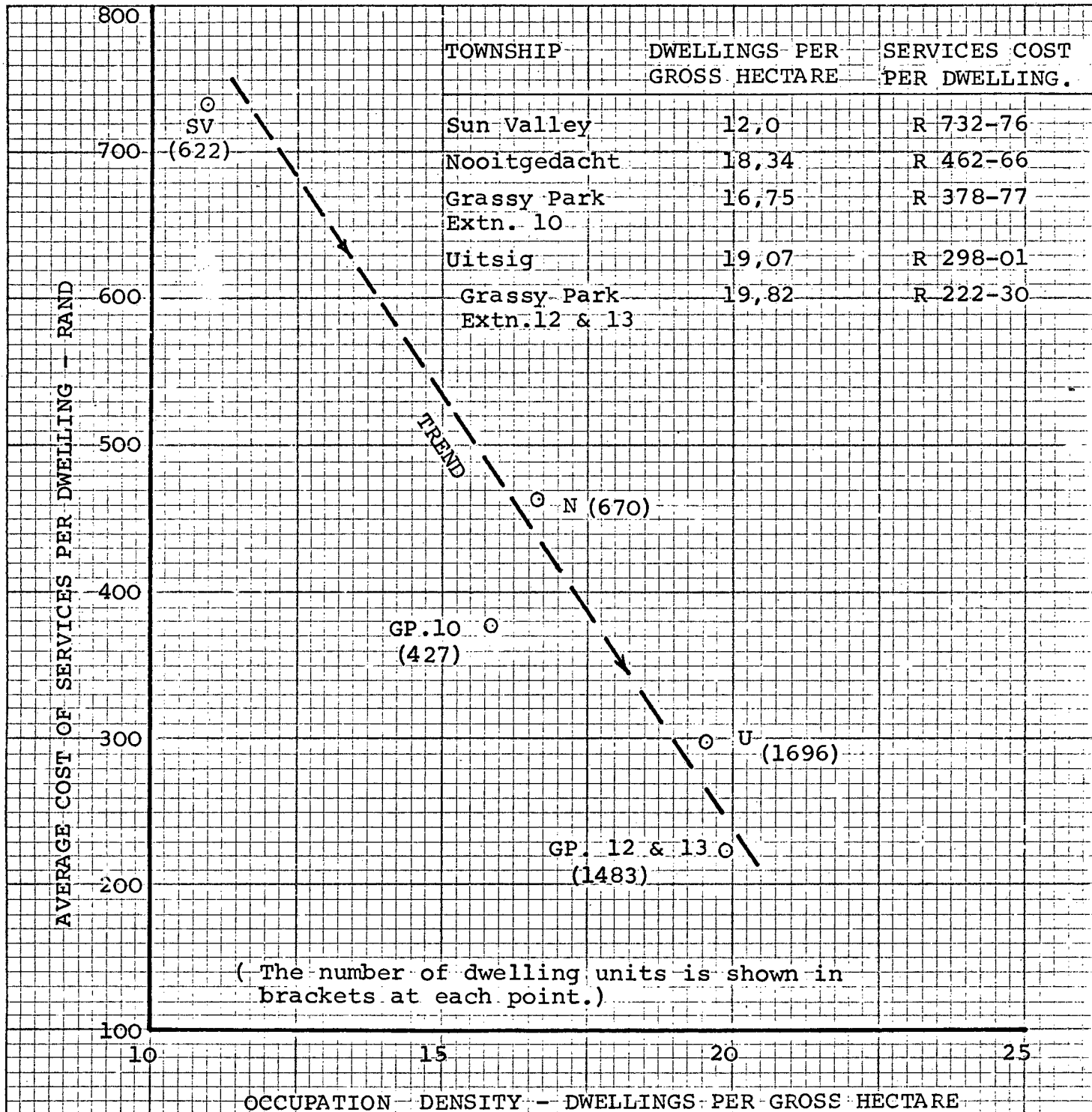


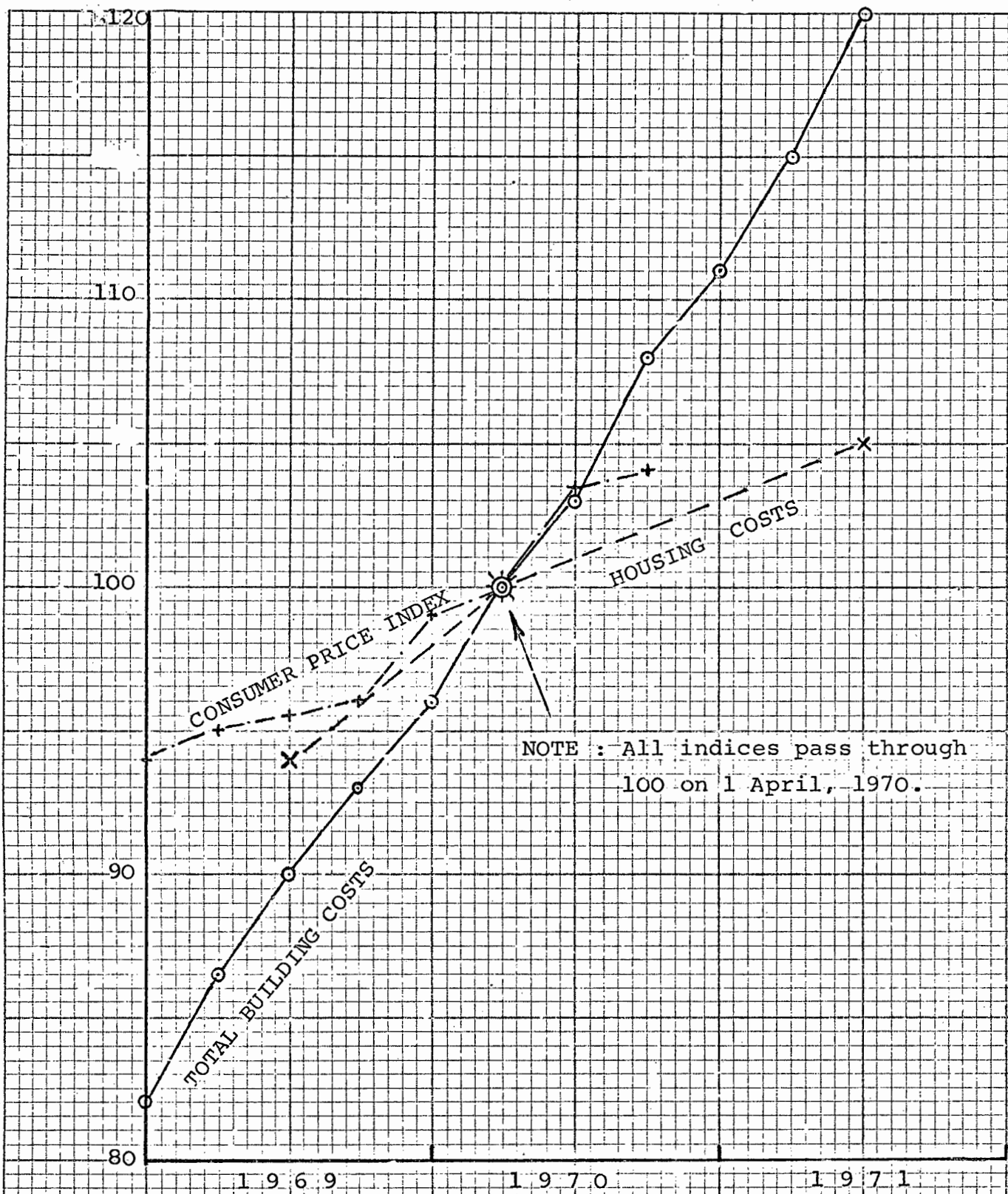
Fig-30

THE TREND TOWARDS LOWERED SERVICES COSTS WITH INCREASED HOUSING DENSITY

The scatter in the points plotted does not allow a quantitative result to be deduced ; many more points would have to be analysed to obtain a quantitative result.

All the townships shown above were developed by the Divisional Council of the Cape.

(Data from Housing Development files, Cape Divisional Council.)



NOTE : All indices pass through 100 on 1 April, 1970.

COMPARISON OF COST INDICES WITH THE MEAN COSTS OF SOME HOUSING TYPES.

(Compiled from the Bureau of Statistics publications, Stellenbosch University Bureau for Economic Research Report No. 10, & Cape Divisional Council files.)

Fig. 31