CHAPTER VIII.

DIRECT FACTORS AFFECTING ECONOMY OF RESIDENTIAL DEVELOPMENT

Introduction.

The basic elements which have direct effect in the appraisal of the costs of any residential estate are residential buildings, land, streets, underground works, green areas, and public buildings.

Residential buildings can be divided according to their kinds into family houses and flat houses. Family houses in their turn are divided into detached family houses, semi-detached family houses, and attached or row of family houses or terrace houses. Flat houses in their turn are divided into corridoor-access type, balcony-access type, and staircase-access type.

Residential buildings can also be divided according to their number of storeys into ground floor houses, walk-up flat houses, low-rise flat houses, andhigh-rise flat houses.

Each kind and type of housing has its own advantages and characteristics, but this is not the place to discuss this subject.

Town planning and design are the main two forces which have direct economic effect on the costs of a residential development. Town planning determines site

allocation, the lay-out of the development, the kind and type of residential buildings used, and the necessary public facilities and public buildings. While design is concerned with architectural and structural desing of the residential units. The object to this chapter is to analyse the forces which have direct economic effect on thecosts of a residential development.

Town palnning.

Town planning economy is concerned with selecting the most suitable site for the required development, and arranging buildings and other public facilities in a manner to get the best benefits with the fewest possible costs.

Selection of site and the degree of developing depend on its area and physical and natural characteristics, location in relation to environment, existence of public utilities, accessitility, public restrictions on site development, and price of site. Land is probably best considered in terms of site suitable for a certain given development. Because the cost of land must represent a less proportion of the final costs of the development, the prices offered to a certain site will greatly depend on the kind of development and on the supposed costs. The price of land, specially the high prices, act as a regulator to the planning process. High densities of building and of population are specially noted as a character of a development which has high land cost.

It is of essential importance, both in the interest of building economy and the preservation of any existing n tural features, to adjust the buildings and

circulation to existing ground conditions. In the interest of economy cut and fill should be in balance as nearly as possible. High steep sites are disagreeable not only due to construction difficulties, but also to the high maintenance costs of streets, drainage, and foot-paths dure to erosion.

The relationship between the site and the buildings themselves is of prime importance. For long narrow units, the most economical placement is parallel to the contours, as it results in minimum foundation, and cut and fill works. On the other hand, when building units are placed perpendicular to the cotnours, it is only economical when buildings are short compared to the amount of slope. It is possible to take use of the slope of site for better orientation and viewing of the buildings. It is also possible to get use of stepped sites to provide basement space, which may be used for garages, stores, playing spaces, and the like.

The simplest plan is always considered to be the most economical. Economy is to be obtained by the simplicity in both the unit and their larger grouping. By a simple unit and grouping savings of land and construction costs can be obtained. Also from the point of view of the daily services costs, as post, waste collection and food supply, the simplest plan is the cheapest plan.

The width of frontage of the residential building is one of the most significant features of dwelling which affect density, and hence costs. A terrace house occupies not just its own floor area but also a strip

of site, back and front, on which other buildings can not be sited, on account of privacy, daylighting and ventillation consideration. An increase in the depth of block has little effect on the area of site thus occupied, while an increase in the frontage has a bigger effect. Also the width of frontage has a significant effect on the scheme costs as it affects the amount of streets and underground works. It is a matter of frontage length which has the main effect on the street and underground works costs. The shorter is the length of frontage the cheaper are the streets and underground costs. Compared with other types of family houses, the use of terrace houses can be considered the most economical as they reduce the amount of land and street length per residential unit.

To study the costs of streets it is obvious that the fewer the junctions thelower cost of streets per residential unit. Costs of streets and other public utility services depend largely on the size of block of flats, especially the length of its frontage, and on the form of lay-out. Complicated lay-outs or lay-outs in which there are long sections in which streets and other public facilities are runnin without a positive function tend to be costly. Residential street pattern should be designed so that not to exceed 2o per cent of the gross ground area of the residential estate.

Laying the public utilities under the streets disturb the subsoil to the street and accordingly causes damage to the street surface. By laying such services under foot-paths or side walks we save costs caused due

to street damages, especially if chekking of the services is required the traffic will be disturbed.

Given more public open spaces this may increase the costs of maintenance of green areas especially if they are badly treated. An approach to solve that problem is to reduce the public open spaces to the minimum, that does not mean to reduce the total area of the greeen areas, because it is possible to join these green areas to the private gardens.

The minimum number of population of any residential estate must be at least that number which support the existence of public buildings which are minimally provided to any residential estate.

Type of building.

As it was mentioned before, residential buildings can be divided into family houses and flat houses. Stressing on the main economic differences between these two kinds, flat houses have the following advantages:

a) Since the entrances of dwellings are grouped around landings, fewer entrances to the building itself are required, also one staircase is required for bigger number of dwellings;

b) Since dwellings are concentrated in one block, communal facilities such as water supply, water disposal, and the like are more economically provided;

c) Savings are obtained in the cost of maintenance of the communal facilities;

d) They result in more compact development with the advantages of saving agricultural land, moreover, it results in saving of time and travel cost;

e) Smaller area of land needed for bigger number of dwellings;

f) Fewer costs for fences, gates and the like are needed.

There is an economic point against the flat house building, that is they need more capital of money to be built.

The different types of family houses have also different economic advantages. Stressing on the main economic differences between detached family houses and rows of family houses, the rows of family houses have the advantages of:

a) They result in more complact development with its advantages of saving land and communal facility costs per dwelling unit;

b) They require less perimeter exterior wall per dwelling unit;

c) Since large numbers of units are compact in one row they give the possibility of mass construction which can be benefited in reducing the costs;

d) In cold regions, the nature of the form of the row houses help to keep them warm, and hence result in cheaper costs of isolation and heating.

The row of family houses has the disadvantages of sound transfer from one house to another through partition walls, so special precautions against sound transfer must be provided to the partition walls.

Flat houses can be broadly divided into staircase-access, balcony-access, and corridoor-access flat houses. Stressing on the main economic differences between staircase-access and balcony-access flat houses, the balcony-access flat house has the following advantages:

a) Bigger number of flats are served by one staircase and lift, if any;

b) Shorter perimeter of exterior wall per unit.

Balcony-access flat houses have, however, the following disadvantages:

a) The cost of outer communication is relatively high per dwelling unit as a result of big areas of corridoors;

b) In cold countries, they result in more costs of heating. This disadvantage is avoided in the corridoor-access flat houses.

Number of storeys of building.

The number of storey of a block affects the building costs. It is obvious that the higher the building the bigger is the capital of money needed to credt it. The total costs of a block rise with the rise of the block. Costs tend to rise rapidly at the point where lifts and extrastaircase are needed to be used (Fig.8-11.

The rise of costs with the rise of the block does not mean that it is more expensive per suqare metre of its superstructure. From Figure 8-1 we can find that within the limits, the cost of one square metre of

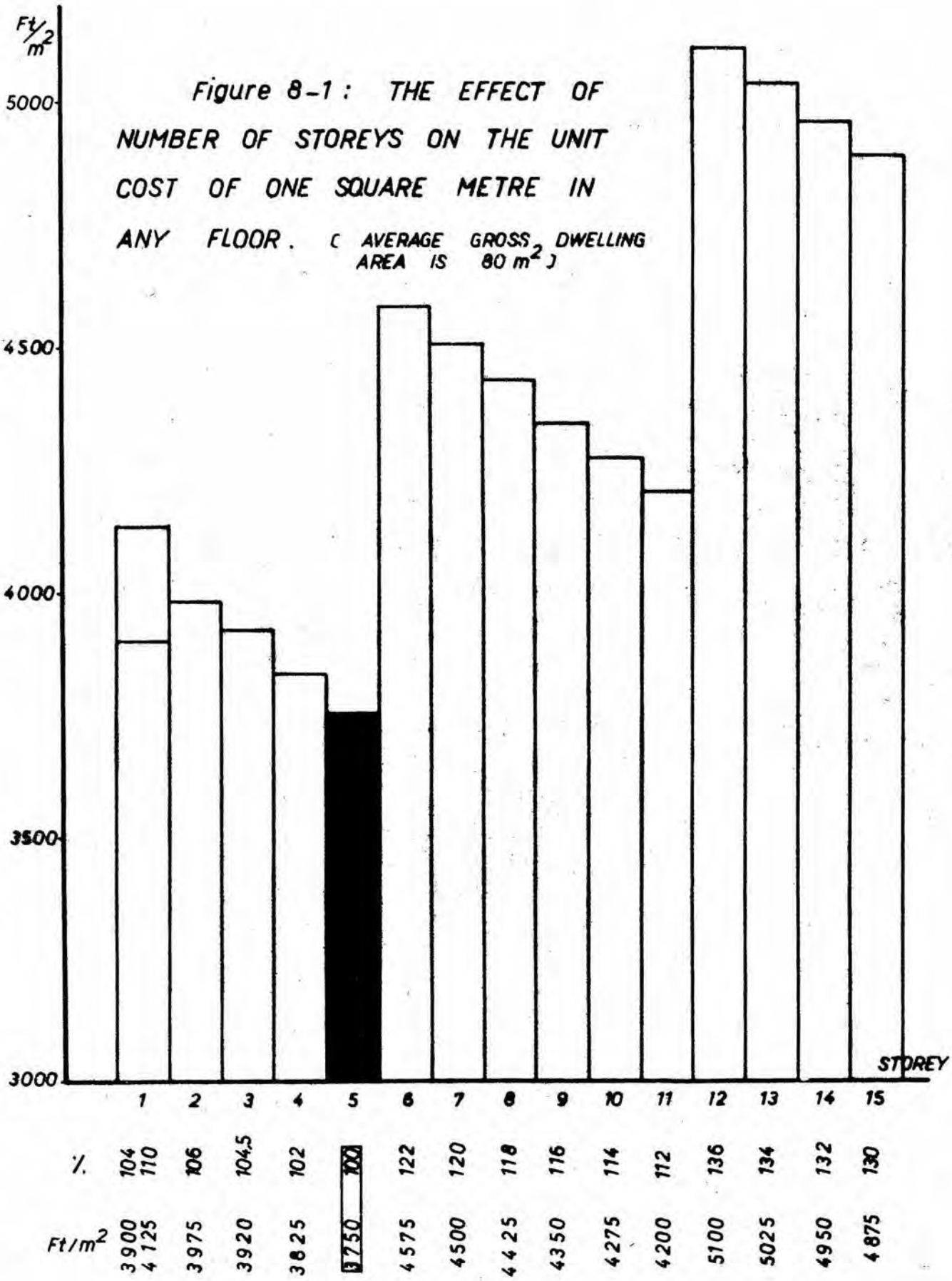


Figure 8-1 : THE EFFECT OF NUMBER OF STOREYS ON THE UNIT COST OF ONE SQUARE METRE IN ANY FLOOR. (AVERAGE GROSS DWELLING AREA IS 80 m^2)

superstructure tends to decrease with the increase in the number of storeys of a block. The rate of decrease, in general, is within the range of 2 per cent.

The most cheap is to build five-storey blocks, because roofing, drainage and other facilities, and the building administration costs are cheaper per dwelling unit than to build, for example, two-storey flat houses. Moreover, a five-storey flat house does not need lifts.

A one-storey house is more expensive per suquare metre than a five-storey flat house. The one-storey house will show a 1o per cent increase in the building cost of one square metre than the five-storey flat house (Fig. 8-1).

A sudden increase in cost occurs when lifts are used. The cost of lift include its installation, lift shaft, motor room, and all other connections concerning lift. It is important to put into consideration that with an increase in block height, the lift costs will increase not only due to extra costs of serving more floors, but also due to the need of bigger, more efficient and speedier lifts. The number of served dwellings per lift may be used as an economic guide for comparison between designs. This method is appreciated with a high cost of the lift and its installation and also with a high using cost.

Developing at six-storey height rather than five-storey height, i.e. using single lift, will result in an increase of 2o per cent, and developing at twelve-storey height ratehr than five-storey height,

i.e. using double lifts and extra staircase will increase the costs with 3½ per cent (Fig. 8-1).

Design.

The aim of studying design economy is to give bases to provide the best design according to certain needs at the lowest possible costs. For the sake of an economic study of residential buildings we have to know the distribution of the costs of a residential building on its main elements. The costs of any building is distributed in four main elements of construction. These main elements are:

a) Substructure. It includes all the foundation costs and the cost of the ground floor slab. The substructure cost is influenced by the site topograhpic and subsoil conditions, and type, shape, and weight of building to be eredted.

b) Superstructure. It includes all the structural works of the building to be erected including all structural frames, roofs and floors, walls and partitions, balconies, and staircases. Stressing on the main differences between a staircase-access and a balcony-access flat house, some characteristics of the costs of superstructural elements can be seen from the following:

i) The cost of the roof and floor per dwelling increases proportionately with the increase in the size of dwelling; and the cost of roof per dwelling increases with the decrease in the number of storeys;

ii) The costs of structural frame, walls, and partitions increase more or less proportionately with the size of the dwelling;

dwelling and the followed changes in the fittings and finishes costs, but, generally, as the size of dwelling increases the costs of fittings and finishes increases more or less proportionately. The costs of floor and ceiling covering will remain constant per square metre of dwelling area whatever the size of the dwelling is, but will increase in cost per dwelling as the size of dwelling increases. The cost of bathroom and kitchen remain constant per dwelling as the size of dwelling changes, but its cost per square metre of dwelling area increases as the size of dwelling decreases.

d) Lifts. This item includes the costs of lift installation, the lift shaft, the machine room, and all other connections of the lift. With a staircase-access flat house, the cost of lift per dwelling remains constant whatever the size of the dwelling is, but it decreases in terms of cost per square metre of dwelling area with the increase of the size of the dwelling. With the balcony-access flat house, the cost of lift increases per dwelling with the increase of the size of dwelling, but it remains constant per square metre of dwelling area.

The main aim of studying the major building elements of a residential building is to find a point of start to reduce the building costs. Saving costs by lowering the standards of construction and finishing or reducing of space in relation to need does not improve the economy of a building, although it may cheapen it. The economic building is the one which provides the values required at the lowest cost.

A reduction of say 1o per cent of the room size will not result in a reduction to the same ratio in the building corridoors, staircase, and elevators space, because the building core will remain the same through a wide variation in room size. Furthermore, the building cost will not vary in direct proportion to the reduction of room size because the cost of the expensive components such as stairs, elevators, bathrooms and kitchens would remain the same.

Costs are affected by the amount of space taken by the communication links. Often too much space is taken by the communication links, whether they are inter-communication lins, such as corridoors, lobbies, stairs and ramps, or outer-communication links, such as stairs, lifts, corridoors and ramps. In general, the ratio of the area of the inter-communication links to the gross area of a flat is ranging from 8 to 15 per cent, with an adequate number of 1o per cent. Whereas the ratio of the area of the outer-communication links to the gross floor area on the upper floors is in the range of 9 to 25 per cent with an adequate number of 15 per cent. Costs of the outer-communication vary as a result of the number of dwellings per floor served by them, and the number of served storeys.

Costs are affected not only by the amount of space of the block but also by the solid shape of the enclosure. A many-sided shape of enclosure will result in additional costs of construction due to building more external walls and forming more number of corners. Cornering usually adds to the costs and right angles are usually cheaper than other forms of angles. A many-sided enclosure will result in more external walls. More

external walls will result in higher costs per dwelling due to the fact that they are expensive to build as they must secure a reasonable standard of sound and heat resistance.

Structural economy depends on the use and choice of materials, and with method of erecting them. It is not sufficient to choose the cheapest possible material, it is also necessary to use its characteristics to their fullest advantage. The way in which materials are put together is important. Savings can be achieved by the use of designs which allow for the repetition of simple operations, and for the concentrated use of mechanical plants. The cost of shuttering for concrete is often high; the simpler the design of the shuttering and the more often it can be used, the cheaper will be the finished product. This point was studied in detail in Chapter IV.

Building economy is not just a question of minimising the quantity of materials or of choosing those with the minimum costs, but of producing a design with the minimum total erection costs in relation to amenities provided. A reduction in the amount of materials is not necessaryly accompanied by a reduction in the amount of labour and costs. For example, while the shortest route for a sewer may be to pass under the building, the use of this method will increase rather than reduce the costs of construction. This might occur as a result of interference in the construction of foundations, it must be built to withstand the effects of settlement and pressure, moreover, it will be expensive to replace or repair.

The effective floor area of a dwelling may be rather less than the actual floor area. Bad adjustments of doors and windows, bad shaping of the internal space of a flat, and even bad system of furnishing will result in big losses in the effective floor area of the dwelling.

A real building economy can be started from the appraisal of the was the building is to be used initially and as far as can be seen over its life. This thorough appraisal will indicate the advantages of different shapes and floor areas, and of arrangement of residential spaces and services required. Cost reduction can be approached through design partly by the elimination of wasteful building spaces, and avoiding of complicated lay-outs, partly by a good structural design avoiding unnecessary dead weight, and partly by a proper design of ancillary through grouping the kitchen, bathroom and water closet in one zone for easy fitting. Cost reduction can also be approached through the building materials used, partly by using lighter materials to reduce the weight of building, partly by using durable materials which offer economy through a reduction of repair and maintenance costs, and partly by arranging for a dimensional pattern convenient for the materials to be used.

It is obvious that different designs and plan types have different aesthetical and social values which cannot be costed, although they are important and must be taken into consideration.

CHAPTER IX.

ECONOMIC ANALYSES OF A NEIGHBOURHOOD UNIT.

The object of the investigation.

The object of this investigation is to study the following:

1) The effect of gross densities on the costs of a neighbourhood unit;

2) The effect of gross densities on the costs of the different elements of a neighbourhood unit;

3) The effect of the change in the cost of one element of the neighbourhood unit on the costs of the other elements;

4) The cost percentage of each element to the total cost of a neighbourhood unit;

5) The effect of the changes in the number of storeys of the residential buildings on the changes in gross densities (GD) and costs.

The main elements of study are residential buildings, streets and parking areas, green areas and footpaths, and sewerage, water pipes and electric cables.

The method.

This investigation is based on the assumption that the area of the neighbourhood unit is constant. The siete is limited from its northern and eastern sides with

heavy traffic roads, and from its other sides with light traffic roads.

For the aim of this investigation, basic plans 1, 2, 3, and 4 were designed. All the basic plans were designed satisfying orientation, privacy and aesthetical factors. Residential buildings, schools, shopping centre, and other public buildings were typified to give unity for all the basic plans. Street pattern was designed to be as far as possible identical in all the basic plans and to be within 2o per cent of the total ground area of the neighbourhood unit.

On the basis of basic plans 1, 2, 3, and 4, and with slight changes, several alternatives were made to achieve different gross densities. The method was to change the number of storeys of the residential buildings population, gross density residential buildings, access streets and parking area, and foot-paths change.

On the basis of the street pattern of basic plan 3, twelve alternative plans (I. - XII.) were theoretically made to achieve gross densities ranging from 8o to 55o persons per hectare. The object of these alternavitve plans is to get the most possible lowest costs of the neighbourhood unit within this range of gross densities. These alternative plans were achieved by using a model of three bedroom dwellings grouped in blocks of staircase-access flat house with two flats in each floor, and with a gross ground area of each block of about 2oo square metres. From the fact that the five-storey blocks are the cheapest to build and on the base of Figure 9-5, several attempts were made at different gross densities to achieve the lowest cost results. The method was that on the base of the street pattern of basic plan 3, five-

storey blocks were introduced to their greatest extremes to achieve the highest possible gross density which was found to be 45o persons per hectare. Once again five-storey blocks were introduced to a reasonable limit to achieve the most lowest gross density, which can be reasonably achieved by five-storey blocks, which was found to be 16o persons per hectare. Now the range of gross densities which can be achieved by five-storey blocks is determined. Moreover, several attempts were made also on the base of Figure 9-5, to get the lowest cost results at gross densities ranging from 8o to 16o persons per hectare and 45o to 55o persons per hectare. From the different attempts, twelve alternative plans, I. - XII., were achieved, which represent the possible lowest costs at the different gross densities.

At the different steps of the study several principles were taken into consideration. These principles are:-

1) All alternatives must satisfy a reasonable standard of orientation and privacy.

2) Access streets and parking areas must be in ratio with the population.

3) In all of the alternative plans demographic, aesthetic and other problems related to buildings of non-residential use were neglected.

Alternative plans.

For the sake of simplicity, given a basic plan composed of five-storey, two-storey and one-storey blocks, it was given a code number 5-2-1, and then assuming that an alternative plan was made and the five-storey blocks were replaced by six-storey blocks and the two-storey

blocks were replaced by five-storey blocks and the one-storey blocks remained as they were, its code number will be 6-5-1, and so on, for all of the alternative plans.

Basic Plan 1. and its alternative plans.
(Fig. 9-1)

1) 5-2-1

It is composed of five-storey, two-storey, and one-storey blocks, representing 31.12, 11.37, and 57.51 per cent, respectively, of the total ground area of the residential buildings.

1A) 2-2-1

Assuming that the five-storey blocks are replaced by two-storey blocks while the two-storey blocks and one-storey blocks remained as they are.

1B) 2-6-1

Assuming that the five-storey blocks are replaced by two-storey blocks and the two-storey blocks are replaced by six-storey blocks, while the one-storey blocks remained as they are.

1C) 6-2-1

Assuming that the five-storey blocks are replaced by six-storey blocks, while the two-storey blocks and one-storey blocks remained as they are.

1D) 5-5-1

Assuming that the two-storey blocks are replaced by five-storey blocks while both of the five-storey and one-storey blocks remained as they are.

Figure 9-1: BASIC PLAN (1)

- 5-storey block
- 2-storey block
- 1-storey block

1 - Shopping centre; 2 - Mosque; 3 - Preparatory school;
4 - Nursery school; 5 - Elementary school.

1E) 6-6-1

Assuming that both of the five-storey and two-storey blocks are replaced by six-storey blocks while the one-storey blocks remained as they are.

Basic Plan 2. and its alternative plans.
(Fig. 9-2)

2) 9-5-1

It is composed of nine-storey, five-storey and one-storey blocks, representing 8.14, 19.19, and 72.67 per cent, respectively, of the total ground area of the residential buildings.

aA) 2-2-1

Assuming that both of the nine-storey and five-storey blocks are replaced by two-storey blocks while the one-storey blocks remained as they are.

2B) 6-2-1

Assuming that the nine-storey blocks are replaced by six-storey blocks and the five-storey blocks are replaced by two-storey blocks while the one-storey blocks remained as they are.

2C) 2-6-1

Assuming that the nine-storey blocks are replaced by two-storey blocks and the five-storey blocks are replaced by six-storey blocks while the one-storey blocks remained as they are.

2D) 5-5-1

Assuming that the nine-storey blocks are replaced by five-storey blocks while both of the five-storey and one-storey blocks remained as they are.

Figure 9-2: BASIC PLAN (2)

- 9-storey block
- 5-storey block
- 1-storey block

1 - Shopping centre; 2 - Mosque; 3 - Preparatory school;
4 - Nursery school; 5 - Elementary school; 6 - Garage.

2E) 6-6-1

Assuming that both of the nine-storey and five-storey blocks are replaced by six-storey blocks while the one-storey blocks remained as they are.

2F) 11-5-1

Assuming that the nine-storey blocks are replaced by eleven-storey blocks while both of the five-storey and one-storey blocks remained as they are.

2G) 11-6-1

Assuming that the nine-storey blocks are replaced by eleven-storey blocks and the five-storey blocks are replaced by six-storey blocks while the one-storey blocks remained as they are.

2H) 5-11-1

Assuming that the nine-storey blocks are replaced by five-storey blocks and the five-storey blocks are replaced by eleven-storey blocks while the one-storey blocks remained as they are.

2I) 12-6-1

Assuming that the nine-storey blocks are replaced by twelve-storey blocks and the five-storey blocks are replaced by six-storey blocks while the one-storey blocks remained as they are.

2J) 15-5-1

Assuming that the nine-storey blocks are replaced by fifteen-storey blocks while both of the five-storey and one-storey blocks remained as they are.

2K) 6-12-1

Assuming that the nine-storey blocks are replaced by sixt-storey blocks and the five-storey blocks are replaced by twelve-storey blocks while the one-storey blocks remained as they are.

2L) 5-15-1

Assuming that the nine-storey blocks are replaced by five-storey blocks and the five-storey blocks are replaced by fifteen-storey blocks while the one-storey blocks remained as they are.

Basic Pala 3. and its alternative plans.
Fig. 9-3)

3) 9-2

It is composed of nine-storey and two-storey blocks, representing 41.45 and 58.55 per cent, respectively, of the total ground area of the residential buildings.

3A) 2-2

Assuming that the nine-storey blocks are replaced by two-storey blocks, while the two-storey blocks remained as they are.

3B) 5-2

Assuming that the nine-storey blocks are replaced by five-storey blocks while the two-storey blocks remained as they are.

3C) 6-2

Assuming that the nine-storey blocks are replaced by six-storey blocks while the two-storey blocks remained as they are.

3D) 5-5

Assuming th t both of the nine-storey and two-storey blocks are replaced by five-storey blocks.

Figure 9-3: BASIC PLAN (3)

● 9-storey block

○ 2-storey block

1 - Shopping centre; 2 - Mosque; 3 - Preparatory school;
4 - Nursery school; 5 - Elementary school; 6 - Garage.

3E) 9-3

Assuming that the two-storey blocks are replaced by three-storey blocks while the nine-storey blocks remained as they are.

3F) 15-2

Assuming that the nine-storey blocks are replaced by fifteen-storey blocks while the two-storey blocks remained as they are.

3G) 11-5

Assuming that the nine-storey blocks are replaced by eleven-storey blocks and the two-storey blocks are replaced by five-storey blocks.

3H) 12-6

Assuming that the nine-storey blocks are replaced by twelve-storey blocks and the two-storey blocks are replaced by six-storey blocks.

Basic Plan 4. and its alternative plans.
(Fig. 9-4)

4) 9-5

It is composed of nine-storey and five-storey blocks, representing 77.54 and 22.46 per cent, respectively, of the total ground area of the residential buildings.

4A) 2-2

Assuming that both of the nine-storey and five-storey blocks are replaced by two-storey blocks.

4B) 5-5

Assuming that the nine-storey blocks are replaced by five-storey blocks while the five-storey blocks remained as they are.

4C) 6-6

Assuming that both of the nine-storey and the five-storey blocks are replaced by six-storey blocks.

4D) 5-15

Assuming that the nine-storey blocks are replaced by five-storey blocks and the five-storey blocks are replaced by fifteen-storey blocks.

4E) 6-12

Assuming that the nine-storey blocks are replaced by six-storey blocks and the five-storey blocks are replaced by twelve-storey blocks.

4F) 11-5

Assuming that the nine-storey blocks are replaced by eleven-storey blocks while the five-storey blocks remained as they are.

4G) 12-6

Assuming that the nine-storey blocks are replaced by twelve-storey blocks and the five-storey blocks are replaced by six-storey blocks.

4H) 15-5

Assuming that the nine-storey blocks are replaced by fifteen-storey blocks while the five-storey blocks remained as they are.

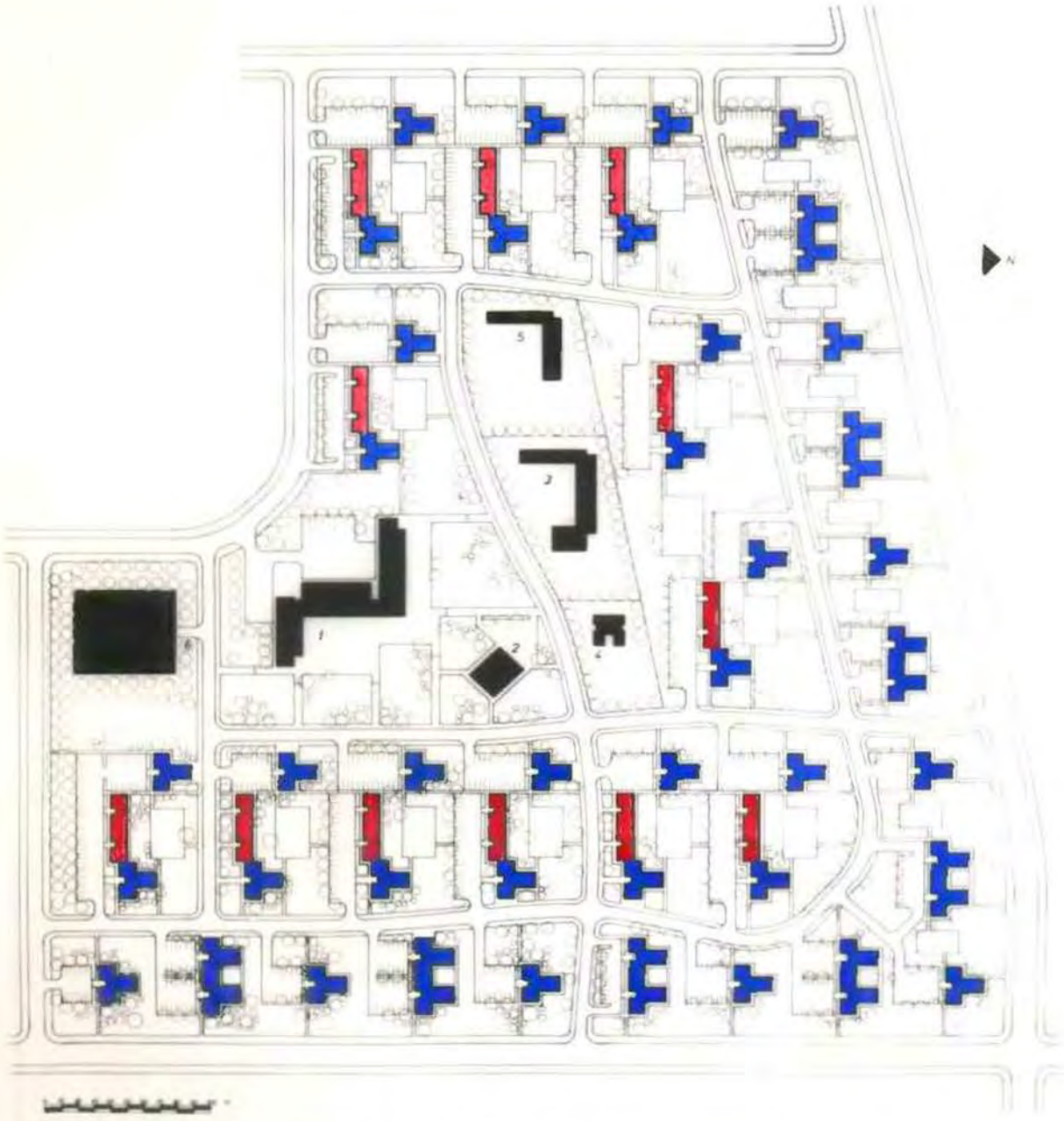


Figure 9-4: BASIC PLAN (4)

- 9-storey block
- 5-storey block

1 - Shopping centre; 2 - Mosque; 3 - Preparatory school;
4 - Nursery school; 5 - Elementary school; 6 - Garage.

ALTERNATIVE PLANS (I. - XII.)

I.
It is composed of 97 two-storey blocks.

II.
It is composed of 8o three-storey blocks.

III.
It is composed of 79 four-storey blocks.

IV.
It is composed of 78 five-storey blocks.

V.
It is composed of 97 five-storey blocks.

VI.
It is composed of 123 five-storey blocks

VII.
It is composed of 168 five-storey blocks.

VIII.
It is composed of 168 five-storey blocks.

IX.
It is composed of 193 five-storey blocks.

X.
It is composed of 217 five-storey blocks.

XI.
It is composed of 7o eleven-storey blocks and 87 five-storey blocks representing 45.18 per cent and 54.82 per cent, respectively, of the total ground area of the residential buildings.

XII.
It is composed of 6o fifteen-storey blocks and 85 five-storey blocks representing 4o.38 per cent and 59.62 per cent, respectively, of the total ground area of the residential buildings.

Unit Costs.

A) Unit costs of residential buildings, prices of 1968, were obtained from the TIPUSTERV.

Unit costs, as shown in Fig. 8-1, are for flats of a gross area of about 8o square metre and an internal clearance of 2.65 metre and a total floor to floor height of about 2.85 metre.

These unit costs were modified according to a flat of a gross area of loo square metre and an internal clearance of 3.1o metre and a total floor to floor height of 3.3o metre.

The modification was made by calculating the cost of one square metre in a loo square metre flat if the cost of one square metre in an 8o square metre flat is known. Then again calculating the cost of one square metre in a loo square metre flat with a total floor to floor height of 3.3o metre if the cost of one square metre in an 8o square metre flat with a total floor to floor height of 2.85 metre is known. Then by adding 5o per cent of the difference in cost due to flat area and 5 per cent of the difference in cost due to height of building the unit cost of one square metre in an 8o square metre flat, the unit cost of one square metre in a loo square metre flat was got. As a result of this calculation, the unit cost of 1 square metre in a flat house of five storeys was found to be about 4.4oo,-Ft. The number 4.4oo,-Ft./m2 represents the total cost of building one square metre in any floor in a five-storey flat house. Then by percentage calculation the unit costs of blocks with other number of storeys were obtained (Fig. 9-5).

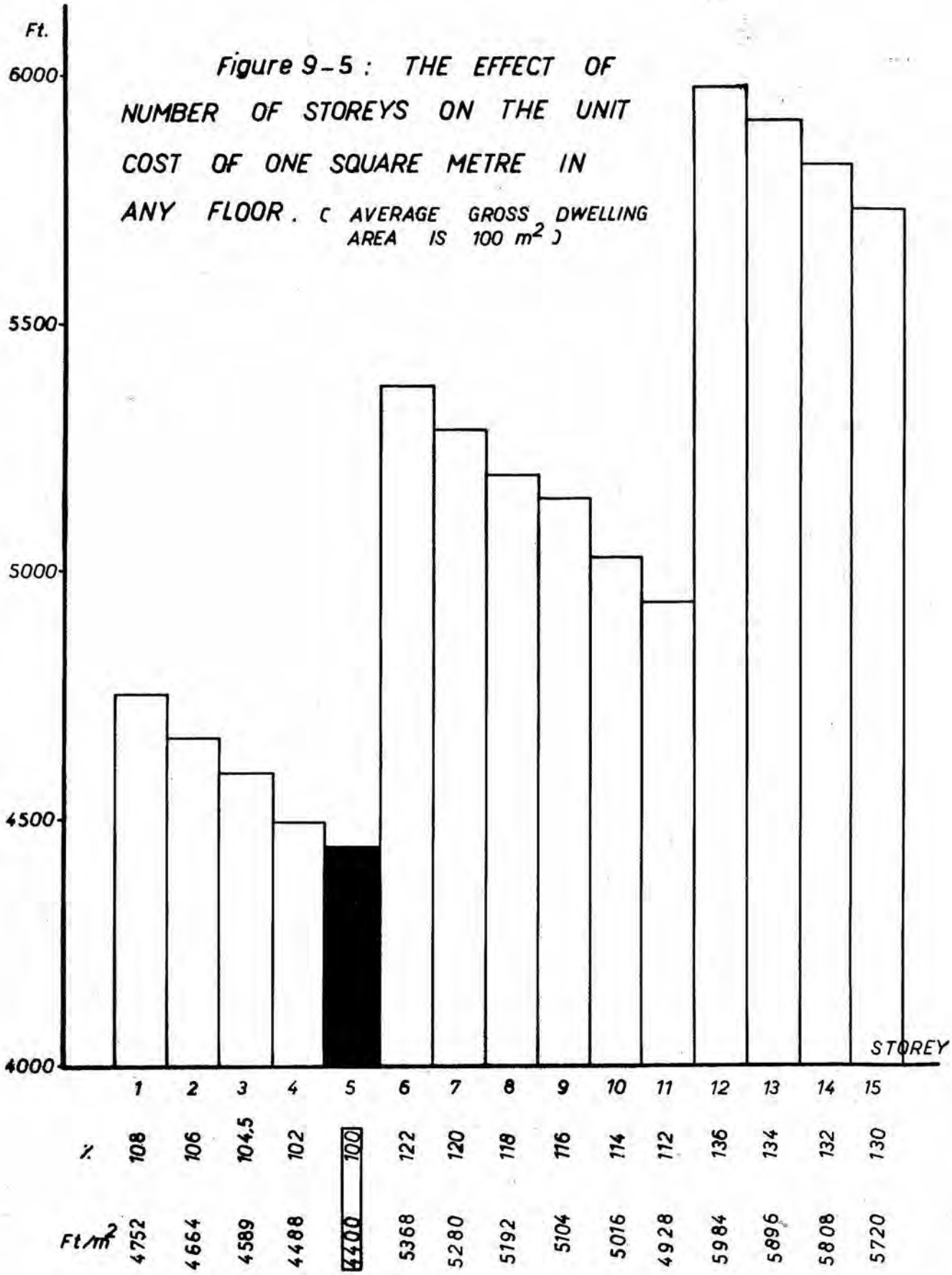


Figure 9-5 : THE EFFECT OF NUMBER OF STOREYS ON THE UNIT COST OF ONE SQUARE METRE IN ANY FLOOR. (AVERAGE GROSS DWELLING AREA IS 100 m^2)

For the sake of calculation, each unit cost of a building was multiplied by its number of storeys to get the unit cost of onesquare metre at its ground area (Fig. 9-6).

For the sake of simplicity, although there are differences in flat areas, just one unit costs were used for calculation.

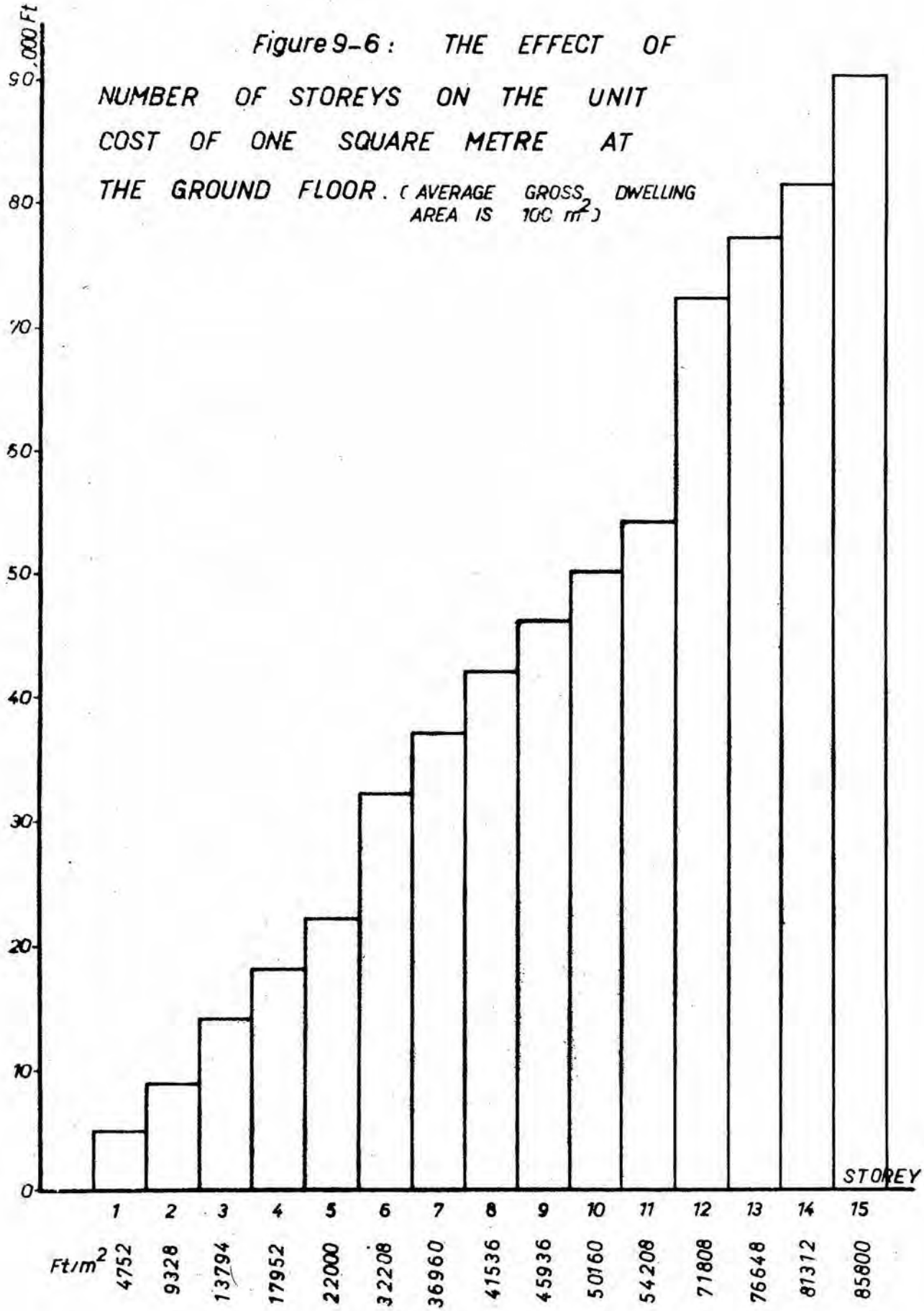
B) Unit costs of public utilities were obtained from UVATERV. Public utilities include all streets and parking areas, green areas, foot-paths, electric cables, water works and sewerage.

Calculations.

The costs of the basic plans 1, 2, 3, and 4, their alternative plans, and the alternative plans I. - XII. are calculated. The interesting items of calculations are sewerage, electric cables, water pipes, green areas, foot-paths, streets, access streets and parking areas, and residential buildings. The different cost results were indicated in Table 9-1 to Table 9-9.

To know the effect of the change of the number of storeys of the residential buildings on the costs, the cost results of each basic plan and its alternatives are studied in isolation from the cost results of the other basic plans and their alternatives. For this aim, the costs of the different items of each basic plan are

Figure 9-6 : THE EFFECT OF NUMBER OF STOREYS ON THE UNIT COST OF ONE SQUARE METRE AT THE GROUND FLOOR. (AVERAGE GROSS DWELLING AREA IS 100 m^2)



considered as a 100 per cent then the costs of the identical items of the alternative plans are calculated as a percentage relative to them. The different cost percentages of each group of alternative plans are indicated in Tables 9-10 to 9-14, and in Figs. 9-7 to 9-11.

All the cost results given in Tables 9-1 to 9-9 are indicated in Figs. 9-12 to 9-15.

Notice.

The following is the key of the indications used in the figures and the tables of this Chapter:

GTC:	Grand Total Cost
GTC/P	Grand Total Cost per Person
P:	Population
Pr:	Person
Pr/hr:	Persons per Hectare
GD:	Gross Density
Ft.:	Forint

TABLE 9-1:

COSTS OF BASIC PLAN 1.

Basic Plan 1. P: 3954 pr. GD: 136.8 pr/hr 5-21-1

ITEM	Unit	Quantity	Unit cost (Ft.)	Cost (Ft.)	Total cost (Ft.)	Total cost per person (Ft.)	%
Main sewerage	m	267o	53o	1415100			
Branch sewerage	m	18oo	15o	27oooo			
Rain-water receivers	pcs	74	18oo	133200			
Disposal pipes	m	13o	15o	19500			
Main water pipes	m	267o	37o	987900			
Branch water pipes	m	18oo	2oo	360000			
Main electric cables	m	267o	1oo	267000			
Branch electric cables	m	18oo	6o	108000	3560700	901	1,16
Green areas	m2	136000	5o	6800000			
Foot-paths	m2	2540o	6o	1524000	8324000	2105	2,71
Main streets	m2	1285o	3oo	3855000			
Side-walks of main streets	m2	1o68o	8o	85440o			
Residential streets	m2	2380o	28o	6664000			

TABLE 9-1. (Continued)

ITEM	Unit	Quantity	Unit cost (Ft.)	Cost (Ft.)	Total cost (Ft.)	Total cost per person (Ft.)	%
Side walks of residential streets	m2	14600	100	1460000			
Access streets and parking	m2	28900	230	6666470oo	19480400	4927	6,34
1-storey blocks	m2	15054	4752	71536608			
2-storey blocks	m2	3176	9328	29625728			
3-storey blocks	m2	7939	22000	174658000	275820336	69757	89,79
Grand Total Cost (GTC)					307185436		
Grand Total Cost per Person (GTC/P)						77690	100,00

TABLE 9-2:

THE COSTS OF THE ALTERNATIVE PLANS OF

BASIC PLAN 1.

1A P: 2514 pr. GD: 86.9 pr/hr 2-2-1

ITEM	Total cost (Ft.)	Total cost per person (Ft.)	%
Underground works	356o7oo	1416	1,74
Green areas	8819ooo	35o8	4,31
Streets and parking	172o34oo	6843	8,4o
Residential buildings	175217328	69697	85,55
Grand Total:	2o48oo428	81464	1oo,oo

1B P: 3282 pr. GD: 113,5 pr/hr 2-6-1

ITEM	Total cost (Ft.)	Total cost per person (Ft.)	%
Underground works	356o7oo	1o85	1,27
Green areas	855465o	26o7	3,o7
Streets and parking	1841941o	5617	6,62
Residential buildings	2478842o8	75528	89,o4
Grand Total:	278418968	84837	1oo,oo

TABLE 9-2. (Continued)

1C P: 4434 pr. GD: 153,4 pr/hr 6-2-1

ITEM	Total cost (Ft.)	Total cost per person (Ft.)	%
Underground works	356o7oo	8o3	o,92
Green areas	8124ooo	1 832	2,o9
Streets and parking	2o3797oo	4596	
Residential buildings	356861648	8o483	91,75
Grand Total:	388926o48	87714	1oo,oo

1D P: 453o pr. GD: 156,7 pr/hr 5-5-1

ITEM	Total cost (Ft.)	Total cost per person (Ft.)	%
Underground works	356o7oo	786	1,o2
Green areas	8o929oo	1787	2,32
Streets and parking	2o543460	4535	5,9o
Residential buildings	316o666o8	69772	9o,76
Grand Total:	348263668	7688o	1oo,oo

TABLE 9-2 (Continued)

1E P: 52o2 pr. GD: 18o pr/hr 6-6-1

ITEM	Total cost (Ft.)	Total cost per person (Ft.)	%
Underground works	356o7oo	685	o,77
Green areas	7844250	15o8	1,7o
Streets and parking	21687250	4169	4,69
Residential buildings	429528528	8257o	92,84
Grand Total:	46262o728	88932	1oo,oo

TABLE 9-3:

COSTS OF BASIC PLAN 2.

Basic Plan 2. P: 6180 pr. GD: 213.8 pr/hr. 9-5-1

ITEM	Unit	Quantity	Unit cost (Ft.)	Cost (Ft.)	Total cost (Ft.)	Total cost per person (Ft.)	%
Main sewerage	m	3570	530	1945100			
Branch sewerage	m	4600	150	690000			
Rain-water receivers	pcs	94	1800	88200			
Disposal pipes	m	239	150	35850			
Main water pipes	m	3670	370	1357900			
Branch water pipes	m	4600	200	920000			
Main electric pipes	m	3670	100	367000			
Branch electric pipes	m	4600	60	276000	5680050	919	1,13
Green areas	m2	10690	50	534500			
Foot-paths	m2	30000	60	1800000	7145000	1156	1,40
Main streets	m2	12850	300	3855000			
Side walks of main streets	m2	10680	80	854400			
Residential streets	m2	30800	280	8624000			

TABLE 9-3. (Continued)

ITEM	Unit	Quantity	Unit cost (Ft.)	Cost (Ft.)	Total cost (Ft.)	Total cost per person (Ft.)	%
Side walks of residential streets	m2	20600	100	2060000			
Access streets and parking	m2	24200	230	5566000	20959400	3392	4,15
1-storey blocks	m2	3053	4752	142811856			
5-storey blocks	m2	7939	22000	174658000			
9-storey blocks	m2	3556	45936	154161216	417631072	76316	93,32
Grand Total Cost (GTC)					505415522		
Grand Total Cost per Person (GTC/P)						81783	100,00

TABLE 9-4:

THE COSTS OF THE ALTERNATIVE PLANS OF BASIC PLAN 2.

2A P: 2514 pr. GD: 86.9 pr/hr 2-2-1

ITEM	Total cost (Ft.)	Total cost per person (Ft.)	%
Underground works	568oo5o	17oo	2,o3
Green areas	7685ooo	23o1	2,75
Streets and parking	18575+oo	75532	26,68
Residential buildings	248171616	743o3	88,62
Grand Total:	88oo12o66	83836	1oo,oo

2B P: 414o pr. GD: 143,2 pr/hr 6-2-1

ITEM	Total cost (Ft.)	Total cost per person (Ft.)	%
Underground works	568oo5o	1372	1,59
Green areas	7527ooo	1818	2,11
Streets and parking	19211+oo	464o	5,38
Residential buildings	324956894	78492	9o,92
Grand Total:	357375346	86322	1oo,oo

TABLE 9-4. (Continued)

2C P: 526o pr. GD: 182 pr/hr 2-6-1

ITEM	Total cost (Ft.)	Total cost per person (Ft.)	%
Underground works	568oo5o	1o8o	1,23
Green areas	73ooooo	1388	1,58
Streets and parking	2o246oo	3849	4,37
Residential buildings	429815963	81714	92,82
Grand Total:	463o42386	88o31	1oo,oo

2D P: 538o pr. GD: 186,1 pr/hr 5-5-1

ITEM	Total cost (Ft.)	Total cost per person (Ft.)	%
Underground works	568oo5o	1o56	1,34
Green areas	7279ooo	1353	1,72
Streets and parking	2o343ooo	3781	4,79
Residential buildings	3913o1856	72733	92,15
Grand Total:	4246o39o6	78923	1oo,oo

TABLE 9-4. (Continued)

2E P: 6o6o pr. GD: 2o9,6 pr/hr 6-6-1

ITEM	Total cost (Ft.)	Total cost per person (Ft.)	%
Underground works	568oo5o	937	1,o5
Green areas	7143ooo	1179	1,32
Streets and parking	2o9686oo	346o	3,88
Residential buildings	5o66o1216	83598	93,75
Grand Total:	54o392866	89714	1oo,oo

2F P: 658o pr. GD: 227,6 pr/hr 11-5-1

ITEM	Total cost (Ft.)	Total cost per person (Ft.)	%
Underground works	868oo5o	863	1,o6
Green areas	7o39ooo	1o7o	1,32
Streets and parking	21447ooo	3259	4,o2
Residential buildings	4993919o4	75895	93,6o
Grand Total:	533557954	81o8@	1oo,oo

TABLE 9-4. (Continued)

2G P: 7e6e pr. GD: 244,2 pr/hr 11-5-1

ITEM	Total cost (Ft.)	Total cost per person (Ft.)	%
Underground works	568ee5e	8e5	e,92
Green areas	6943eee	983	1,12
Streets and parking	2188866e	31ee	3,48
Residential buildings	58e433216	82214	94,48
Grand Total:	614944866	871e2	1ee,ee

2H P: 726e pr. GD: 251,2 pr/hr 5-11-1

ITEM	Total cost (Ft.)	Total cost per person (Ft.)	%
Underground works	568ee5e	782	e,83
Green areas	69eeeee	95e	1,e1
Streets and parking	22e864ee	89118	94,92
Grand Total:	681667618	93892	1ee,ee

TABLE 9-4. (Continued)

2I P: 726o pr. GD: 251,2 pr/hr 12-6-1

ITEM	Total cost (Ft.)	Total cost per person (Ft.)	%
Underground works	568oo5o	782	o,84
Green areas	693oooo	951	1,o2
Streets and parking	22o726oo	3o4o	3,27
Residential buildings	639498816	88o85	94,87
Grand Total:	674154466	92858	1oo,oo

RJ P: 738o pr. GD: 255,3 pr/hr 15-5-1

ITEM	Total cost (Ft.)	Total cost per person (Ft.)	%
Underground works	568oo5o	77o	o,89
Green areas	6879ooo	932	1,o7
Streets and parking	22183ooo	3oo6	3,47
Residential buildings	6o5414656	82o35	94,57
Grand Total:	64o1567o6	86743	1oo,oo

TABLE 9-4. (Continued)

2K P:894o pr. GD: 3o9,3 pr/hr 6-12-1

ITEM	Total cost (Ft.)	Total cost per person (Ft.)	%
Underground works	568oo5o	635	o,66
Green areas	7565ooo	846	o,88
Streets and parking	2362740o	2623	2,73
Residential buildings	82o985616	91833	95,73
Grand Total:	857858o66	95937	1oo,oo

2L P: 1o18o pr. GD: 352,2 pr/hr 5-15-1

ITEM	Total cost (Ft.)	Total cost per person (Ft.)	%
Underground works	568oo5o	558	o,61
Green areas	6315ooo	62o	o,68
Streets and parking	2477740o	2434	2,65
Residential buildings	897810o56	88194	96,o6
Grand Total:	9345825o6	918o6	1oo,oo

TABLE 9-5:

COSTS OF BASIC PLAN 3.

Basic Plan 3. P: 8544 pr. GD: 295.6 pr/hr 9-2

ITEM	Unit	Quantity	Unit cost (Ft.)	Cost (Ft.)	Total cost (Ft.)	Total cost per person (Ft.)	%
Main sewerage	m	383o	53o	2o299oo			
Branch sewerage	m	186o	15o	279ooo			
Rain-water receivers	pcs	98	18oo	1764oo			
Disposal pipes	m	343	15o	5145o			
Main water pipes	m	383o	37o	141710o			
Branch water pipes	m	186o	2oo	372ooo			
Main electric pipes	m	383o	1oo	383ooo			
Branch electric pipes	m	186o	6o	1116oo	482o45o	564	o,65
Green areas	m2	14oooo	5o	7oooooo			
Foot-paths	m2	17ooo	6o	1o2oooo	8o2oooo	939	1,1o
Main streets	m2	1285o	3oo	3855ooo			
Side walks of main streets	m2	1o68o	8o	8544oo			
Residential streets	m2	1932o	28o	54o96oo			

TABLE 9-5. (Continued)

ITEM	Unit	Quantity	Unit cost (Ft.)	Cost (Ft.)	Total cost (Ft.)	Total cost per person (Ft.)	%
Side walks of residential streets	m2	1656o	1oo	1656ooo			
Access streets and parking	m2	231oo	23o	5313ooo	17o88ooo	2ooo	2,3o
2-storey blocks	m2	17o69	9328	159219632			
9-storey blocks	m2	12o83	45936	555o44688	71426432o	83598	95,95
Grand Total Cost (GTC)					74419277o		
Grand Total Cost per Person (GTC/P)						871o1	1oo,oo

TABLE 9-6:

THE COSTS OF THE ALTERNATIVE PLANS OF BASIC PLAN 3.

3A P: 35o4 pr. DG: 121,2 pr/hr 2-2

ITEM	Total cost (Ft.)	Total cost per person (Ft.)	%
Underground works	482o45o	1377	1,6o
Green areas	852oooo	2434	2,83
Streets and parking	14788ooo	4225	4,87
Residential buildings	271929856	77798	9o,7o
Grand Total:	3oo1133o6	85834	1oo,oo

3B P: 5664 pr. GD: 195,9 pr/hr 5-5

ITEM	Total cost (Ft.)	Total cost per person (Ft.)	%
Underground works	482o45o	851	1,o6
Green areas	8325ooo	147o	1,83
Streets and parking	15685ooo	2769	3,46
Residential buildings	425o45632	75o43	93,65
Grand Total:	453876o82	8o133	1oo,oo

TABLE 9-6. (Continued)

3C P: 6384 pr. GD: 22o,8 pr/hr 6-2

ITEM	Total cost (Ft.)	Total cost per person (Ft.)	%
Underground works	482o45o	755	o,83
Green areas	8215ooo	1288	1,42
Streets and parking	16191ooo	2536	2,8o
Residential buildings	548388896	859oo	94,95
Grand Total:	577615346	9o479	1oo,oo

3D P: 876o pr. GD: 3o3,1 pr/hr 5-3

ITEM	Total cost (Ft.)	Total cost per person (Ft.)	%
Underground works	5173o5o	591	o,77
Green areas	798oooo	912	1,19
Streets and parking	17824ooo	2o35	2,65
Residential buildings	641344ooo	73223	95,39
Grand Total:	672321o5o	76751	1oo,oo

TABLE 9-6. (Continued)

3E P: 9576 pr. GD: 331,3 pr/hr 9-3

ITEM	Total cost (Ft.)	Total cost per person (Ft.)	%
Underground works	5173o5o	54o	o,63
Green areas	786oooo	821	o,96
Streets and parking	18376ooo	1919	2,24
Residnetial buildings	79o494474	8255o	96,17
Grand Total:	8219o3525	8583o	1oo,oo

3F P: 12864 pr. GD: 443,1 pr/hr 15-2

ITEM	Total cost (Ft.)	Total cost per person (Ft.)	%
Underground works	482o45o	375	o,38
Green areas	7885ooo	613	o,64
Streets and parking	177o9ooo	1377	1,44
Residnetial buildings	1195941o32	92968	97,54
Grand Total:	1o83o65482	95333	1oo,oo

TABLE 9-6. (Continued)

3G P: 13080 pr. GD: 452,2 pr/hr 11-5

ITEM	Total cost (Ft.)	Total cost per person (Ft.)	%
Underground works	5173050	385	0,49
Green areas	7330000	560	0,68
Streets and parking	20814000	1591	1,95
Residential buildings	1030523264	78781	96,88
Grand total:	1063840315	81317	100,00

3H P: 14832 pr. GD: 513,2 pr/hr 12-6

ITEM	Total cost (Ft.)	Total cost per person (Ft.)	%
Underground works	5173050	349	0,36
Green areas	7570000	511	0,52
Streets and parking	19710000	1329	1,35
Residential buildings	1417346140	95560	97,77
Grand Total:	1449799190	97749	100,00

TABLE 9-7:

COSTS OF BASIC PLAN 4.

Basic Plan 4. P: 1o26o pr. GD: 355 pr/hr 9-5

ITEM	Unit	Quan-tity	Unit cost (Ft.)	Cost (Ft.)	Total cost (Ft.)	Total cost per person (Ft.)	%
Main sewerage	m	343o	53o	1817900			
Branch sewerage	m	194o	15o	291ooo			
Rainwater receivers	pcs	9o	18oo	162ooo			
Disposal pipes	m	175	15o	2625o			
Main water pipes	m	343o	37o	1269loo			
Branch water pipes	m	194o	2oo	388ooo			
Main electric pipes	m	343o	1oo	343ooo			
Branch electric pipes	m	194o	6o	1164oo	4413650	43o	o,5o
Green areas	m2	3o38o	5o	6519ooo			
Foot-paths	m2	36ooo	6o	2160ooo	8679ooo	846	o,97
Main streets	m2	1285o	3oo	3855ooo			
Side walks of main streets	m2	1o68o	8o	854oo			
Residential streets	m2	1652o	28o	462560o			

TABLE 9-7. (Continued)

ITEM	Unit	Quan-tity	Unit cost (Ft.)	Cost (Ft.)	Total cost (Ft.)	Total cost per person (Ft.)	%
Side walks of residential streets	m2	14160	100	1416000			
Access streets and parking	m2	34400	230	7912000	18663000	1819	2,10
5-storey blocks	m2	4764	22000	104808000			
9-storey blocks	m2	16446	45936	755463456	860217456	83847	97,43
Grand Total Cost (GTC)					892027106		
Grand Total Cost per Person (GTC/P)						86942	100,00

TABLE 9-8:

THE COSTS OF THE ALTERNATIVE PLANS OF BASIC PLAN 4.

4A P: 2536 pr. GD: 87,7 pr/hr 2-2

ITEM	Total cost (Ft.)	Total cost per person (Ft.)	%
Underground works	4413650	1740	1,97
Green areas	7489000	2953	3,34
Streets and parking	14201000	5600	6,34
Residnetial buildings	19784680	78015	88,35
Grand Toltal:	223950530	88308	100,00

4B P: 6340 pr. GD: 219,3 pr/hr 5-5

ITEM	Total cost (Ft.)	Total cost per person (Ft.)	%
Underground works	4413650	696	0,89
Green areas	9289000	1465	1,87
Streets and parking	15857000	2501	3,20
Residential buildings	466620000	73599	94,04
Grand Total:	496179650	78261	100,00

TABLE 9-8. (Continued)

4C P: 76o8 pr. GD: 263,2 pr/hr 6-6

ITEM	Total cost (Ft.)	Total cost per person (Ft.)	%
Underground works	441365o	58o	o,62
Green areas	9o675oo	1192	1,27
Streets and parking	168759oo	2218	2,37
Residential buildings	68313168o	89791	95,74
Grand Total:	71348873o	93781	95,74

4D P: 922o pr. GD: 319 pr/hr 5-15

ITEM	TOTAL COST (Ft.)	Total cost per person (Ft.)	%
Underground works	441365o	479	o,55
Green areas	8785ooo	953	1,1o
Streets and parking	18173ooo	1971	2,27
Residential buildings	77o5632oo	83575	96,o8
Grand Total:	8o193345o	86978	1oo,oo

TABLE 9-8. (Continued)

4E	P: 9336 pr.	GD: 323 pr/hr	6-12
ITEM	Total cost (Ft.)	Total cost per person (Ft.)	%
Underground works	4413650	473	0,49
Green areas	8765000	939	0,97
Streets and parking	18267400	1957	2,03
Residential buildings	871786080	93379	96,51
Grand Total:	903232130	96748	100,00

4F	P: 1222 pr.	GD: 422,8 pr/hr	11-5
ITEM	Total cost (Ft.)	Total cost per person (Ft.)	%
Underground works	4413650	361	0,45
Green areas	8 259000	676	0,83
Streets and parking	20595000	1685	2,08
Residential buildings	952312768	77929	96,54
Grand Total:	985580418	80651	100,00

TABLE 9-8. (Continued)

4G P: 13488 pr. GD: 466,7 pr/hr 12-6

ITEM	Total cost (Ft.)	Total cost per person (Ft.)	%
Underground works	4413650	327	0,32
Green areas	8039000	596	0,59
Streets and parking	21607000	1602	1,58
Residenti l buildings	1334393280	98932	97,51
Grand Total:	1368452930	101457	100,00

4H P: 15140 pr. GD: 523,8 pr/hr 15-5

ITEM	Total cost (Ft.)	Total cost per person (Ft.)	%
Underground works	4413650	292	0,29
Green areas	7749500	512	0,50
Streets and parking	22938700	1515	1,48
Residential buildings	1515874800	100124	97,73
Grand Total:	1550976650	102443	100,00

TABLE 9-9:

THE COSTS OF ALTERNATIVE PLANS I. - XII.

I. P: 2328 pr. GD: 8o,5 pr/hr 2

ITEM	Total cost (Ft.)	Total cost per person (Ft.)	%
Underground works	5173o5o	2222	2,48
Green areas	9247450	3972	4,45
Streets and parking	13385oooo	5749	6,43
Residential buildings	18oo58384	77344	86,74
Grand Total:	2o7863884	89287	1oo,oo

II. P: 288o pr. GD: 99,6 pr/hr 3

ITEM	Total cost (Ft.)	Total cost per person (Ft.)	%
Underground works	5173o5o	1795	2,o6
Green areas	9438600	3277	3,78
Streets and parking	137622oo	4778	5,49
Residential buildings	22o6oo48o	76597	88,67
Grand Total:9	24897433o	86447	1oo,oo

TABLE 9-9. (Continued)

III. P: 3792 pr. GD: 131,2 pr/hr 4

ITEM	Total cost (Ft.)	Total cost per person (Ft.)	%
Underground works	5173o5o	1364	1,66
Green areas	931o45o	2455	2,99
Streets and parking	1439148o	3797	4,61
Residential buildings	282217392	74424	9o,74
Grand Total:	311o92372	82o4o	1oo,oo

IV. P: 468o pr. GD: 161,9 pr/hr 5

ITEM	Total cost (Ft.)	Total cost per person (Ft.)	%
Undergro nd works	5173o5o	11o6	1,39
Green areas	1o1859oo	2177	2,71
Streets and parking	15oo42oo	32o6	4,o3
Residential buildings	341484ooo	72966	91,87
Grand Total:	371857 15o	79455	1oo,oo

TABLE 9-9. (COntinued)

V. P: 582o pr. GD: 2o1,1 pr/hr 5

ITEM	Total cost (Ft.)	Total cost per person (Ft.)	%
Underground works	5173o5o	889	1,14
Green areas	889355o	1528	1,95
Streets and parking	15823ooo	2719	3,48
Residential buildings	424666ooo	72966	93,43
Grand Total:	4545556oo	781o2	1oo,oo

VI. P: 738o pr. GD: 255,3 pr/hr 5

ITEM	Total cost (Ft.)	Total cost per person (Ft.)	%
Underground works	5173o5o	7oo	o,92
Green areas	839165o	1136	1,47
Streets and parking	168672oo	2286	2,96
Residential buildings	538494ooo	72966	94,55
Grand Total:	5689259oo	77o88	1oo,oo

TABLE 9-9. (Continued)

VII. P: 87oo pr. GD: 3o1 pr/hr 5

ITEM	Total cost (Ft.)	Total cost per person (Ft.)	%
Underground works	5173o5o	594	o,78
Green areas	79o335o	9o9	1,18
Streets and parking	168672oo	2o44	2,67
Residential buildings	6348looco	72966	95,37
Grand Total:	665664oo	76513	1oo,oo

VIII. P: 1oo8o pr. GD: 348,4 pr/hr 5

ITEM	Total cost (Ft.)	Total cost per person (Ft.)	%
Underground wokrs	5173o5o	513	o,67
Green areas	7697+oo	764	1,oo
Streets and parking	1873o2oo	1858	2,44
Residential buildings	7355o4ooo	72966	95,89
Grand Total:	7671o465o	761o1	1oo,oo

TABLE 9-9. (Continued)

IX. P: 1158o pr. GD: 4oo,4 pr/hr 5

ITEM	Total cost (Ft.)	Total cost per person (Ft.)	%
Underground works	5173o5o	447	o,59
Green areas	7155250	618	o,82
Streets and parking	19765200	17o7	2,25
Residential buildings	844954ooo	72966	96,34
Grand Total:	877o475oo	75738	1oo,oo

X. P: 13o2o pr. GD: 45o,5 pr/hr 5

ITEM	Total cost (Ft.)	Total cost per person (Ft.)	%
Underground works	5173o5o	397	o,53
Green areas	6732450	517	o,68
Streets and parking	2o7588oo	1594	2,11
Residential buildings	95oo26ooo	72966	96,68
Grand Total:	98296o3oo	75474	1oo,oo

TABLE 9-9. (Continued)

XI. P: 1446o pr. GD: 5eo,3 pr/hr 5-11

ITEM	Total cost (Ft.)	Total cost per person (Ft.)	%
Underground works	5173o5o	358	o,44
Green areas	7o3545o	487	o,6o
Streets and parking	21752ooo	15o5	1,85
Residential buildings	1136oo344o	78555	97,11
Grand Total:	116996434o	8o9o5	1oo,oo

XII. P: 159oo pr. GD: 55o,2 pr/hr 5-15

ITEM	Total cost (Ft.)	Total cost per person (Ft.)	%
Underground works	5173o5o	33o	o,36
Green areas	692485o	43o	o,48
Streets and parking	22747ooo	1431	1,59
Residential buildings	1396582ooo	87829	97,57
Grand Total:	143142592o	9oo2o	1oo,oo

Results, discussion and conclusions.

The results of this investigation, and its discussion and conclusions are divided into two main parts. Part A concerns the analysis of the changes in the costs of a neighbourhood unit due to the change of the number of storeys of the residential buildings. In other words, it is to analyse the effect of developing the residential buildings at a certain number of storeys rather than another on the costs of a neighbourhood unit. This part also concerns the general trend of the change of GTC and GTC/P. Part B concerns the analysis of the effect of the change of gross density on the GTC and GTC/P. It also concerns the effect of gross density on the cost percentages of the different elements of the neighbourhood unit.

PART A.

This investigation is based on the analysation of the cost results of each basic plan and its alternative plans in isolation from the cost results of the other basic plans and their alternative plans.

Basic Plan 1. and its alternatives.

(Tables 9-1, 9-2, 9-1a.)
(Figure 9-7)

Basic plan 1. is composed of five-storey, two-storey and one-storey residential blocks representing 31.12 per cent, 11.37 per cent, and 57.51 per cent, respectively, of the total ground area of the residential buildings.

TABLE 9-1e:

COST PERCENTAGES OF THE ALTERNATIVE PLANS
RELATIVE TO THE COSTS OF THEIR BASIC PLAN

Basic Plan 1. 5-2-1 31.12% - 11.37% - 57.51%

ALTERNATIVE PLAN		GTC		GTC/P	
		+	-	+	-
1A	2-2-1		33,3	4,8	
1B	2-6-1		9,5	9,0	
1C	6-2-1	26,7		12,8	
1D	5-5-1	13,3			1,1
1E	6-6-1	5o,8		14,5	

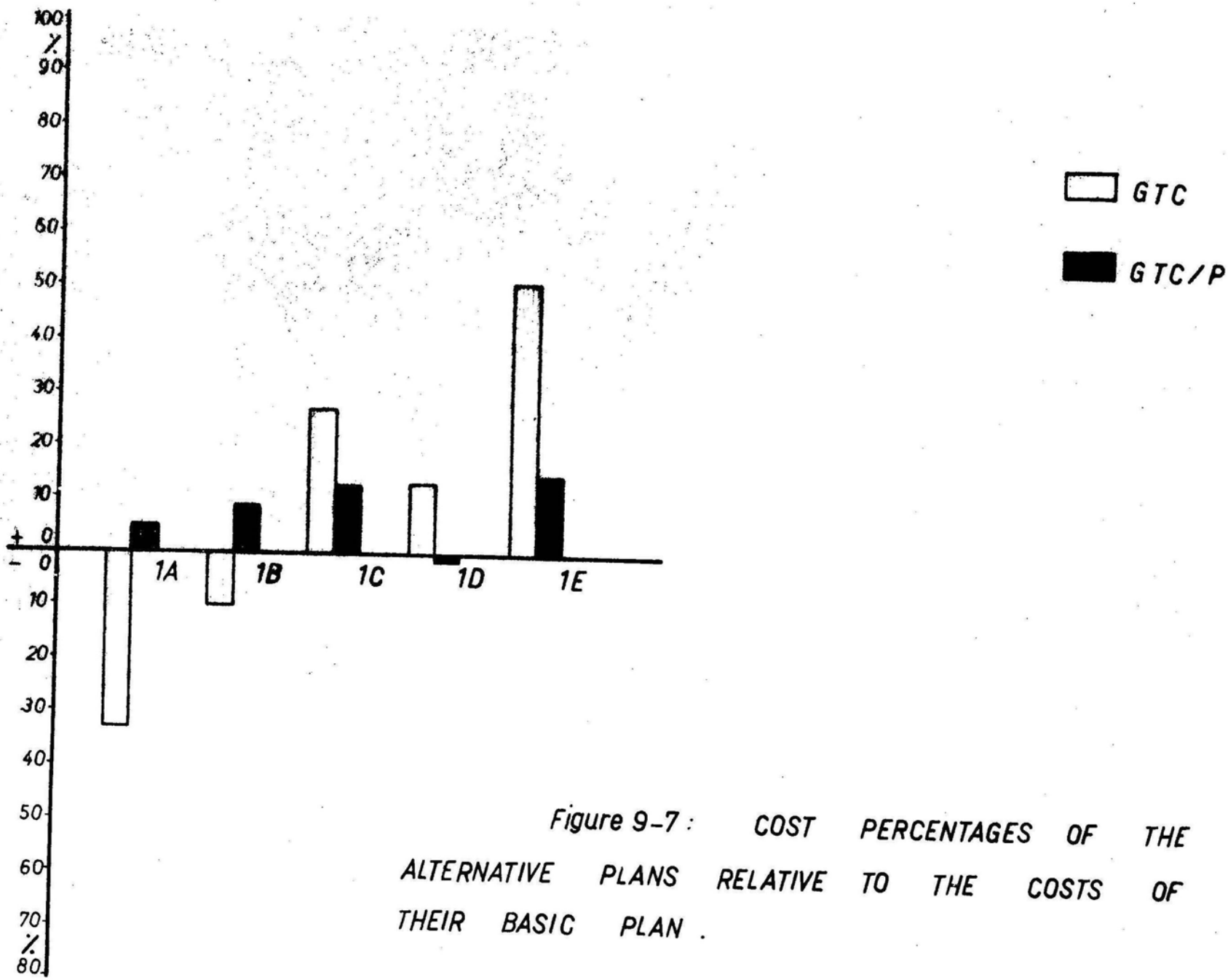


Figure 9-7 : COST PERCENTAGES OF THE ALTERNATIVE PLANS RELATIVE TO THE COSTS OF THEIR BASIC PLAN .

Replacing the five-storey blocks by two-storey blocks, 1A, reduced 33.3 per cent of the GTC and increased the GTC/P with 4.8 per cent. This means that developing at two-storeys rather than five-storeys although it shows a reduction in the GTC, i.e. the capital of money needed for erection, but it shows an increase in the GTC/P.

Replacing the five-storey blocks by six-storey blocks, 1C, increased both the GTC and GTC/P with 26.7 per cent and 12.8 per cent, respectively. Comparing the cost results of 1A and 1C it was found that in this case developing at two-storeys rather than six-storeys showed a reduction in the GTC and GTC/P amounting to 60.0 per cent and 8.0 per cent, respectively. This means that neighbourhoods which are satisfying the demographic and social factors, can be built at lower costs rather than neighbourhoods which are not satisfying those factors.

Basic Plan 2. and its alternatives.
(Tables 9-3, 9-4, 9-11)
(Figure 9-8)

Basic plan 2. is composed of nine-storey, five-storey, and one-storey residential blocks, representing 8.14 per cent, 19.19 per cent, and 72.67 per cent, respectively, of the total ground area of the residential buildings.

Replacing the nine-storey and five-storey blocks by two-storey blocks, 2A, reduced 44.6 per cent of the GTC and increased the GTC/P with 2.4 per cent. This means that a reduction in the GTC does not necessitate a reduction in the GTC/P, but it may add to it.

TABLE 9-11:

COST PERCENTAGES OF THE ALTERNATIVE PLANS RELAVITE TO THE COSTS OF THEIR BASIC PLAN

Basic Plan 2. 9-5-1 8.14% - 19.19% - 72.67%

ALTERNATIVE PLAN		GTC		GTC/P	
		+	-	+	-
2A	2-2-1		44.6	2.4	
2B	6-2-1		29.4	6.7	
2C	2-6-1		8.4	7.5	
2D	5-5-1		15.9		2.9
2E	6-6-1	6.9		9.0	
2F	11-5-1	5.7			0.9
2G	11-6-1	21.6		6.4	
2H	5-11-1	35.0		14.6	
2I	12-6-1	33.4		12.3	
2J	15-5-1	26.7		5.9	
2K	6-12-1	69.9		17.3	
2L	5-15-1	85.0		12.2	

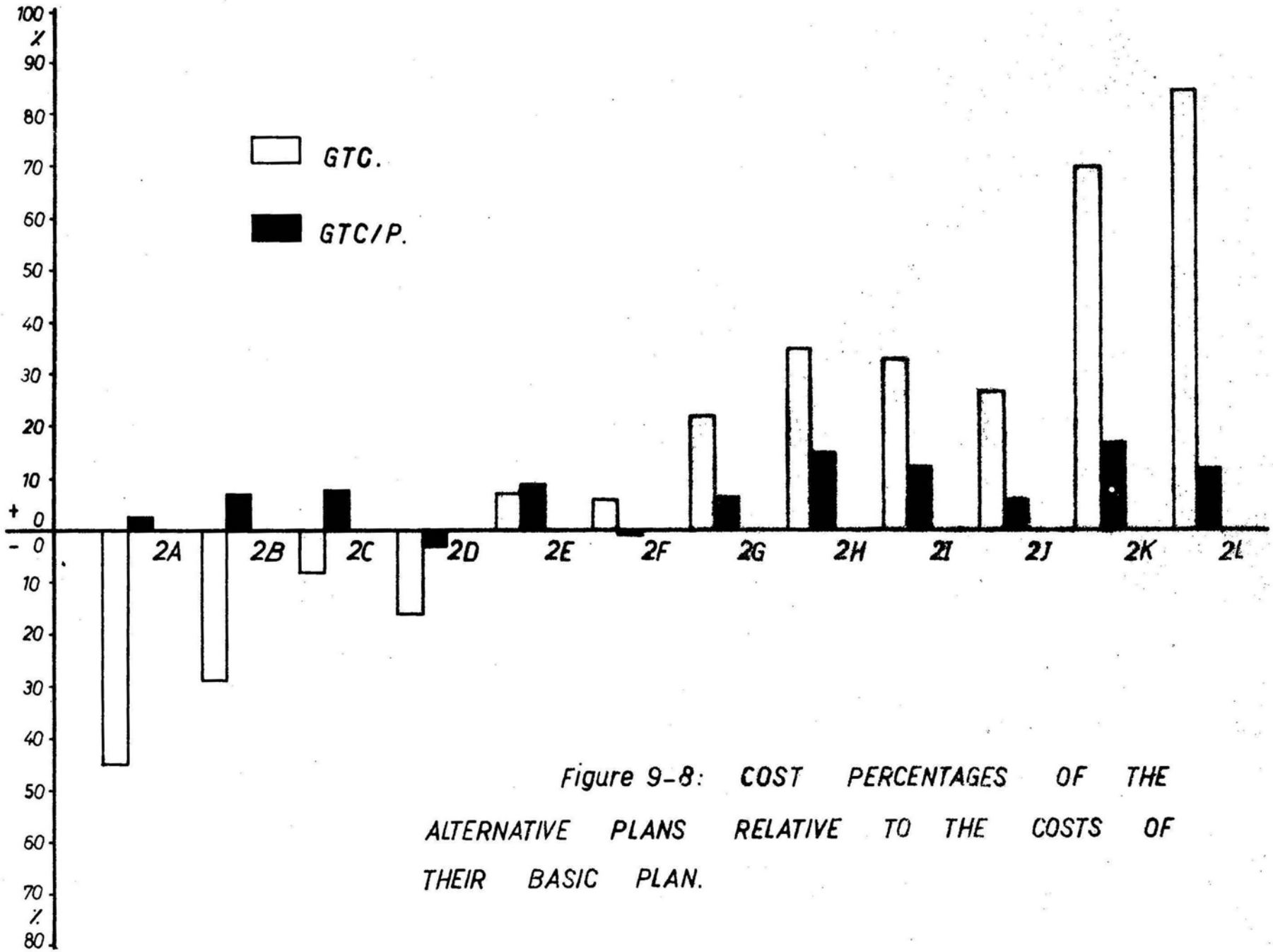


Figure 9-8: COST PERCENTAGES OF THE ALTERNATIVE PLANS RELATIVE TO THE COSTS OF THEIR BASIC PLAN.

Replacing the nine-storey blocks by five-storey blocks, 2D, reduced both of the GTC and GTC/P reppectively with 15.9 per cent and 2.9 per cent. Introducing six-storey blocks to replace both of the nine-stores and five-storey blocks, 2E, increased both of the GTC and GTC/P respectively with 6.9 per cent and 9.0 per cent. Comparing the results of 2D with those of 2E, it was found that developing at six-storeys rather than five-storeys increased both of the GTC and GTC/P with 22.8 per cent and 11.9 per cent. This means that, building neighbourhoods composed of low-rise blocks rathern than building neighbourhoods composed of walk-up blocks will result in an increase in both of the GTC and GTC/P. In other words, introducing lifts will result in an increase of both the GTC and GTC/P.

Although it is obvious that to build a five-storey block is cheaper than to build a six-storey block, and to build an eleven-storey block is cheaper than to build a twelve-storey block, sometimes a mixture between five-storey blocks and eleven-storey blocks will result in a more expensive GTC and GTC/P, than a mixture between six-storey blocks and twelve-storey blocks. The alternative plan 2H was composed by replacing the nine-storey blocsk and the five-storey blocks, respectively, by five-storey blocks and eleven-storey blocks. This resulted in an increase in both of the GTC and GTC/P of 35.0 per cent and 14.6 per cent, respectively. The alternative plan 2I was composed byreplacing the nine-storey blocks and the five-storey blocks, respectively, by twelve-storey blocks and six-storey blocks. This resulted in an increase in both of the GTC and GTC/P amounting to 33.4 per cent and

12.3 per cent, respectively. Comparing the results of the alternative plan 2H with those of 2I, it was found that 2H is more expensive by 1.6 per cent and 2.3 per cent in the GTC and GTC/P, respectively. That happened as a result of the percentage of the mixture between the five-storey and the eleven-storey blocks, on one hand, and the twelve-storey and six-storey blocks, on the other hand. This means that, it is not enough for the sake of economy that the residential blocks are cheap in themselves, but also the percentage of their mixture is of prime importance.

Basic Plan 3. and its alternatives.
(Tables 9-5, 9-6, 9-12.)
(Figure 9-9)

Basic Plan 3. is composed of nine-storey and two-storey residential blocks, representing 41.45 per cent and 58.55 per cent, respectively, of the total ground area of the residential blocks.

Replacing the nine-storey blocks by two-storey blocks, 3A, reduced both of the GTC and GTC/P, respectively, with 59.7 per cent and 1.5 per cent. This means that a reduction in the GTC does not necessitate a rational reduction in the GTC/P.

Replacing the nine-storey blocks by twelve-storey blocks and the two-storey blocks by six-storey blocks, 3H, increased both of the GTC and GTC/P, respectively, with 94.8 per cent and 12.2 per cent. This means that an increase in the GTC does not necessitate a rational increase in the GTC/P.

TABLE 9-12:

COST PERCENTAGES OF THE ALTERNATIVE PLANS RELATIVE TO THE COSTS OF THEIR BASIC PLAN

Basic Plan 3. 9-2 41.45% - 58.55%

ALTERNATIVE PLAN		GTC +	GTC -	GTC/P +	GTC/P -
3A	2-2		59.7		1.5
3B	5-2		4o1e		8.1
3C	6-2		22.4	3.9	
3D	5-5		9.7		11.9
3E	9-3	1e.4			1.5
3F	15-2	32.1		9.4	
3G	11-5	43.e			6.7
3H	12-6	94.8		12.2	

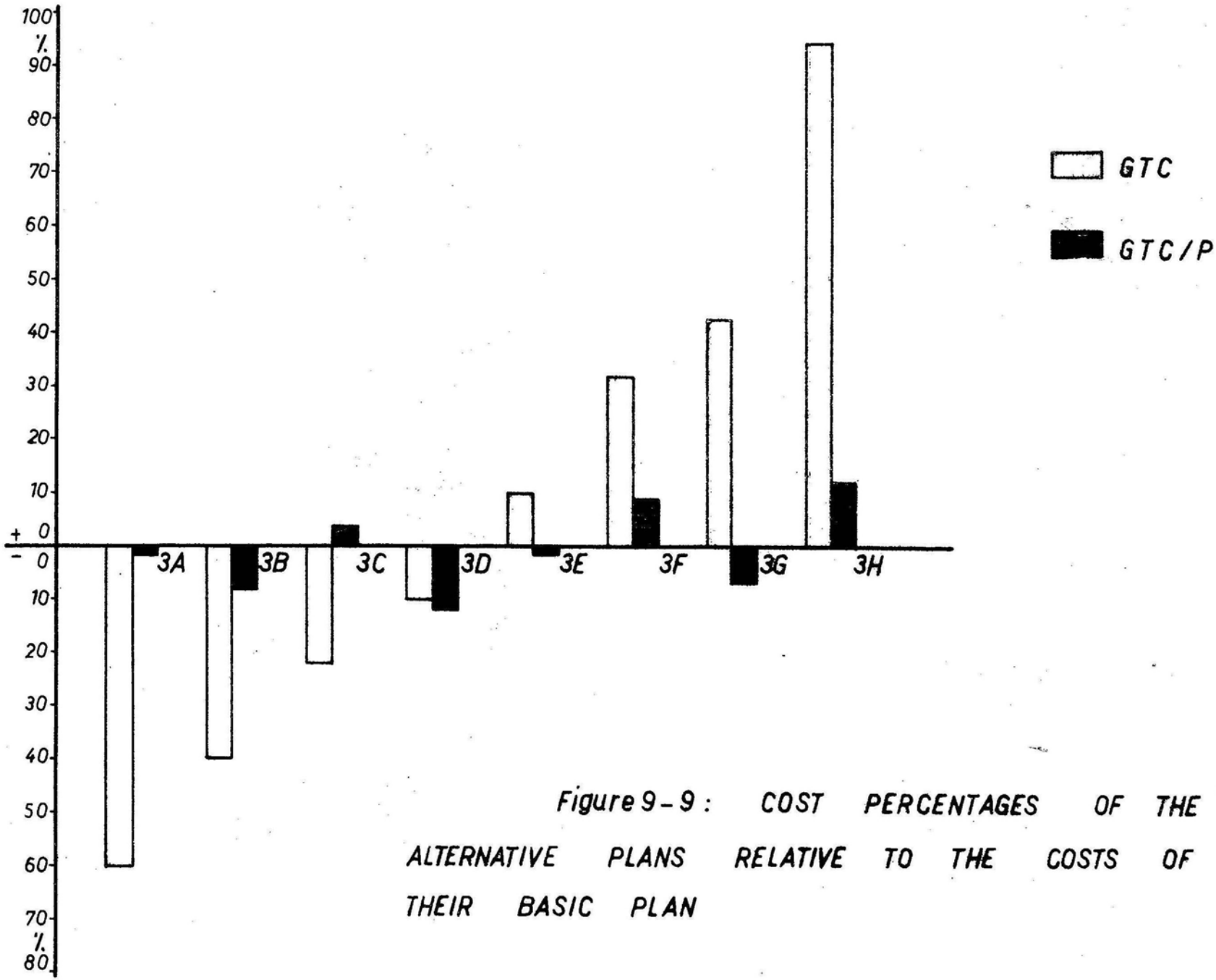


Figure 9-9: COST PERCENTAGES OF THE ALTERNATIVE PLANS RELATIVE TO THE COSTS OF THEIR BASIC PLAN

Basic Plan 4. and its alternative plans.
(Tables 9-7, 9-8, 9-13)
(Figure 9-1o)

Basic Plan 4. is composed of nine-storey and five-storey residential blocks, representing 77.54 per cent and 22.46 per cent, respectively, of the total ground area of the residential blocks.

Replacing the nine-storey blocks by eleven-storey blocks, 4F, increased 1o.5 per cent of the GTC, and decreased 7.2 per cent of the GTC/P. This means that an increase in the GTC does not necessitate an increase in the GTC/P, but it may reduce it. Also, this means that if lifts were introduced, then the advantage of their existence must be fulfilled by increasing the number of storeys of the building till a maximum allowance of the number of storeys which a lift can serve.

Alternative Plans I. - XII.
(Tables 9-9, 9-14.)
(Figure 9-11)

The alternative plans I. - XII. are composed of walk-up blocks to achieve a range of gross density of 8o to 45o persons per hectare, and above that density low-rise and high-rise blocks are introduced with the walk-up ones.

In Table 9-14, the costs of the alternative plan X. were considered as the 1oo per cent.

TABLE 9-13:

COST PERCENTAGES OF THE ALTERNATIVE PLANS
RELATIVE TO THE COSTS OF THEIR BASIC PLAN

Basic Plan 4. 9-5 77.54% - 22.46%

ALTERNATIVE PLAN		GTC		GTC/P	
		+	-	+	-
4A	2-2		74.9	1.5	
4B	5-5		44.4		9.9
4C	6-6		2o.o	7.9	
4D	5-15		1o.2	o.1	
4E	6-12	1.1		1o.2	
4F	11-5	1o.5			7.2
4G	12-6	53.3		28.3	
4H	15-5	75.o		17.8	

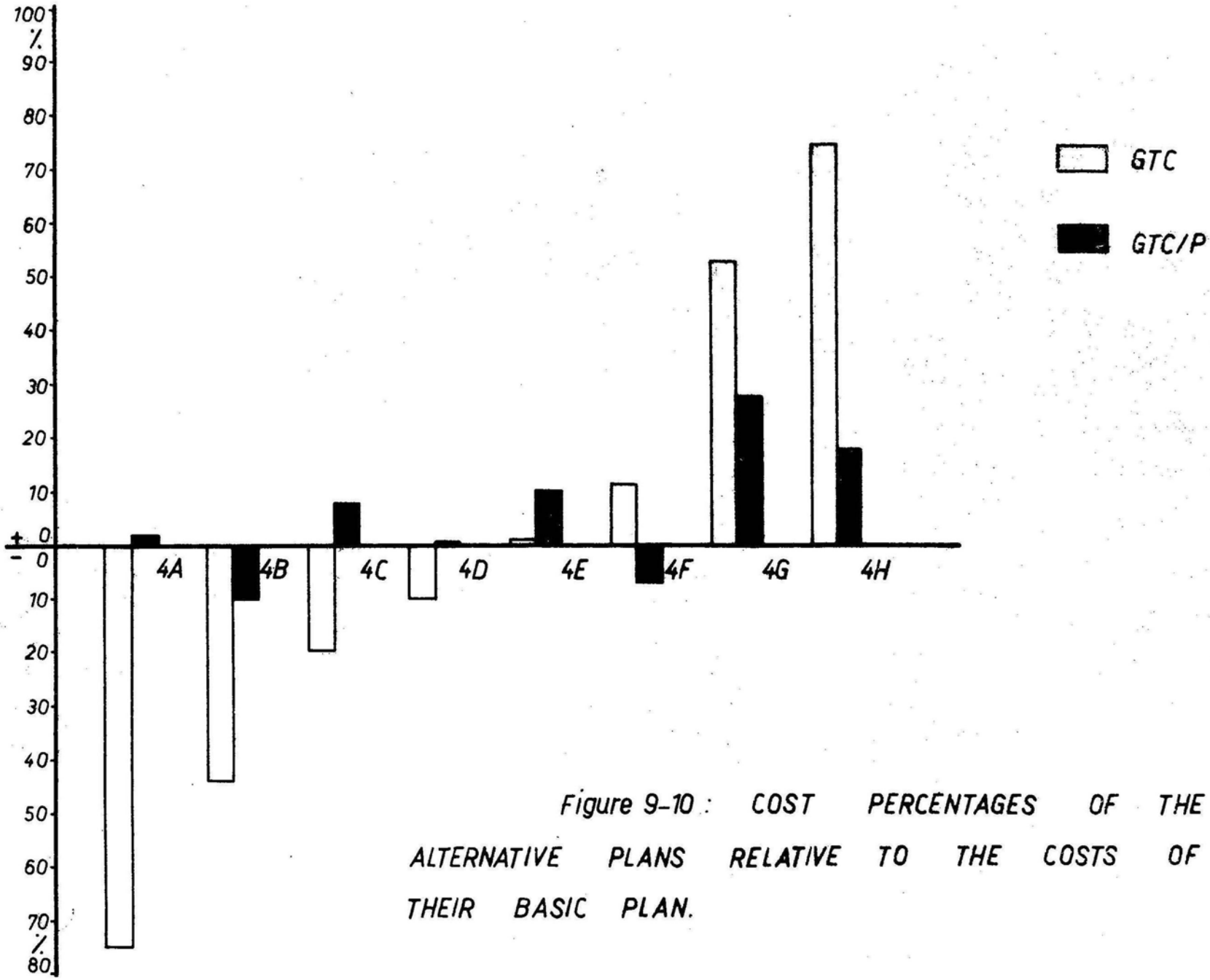


Figure 9-10 : COST PERCENTAGES OF THE ALTERNATIVE PLANS RELATIVE TO THE COSTS OF THEIR BASIC PLAN.

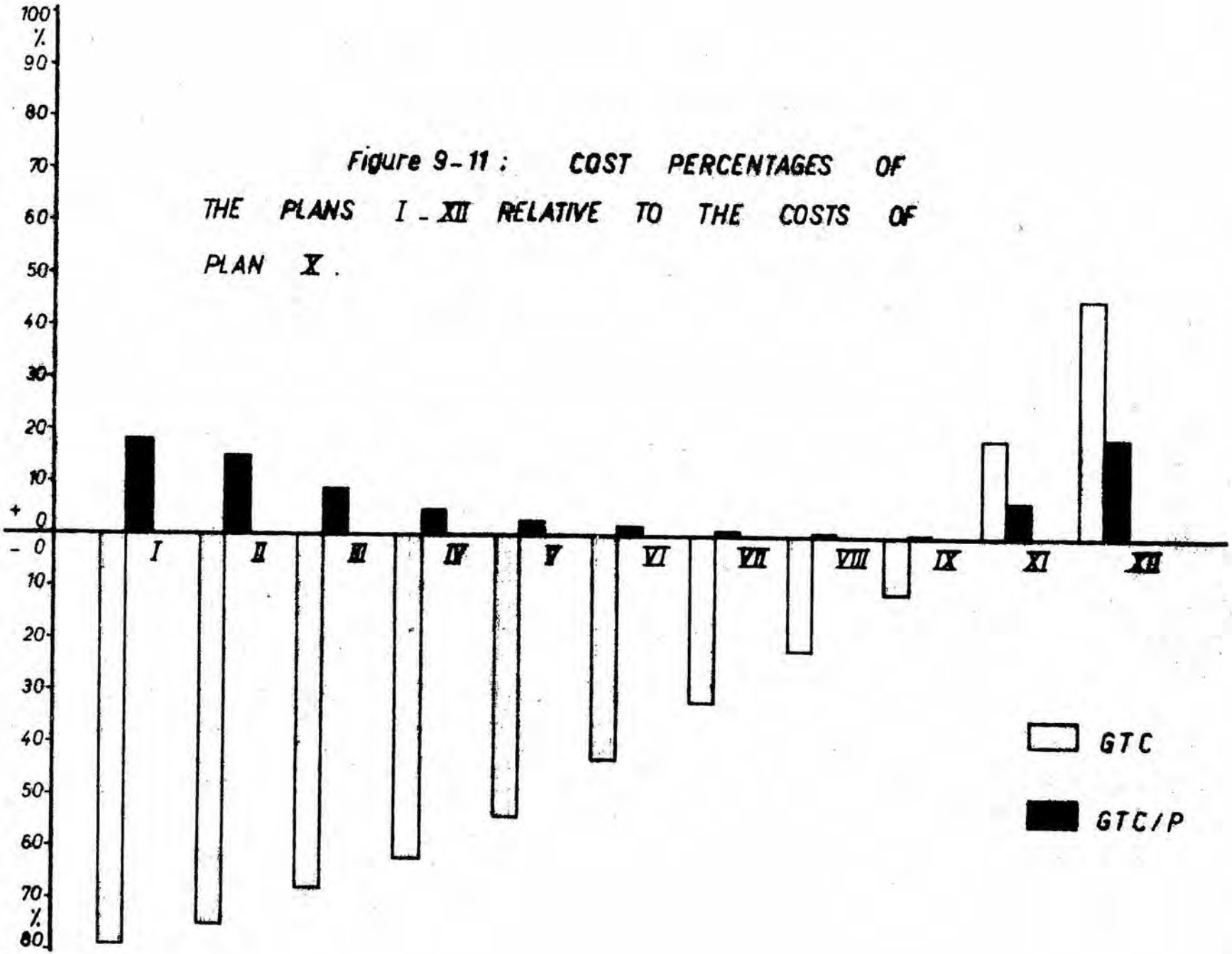
TABLE 9-14:

COST PERCENTAGES OF THE ALTERNATIVE PLANS I. - XII.
RELATIVE TO THE COSTS OF ALTERNATIVE PLAN X.

Alternative Plan X. 5.

ALTERNATIVE PLAN		GTC +	GTC -	GTC/P +	GTC/P -
I.	2		78.9	18.2	
II.	3		74.7	14.5	
III.	4		68.4	8.6	
IV.	5		62.2	5.2	
V.	5		53.7	3.4	
VI.	5		43.1	2.1	
VII.	5		32.3	1.3	
VIII.	5		22.0	0.8	
IX.	5		10.8	0.3	
XI.	5-11	19.0		7.1	
XII.	5-15	45.5		19.2	

Figure 9-11 : COST PERCENTAGES OF THE PLANS I - XII RELATIVE TO THE COSTS OF PLAN X .



Alternative plans I. - X. are composed of walk-up blocks to achieve a range of gross densities of 8o to 45o persons per hectare. This means that a wide range of gross densities can be achieved by walk-up blocks without the need to use low or high-rise blocks.

Alternative plans IV. - X. are composed of five-storey blocks to a chieve a range of gross densities of 161 to 45o persons per hectare. This means that a wide range of gross densities can be achieved by the same block with the same number of storeys.

Alternatives I., II., and III. which are composed of 2, 3, and 4 storey blocks, respectively, show higher GTC/P than wh t is shown in alternatives XI. and XII. which are composed of walk-up blocks and lor or highr-rise blocks. This means that residential estates built of walk-up blocks rather than low or high-rise blocks do not always result in lower GTC/P.

The GTC/P of the alternatives IV. to X., which are composed of five-storey blocks, are always lesser than those of all of the other alternatives. This means that residential estates developed at five-storey blocks always give the lowest GTC/P.

PART B.

For the sake of this investigation, all the cost results of the basic and alternative plans are indicated in Fig. 9-12 to Fig. 9-15.

Fig. 9-12 shows the effect of the gross density of the population on the GTC. The continuous red line represents the GTC of the alternative plans I. - XII. The con-

Figure 9-12: THE EFFECT OF THE GROSS DENSITY OF THE POPULATION ON THE GRAND TOTAL COST OF THE DIFFERENT BASIC AND ALTERNATIVE PLANS.

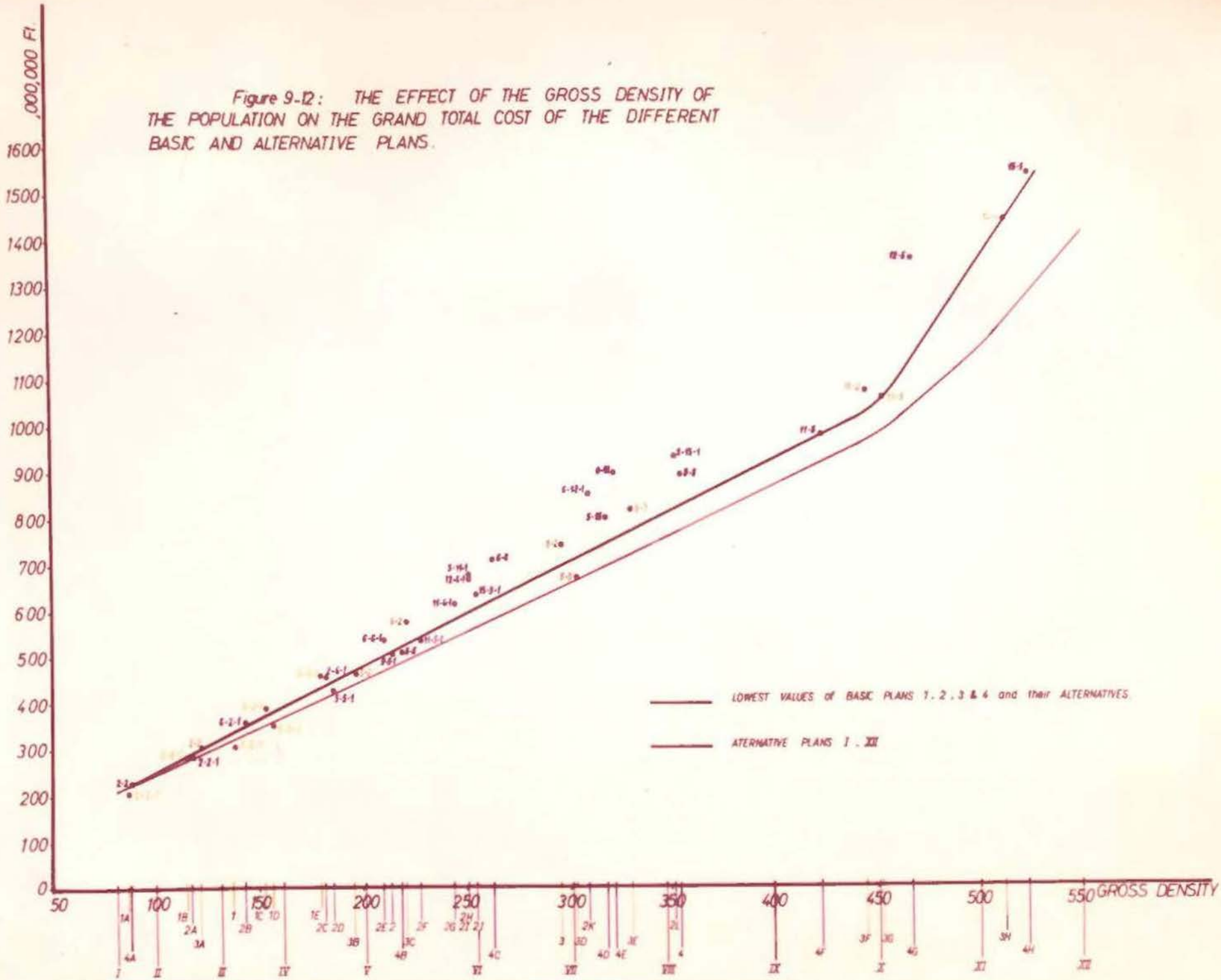
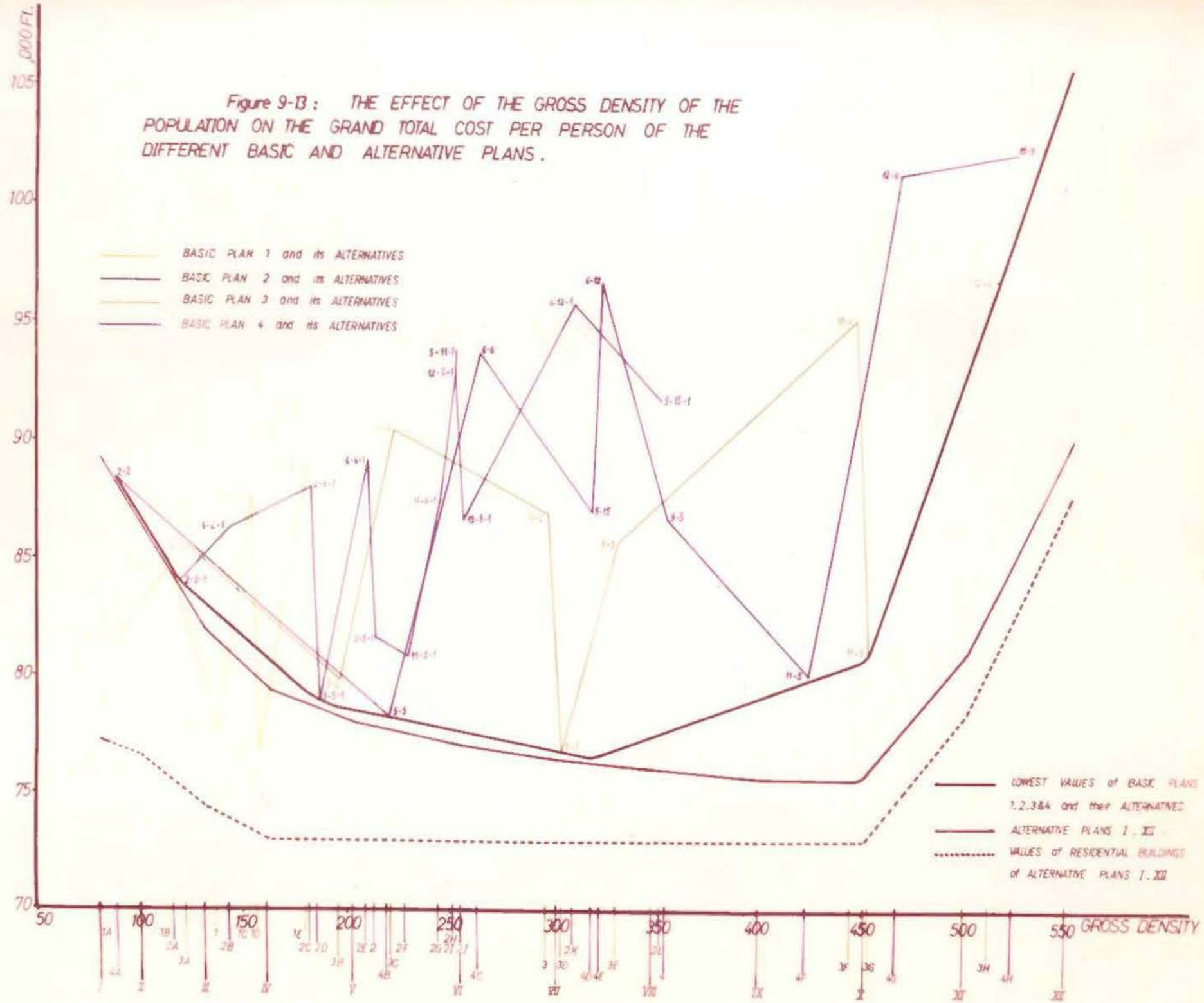


Figure 9-13 : THE EFFECT OF THE GROSS DENSITY OF THE POPULATION ON THE GRAND TOTAL COST PER PERSON OF THE DIFFERENT BASIC AND ALTERNATIVE PLANS.



tinuous black line represents the lowest values of GTC of basic plans 1, 2, 3, and 4, and their alternative plans.

Fig. 9-13 shows the effect of gross density of the population on the GTC/P of the different basic and alternative plans. The continuous red line represents the GTC/P of the alternative plans I. - XII. The continuous black line represents the lowest values of basic plans 1, 2, 3, and 4, and their alternatives. The difference between the continuous red and black lines represents the difference between the rigid theoretical plans and the more free and aesthetic like plans. The dotted red line represents the total cost per person of residential buildings of the alternative plans I. - XII. The difference between the cntinuous and the dotted red lines shows the cost per person of the public utilities at the different gross densities.

Fig. 9-14 shows the effect of the gross density of the population on the cost percentages of the residential buildings and the public utilities of the different basic and alternative plans. The red lines represent the percentages of the costs of the alternative plans I. - XII., and the black lines represent the lowest percentages of the costs of basic plans 1, 2, 3, and 4, and their alternatives. Tracing the lines which represent the percentages of the costs of the residential buildings, the black line is below the red one when the costs of the residential buildings of the alternative plans I. - XII. are lesser than the lowest costs of all of the other basic and alternative plans and the difference between them is very small. They tend to be equal, i.e. the two lines intersect, when the costs of the residential buildings of the alternative plans I. - XII. are smaller than the lowest values of all the other basic

and alternative plans, and the difference between them became bigger. The black line is above the red line when the costs of the residential buildings of the alternative plans I. - XII. are smaller than the lowest values of all the other basic and alternative plans and the difference between them is significant. The lines representing the cost percentages of the public utilities are inversely affected by the behaviour of the lines representing the residential buildings.

Fig. 9-15 shows the effect of the gross density of the population on the cost percentages of the public utilities of the different basic and alternative plans. The red lines representing the cost percentages of the public utilities of the alternative plans I. - XII. show always higher percentages than the lines representing the lowest values of the public utilities of the basic plans 1, 2, 3, and 4, and their alternatives, because in the first the costs of the public utilities represent a relatively bigger sector of the GTC due to the relatively low costs of the residential buildings, while in the second the costs of the public utilities represent a relatively smaller sector of the GTC due to the relatively high costs of the residential buildings.

From the alternative plans I. - XII. the following could be concluded:

1) As long as no lifts or extra staircases are introduced, the rate of increase of the GTC is nearly constant. A sudden increase in the GTC occurs as lifts or extra staircases, or both of them are introduced.

2) The GTC/P decreases as gross density increases, then tends to increase sharply as lifts or extra staircases or both of them are introduced.

3) Within a reasonable range of gross densities, using blocks of five-storeys always gives the lowest GTC/P. Within that range of gross densities the costs of the residential buildings per person remain constant and the differences in the GTC/P within that range is dependent on the differences in the costs per person of the public utilities.

4) As gross density increases the percentages of the costs of the residential buildings to the total costs increase and the percentages of the public utilities costs decrease with the same ratio.

From all the basic and alternative plans the following could be concluded:

1) The GTC increases as the gross density increases.

2) The GTC is far long dependent on the costs of the residential buildings, any change in the costs of the residential buildings will positively affect the GTC.

3) High densities are achieved not only by high-rise blocks butalso by low-rise and walk-up blocks.

4) Introducing five-storey blocks always give the lowest GTC/P.

5) GTC/P of alternatives composed of low walk-up blocks, 1, 2, 3, and 4 storeys, are as expensive as those

of alternatives composed of high-rise or low-rise blocks. The high GTC/P resulting from low walk-up blocks is due to the relatively high costs per person of both the residential buildings and the public utilities. The high GTC/P resulting from high or low-rise blocks is only related to the high cost per person of the residential buildings. The cost per person of the public utilities is very small. This means that obtaining economy in building of neighbourhoods is of prime importance by obtaining economy in the cost of the residential buildings in the case of high rose densities, and by obtaining economy in both the costs of the residential buildings and the public utilities in the case of low densities. Of course it is obvious that any reduction in costs is appreciated.

6) The cost of the residential buildings represent the biggest percentage of the GTC and GTC/P, followed by the costs of the streets, then gardening and then all the underground works. Their percentages to the GTC and GTC/P vary from 84 to 98, 8.5 to 1.3, 4.4 to 0.4, and 2.5 to 0.2, respectively.

7) The costs of the public utilities represent from 2 per cent to 15 per cent of the GTC and GTC/P.

8) It is obvious that if there is lack of funds needed for erection, it is not always possible to build with the most economic costs because it may be possible that the design which gives the most economic costs needs more capital of money than what is available.

9) The GTC/P must be the final in determining the most economic designs for residential estates.

LIST OF REFERENCES.

Abel, Joseph and Severud, fred; Apartment Houses, Reinhold Publishing Corporation, 1947.

Abrahams, Charles; Housing in the Modern World, Faber and Faber, 1964.

Beyer, Gelan and Nierstrasz, F.; Housing the Aged in Western Countries, Elsevier Publishing Company, 1967.

Central Agency for Public Mobilisation and Statistics, Cairo, Reference Number 65/2000, 66/1107, and 350/54; statistical indices 1952-1963; selection of statistics 1951/1952 - 1964/1965; Existing Buildings 1960; and Basic Statistics 1964.

Cole, Harvey; The Economist in Planning, T.C.P. October, 1963.

Cook, J.; Gardens in Housing Estates, TPR, Vol. 39, No. 3.

Cost Research Panel; Factors affecting the relative costs of multi-storey housing, J. Roy. Inst. Surveyors, March 1958.

Dick, J.; Urban Planning Research at the Building Research Station, J.T.P.L. Vol. 52, No. 4, 1966.

Egyptian Ministry of Housing, Data on Housing Programmes and Existing Conditions of the Rural and Urban Housing, personal contacts, 1966.

Fisher, Ernest; Has the Building Boom Reached a Peak? Arch. Forum, September, 1962.

Fry, Maxwell, and Drew, Jane; Tropical Architecture, Batsford, 1964.

Gallion, Arthur, and Eisner, Simon; The Urban Pattern, D. Van Norstrand, 1963.

Gibberd, Frederick; Town Design, The Architectural Press, 1962.

Graig, N.; Factors Affecting Economy in Multi-Storey Flat Design; Journal R.I.B.A., April, 1956.

Gropius, Walter; Scope of Total Architecture, Collier Books, 1962.

Havas, Jàdit, and Kocsis, Ferenc; Korszerü Épitésszervezés, Müszaki Könyvkiadò, 1965.

Ibrahim, Abd-el-Baki; Analytical Studies of Planning of Egyptian Towns, Eight Conference of the Arab Engineers, Alexandria, 1962.

International Council forBuilding Research Studies and Documentation - CIB, 3rd Congress, Copenhagen, August, 1965.

Keeble, Lewis; Principles and Practice of Town and Country Planning, Estates Gazette, 1964.

ibid; Cost of Residential Estate Development in Relation to Density, Chartered Surveyor, May, 1956.

Lean, W., and Goodall, B.; Aspects of Land Economics, Estates Gazette, 1966.

Lean, W.; Economics of Regional Planning Strategy; J.T.P.I., Vol. 53, No. 1.

ibid; Town Planning and Economics, J.T.P.I., Vol. 52, No. 2.

ibid; Economics of New Town Size and Form, J.T.P.I., Vol. 52, No. 7.

Lichfield, Nathaniel; Economics of Planned Development; Estates Gazette, 1956.

ibid; Economics in Town Planning, T.P.R., Vol. 39, No. 1.

Martin, Al; Environment, Housing and Health, Urban Studies, Vol. 4, No. 1.

Meyerson, Martin, and Banfield, Edward; Boston; The Job Ahead, Harward University Press, 1966.

Mokk, László; Prefabricated Concrete for Industrial and Public Structures, Publishing House of the Hungarian Academy of Sciences.

Mumford, Lewis; Art and Technics,
Columbia University Press, 1964.

Nawrath, Alfred, edited; Egypt, the Land between Sand and Nile, Kümmerly, & Frey, 1962.

Nevitt, Adam, edited; The Economic Problems of Housing, Proceedings of a Conference held by the International Economic Association, Macmillan, 1967.

New Towns Come of Age, a special issue of T.C.P., January - February, 1968.

Proceedings of the seminar on changes in the structure of the building industry necessary to improve its efficiency and to increase its output, 3 volumes, Prague, CSR, UN Publications, 1965.

Reynolds, D.; Economics and its Application to Planning and the Environment, T.C.P., March, 1966.

Ritter, Paul; Planning for Man and Motor,
Pergamon Press, 1964.

Rogers, Kate; The Modern House
USA, Harper & Row, 1962.

Roth, G.; Town Planners and Road Pricing,
T.C.P., August - September, 1964.

Sebestyén, Gyula; Az épités hatékonysága,
Lakásépitése, Müszaki Könyvkiadó, 1964.

Senior, Derek, edited; The Regional City,
Anglo-American discussion of metropolitan planning, Aldine, 1966.

Stone, P.A.; Building Economy
Pergamon Press, 1966.

ibid; Housing, Town Development, Land and Costs,
Estates Gazette, 1962.

ibid; The Economics of Building Designs, J. Roy. Stat. Soc. Ser. A., 123(3), 1960.

Weichinger, Károly, and Hámor, István; Az elhelyezésmód kihatása lakóházak épitési költségeire, Budapesti Müszaki Egyetem, 1962.