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URBAN HOUSING FOR NEW DELHI, INDIA

A thesis submitted in partial fulfillment of the requirements for the degree of Master in Architecture at the Massachusetts Institute of Technology

June 19, 1967

Author

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Cambridge, Massachusetts

June 19, 1967

Lawrence B. Anderson, Dean
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Dear Dean Anderson:

In partial fulfillment of the requirements for the degree of Master in Architecture, I hereby submit this thesis entitled " Urban Housing for New Delhi, India".

Very truly yours,

Satish C. Dhingra

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THE ABSTRACT

The problem of housing India's millions is indeed enormous. Not only is there a great backlog because of the existing acute shortage but the ever increasing demands due to phenomenal population growth is adding to the plight, and the gap between the supply and the demand is ever increasing.

Although Housing is more an economic problem than a technical one, nevertheless, it becomes very important that whatever resources are available, they should be used in the most economical and efficient way. Prevelant techniques of building are very primitive. Revolutionary methods will have to be adopted. Prefabrication on a widespread scale seems the best answer.

In India, just as in most of the developing countries, the government owns and provides housing for all its employes. This is quite a large program. Therefore, the government being the only agency having so much participation in the housing industry, must provide leadership by developing more efficient techniques of construction. Its own housing program could serve as testing ground. This study deals with the design of a government-employe community using improved methods of construction and planning.

DEVELOPMENT OF THE PROGRAM

A BRIEF REVIEW OF THE PROBLEM OF HOUSING IN INDIA:

Apparently, there is no need to spend a great deal of time in merely establishing the various reasons for the necessity of decent housing for every human being. Next to food, shelter is considered the basic human need.

As is the case in a majority of the developing nations, there is an acute shortage of housing in India. In fact the shortage is enormous. This situation is aggravated by the population explosion which quickly neutralizes the gains that might by themselves appear quite significant. And the gap between the total need and the total productivity, is ever increasing. Therefore, this merely reinforces the point that unless some radical and even revolutionary approach is taken to grapple with the problem on a national scale, we would soon reach "a point of no return". Perhaps we are already there.

There are many reasons for this gloomy picture. The foremost is of course the spiralling population that is growing at the rate of 12 million and more per year. Others include urban migration, antiquated land policies, lack of public services such as water, sewers, electricity and fuel, and most of all a total absence of any means or system of financing construction. Building products of often the most primitive kind are scarce, and in many cases the building trades, where they exist, are extremely backward.

Thus, the housing problem emerges more as an economic, social and political problem than a technical one.

For obvious reasons, this study attempts to investigate only the technical aspects (physical planning and construction of housing), as the others are best left to the experts in the respective fields.

The housing problem in India has grown steadily over the past few decades. In urban as well as in rural areas there is an acute quantitative shortage of housing, and much of the available accommodation is qualitatively substandard. Overcrowding and slums have become a common feature of the industrial areas and large towns in the country.

The following are some statistics to illustrate the gravity of the problem of housing:

According to the Census Reports, the urban population in India increased by 27.5 million between 1951 and 1961. During the same decade the number of occupied houses in urban areas increased by 2.2 million. Thus, even apart from the question of the quality of housing, the quantitative shortage in housing increased considerably during the decade 1951 to 1961, and will increase still more between 1961 and 1971. During this decade the urban population is expected to increase by 35 p.c.

In the rural areas of India, the problem of housing is diverse in character and enormous in magnitude. According to the 1961 Census, the rural population was 360 million or nearly 82 p.c. of the total population of 440 million. The average number of persons per house was 5.5 and the average number of households per house was 1.2 . It has been estimated that about 50 million of the houses in rural areas would require to be reconditioned or entirely rebuilt. The village houses are cramped, the roof is flimsy, the flooring is sometimes damp, the walls are dilapidated and light and air are not adequate.

The following will explain briefly the economic aspects of the housing problem:

Till the introduction of the First Five Year Plan in 1951, housing in India was an undertaking almost entirely executed and financed by private enterprise, the Federal and the State Governments assuming responsibility primarily for the housing of their own employees. This policy was adequate for an economy which was predominantly agricultural and in which the population in the old towns was more or less static. With the advent of the industrial era at the beginning of this century, the towns started expanding with the influx of population from the villages. The investors and industrialists constructed some sort of accommodation of low rent, because the cost of materials and labour was not high and the standard of environmental hygiene was poor. All these factors made it possible for the investor to get an economic rent for his investment in housing. This picture, however, changed during and after the Second World War. The cost of land and prices of materials and labor changed, causing an increase of about 250 percent, while the rent-paying capacity still remained low. Thus, the economic rent became high due to high capital cost.

When it became unprofitable for the private enterprise to invest in housing for the low-income groups, there was no agency, apart from

the Government, which could take its place. The results of the National Income Unit Sample Survey investigations also show that the income of more than 50 percent of the households does not exceed Rs. 125 per month and that the income of only 10 percent of the urban households is more than Rs. 350 per month. When it is realized that the economic rent (which yields a net return of 6 percent on the capital cost) of one-room tenement and two-room tenement is about Rs. 25 and 35 per month respectively, the gravity of the problem becomes obvious.

These facts point to the necessity of subsidizing the construction of houses for the lower income groups in some form or the other.

Now to look at the Government's housing policy and plans to tackle this problem:

It was recognized in the First Five Year Plan that in the field of housing, the State could not afford to confine its role to planning and regulation alone. Since private enterprise was no longer in a position to provide adequate housing for the low income groups, the State therefore must fill the gap and assist in the construction of suitable houses for the low and middle income groups, and this

would involve a large measure of assistance in the form of subsidies on a generous scale and loans at a low rate of interest.

With medium projections for planning purposes, the study of the growth of population indicates that the population in India in the year 1981 would be 695 million.

Considering this colossal need for housing, an investment of about Rs. 15,670 millions was envisaged in the Third Five Year Plan;

1.	Private Sector Housing	Rs. 11,250 millions
2.	Public Sector Housing	Rs. 2,600 millions
3.	Social Housing	Rs. 1,800millions
	Total	Rs. 15,670 millions

This amounted to 15 percent of the total investment for the above plan period 1961-66.

The Fourth Five Year Plan (1966-67) calls for a construction of 28.5 million houses. Keeping in view the housing needs as well as the limitations of physical and financial resources, the Government has an investment target of Rs. 28,900 millions for housing in the Fourth Five Year Plan.

The breakup of the investment target is as follows:

1.	Public Sector Housing	Rs. 4,000 millions
2.	Private Sector Housing	Rs. 17,900 millions
3.	Social Housing	Rs. 7,000 millions
	Total	Rs. 28,900 millions

This would amount to only 14.5 percent of the total outlay for the Fourth Five Year Plan. To clarify, "Public Sector" means Government owned or affiliated.

GOVERNMENT OWNED HOUSING FOR ITS EMPLOYES

In most of the developing countries, a significant part of the national housing program is devoted to the housing of government employes and similar groups. The accommodation provided is usually subsidized, and this fact has helped to make government employment attractive and has given stability during difficult years of reconstruction and political development.

This is very true of India where the government is the owner of a large housing real-estate. All employes of the Central (Federal) Government, State Governments, semi-government agencies, Armed Forces and the Railways, are entitled to receive subsidized accommodation, usually paying only 10 percent of their salary as rent.

After Independence the size of many government departments increased enormously, and many new ones were also created. To meet the growing need of housing for its employes, the government has had to build dozens of large developments in the many cities all over India. This massive sprawl of such developments is most evident in New Delhi which is the Federal capital and

which, therefore, also has the largest government employes population.

Thus, the government is the largest single builder in the housing industry. It is the only agency that can afford to experiment and do research on finding more efficient techniques of construction and planning. And therefore it has an important role to play in providing leadership in the industry.

CRITICISM OF GOVERNMENT HOUSING IN NEW DELHI

The general approach to government housing is pretty much the same all over the country. As New Delhi offers the largest single concentration, it is a good example for analysis.

First, and the most important drawback is that although thousands upon thousands of identical units of, say, one plan type are built in a community, no attempt whatever is made for any kind of prefabrication. The same archaic methods of construction continue to be used -- load-bearing brick walls, poured-in-place reinforced concrete roof slabs, plastering the brick walls on both sides and then whitewashing the surfaces etc. It is an undisputed fact that prefabrication at this scale of repetitive elements, is economical in terms of construction costs as well as time .

Second, most of such housing consists of single story or two-story semi-detached and (sometimes) row-housing. The resultant density is neither urban in character, nor suburban. Such urban housing should certainly have more density for getting

greater economy and better use of the land. For low-income and middle low income housing in the city, 3-story apartments offer an economical solution.

Third, the site-planning of such communities is inefficient and monotonous. Because most of the houses are two-story semi-detached there is wastage of land. The length of the services like roads, sewer, water and electric lines, should be kept to a minimum. Also, such units cannot define and enclose outer spaces as well as row-housing. Moreover, there is enough opportunity for providing variety and interest and for creating interesting courtyards, even though there are not many different plan types in such schemes.

THE PROGRAM

The problem of meeting India's housing needs is indeed colossal. This is compounded by the fact that the demand is increasing at a much faster rate than the present supply. To bridge this ever-widening gap, it is imperitive that some drastic and revolutionary means be adopted.

Assuming therefore that the economic and organisational aspects (which really are the crux of the problem) are solved in some way, it then becomes all the more important that the available resources be transformed into the physical form of housing by the most efficient, economical and best techniques of building and of planning.

Hence, prefabrication on a very large scale and of a very sophisticated type is needed to make any appreciable headway in meeting the demand. Obviously, the traditional materials and methods of construction for repitive buildings of this nature, is very uneconomical and time-consuming. At the present moment in India any large scale prefabrication in the housing industry is non-existant.

As the government is building so much housing all over the country, most of it being very repetitive and similar in planning requirements, extensive prefabrication ought to be the most natural and logical thing to do. Moreover, the government is the one single agency that can afford the initial outlay in development and equipment. Because of the sheer number of units being built, this cost would soon be offset by the overall economy resulting from mass prefabrication. In the designing of various elements it ought to be borne in mind that there should be a possibility of a wide variety of permutations and combinations, thus allowing a greater flexibility in planning.

In this way, after the success of this system and the resultant economy has been demonstrated, many of the prefab elements could be commercially produced by private industry for the vast market of the private home-builder.

Thus, the government would not only modernize and refine its own housing program, but would also give a lead to the housing industry as a whole by adaptation of newer techniques.

Assuming therefore that this would probably be the general direc-

tion of the Government's future housing programs, the object of this study is to design a prototype community of government-employe housing in New Delhi, incorporating improved techniques of construction and of planning.

Thus, the program of this study covers the following:

SYSTEM OF CONSTRUCTION: In order to catch up with the existing backlog of housing shortage, and then to keep up with the ever-growing demands, the most hopeful solution would be the widespread use of the latest and the finest techniques of prefabrication. Evidently, a sudden switch-over from the traditional and often primitive systems of construction to the most sophisticated types, would present innumerable problems. Hence, the change would be phased in various stages, and spread over several years. In this study, the object is to develop what might be the "First Phase", or the simplest form of prefabricated construction.

COMMUNITY PLANNING: To design a self-contained community unit within a larger housing development. This Unit would contain its own primary school and about a dozen shops. It would have a density of at least 75 family units per hectare, gross. And the percentage of public

spaces (roads, sidewalks, open areas, public courtyards) to be maintained by the municipality, should not exceed 40. Attempt should be made to minimise monotony and to create lively public spaces and courtyards.

UNIT PLANS: Using the existing housing as a basis for the floor-area requirements, there would be the following unit types and the areas:

Unit A	3 rooms, bath, kitchen, verandahs	80 sq. m.
Unit B	2 rooms, bath, kitchen, verandahs	70 sq. m.
Unit C	1 room, bath, kitchenette, verandah	25 sq. m.

Following are the approximate percentages:

Unit A	45
Unit B	45
Unit C	10

Unit C is an "Efficiency Apartment", meant for young marrieds with perhaps a small child, or two bachelors.

BACKGROUND INFORMATION

THE PEOPLE:

The residents are composed of only government employes and their families. The income ranges from 150 to 500 rupees per month. As already explained earlier, the accommodation allotted depends on the seniority and sometimes on the size of the household. Rents are standardized to 10 percent of the salary.

Within this income group, the only means of personal transportation that one can afford is a bicycle. And it will remain so for a long time within this low-income community. As soon as an employe's salary exceeds say, Rs. 500 p.m., he is entitled to better housing in the "middle-income" group, and moves elsewhere as soon as a house is available. Cars would not be within the reach of this group even in the distant future. At the most, a few might manage a scooter. Therefore, there is no need of providing for parking. The other means of transportation is the bus.

LOCATION OF THE SITE:

As this study is purely an academic exercise for the design of a prototype community, the site is assumed to be located where there is existing government housing. This is in South Delhi, opposite Ansari Nagar.

It is about 3 miles to the main Government offices, and the residents commute either by bicycles or by public transportation.

CLIMATE:

The climate of New Delhi on the whole, is hot and dry. Summer temperatures from April to June average around 100 degrees F. Three months of the winter are cool, with the low temperature going down to freezing on a few nights. During 4 months of the summer, people generally sleep out in the open, under the sky. In the winter they sleep inside under quilts or heavy blankets, and during the rest of the year, in "Verandahs". Because of the climatic conditions, and partly because of economic reasons, Verandahs form a very important living space.

Average Temperatures:	Max	Min
January	53.0	38.7
February	60.9	45.4
March	70.5	52.0
April	83.7	61.6
May	98.4	78.5
June	96.8	79.0
July	91.0	72.0
August	90.5	69.8
September	88.8	68.7

Octomber	72.8	55.2
November	63.0	48.9
December	54.8	41.3

RAINFALL:

The total annual rainfall for New Delhi is 31.6" average. The rainy season or the "Monsoons", generally start in the second or third week of June and end by the first or second week of September. Approximately 70 percent of the precipitation occurs during this period. About 22 percent falls during the winter months, December and January, and the remainder during the other months.

BUILDING CODES:

An important clause of the building code that influences and even determines the floor plan, is the one that requires that all staircases, kitchens and toilet facilities must have their windows opening directly to the outside light and air.

Another clause requires that all habitable rooms have a clear floor to ceiling height of at least 10 feet. This is partly justified by the fact that ceiling fans as a cooling device are quite commonplace.

DESIGN APPROACH

SYSTEM OF CONSTRUCTION:

As the "First Phase" toward prefabrication, a very simple system is used. After analyzing the traditional method of construction, it is apparent that the poured-in-place reinforced cement concrete roof is an extremely wasteful and time-consuming process. Especially when there are hundreds or even thousands of identical floor slabs, there is no justification at all for fixing up the formwork for each slab, laying out the reinforcement, pouring the slab, curing it etc.

In this system it is proposed to have a prefab floor slab unit, measuring 3.40 m x 0.40 m and 0.20 m deep. It is channel-shaped in section (see drawings) and therefore uses concrete and steel where they are necessary. For the same strength, this unit uses much less concrete and steel than the conventional slabs.

The various floor plans of all the three Unit types have been organized in such a way as to have a span of 3.50 m between the load-bearing walls. Hence basically one floor slab unit can be used for all the plans. There is a smaller, but identical unit however in the staircase area. These units, when used sideways, can also serve as railings or parapets in the verandahs. For transporting them and positioning in place, it is assumed that some form of light machinery or pulleys will be used. It is estimated that one floor per day can be laid using these units.

On the assumption of simplification and universality the scheme of parallel bearing walls has been adopted. The bearing wall system has several advantages. It reduces the number of structural precast elements: wall and the floor units, to two.

The traditional material for load-bearing walls is brick. In order to have something that is quick to make (compared to brick walls) and yet not too comlex for the First Phase, it is proposed to use concrete blocks (hollow), measuring 40x20x20 cms. Of course, there will be a few of 20x20x20, and other smaller size to give bonding in the courses. As the buildings are proposed to go 3 and 4 floors, and as it is desirable at this stage to keep the different block sizes to the minimum, it becomes necessary to reinforce

the walls with small columns. This is done by means of special column blocks (of the same width) that line up vertically forming a hollow core. This is filled with reinforcing bars and concrete. Thus a small column has been added to the wall without making any special formwork. The spacing of these is 1.20 m.

The hollow concrete blocks have the added advantage of providing better insulation against the hot sun than the same thickness of conventional brick wall.

Partition walls are of 10 cm blocks. Outside walls, though not load-bearing, must be 20 cm for insulation.

One precast element, though not forming a part of the main structural system, is the boxed type window shade unit in the kitchens and in Unit A. The design is such that it removes the need of any lintel above those windows. The box acts not only as a protection against sun and rain, but also as a lintel.

Throughout the whole design, punctures in the load-bearing walls have been kept to a very minimum. When they occur, there is just one standard size of precast lintel piece.

UNIT PLANS:

The apartments have been designed in such a way as to have the maximum depth and the minimum frontage. The depth helps to keep the house cool. The minimum frontage reduces the heat absorption of the sun's rays. In addition, it reduces the length of public services like sewers, electric, water and other lines to a very economic figure.

As pointed out earlier, Verandahs form a very important living space in this climate and this way of life.

To conform to the building codes, bathrooms, kitchens and staircases have direct access to outside light and air. These service spaces have been grouped together in very efficient manner. This arrangement also reduces the plumbing costs to a minimum. All the three plan layouts make a very efficient use of space.

The wooden louvers above the doors permit good cross-ventilation through the house.

COMMUNITY PLANNING:

Assuming that 16 percent of the population is composed of children of primary-school age, and assuming that the optimum size for a school would be 1,000 to 1,200 children, the size of a self-contained Community Unit would be about 8,000 people. Taking the average size of a family to be 5, this means a total of about 1,600 housing units.

With a target of 75 families per hectares as the density of this community, the site allocation comes to about 21 hectares.

As a contrast to the typical government housing in New Delhi which is one or two stories only, it is proposed in this scheme to go to 3 floors for the larger units. Going higher than that would be more inconvenient than economical. However, the smallest type, Unit C, goes up to 4 floors, assuming that the residents of this group, young marrieds and bachelors, can cope with an extra floor.

As shown on the "Abstract" on the Layout plan of the Community, the density achieved in the final scheme is 85 families per hectare. The area of the site, inclusive of all roads, is 18.87 hectares,

and the number of housing units is 1606.

The School, the playground and the Shops are placed in the center. The whole Community Unit is divided into 6 smaller groups, each having as its focus a series of courtyards. As the mode of transportation is either a bicycle, or the public bus, roads are kept to the minimum. Special care has been taken to layout the houses in such a way that there are various interesting spaces. There are plenty of pedestrian paths criss-crossing through the community.

As a departure from the government's traditional method of having semi-detatched housing, this scheme proposes row housing. The latter is not only economical in its use of the land, but helps in a long way to define and enclose outer spaces. The creation of pleasant public courtyards is an obvious improvement over the monotonous layout that is generally adopted.

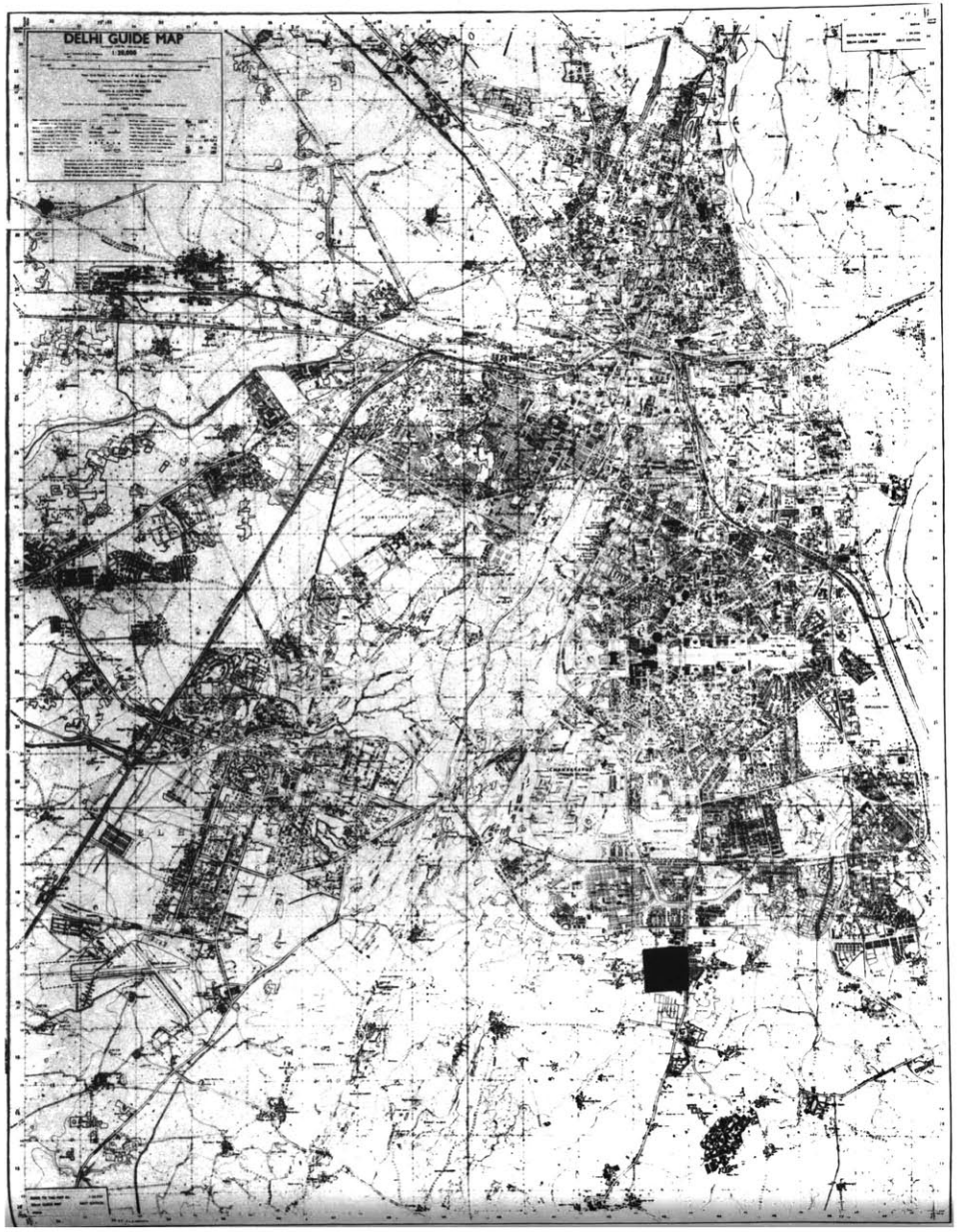
In conclusion, this scheme presents merely an academic study to show that there are several possibilities of improvement in the Government's vast housing projects. Because India is a poor country, it becomes all the more important that the available resources of money and materials be used in the most efficient way.

ACKNOWLEDGEMENTS

The author wishes to gratefully acknowledge the advice and criticism of the following during the course of this study:

Professor Horacio Caminos

Professor Waclaw Zalewski



LOCATION OF SITE

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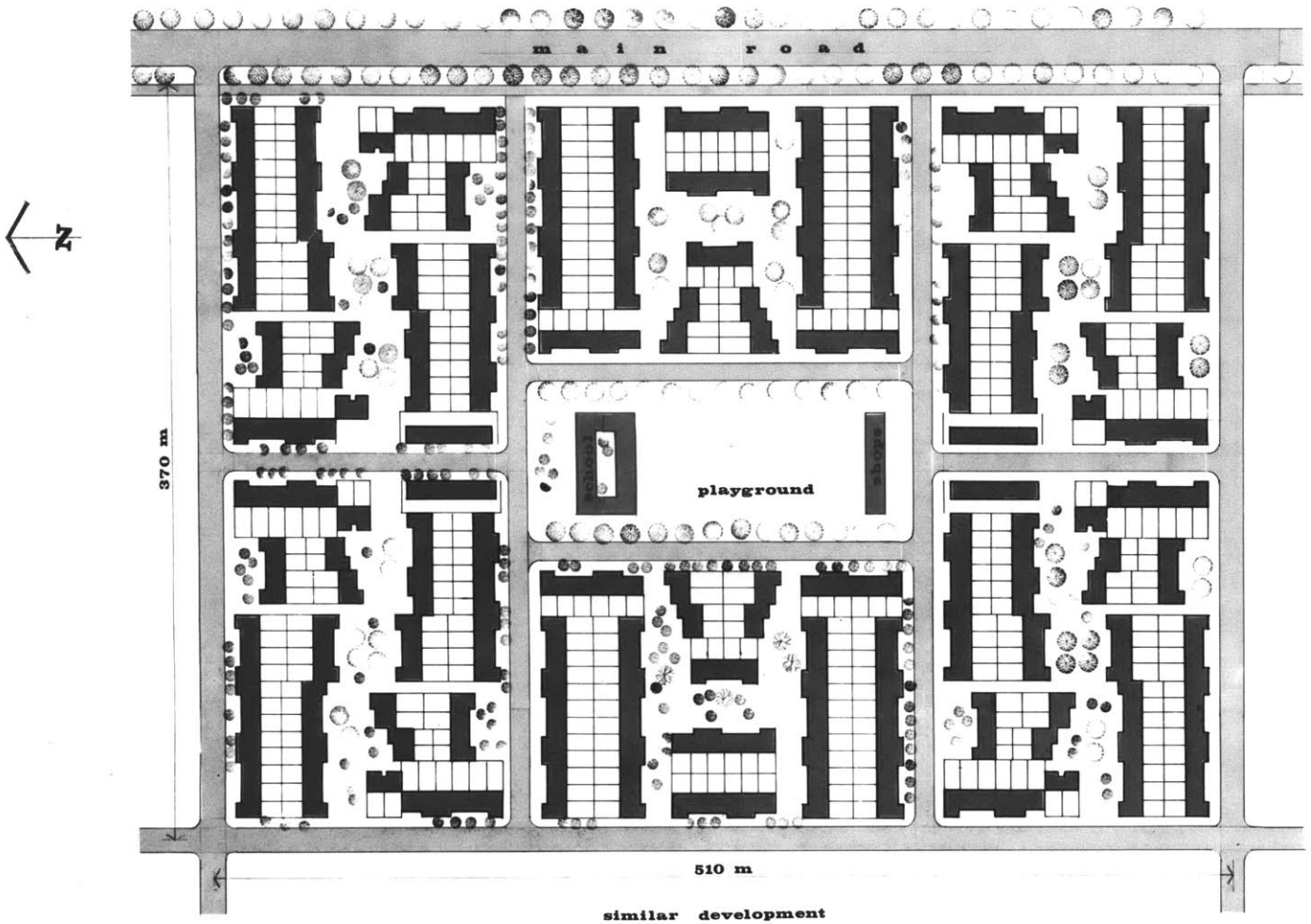

LAYOUT PLAN OF THE COMMUNITY

A B S T R A C T

area of site	18.87 hectares
number of units	1,608
density	85 units per ha.
3 b.r. units	708 (39 p.c.)
2 b.r. units	708 (39 p.c.)
1 b.r. units	192 (12 p.c.)

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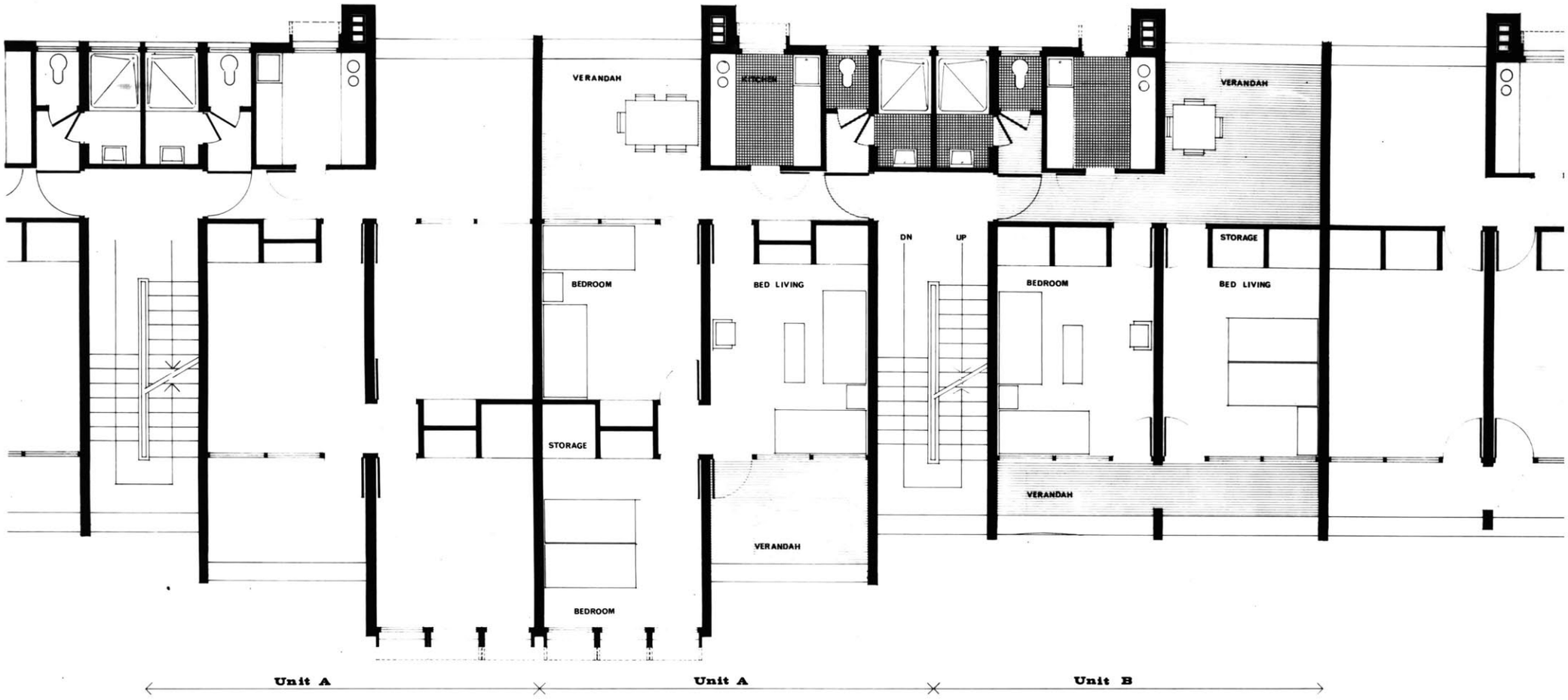

UNITS A and B: TYPICAL FLOOR PLAN

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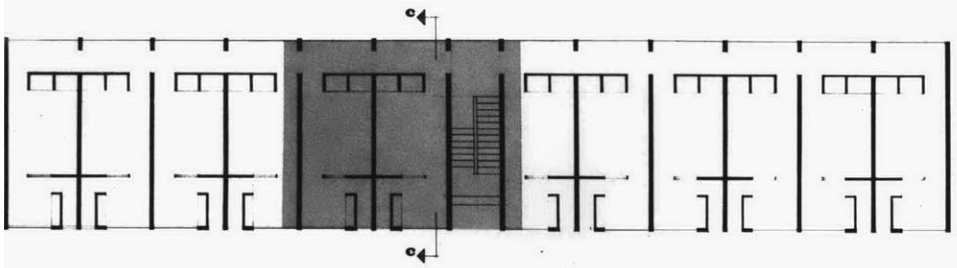
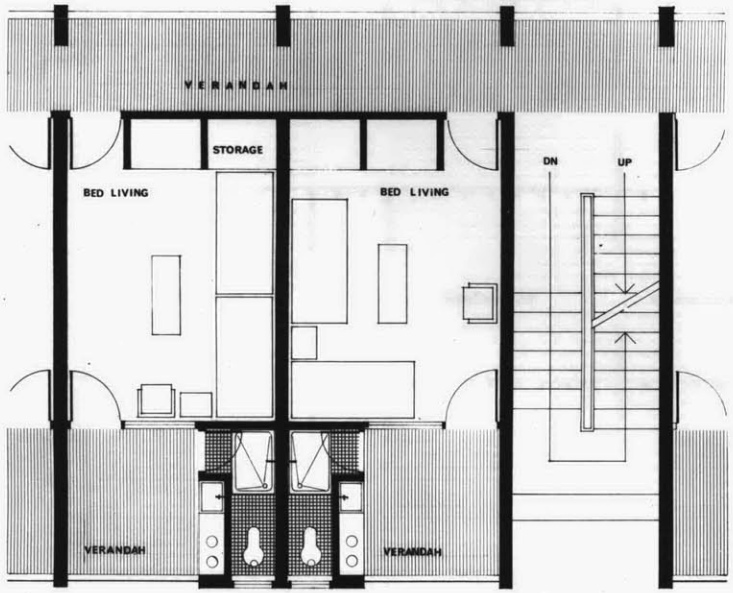
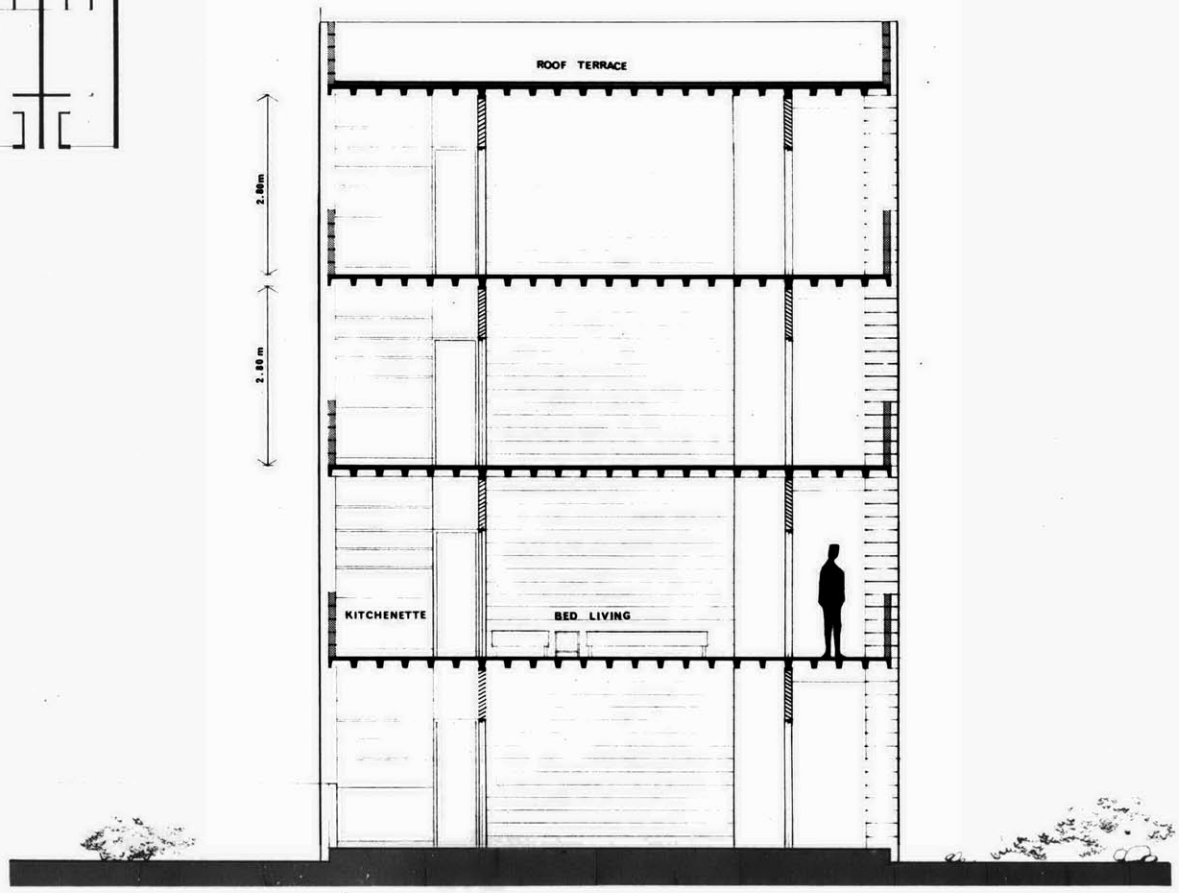


KEY PLAN





C-C

UNIT C: PLAN and SECTION

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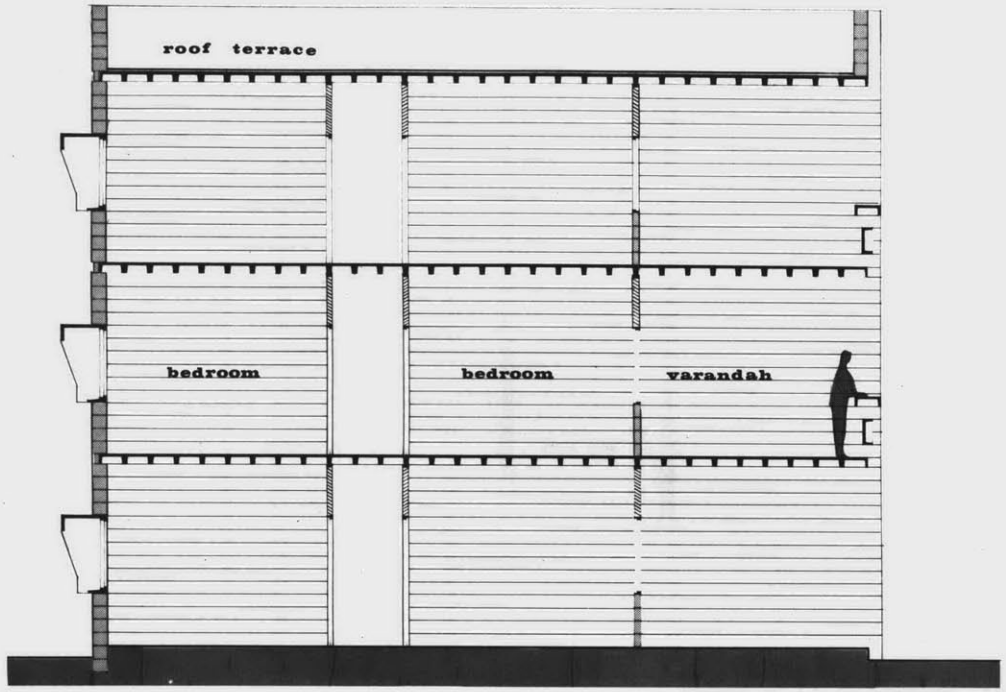
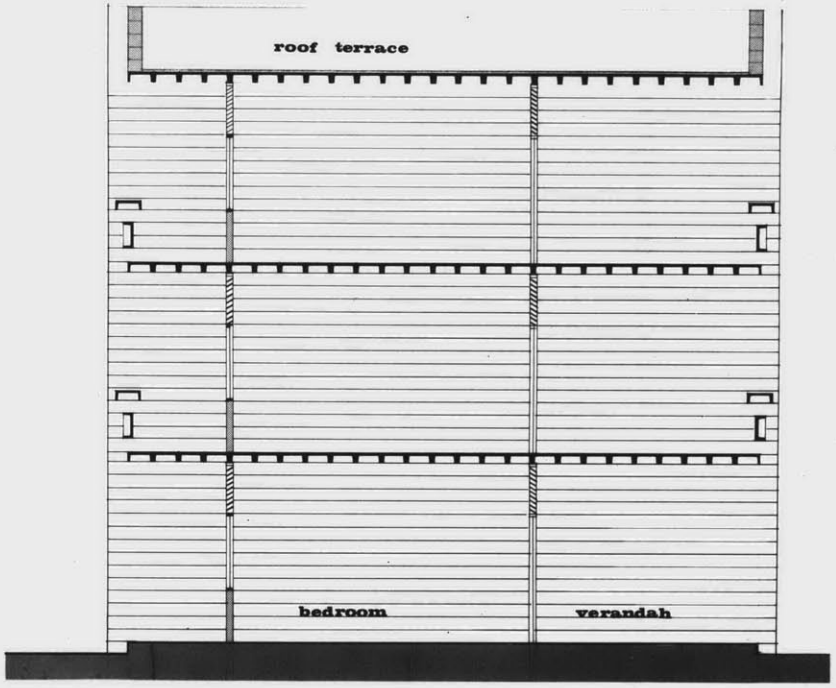


A - A



B - B

UNITS A and B: SECTIONS

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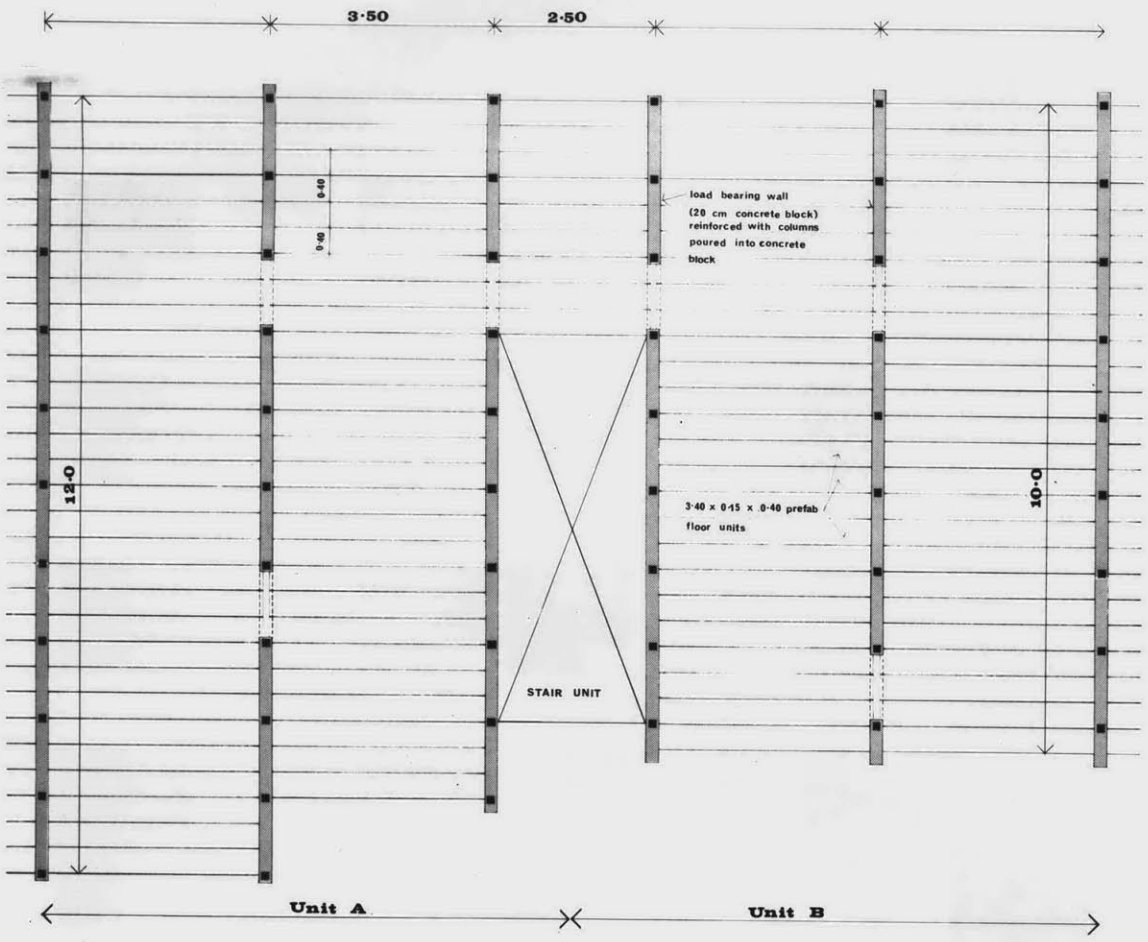

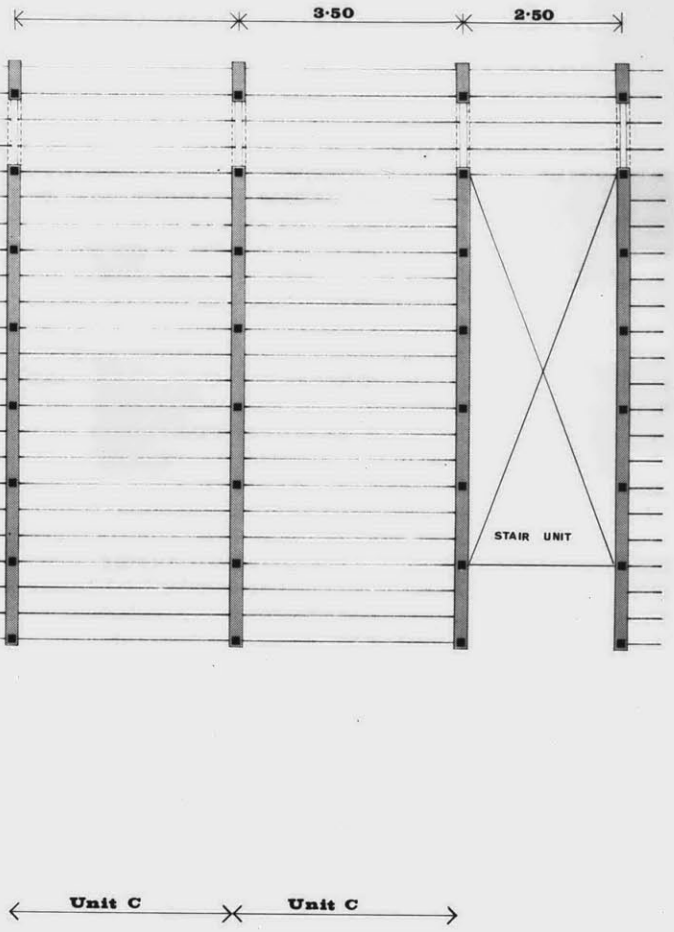

UNITS A, B and C: STRUCTURAL PLAN

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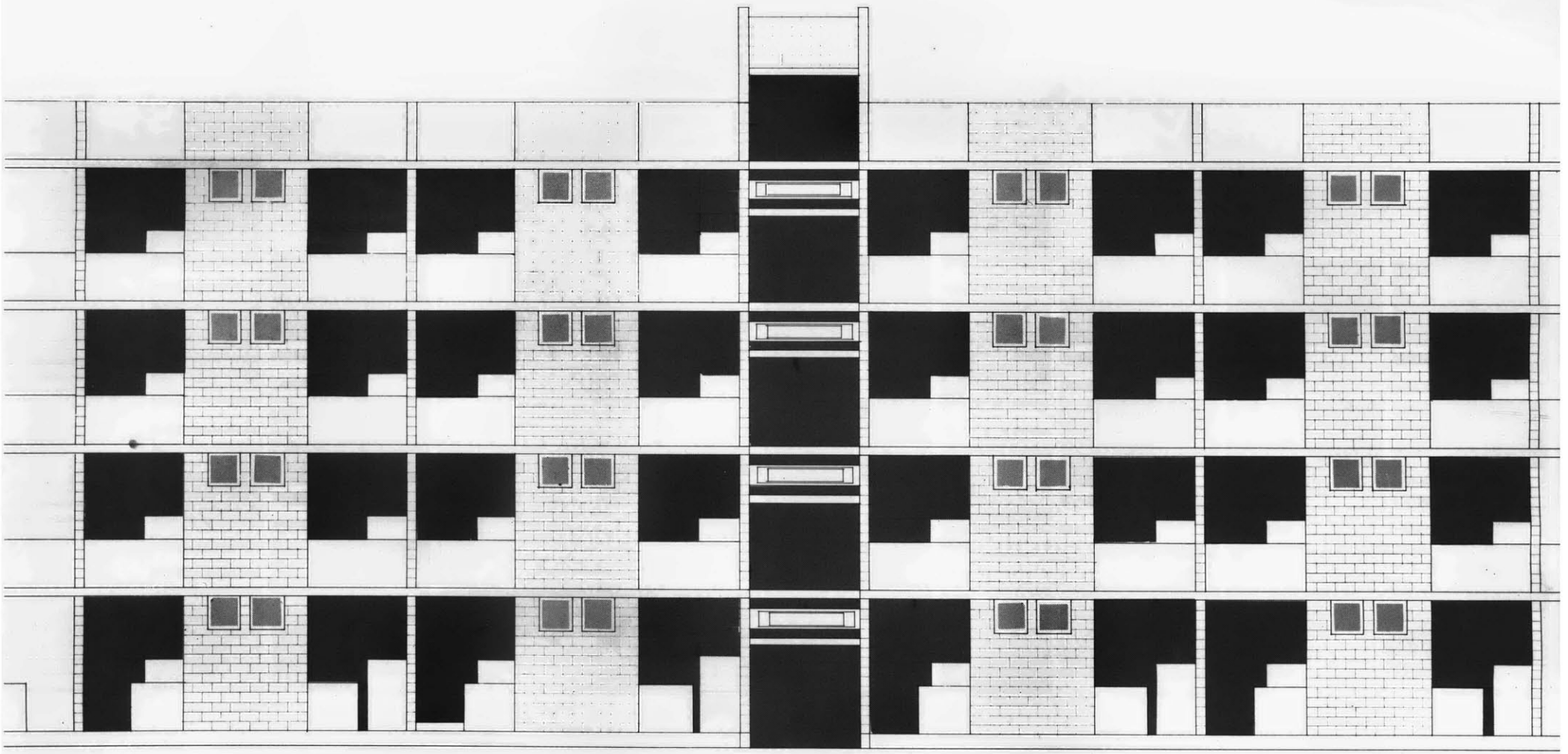

UNIT C: ELEVATION

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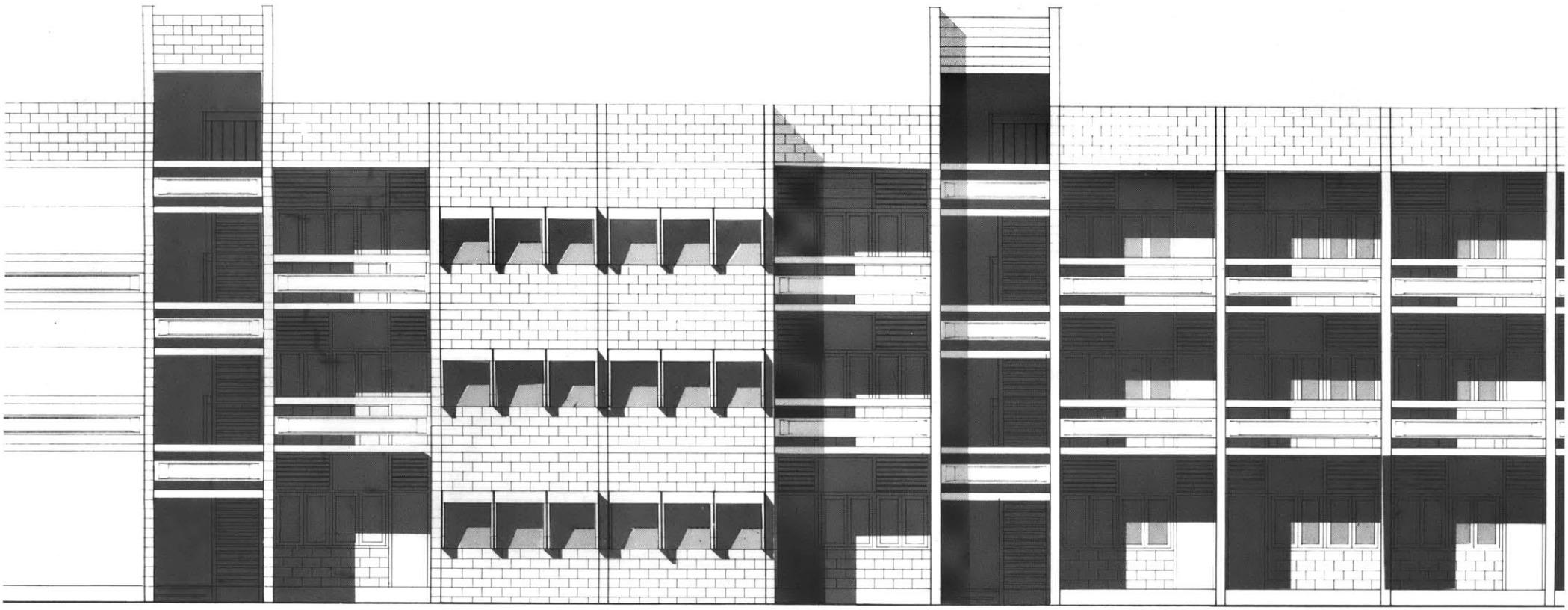

UNITS A and B: ELEVATION

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