

A BUILDING SYSTEM:
AN ALTERNATIVE TO THE URBAN SPRAWL
IN CONTEMPORARY METROPOLITAN SAN JUAN

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(ABSTRACT)

The intent of this thesis is to develop a concept for a structural and enclosure building system that will be applicable to the typical existing housing units in San Juan, P.R. The system will respond to criteria based on environmental, socio-cultural and architectural concerns.

Acknowledgments

I dedicate this thesis to:

My Friends, for their encouragement

My Mother and Father, for what I am

Prof. Ruiz, for your time and interest

And especially to _____, for
her love, support, patience and
for believing in me,

gracias!

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INTRODUCTION

The tropical island of Puerto Rico, the smaller of the greater Antilles, lies at 18°-15' north latitude and 66°-25' west longitude right where the Atlantic Ocean meets the Caribbean Sea. The rectangular shaped island is 110 miles east to west and 35 miles north to south. Total land amounts to 3,435 square miles. With a total population of more than 3 million people, the island is one of the most densely populated countries in the world, having approximately 800 persons per square mile. (See Fig. 1.-2.)

Its capital, San Juan with an approximate population of 1 million, is spreading in all directions, to the north it already faces the ocean, to the south it is slowly growing into the central chain of mountains, it still has the valleys to the east and west.

In the last twenty years former sugar cane fields and smaller agricultural patches have been transformed into urban land. The uncontrollable urban sprawl, a result of partly poor government control and the unscrupulous urbanization of the land by private developers, is slowly spreading over the north coast of the island. (See Fig. 3.)

Housing constitutes the major sector of the construction industry in the island. The preference of the single family house by the Puerto Ricans combined with the willingness of the developers to supply this demand results in the lowest population density in this century for San Juan. The typical detached single family house is the single major cause for the low density problem. The recognition of this fact by the government and the private developers would be the first step toward solving the problem of urban sprawl and the wasteful use of the existing available land.

OBJECTIVES

The objective of the thesis is to develop a concept for a structural and enclosure building system that will be applicable for potential additions to the typical existing urban housing in San Juan.

Such a system will be a factor in increasing the housing density in San Juan and thereby improve the efficiency of land use. The system will facilitate different housing schemes that can respond to the varying existing house plans, as well as be compatible with customary social, cultural and spatial organizations in Puerto Rico.

This will be a flexible system that will attempt to meet physical requirements that respond to climate, materials and methods of construction usually utilized in the area.



Fig.1.



Fig.2.

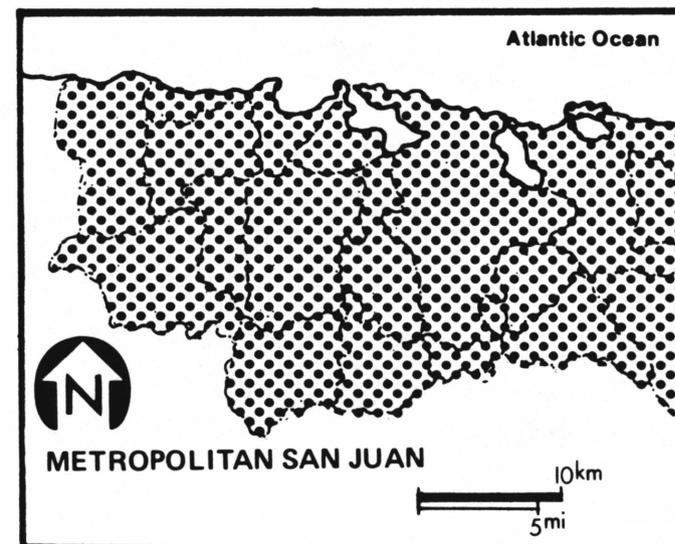


Fig.3.

EXISTING CONDITIONS

SAN JUAN, PUERTO RICO

The island was discovered by Christopher Columbus in 1493 and was a melting point for the Siboney and Aruaca Indian cultures the local tainos, and ferocious caribs. After its discovery the island developed into a Spanish colony strategically important for the defense of other Spanish colonies in the area. The first settlement occurred in the area of Caparra (today west of San Juan) established in 1515 by Juan Ponce de Leon. Later on, it was moved to the small island that is today called "Old San Juan".

It took about 150 years for the total settlement of the small fortified city to grow and expand itself out of its walls. By the 16th century other settlements and towns started to be established. Towns were small, dispersed and in close proximity to the "haciendas" or agricultural centers. By 1900 there were around 124,000 inhabitants around the San Juan area which corresponded to 13% of the total island population.

It was not until the beginning of this century that a movement from the agricultural centers towards the coasts started due to the cultivation of sugar cane in the coastal valleys, and by the economic development and changes brought about by the occupation and colonization of Puerto Rico in 1898 by the United States of America. (As a result of the Spanish American War).

By 1920 towns around the small island of San Juan (Old San Juan) started to consolidate with approximately 212,000 person or 16% of the total of the population in the area. The economic condition on the island kept improving and San Juan's importance along with it. By 1940 the population increased to 411,000 (22%), and afterwards to 500,000 in 1950, (27%), to 647,929 in 1960 (32%) and to 1,175,451 (37%) in 1980. (See Fig. 4. to 9.)

Since its beginnings the region of San Juan has attracted the greatest concentration of people in the island thereby becoming a large urbanized area with all of its corresponding problems.

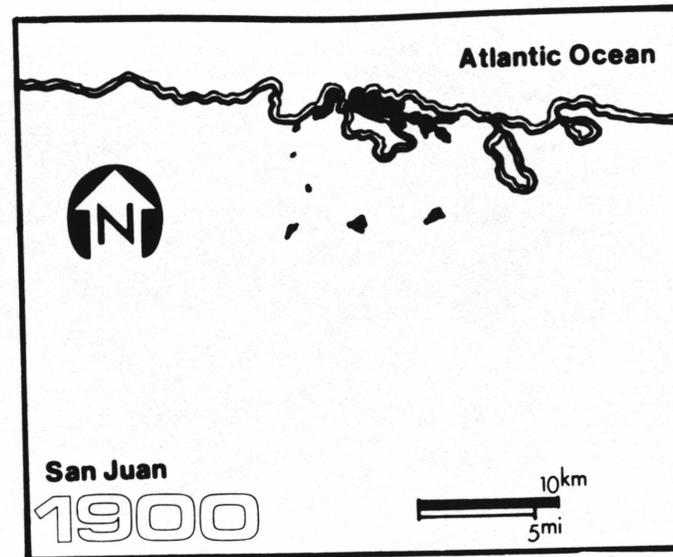


Fig. 4.

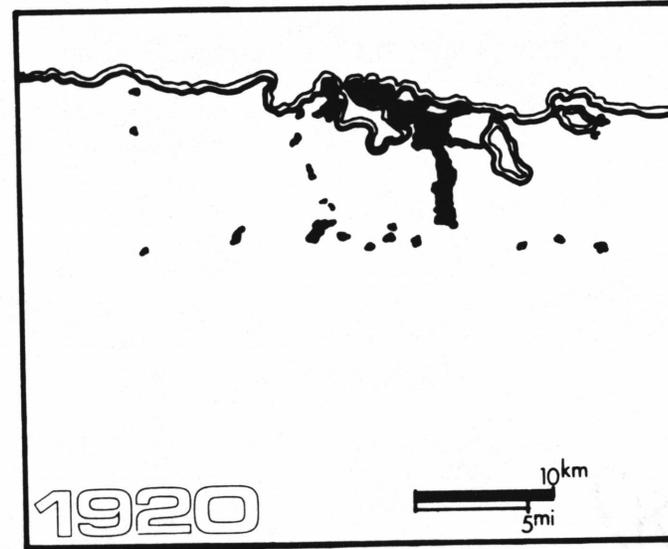


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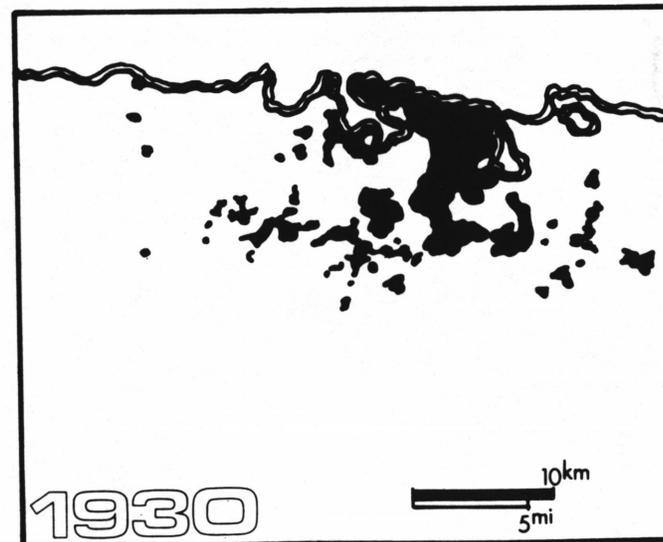


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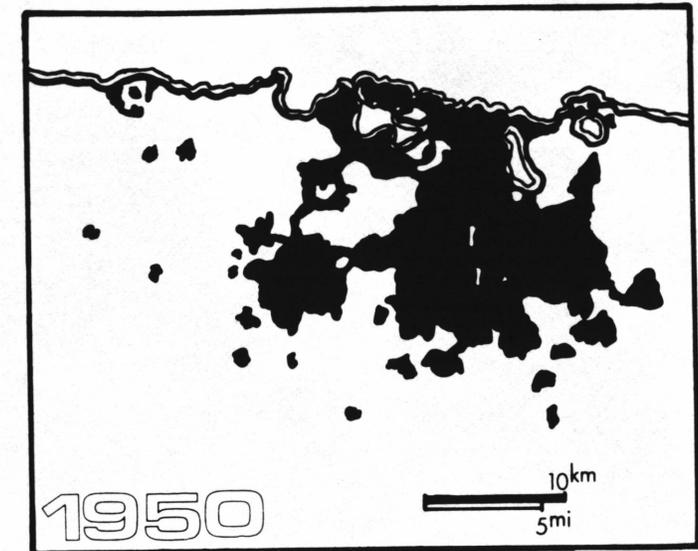


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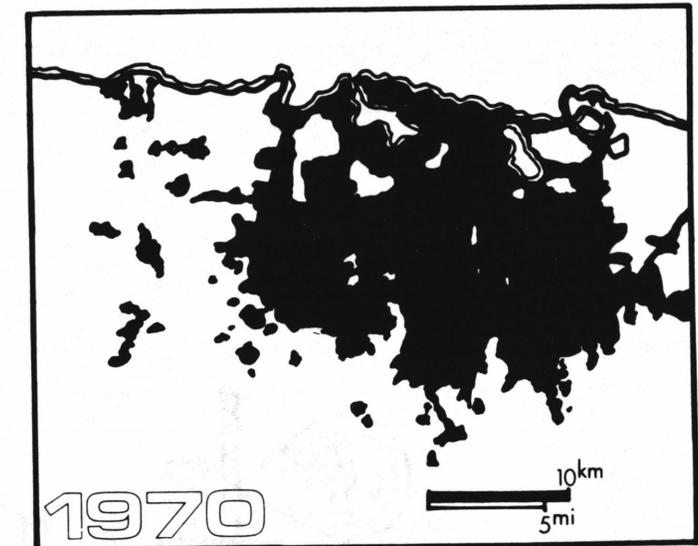


Fig. 8.

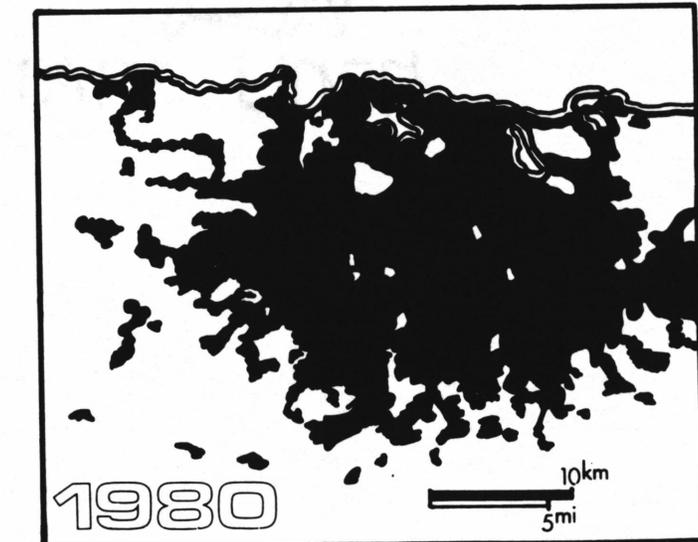


Fig. 9.

POPULATION

The population increase in Puerto Rico and in the San Juan area itself is one of the main factors causing the urban sprawl and the corresponding need for new housing. The total population of Puerto Rico for 1980 was 3,000,000 inhabitants and San Juan's portion was 1,000,000. The total density of the island is of approximately 800 persons per square mile.

Following the island vital statistics we learn that the mortality rate is decreasing while the fertility rate is increasing. The planning agencies in Puerto Rico predict a population of barely 4,000,000 by the year 2,000, but if these rates of mortality and fertility continue we will probably have more than five million people.

If the rate of urban sprawl follows that of population increase as it has done in the last 20 years, we will have approximately 2 million people in the San Juan metropolitan area, an area consisting of just 250,000 acres. I am deeply concerned with the task that we have ahead of us. Not only must we deal with the problem of the intensification of the existing and new urban areas but also with such factors as specialization of the uses, infrastructure systems, the possible damage to the natural ecological systems, energy utilization, etc... This study, will focus on one way to respond to the land use intensification of the existing urban areas.

LAND

The shortage of suitable developable land is a problem being aggravated every day. Out of the 3,435 square miles which form P.R., only 25% of the land have a slope of 15% or less. Of that land, approximately 35% is already urban or in the process of becoming urban.

During the 1950's and 60's most of the population increase of the island was absorbed by the City of San Juan. Although the urban population doubled from 1950 to 1970, the urban areas increased four times its original size. This fast concentration of population and the rapid construction and extension of the urban areas takes the form of an urban sprawl. (See Fig. 10. 11.)

The density for urban San Juan dropped to its lowest point this century to 16 person per acre, placing an incredible demand on the scarce land available. We have an average of 3.4 persons per unit. These facts reflect the mentality of the consumer which chooses and buys these mass produced and visually unattractive "concrete boxes" that saturate the "urbanizaciones", which is the term used to refer to the single family-detached unit housing developments.

This concrete box has become a status symbol for the average family. This translates into a preference of the family to own a single-family detached unit. Common characteristics of the "urbanizaciones" are the lack of visual character and harmony and the poor and useless imitation of foreign architectural styles. Urban and architectural mannerisms originally imported from Spain, can be seen in the colonial sector of San Juan. After the 50's the tendency was to imitate the patterns of suburbia in Miami, New Jersey and Chicago. Small concrete boxes in checkered pattern with no relationship to the region in which street and houses seem to respond only to engineering criterias and too comply with the minimum requirements of the zoning laws.

(See Fig. 12. to 14.)



Fig.10.



Fig.11.

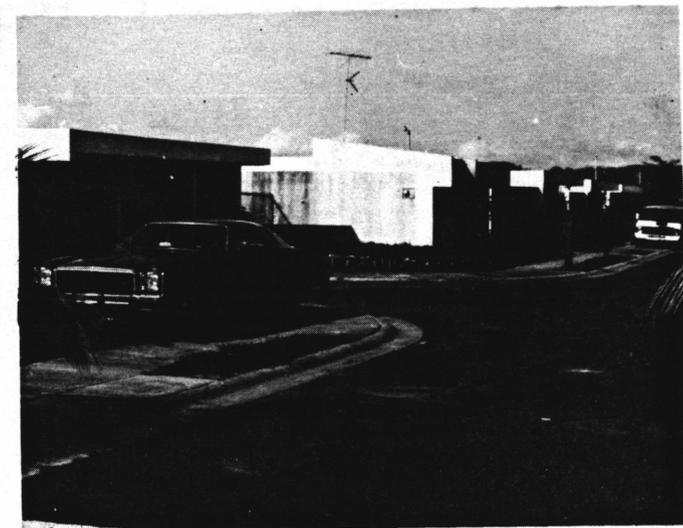


Fig.12.



Fig.13.



Fig.14.

CULTURE, SOCIETY & HOUSING

"This is really a schizophrenic society. Puerto Ricans have two languages, two citizenships, two basic philosophies of life, two flags, two anthems, two loyalties. It is very hard for human beings to deal with all this ambivalence".

René Marqués

Is there a Puerto Rican culture? Culture defined by the American Heritage Dictionary is a "totality of socially transmitted behavior patterns, arts, beliefs, institutions, and all other products of human work and thought characteristic of a community of population".

It is very hard to identify the behavior patterns transmitted through the years to the typical urban Puerto Rican family. Maybe a result of the ambivalence described by Marqués and the cause which is the direct imposition of an urban-industrial-capitalistic society over a generally rural-agricultural-humanitarian society. This happened very rapidly, in the course of a couple of decades.

The urban Puerto Rican commuting by car for usually two hours or more each day between home and office has made an irreversible break with the past. There is no quiet semirural or small town life to go back to, for San Juan is paved with roads serving the sprawling municipalities. He is coming back only to "little tiny subdivisions of squares, little pigeonholes, little lots, everything divided up into little lots, little boxes on little lots, little boxes on little lots, little tacky things". F. Lloyd Wright on Miami, Florida.

Probably the few factors of the Puerto Rican culture still reflected in the urban society are first; the traditional extended family, where parents, grandparents, children, cousins, uncles, and aunts live in close proximity. Even though is also undergoing change it is an important consideration for this thesis, for most of the second stories or additions made to the typical "urbanizacion" house are done in fact for the sons or daughters getting married or for relatives not being able to afford a new house. The pattern reverses when the parents grow older and then move to the smaller house built above the original one therefore ceding the lower house to their children.

The second factor still latent in the San Juan urban society is that of land and property ownership. The owning of a house or piece of land gives security to the individual. The availability of the typical concrete family house and in most instances the only available choice, has made it the status symbol of the society.

Puerto Rico's small size and condition have nurtured other values or traits that emphasize the sense of status in the

society and increases the need for having and owning a house or property. The smallness of the island and of San Juan (with its one million people) account for the small society nucleus. For example, in San Juan, in certain professions a man can still know everybody among his colleagues. The lack of anonymity also tends to reinforce this convention of status not out of conviction, but because of "el que diran" or what people might say.

This is reflected on the preference of the typical family for detached houses over apartments, row-houses or town-houses. (81% individual detached, 17% apartments in condominiums and 2% other). The typical tract house of the Puerto Rican "urbanización" resembles a minimum-standard six-room ranch house in the U.S. Its three bedrooms, one or two bathrooms, living room, dining room, and kitchen areas are tightly arranged and extending almost to the limits of its building lot, windows tend to look into other windows, terraces into other terraces, thus diminishing the possibilities for privacy. (See Fig. 15.- 16.)

To make matters worse the carport and terrace concept came into use. The automobile is an essential link between home and one's place of employment, as well as the shopping center where incidentally most of the community services are concentrated. Subsequently, the carport and the terrace has a double function, usually they are used either as a family room or as a completely enclosed extra room.

The average consumer is not usually satisfied with either the size or design of his house. 90% of their owners build during the first 5 to 10 years of ownership permanent additions to their houses such as carports and terraces, extra bedroom or bathrooms. Elements for security such as iron works and fences, or insect screens for all openings are a must and usually added in the first six months by 96% of the owners.

A study done by the Puerto Rican firm of Roberto Ponce and Associates shows four major factors considered by families when buying a house, they are:

- | | |
|-----------------------------------|-------|
| 1. Cost of the unit | (32%) |
| 2. Size and ability for expansion | (25%) |
| 3. Accesibility and proximity | (23%) |
| 4. Marketing potential | (19%) |
| a) Re-sale value | |
| b) Neighborhood appearance | |
| c) Neighborhood compatibility | |
| d) Stability | |
| f) Privacy | |

From 1959 to 1973, the housing construction industry grew steadily at the same rate as the island's economy. After 1973 a decline in both sectors was felt.

The great demand for new housing created between the 50's and 70's was well perceived by the private builders and entrepreneurs of that time who responded accordingly.

Various factors accounted for the proliferation of the typical concrete box and the "Urbanizacion" concept. One was the availability of financing methods for possible buyers, another, the increase of income levels per capita which made a greater section of the population capable of acquiring their own house.

Because of the repetitive techniques of construccion and the availability of building materials San Juan ended up with the stereotyped concrete box house which does not respond to the unique climatic factors of Puerto Rico except with the help of air conditioners.

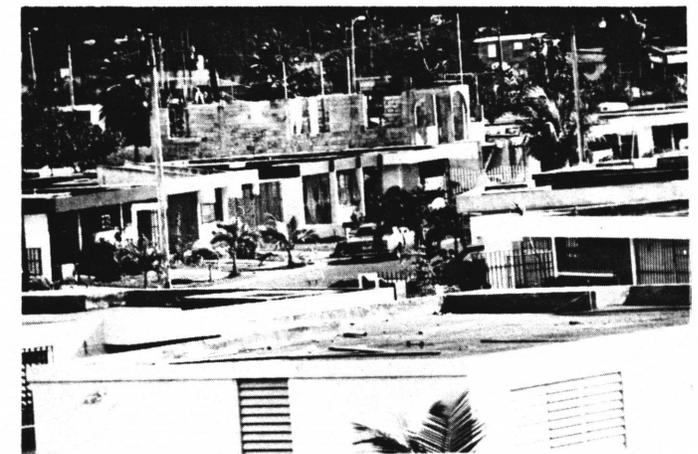


Fig. 15.



Fig. 16.

ANALYSIS AND PROGRAMMING

CLIMATE COMPONENTS

The most important factors which influence the island's climate are the following:

LATITUDE

P.R. lies between 17°52' and 18°30' north of the equator, in the tropical humid zone. This locates the island within the zone of maximum insolation, between the Tropics of Cancer and Capricorn, where the sun rays at noon are nearly vertical. (See Fig. 17.)

INSULARITY

Because of the smallness of the island, the ocean exerts a large influence over its climate. The marine influence is a moderating one since it tends to warm the island in winter and cool it in summer (the sea warms up and cools off more slowly than the land). Therefore the air temperature never reaches great extremes of heat and cold. The same circumstances of location also produces maximum and minimum temperatures that do not coincide with the dates of maximum and minimum insolation.

GEOGRAPHIC LOCATION

P.R. is located east of the middle part of the American continent and west of the North Atlantic Ocean. This places the island within the influence of the Great Northern Equatorial Current. The fact that this is a warm current and the air above it is humid, tends to intensify the characteristics of the P.R. climate. (See Fig. 18.)

TRADE WINDS

The Trades are easterly winds which normally blow between 5° and 30° or either side of the equator and toward that line, NE in the north and SE in the south. When they reach the surface an easterly direction prevails. Within its latitudes, P.R. is clearly always within the zone of the Trade winds that blow from the east (NE-SE) throughout almost the entire year.

EASTERLY WAVES

This recently studied phenomenon, easterly waves or "ondas alisas" in Spanish, occur in both of the trade wind belts. They are simply deformations in the form of horizontal waves which are observed in the isobars (line of equal pressures), near the earth's surface, moving from E to W, with a constant velocity of 10 to 15 mph. The effect is to create barometric depressions of low intensity, causing frequent rains which at times last two or three days.

FRONTS

Usually north fronts, they are air masses and other systems that are displaced southward toward the tropics contributing to variation in the climate, usually making the temperature to drop.

HURRICANES

Hurricanes, centers of low pressure are characteristic of the tropical regions east of continental lands, fortunately, few of them pass over P.R., but every year some pass near enough to cause high precipitation mostly during the months of August, September and October.

TOPOGRAPHY

Temperature are lower in the mountain regions than in the coastal region. The mountains serve certain regions as a screen and protection against winds. As a result, despite its small size, the island displays a number of distinct and contrasting climatic regions.

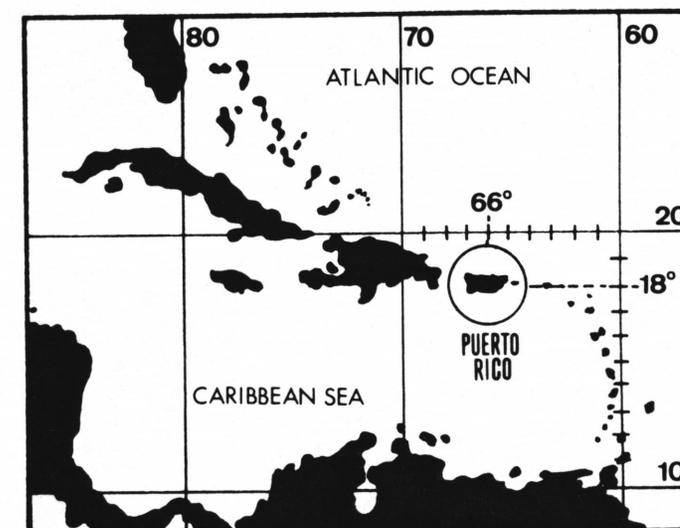


Fig. 17.

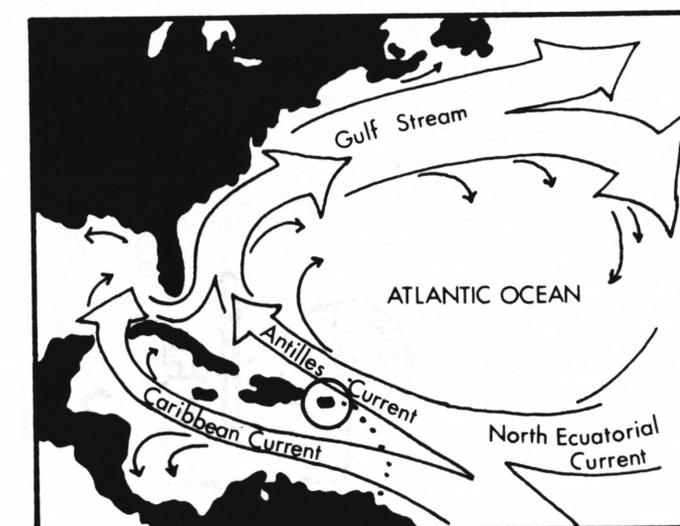


Fig. 18.

CLIMATE PARAMETERS

TEMPERATURE/HUMIDITY

P.R. has two temperature zones, differentiated by altitude. The plains or low hills fall under hot tropical zone and the mountains under moderate subtropical. The city of San Juan falls within the hot tropical zone. The daily average variation of temperature in San Juan indicates a minimum one of 76.6°F early in the morning and maximum of 86.6°F at noon, both during summer or winter. The maximum and minimum differences are 11°-12°F. The time of maximum relative humidity 2:00 A.M., does not coincide with that of the maximum isolation at noon. The daily variation of temperature in San Juan is typical of a coastal region with a good maritime wind pattern which influences the area by moderating it. (See Fig. 21.)

The higher the humidity and temperatures the more uncomfortable the conditions for the human body. For San Juan, the daily variation in relative humidity reaches its maximum of 81.8% at 2:00 A.M., and its minimum of 66.5% at 2:00 P.M. contrary to the temperature fluctuations which are maximum during the day and minimum at night.

The absolute average humidity for P.R. is 18.5 grams of water per cubic meter of air. It fluctuates little through the year with 20 gram/cu.mt. during the most humid months and 17 gram/ cu.mt. during the drier months.

SOLAR RADIATION

The island, lies within the zone of maximum insolation. Once a year in P.R. during the second half of December, the noonday sun reaches its farthest distance from the zenith, some 40° to 41° south of it. The sun rays strike the earth at an angle of 50° to 51° to the horizontal, therefore, marking the onset of the tropical winter. The weather is cool for about three months after December, but it moves again toward the noonday zenith making the weather warmer until the end of May when the noon rays are vertical to the earth. This marks the beginning of the tropical summer, which last for five months. Early in June it continues its northward course, changing from the sky's southern half to the northern when it reaches to 5° north from P.R.'s zenith. Then it returns toward the south, again passing the zenith about the middle of July, after which it continues descending until the winter solstice, when it returns to its original maximum distance from the vertical. (See Fig. 19.)

WINDS

According to Weather Bureau data, the wind in San Juan is from the east 50% of the time, 10% north-east, 19% south-east, and the rest of the time a small tendency for a north west, south west or west direction. The times of maximum wind velocity and force are in winter and in the month of July. Daily variation of wind velocity is the highest at 18 mph from noon to 6 P.M. and at 12 mph from 6 P.M. until noon.

The sea breezes arise during the day when the earth warms up more rapidly than the ocean and the warm air rises, leaving a low pressure area toward which the cooler sea air flows. At night the situation reverses since the land cools more rapidly than the sea, the warmer sea air now rises to be replaced by that from the land, resulting in dawn movements which are much gentler than those from the sea. The trade winds and sea breezes tend to cool the climate, tempering extremes to make the summer heat bearable, specially in the shade. (See Fig. 20.)

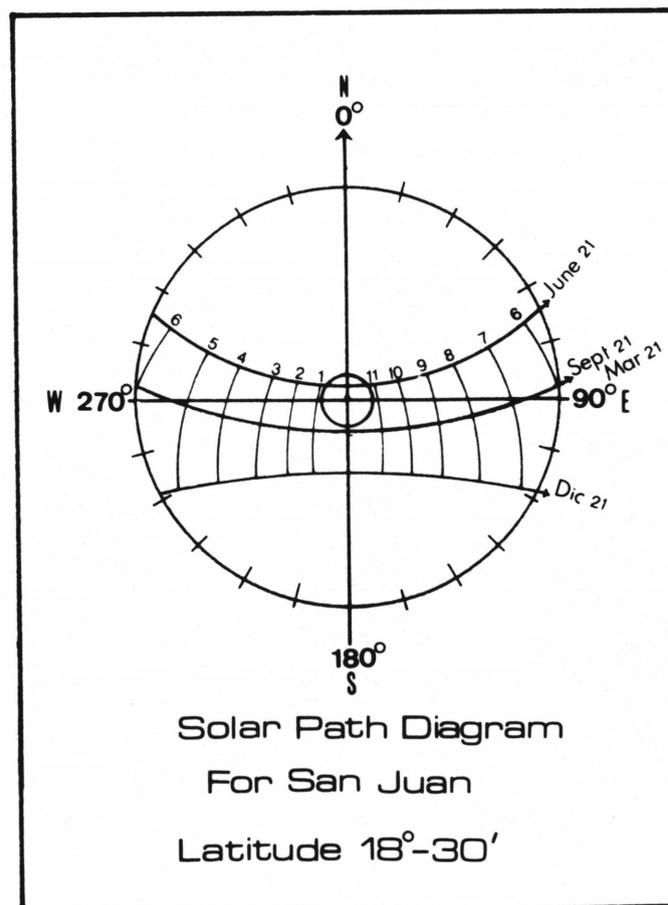


Fig. 19.

PRECIPITATION

In P.R. the rain is caused by five principal factors: relief of topography, convection, easterly waves, frontal zones, and hurricanes. Each of them, according to the form of its origin and the circumstances of its occurrence, affect various of the island's regions with varying effectiveness. The amount of precipitation throughout the year varies with the seasons and with variation in the factors causing it. But it is difficult to determine precisely what part of the rain at any one place is caused by any of the factors described above.

In her study of P.R. climate, Margaret Howarth subdivides the island into XI rainfall regions. San Juan falls into region no. II which is the north coast humid region. The average annual rainfall varies between 60" and 90". The first four months of the year are less humid, but only February and March can be considered dry. The last seven months are rainy, the rain diminishes in June and July and builds up toward a maximum again in November.

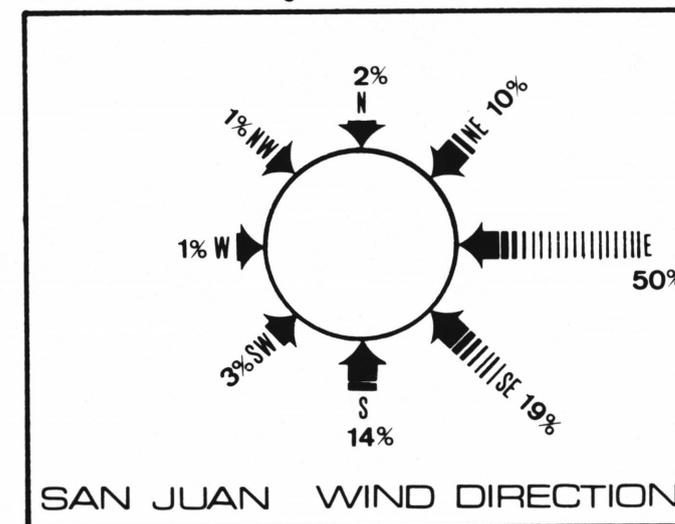


Fig. 20.

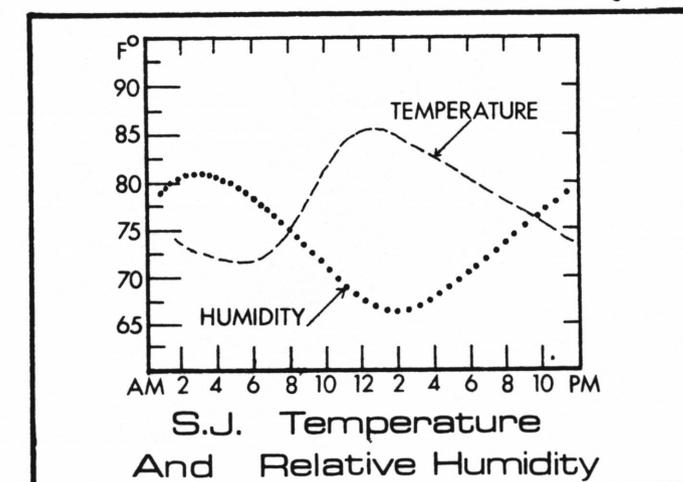


Fig. 21.

CONTEXTUAL FACTORS AND DESIGN IMPLICATIONS

EXISTING HOUSING (See Fig. 22.)

a) Structure

- Usually well built
- 5 to 15 years old
- Poured-in place concrete construction
- One way bearing walls

b) Planning Aspects

- Low Floor Area Ratio (FAR)
- Orientation does not responds to climatic factors

c) Materials

- Roof: - Concrete
- Walls: - Concrete
- Structure: - Concrete
- Window-Doors: - Aluminum/Wood

DESIGN IMPLICATIONS (See Fig. 23.)

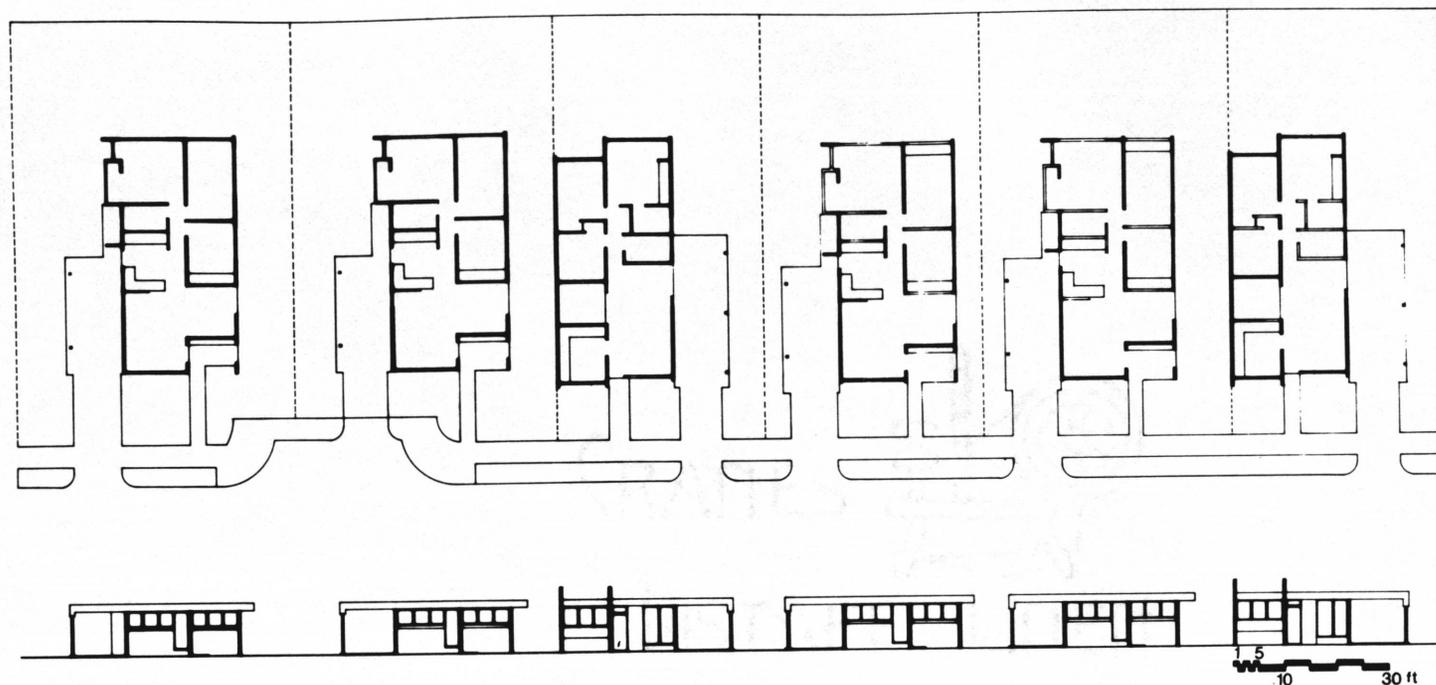
- Structural condition of existing houses suggest that new building could be totally or partially supported by its structure.
- Variations of existing houses width and length suggest construction of new units as parts of a total system in order to facilitate construction and cause minimum disturbance to existing dwelling
- The use of a building system allows for flexibility of planning, spatial organization and construction

SOCIO-CULTURAL

- Preference for clear definition between private and public areas
- Preference for clear definition between night-day functions
- Kitchen, dining, and living areas in close proximity
- Bathroom in proximity to bedrooms
- New dwellings are usually built for the young family market
- Need for an outdoor gathering area

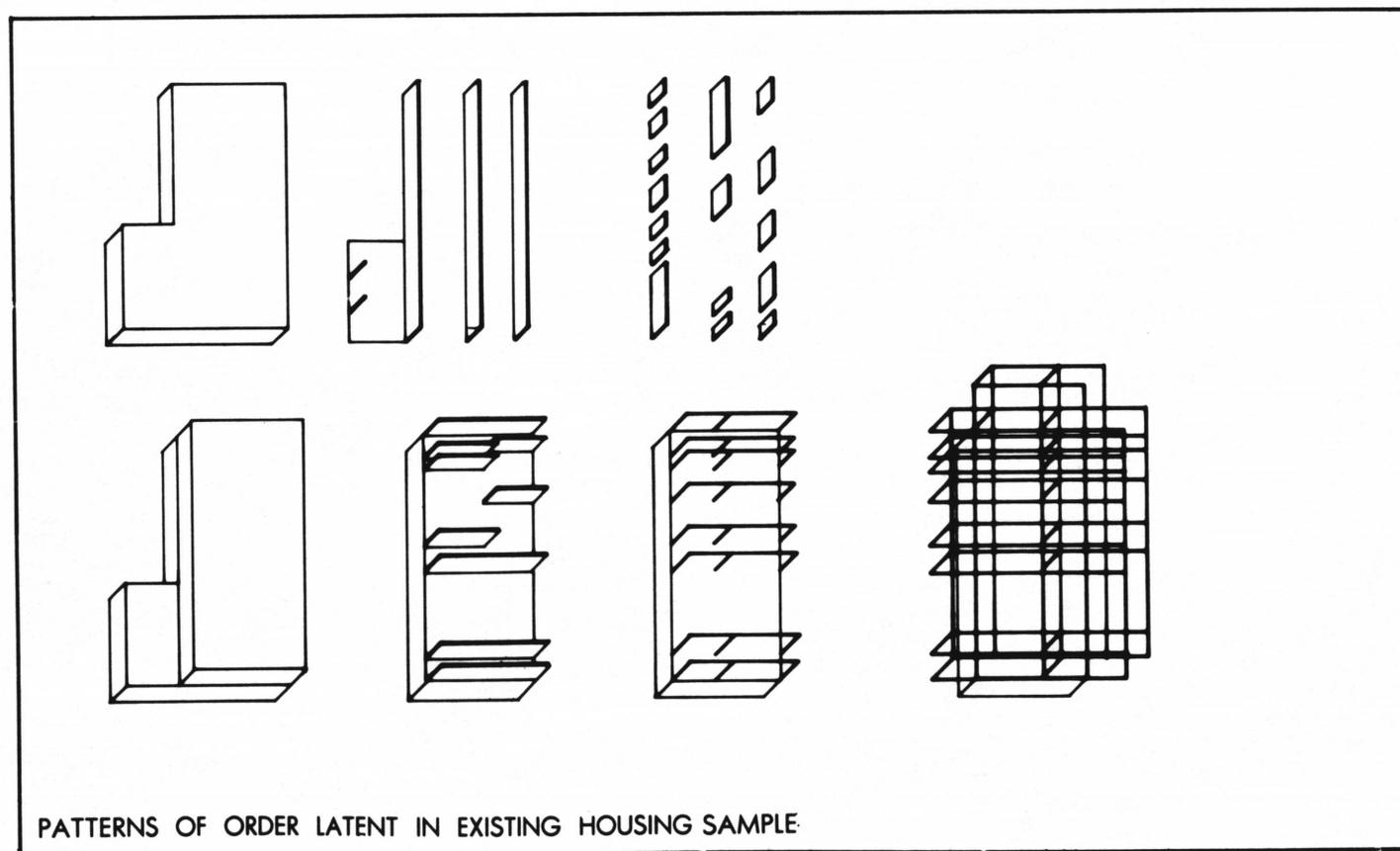
DESIGN IMPLICATIONS

- Differentiation of public and private areas
- Provision of controlled outdoor areas
- Dwelling units with and average two bedroom capacity



A SAMPLE OF A TYPICAL "URBANIZACION" LAYOUT AND ELEVATION

Fig. 22.



PATTERNS OF ORDER LATENT IN EXISTING HOUSING SAMPLE

Fig. 23.

WIND (See Fig. 24)

- a) Trade Wind - Predominant Easterly
- b) Sea to Land - Maximum velocity during day (See Fig. 25.)
- c) Land to Sea - Minimum velocity during night
- d) Hurricanes - Vary

DESIGN IMPLICATIONS

- Ample opportunities to utilize natural ventilation (No need for mechanical climate control systems)
- Ventilation openings and building configuration oriented towards easterly winds
- Minimize use of solid walls
- Use of louvers, screens and shading devices to maximize ventilation.

TEMPERATURE/HUMIDITY

- Hot humid tropical zone
- Temperature range, 76°-86°F
- Hottest time of day, 12-2:00 P.M.
- Coolest part of day, 3-6:00 A.M.
- Relative Humidity, 65% - 90%
- Minimum Humidity, 12-2:00 P.M.

DESIGN IMPLICATIONS

- Provide cross-ventilation to reduce inside temperature
- Induce maximum ventilation by good building and openings orientation
- Maximize overhangs for shading
- Minimize structure to induce maximum ventilation.

PRECIPITATION

- San Juan lies in the North coast which is a tropical-humid region
- Average annual rainfall, 60"-90"
- Drier Months - January to April
- Humid Months - August to November

DESIGN IMPLICATIONS

- Use of roofing configurations which shed rain quickly and effectively
- Proper protection of openings from rain
- Adequate roof drainage system
- Adequate joints among all system components to prevent water penetration
- Utilization of the over-lapping principle as a design parameter

SUN

- The island of P.R. is situated within the tropical belt
- Position of the sun:
Southernmost - December, 41° South
Zenith - March
Northernmost - June, 5° north

DESIGN IMPLICATIONS

- Protection of roof and wall surfaces from intense insolation
- Use of light colors and reflective surfaces for walls and roofs
- Protect east walls from morning sun
- Protect west walls from afternoon sun

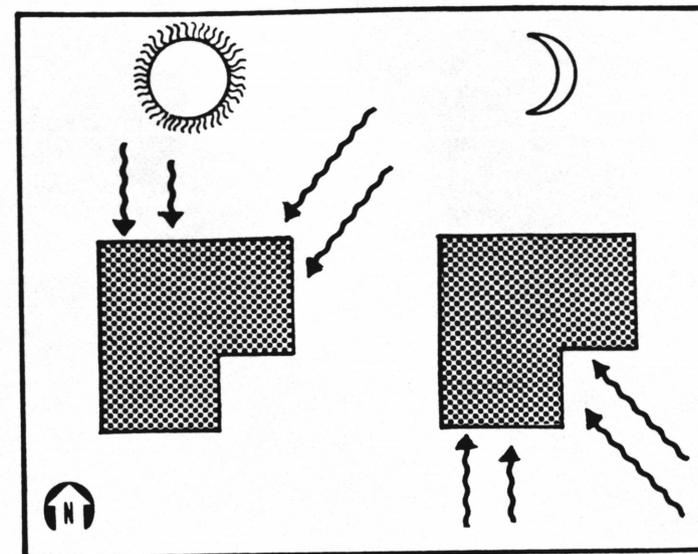


Fig. 24.

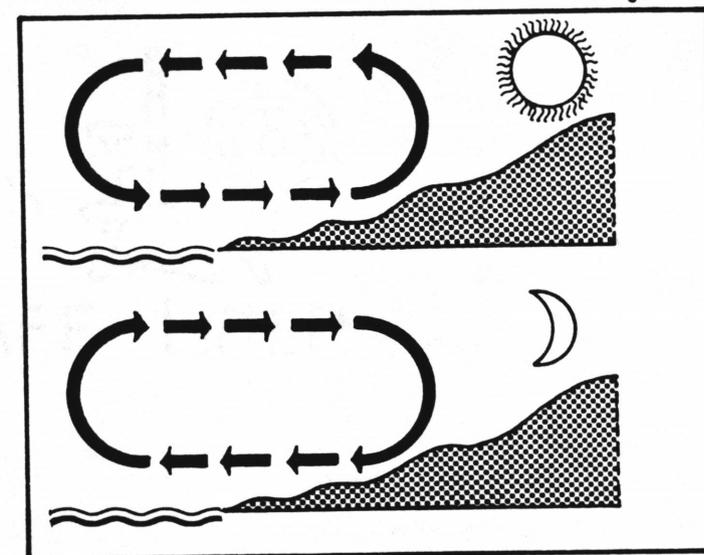


Fig. 25.

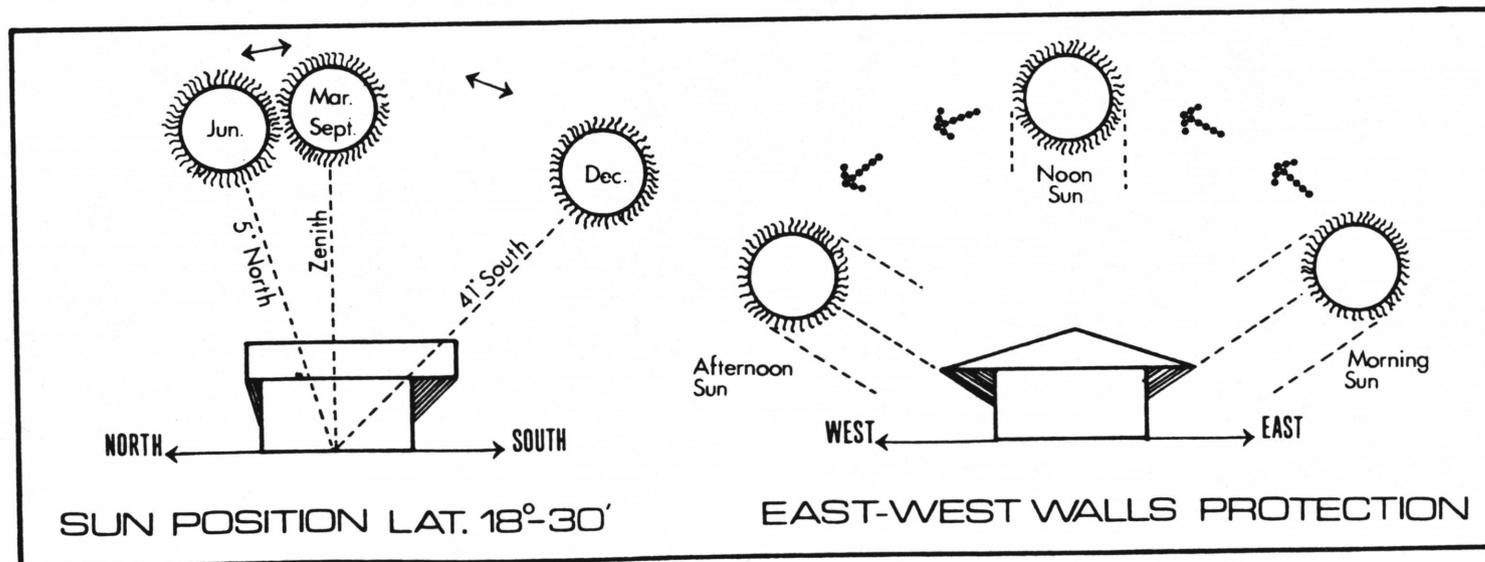


Fig. 26.

THE BUILDING SYSTEM

OBJECTIVES

In the design of this building system the following factors were considered:

1. The system must respond to the maximum number of variables which are found in the existing houses, such as structural arrangement, spatial organization, building orientation, widths and length of bays, lots dimensions, etc...
2. The system must provide control of geometric, spatial, structural, and visual orders, as a way to bring about the maximum amount of harmony and integration to the urban landscape while at the same time, allowing for variety and diversity.
3. Achieve maximum degree of simplicity for both design and construction purpose.
4. The system will respond to two opposing factors: A) the existing house orientation and configuration which are variable. B) climate parameters which are somehow predictable and /or constant.
5. The system will be built of durable materials; to give a sense of permanence, as a response to the Puerto Rican cultural heritage.
6. The system can be built in P.R. with available labor and building materials.
7. The system will respond to the existing climatic factors. (light, ventilation, shade, rain,...)
8. The system must be able to be handled without the use of expensive machinery.

SYSTEM DEFINITION

The housing system developed attempts to respond to the different requirements and concepts established in accordance to the contextual factors studied. The aim of the system is to evolve schemes that bridge the gap between the existing housing and the additions in relationship to climatic response.

Different dwelling units can be created through the selection and combination of the system components. As an example, a typical floor plan is here presented basically organized around the central idea of providing day/public and night/private spatial units. Furthermore this organization responds to the need of an east-west house orientation in the tropics, and the limitations of the lots length and width. By dividing the dwelling units into two areas this need can be met in most situations.

The interior court is an element of Mediterranean and Middle East origins. In the scheme here developed it provides privacy and separate the night/day spatial units. Furthermore the openings of both units are oriented towards this patio as a means to induce cross ventilation.

A wall/column axis grid was adopted for simplicity and economy. The walls and columns centerlines coincide with the modular lines.

The units are based on a 12'-0" Structural Module which is flexible along the long axis of the existing house in response to fluctuations in floor plan. The spatial arrangements follow a 3'-0" x 3'-0" Planning Module which also serves to define the location and size of doors, windows, partitions, wall panels and other elements.

(SEE DRAWINGS 1 AND 2)

SYSTEM COMPONENTS

All building components can be prefabricated. The degree of variations within its parts will be determined by each particular project. These components could also be pour-in-place by local-skilled labor. (SEE DRAWING 5)

STRUCTURE

The structural support for the units is provided by a two-way post and beam system made of reinforced concrete, which could be partially dependent or independent of the existing structure. This strategy results in flexibility for adjustments in plan and/or orientation.

ENCLOSURE

The requirements for providing as much ventilation as possible suggested an utilization of light-weight concrete panels that would adjust to the basic module of 3'-0". The panels have been designed as two part sections that will form a hollow wall which offers economy of materials, ease of handling and installation, the possibility of carrying the plumbing, electrical systems and insulation where needed. The panel's end are designed to form a "C" so two form a hollow square which will be filled up with concrete and the necessary steel reinforcement achieving a solid joint and structural bracing of the walls. (SEE DRAWING 4)

ROOF

The roof structure is comprised of two parts, a sun roof and a rain-roof. This system reflects the "parasol" concept, (D. Oakley) or the idea of a large umbrella or cool hat over the house.

The length and width of the roof planks and beams vary according to the spatial considerations.

(SEE DRAWING 3)

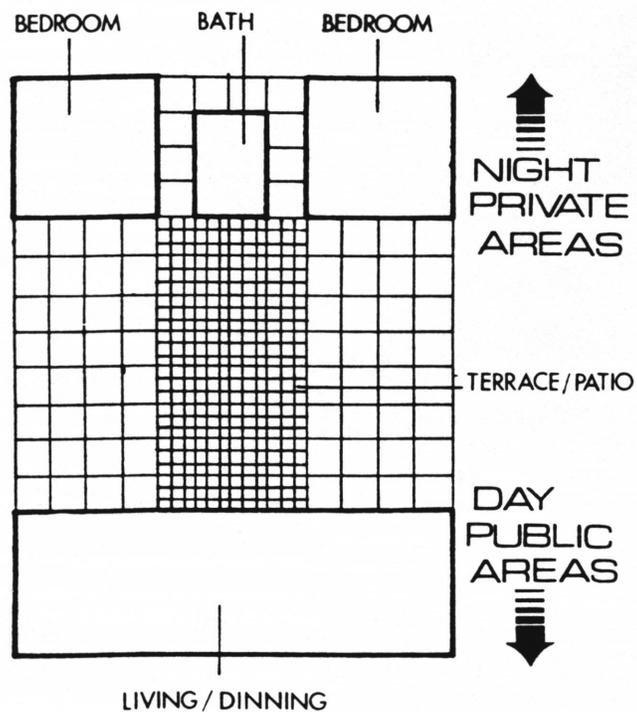
MATERIALS

The program requirements suggest a material which would be flexible, durable and permanent in the tropics as well as being available in the area.

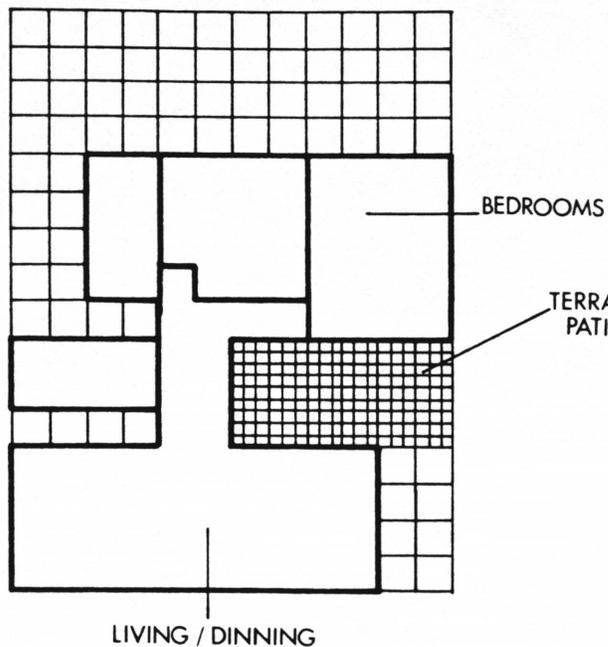
The construction material that fulfills these requirements is reinforced concrete, whose components are all found in Puerto Rico, (with the exception of reinforcing steel). The quality of the material reflects the needed sense of permanence of the dwelling, still part of our mediterranean cultural heritage.

The problem of concrete's great thermal capacity will be solved by providing shading to the roof and walls as well as by minimizing solid wall panels.

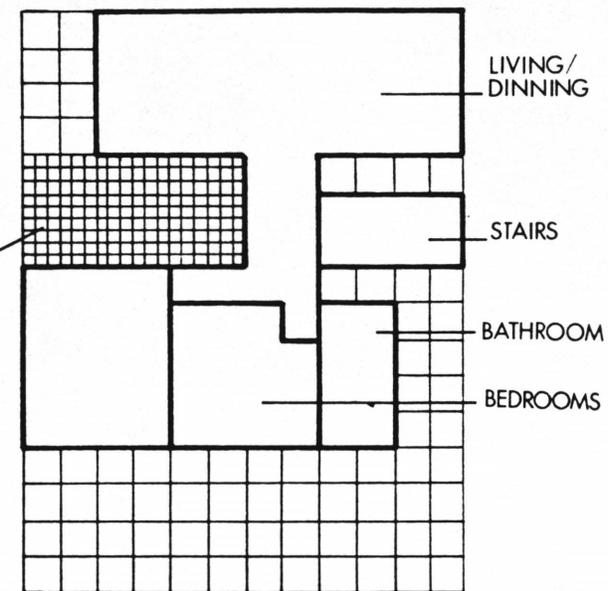
All roof surface are to be treated with waterproofing and light reflecting membranes.



OPTIMUM SPACE NEEDS

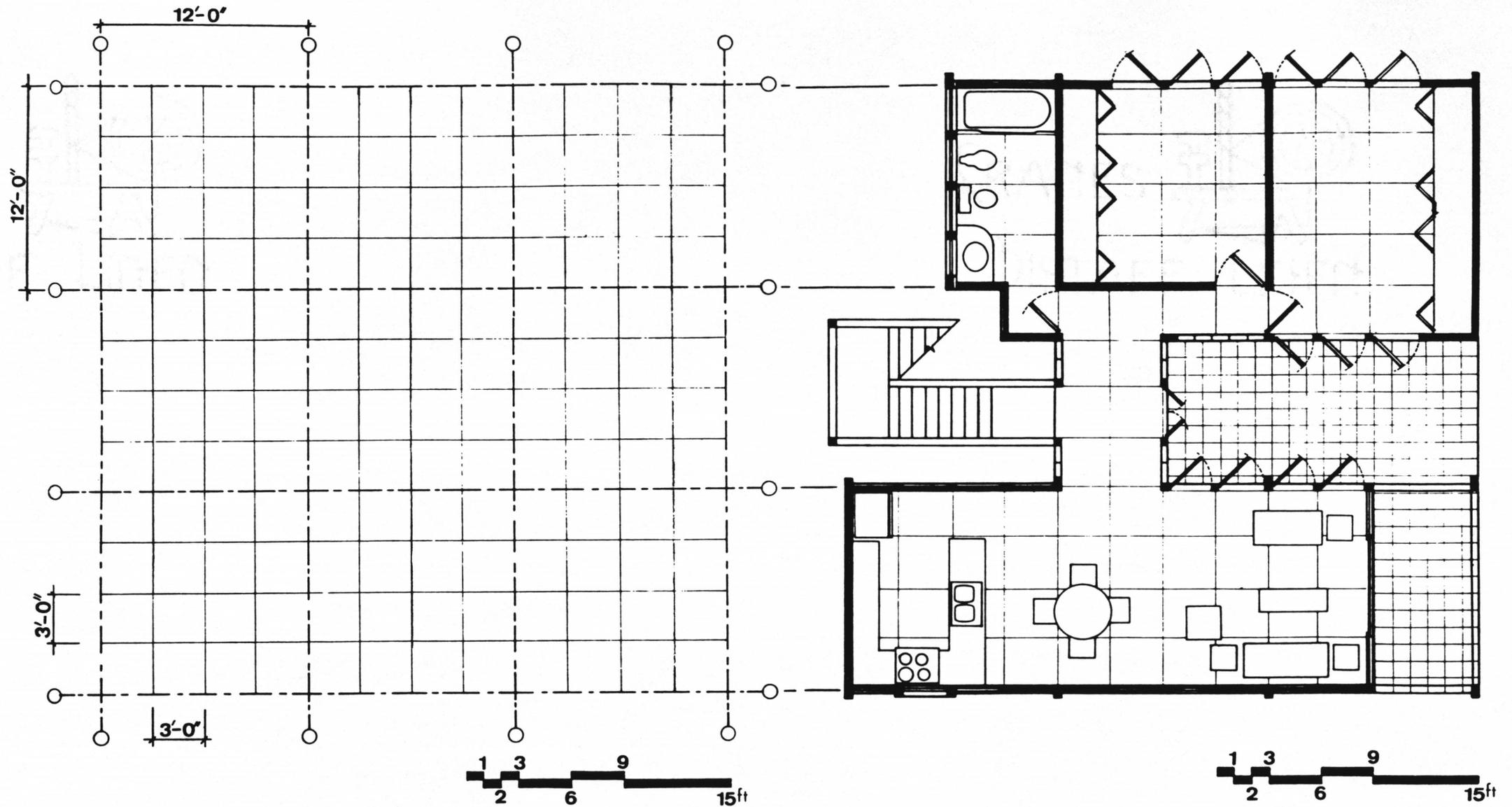


TYPICAL LAYOUT

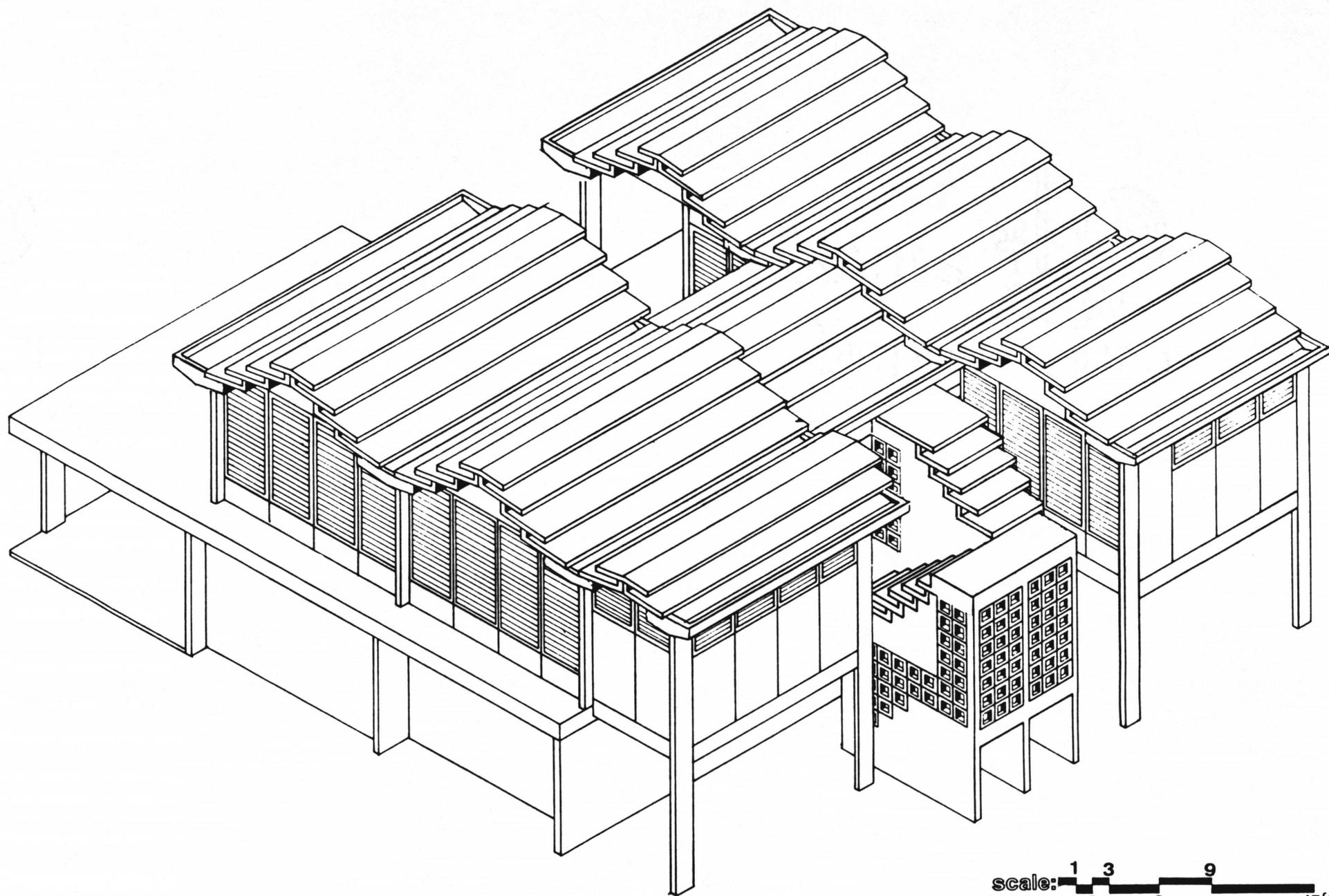


TYPICAL LAYOUT

A HOUSING SYSTEM FOR S.J. DRAWING NUMBER 1 AREAS DISTRIBUTION AND LAYOUTS

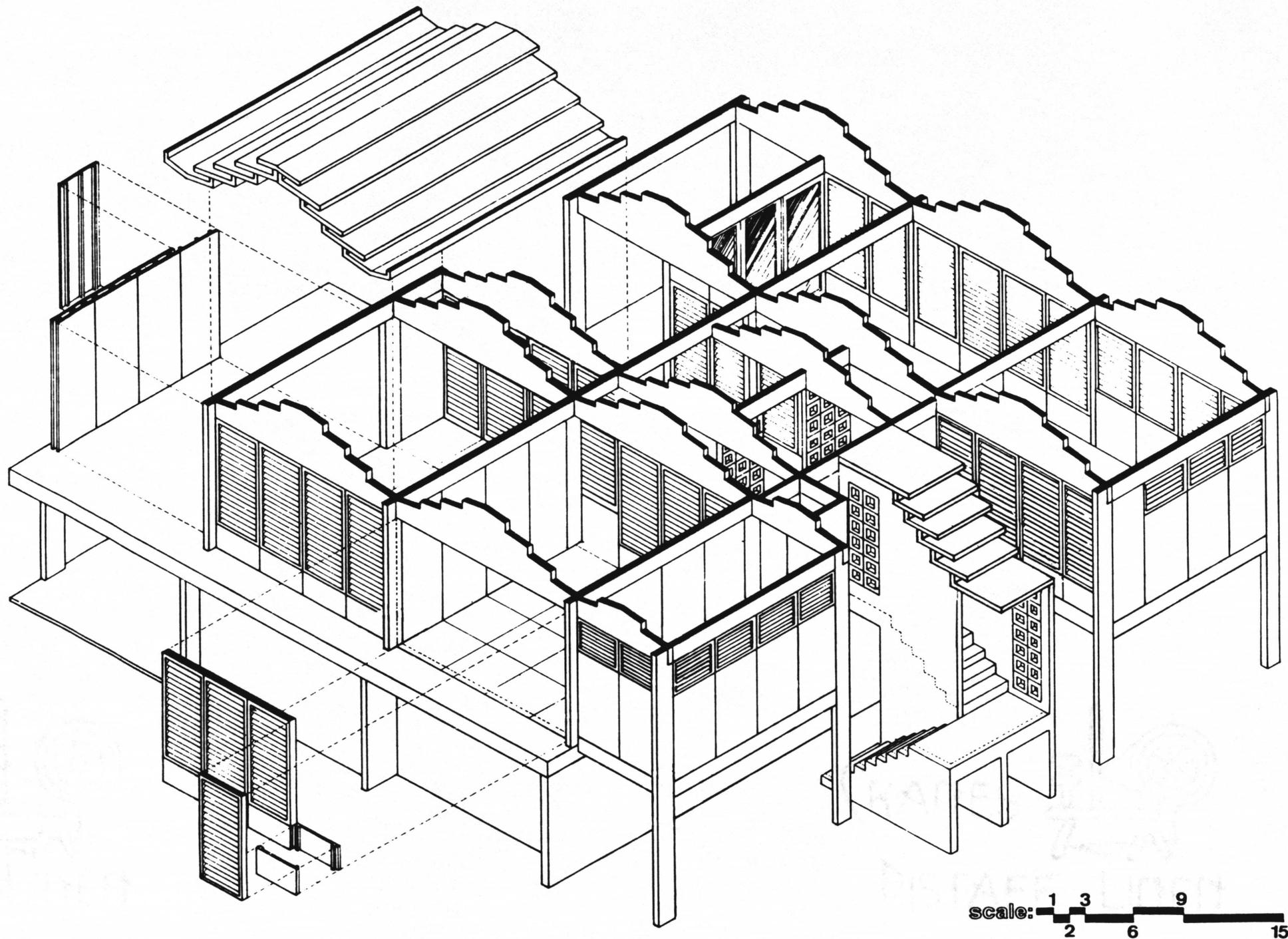


A HOUSING SYSTEM FOR S.J. DRAWING NUMBER **2** PLANNING GRID AND TYPICAL FLOOR PLAN



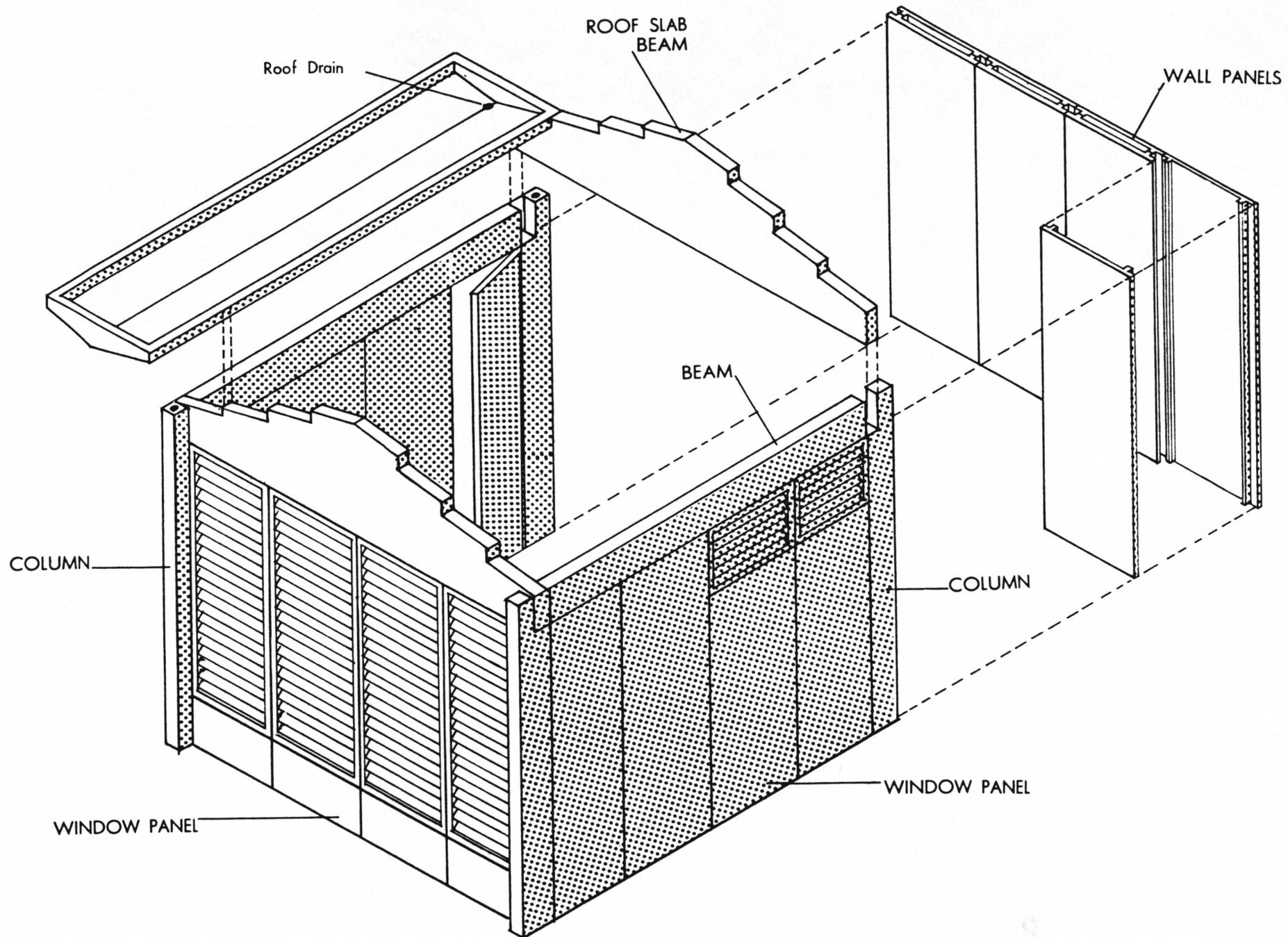
scale: 1 3 9
2 6 15ft

A HOUSING SYSTEM FOR S.J. DRAWING NUMBER 3 BUILDING ISOMETRIC



scale: 1 3 9
2 6 15ft

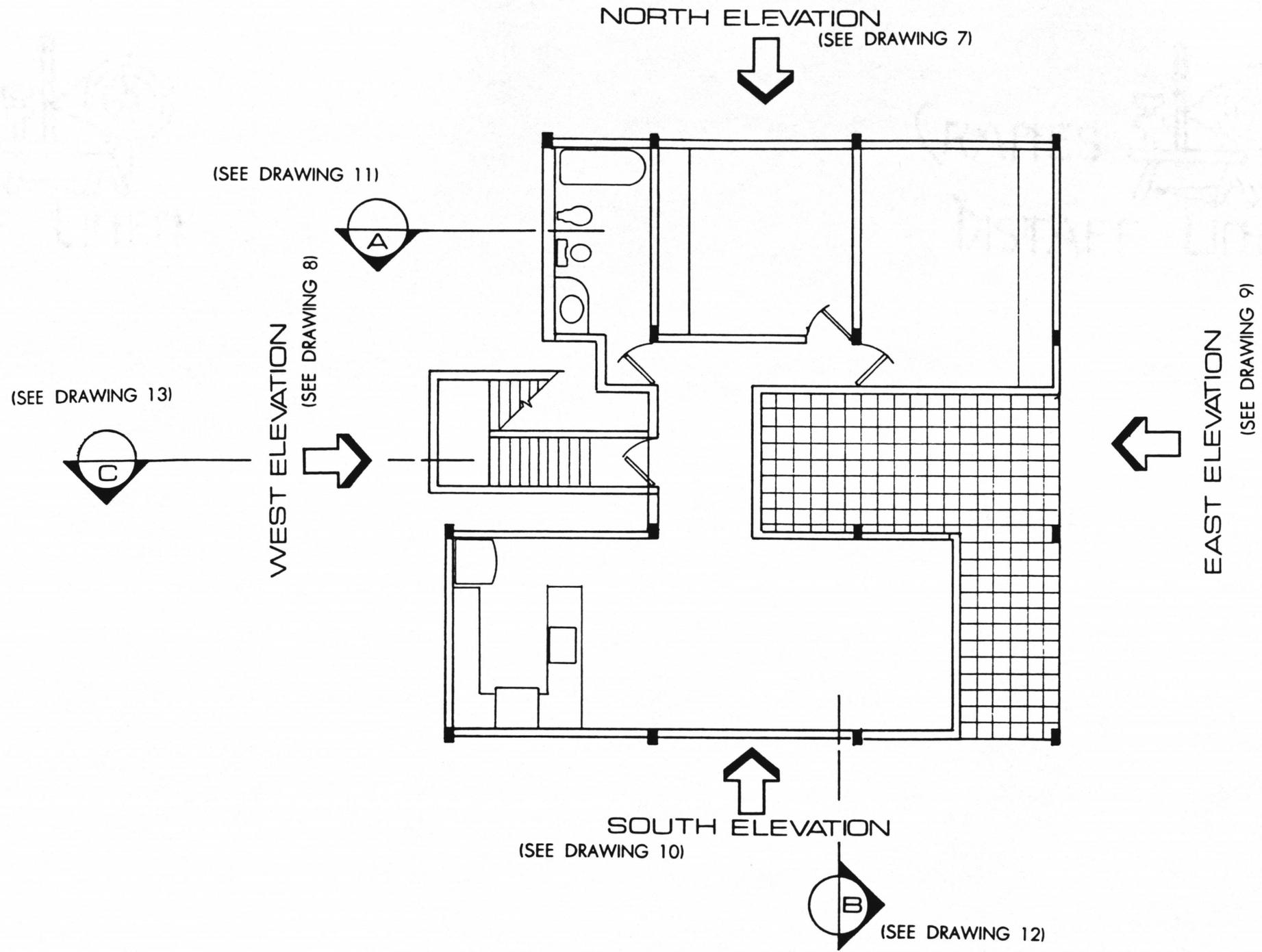
A HOUSING SYSTEM FOR S.J. DRAWING NUMBER 4 STRUCTURE ISOMETRIC



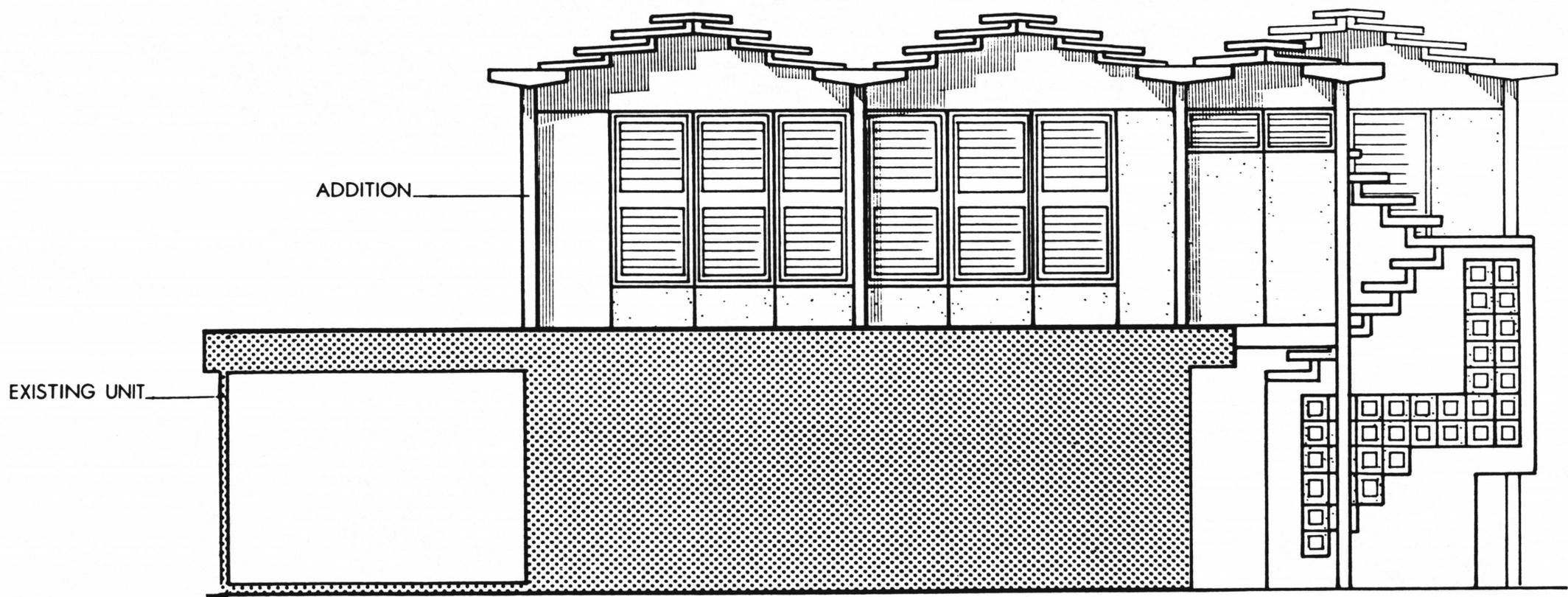
A HOUSING SYSTEM FOR S.J. DRAWING NUMBER

5

TYPICAL ROOM ISOMETRIC



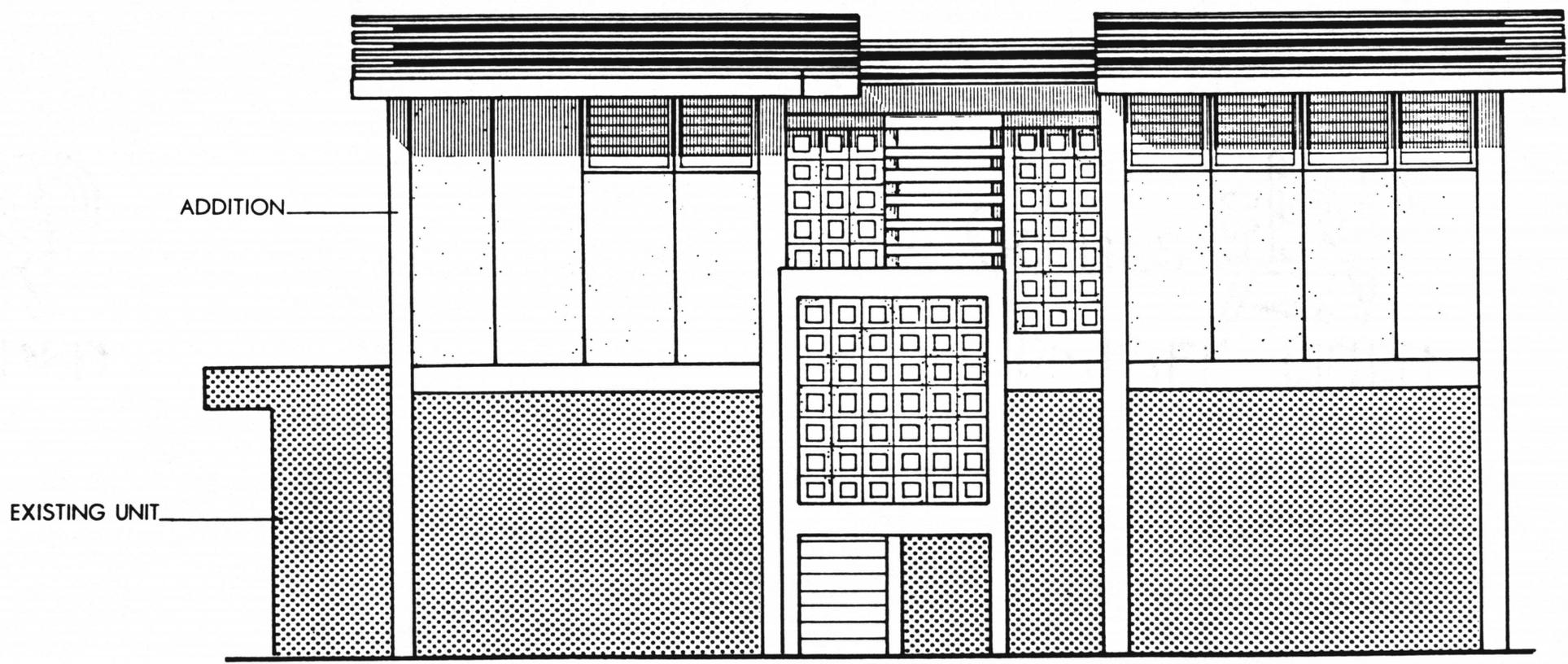
A HOUSING SYSTEM FOR S.J. DRAWING NUMBER 6 TYPICAL FLOOR PLAN



A HOUSING SYSTEM FOR S.J. DRAWING NUMBER

7

NORTH ELEVATION



ADDITION

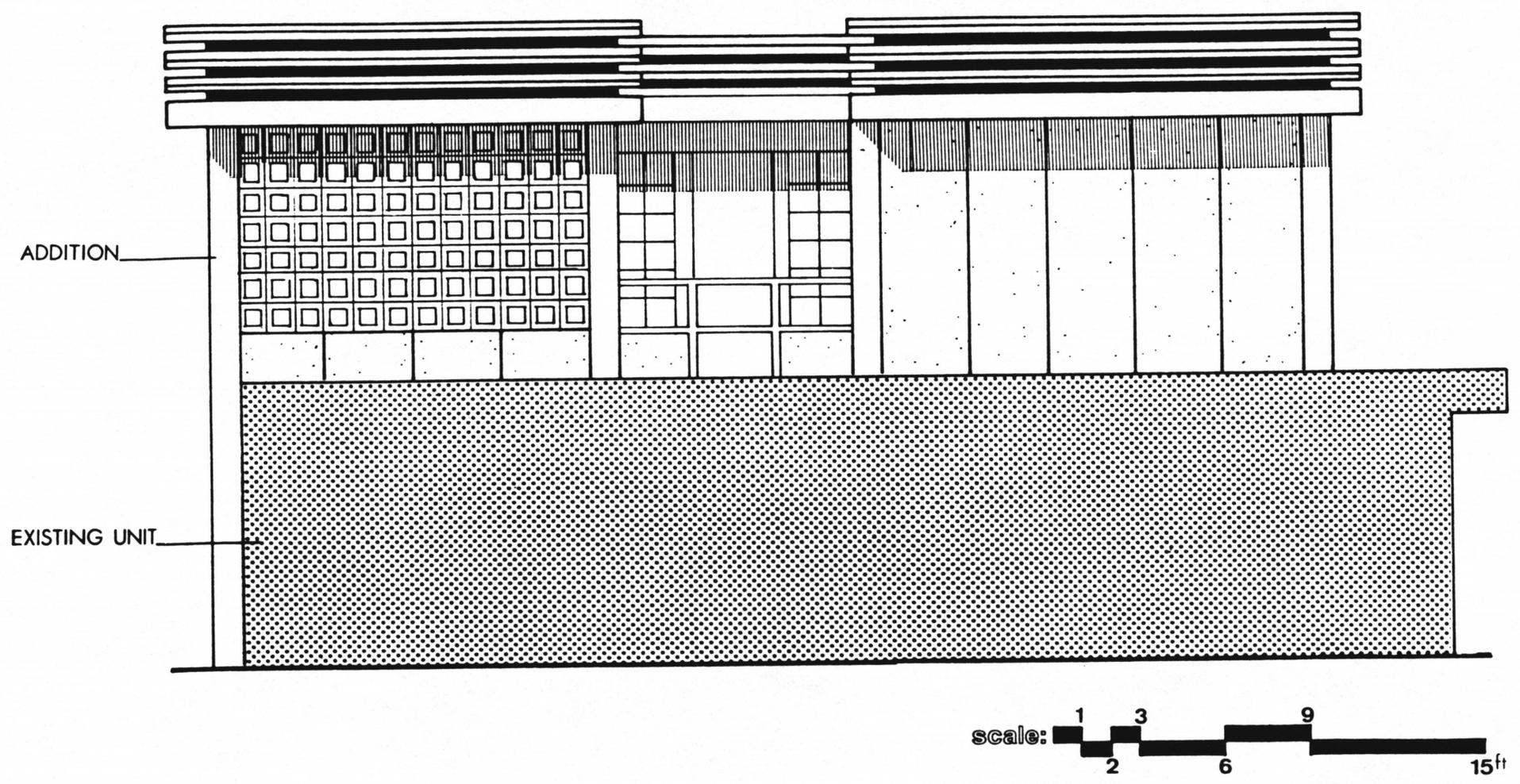
EXISTING UNIT



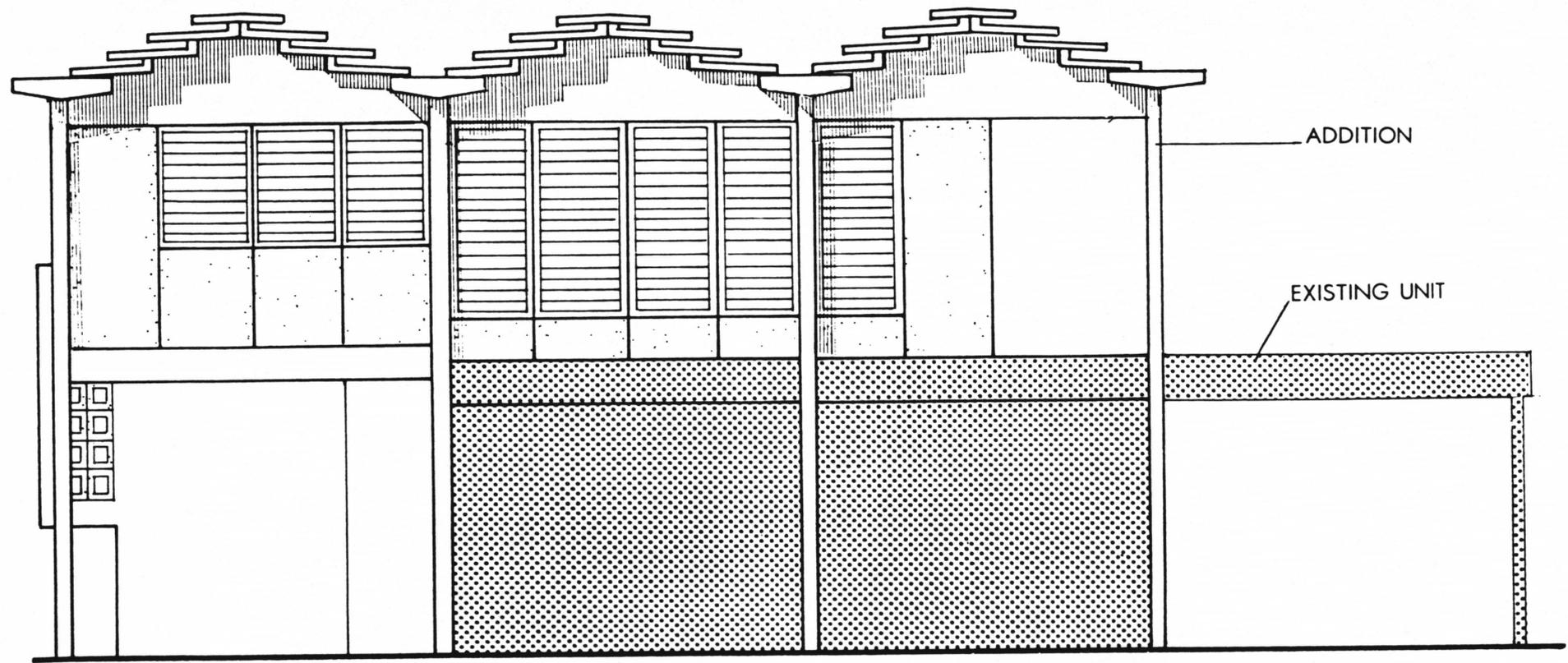
A HOUSING SYSTEM FOR S.J. DRAWING NUMBER

8

WEST ELEVATION

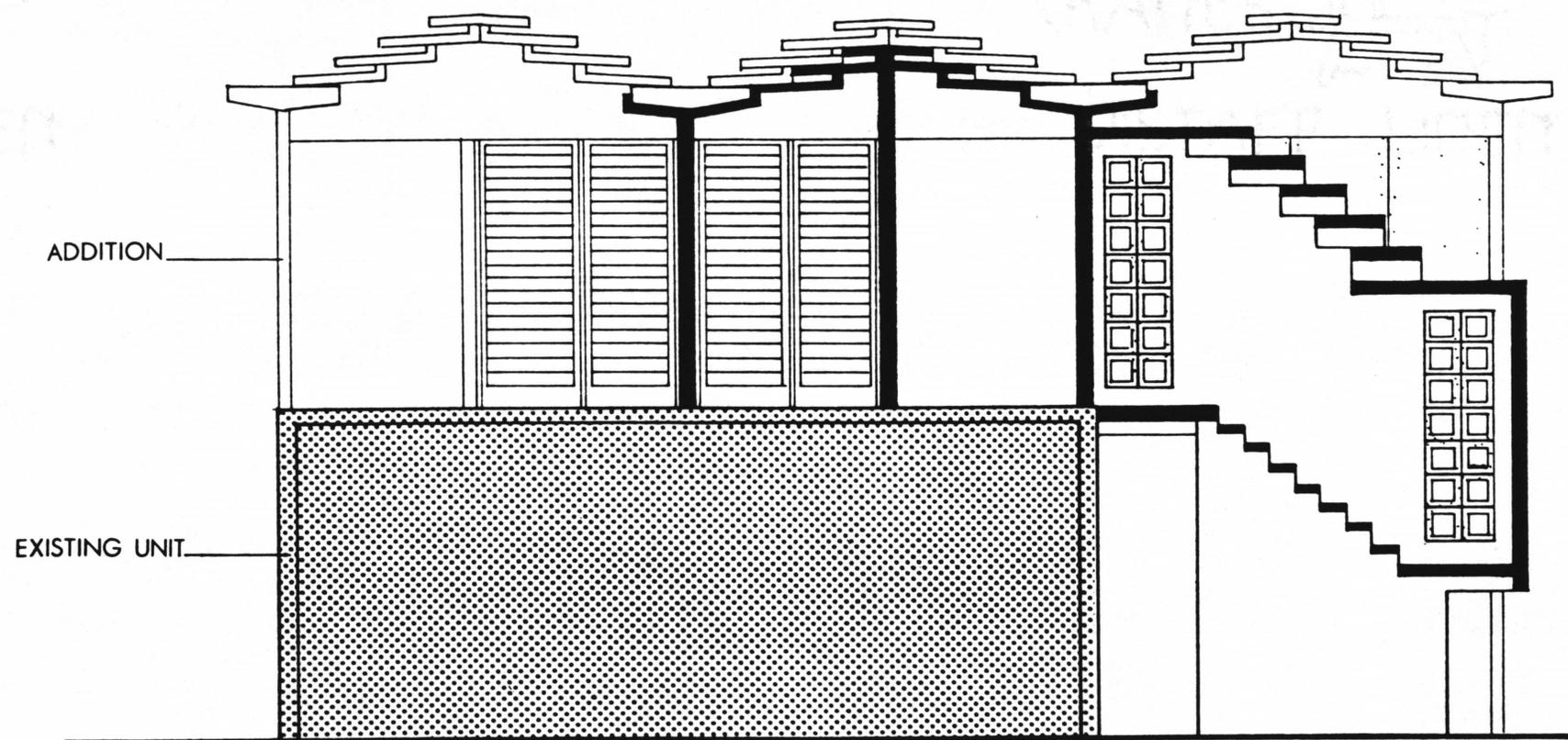


A HOUSING SYSTEM FOR S.J. DRAWING NUMBER 9 EAST ELEVATION



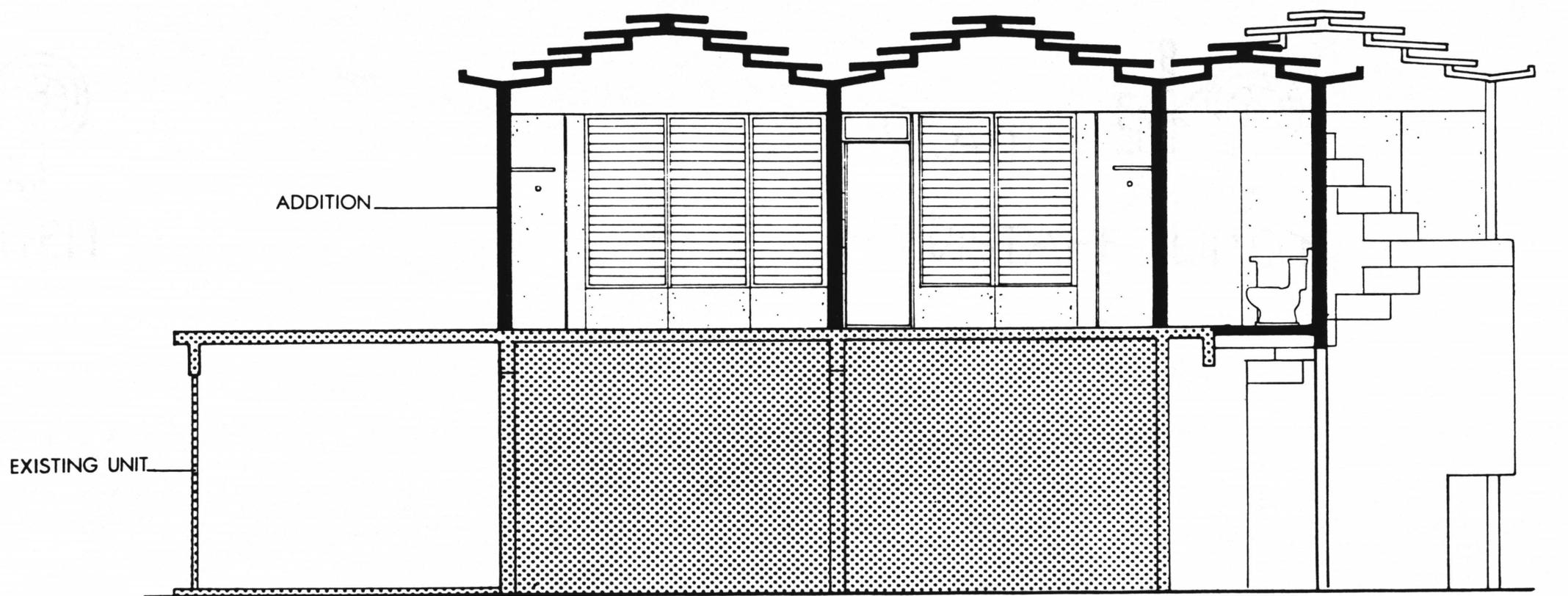
scale: 1 3 9
2 6 15ft

A HOUSING SYSTEM FOR S.J. DRAWING NUMBER 10 SOUTH ELEVATION



A HOUSING SYSTEM FOR S.J. DRAWING NUMBER 13 SECTION

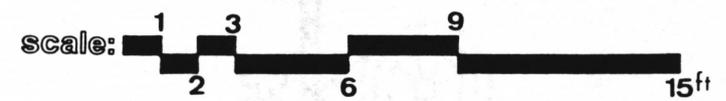
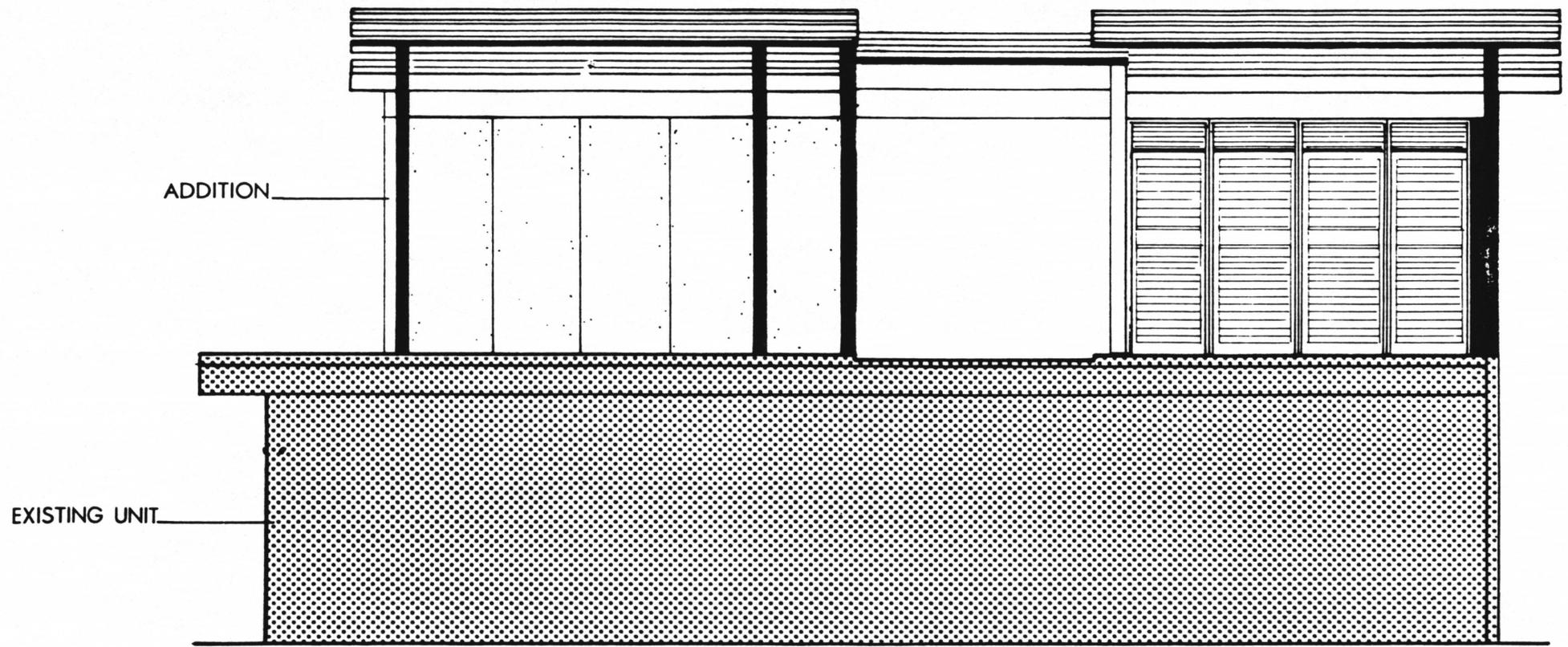




A HOUSING SYSTEM FOR S.J. DRAWING NUMBER 11

SECTION





A HOUSING SYSTEM FOR S.J. DRAWING NUMBER 12

SECTION 

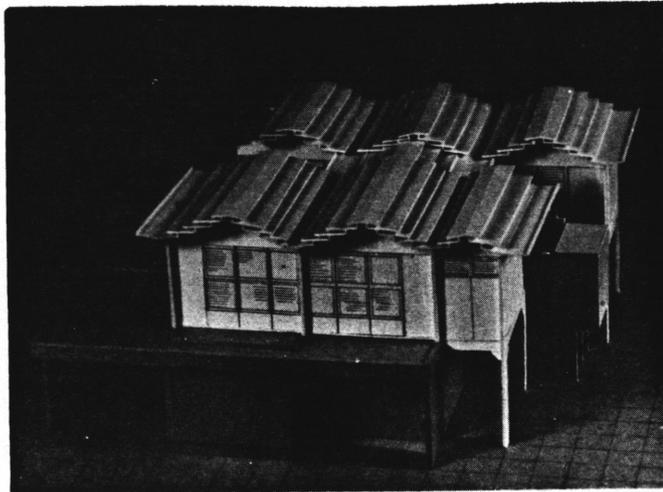


FIGURE .27

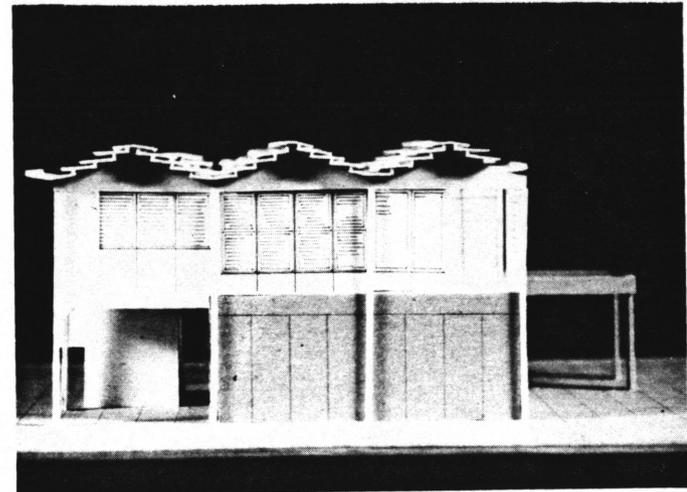


FIGURE .30

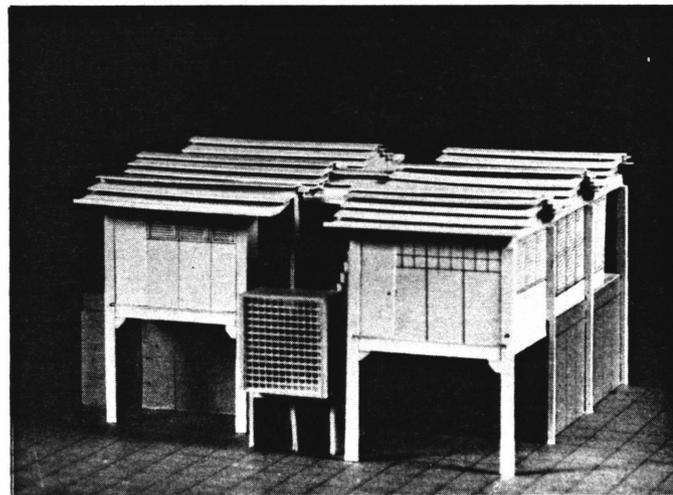


FIGURE .28

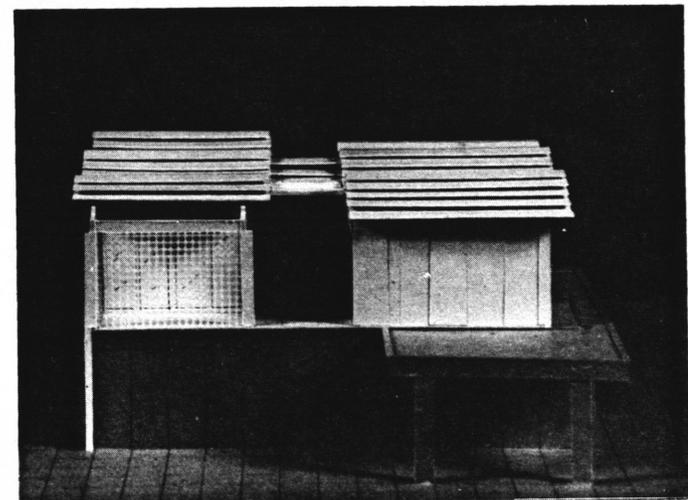


FIGURE .31

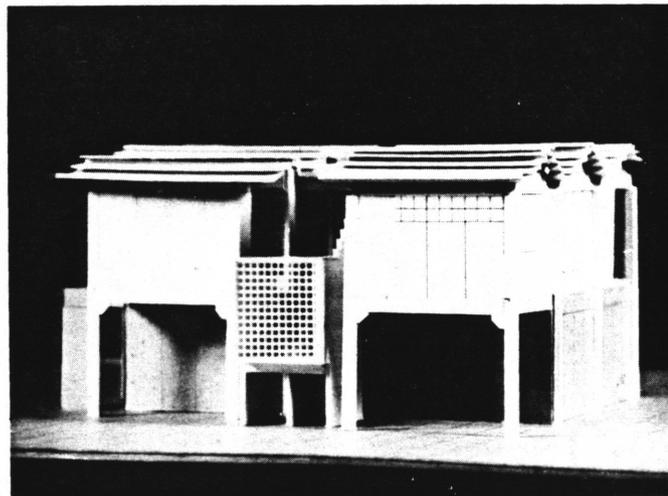


FIGURE .29

STUDY MODEL, FIG. 27-31

OFF LINE

DISTANCE

CONCLUSIONS

In developing a concept for a structural and enclosure system applicable to the typical existing urban housing in San Juan, it was found that the existing units are indeed important aspects of the problem. Each housing project in San Juan has its own identity and is intended for a specific population segment, making the units usually unique.

The statistics in the Roberto Ponce's study about housing in P.R. clearly shows the owners dislike for their house size and design by making structural and decorative changes during the first five to ten years of owning the unit.

Therefore the housing system developed is as independent as possible from the existing housing unit and its particular characteristics such as: structural arrangement, spatial organization, building orientation, etc...

The combination of the housing system characteristics such as its flexible planning and structural module and the organization of the plans into two areas, divided by a central court, allows for the additions to respond directly to the contextual factors and existing conditions in each case.

The division of the units into two functional areas divided by a central patio respond to the cultural and social needs of the Puerto Rican's providing them with private-public areas which at the same time function as night/day, and with an outdoor gathering place.

The use of relatively small building components make it possible to have a system either pre-fabricated or poured-in-place by local labor.

The findings and suggestions proposed in this work are presented in a general sense and do not address a particular project or housing scheme. The system proposed does not pretend to be the final solution to the problems of housing in San Juan, but to identify general objectives and solutions that would help to bring about harmony, simplicity, economy variety, and above all meaning to future alternatives to solve this interesting problem.

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