CENTER FOR ENVIRONMENTAL STRUCTURE

HOUSES GENERATED BY PATTERNS

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ACKNOWLEDGEMENTS

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Finally, we should like to thank Peter Land for having created the whole idea of the Proyecto Experimental de Vivienda and the competition, which gave us the chance to make these designs.

Second Printing 1970

printed by bgd

Jurors' comments on 4 of the international submissions

The jurors

Eduardo Barclay (Peru), José Antonio Cederch (Spain), Halldor Gunnlögsson (Denmark), Carl Koch, (USA/UIA), Peter Land (UNO), Ricardo Malachowski (Denmark), Alfredo Perez (Peru), Manuel Valega (Peru), Ernest Weissmann (UNO), Darío González (Peru), and Alvaro Ortega (UNO).

Jurors' comments on 4 of the international submissions

Atelier 5

An interesting method of construction with pre-cast concrete elements is proposed for use in both wall and roof construction, with good possibilities for reducing building costs. The design of the house is on two levels with somewhat complex combination of internal spaces and patios. The compact grouping of houses around small plazas is good, which together with the separation of pedestrians and automobiles should provide a tranquil environment for family life. The commercial and educational facilities are located on landscaped plazas in the centre of the community and are conveniently accessible from the housing clusters by means of a winding service road.

Kikutake, Maki and Kurokawa and Associates

The building method employs pre-cast concrete wall and floor units which are assembled in single or double combinations depending upon the loading conditions. Foundations are also pre-cast and the overall system is simple, well worked out and could lead to building economies. The design of the houses separates service and living functions through the cross section of the house and all houses contain a central patio the size of which depends upon the amount of living accommodation. The house design also includes proposals for service zone equipment including kitchen, sanitary and storage units. This approach to low-cost housing design could produce interesting new ideas and economies and could encourage the local industry for producing these elements. The overall design for the community proposes a separation of pedestrians and automobiles and landscaping proposals with water gardens and channels. Some members of the jury felt however, that the central public area was too extensive for effective use.

Herbert Ohl

This project brakes away from conventional concepts of urban development. It proposes a highly mechanized method of manufacturing rectangular reinforced concrete elements which can be assembled in different patterns and numbers of units to create the shell of the house in sizes accommodating different requirements. The project also offers a new method of foundation which should result in a reduction of construction time and costs. The internal arrangement of houses is independent of the shell thus offering flexibility in use and a possibility of changing the disposition of the built-in space in response to changing family size or standard of living. The design of the community proposes a central spine below the pedestrian level which also contains the utility mains and underground parking which could be built in stages as required in the future. Series of small pedestrian streets and plazas connect the spine with residential zones north and south and also cross the spine at ground level as and where necessary. The design provides a safe environment for family and community life by excluding cars entirely from the ground level in residential areas. In connection with this radical departure from conventional urban design some members of the jury felt that collective transportation was a means of reducing the use of private automobiles, a major source of accidents and environmental pollution.

The project combines contemporary ideas in urban planning with industrial housing technology which, if used wisely and guided by concern for human dignity, could provide flexibility for growth and change.

See, below, a minority opinion on this project.

Center for Environmental Structure

This proposal recommends the use of several traditional building materials such as bamboo and a new type of block construction for the walls. Patios are included in the houses which are placed on long lots and arranged in groups from which the traffic is excluded. In this project special emphasis is put on the processes of building and exercising choice by families, among a variety of house arrangements, in regard to individual requirements and preferences. The special contribution of this project is its sociological approach in analysing family living and providing a considerable level of 'decency' at rents attainable to families with low incomes. A group of these houses using the building processes and methods proposed would provide a feasibility test of methods and techniques of social inquiry into family requirements and preferences; the degree of flexibility of the system in terms of changed family requirements and levels of living; and the contribution of self-help and the use of local building materials in combination with industrialized methods of construction. Some members of the jury felt that this project therefore was highly applicable in connection with the pilot project of sites and services. They also felt that the house design as presented tends to respond to customs and traditions some of which have been already changed rather than accommodating a process of change and improvement as family incomes rise. It also accepts the private car as the major means of urban transportation without suggesting alternative ways of organizing urban transport. Some members however stressed that though the street pattern was too complex; the convenience of ready access from the house to the family car was important.

See, below, a minority opinion on this project.

Minority report

The undersigned are in complete disagreement with the majority on two projects, as follows:

Herbert Ohl's is a personal regimented and expensive solution both as to dwelling units and site plan. It is inhuman.

Christopher Alexander's (Center for Environmental Structure) attacks the low-cost housing problem with special application to Peruvian conditions and resources in an imaginative way far above the level of all other projects. It is the only project which effectively meets the programme requirements to develop new ideas and techniques for low-income housing. We particularly commend it for emphasizing in every design decision the need to provide freedom of individual choice.

We strongly urge the UN to publish this milestone in low-cost housing design as it is—*now*, so that it may benefit the many in all countries who need and are awaiting new and better answers.*

The highly complex problem of low-cost housing in Peru, as in many other countries all over the world, is perhaps not a practical subject for an international competition. Unanimity cannot be expected on a problem still so far from being effectively attacked, let alone being solved. We wish to record our opinions of the aforesaid two international projects in the hope that they may be useful to others that may share our disappointment with the results of this competition.

Herbert Ohl's exemplifies a philosophy of design which we deplore as the basis for determining a living environment for free families of individuals. Reasonable choice, adequate access, light and air, pleasant living arrangement, indeed any economy or advantage other than repetition have been sacrificed to a limited and limiting structural concept. The precast rectangular concrete rings even fail in this submission to utilize their main advantage—the opportunity to prefabricate the mechanical and interior components off site.

The site plan was to us as disappointing as the dwelling units. The travelling crane appeared to be, rather than a useful tool, the designer of the whole project. To base the overall plan on a central sunken automobile road and garage is both economically unrealistic and of questionable virtue. We agree that the automobile is a serious problem, but what Herbert Ohl proposes is a questionable solution.

Christopher Alexander, on the other hand, throws a bright new light on a gloomy subject. A freshness of approach, a commitment to the dignity and worth of the individual, a recognition and understanding of the complex linkages between this individual, his family, his belongings, his neighbours, and the entire community are implicit in each part of their proposal. On the mundane practical level, they met well the requirement to provide a building system to use the fewest standard components to provide the maximum variety and choice of solution. The technical proposals indicated a balance between innovation and assured practicality. We believe that in the context of present Peruvian building practice, the proposed bamboo and urethane structural components as well as the sulphur components, while neither all original, nor yet proven were much more in the spirit of the programme than appeared to be recognized by a majority of the jury. The workability of their concept, however, is not dependent on any or all of these technical proposals and in our opinion, even if only presently proven materials and methods are used, the outstanding quality of the overall submission remains unimpaired.

Fortunately for all others needing low-cost housing (though it may have worked against them in this instance) their presentation was also innovative in the form of a booklet in both English and Spanish which included their plans and arguments well related.

Carl Koch, Alfredo Perez, Halldor Gunnlögsson

* *It has already been published* (*see p. 169*)

Reprinted from Architectural Design, April 1970 issue, page 189.

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PREFACE: THE PROYECTO EXPERIMENTAL DE VIVIENDA

In January 1969 the United Nations, working with the Banco de la Vivienda of Peru, asked us and twelve other architects from various countries to submit competition designs for a community of 1500 houses. The houses are to be built at a gross density of 37 houses per hectare on a site of 40 hectares, 8 kilometers north of Lima. The site is bounded by two major arterial highways, and crossed by a third; these highways are fixed by the Lima transportation plan. The financial arrangements require that each house be contractor built, on its own land, at a cost ranging from 78,000 to 164,000 soles ($1800 - $3800), and that they be sold to low income white collar workers (empleados) earning between 2,800 and 5,800 soles ($65 - $135) per month.

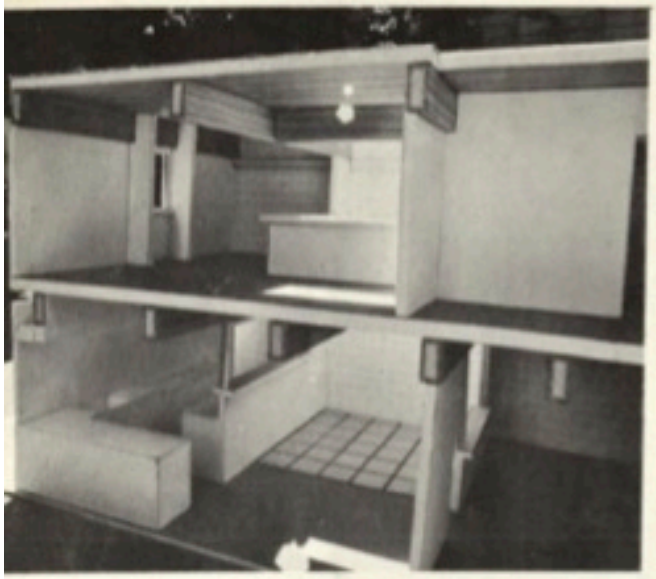
We were asked to present our designs in a way that would help the evolution of Peruvian community and house design in the future. We have therefore chosen to present our work in two parts:

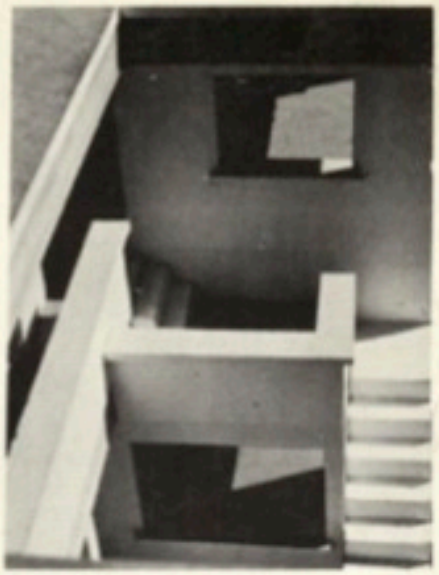
In part one we present our designs. This includes a site plan, drawings and construction details for individual houses,

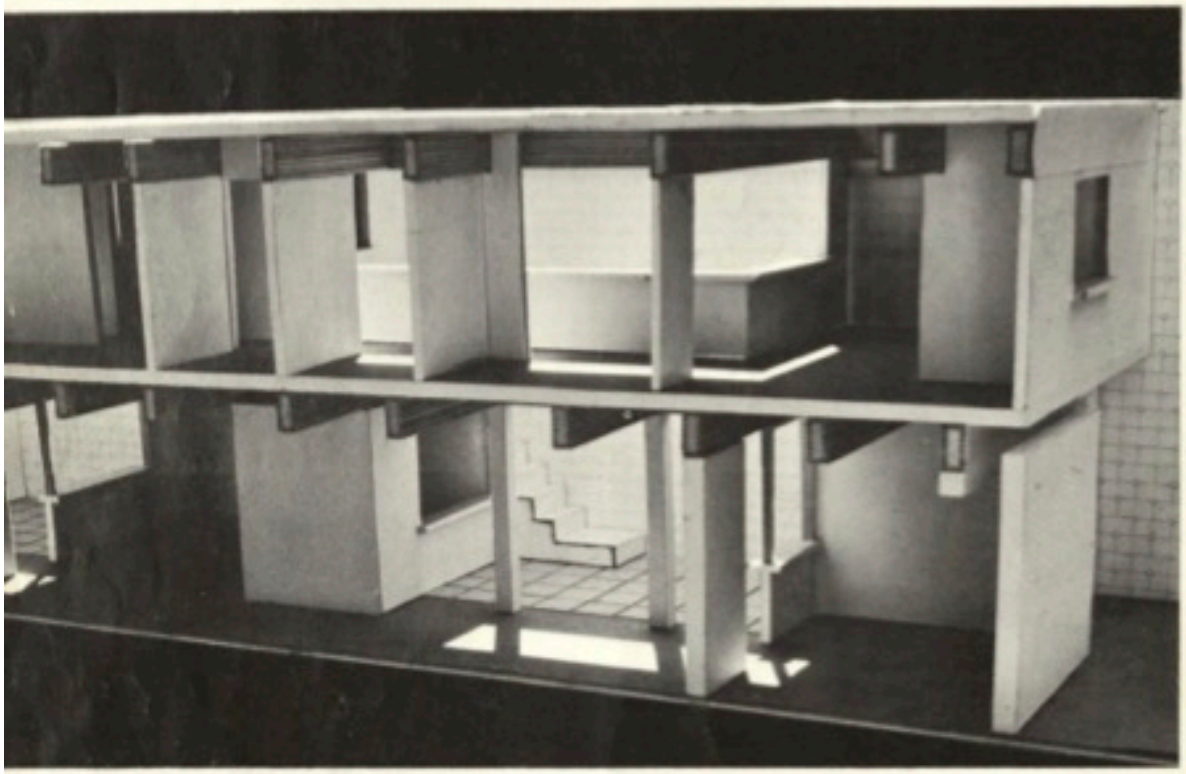
and a choice process which allows the final site and house plans to be formed, in detail, by the idiosyncratic needs of the individual families who buy the houses.

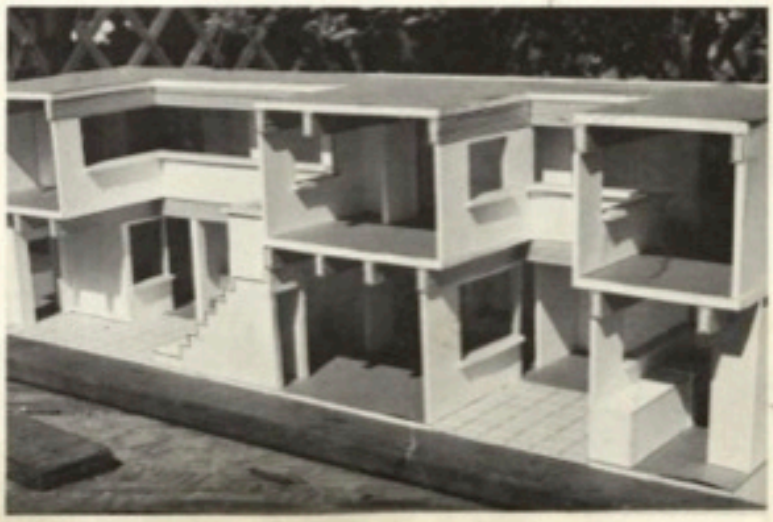
In part two we present sixty-seven general design principles which we call patterns. These patterns describe, in an abstract sense, the lessons which a Peruvian architect might learn from our designs, and could re-use, over and over again, in his own designs. We have combined these sixty-seven patterns in one particular way, to form the designs presented in part one. However, in the hands of different Peruvian architects, or in the hands of different individuals designing and building their own houses, these patterns can generate an almost infinitely rich variety. In this sense, these patterns may begin to define a new indigenous architecture for Peru.

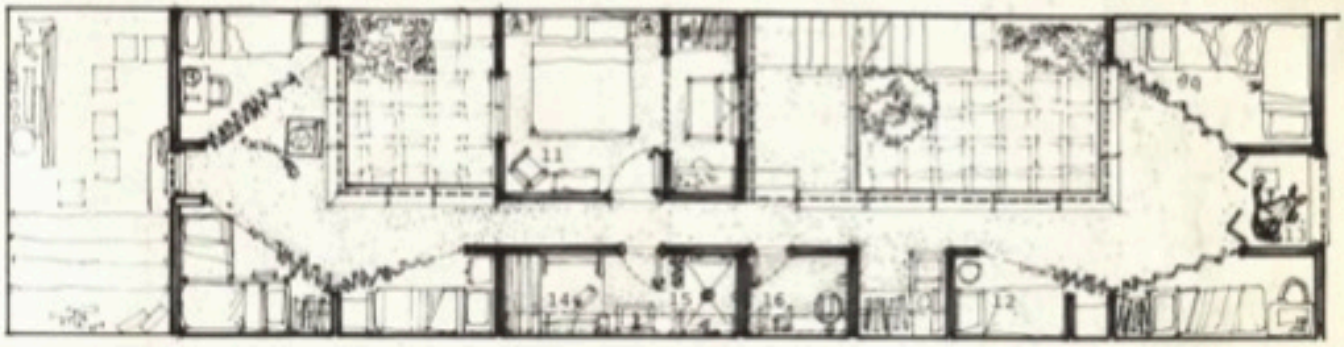
THE DESIGNS



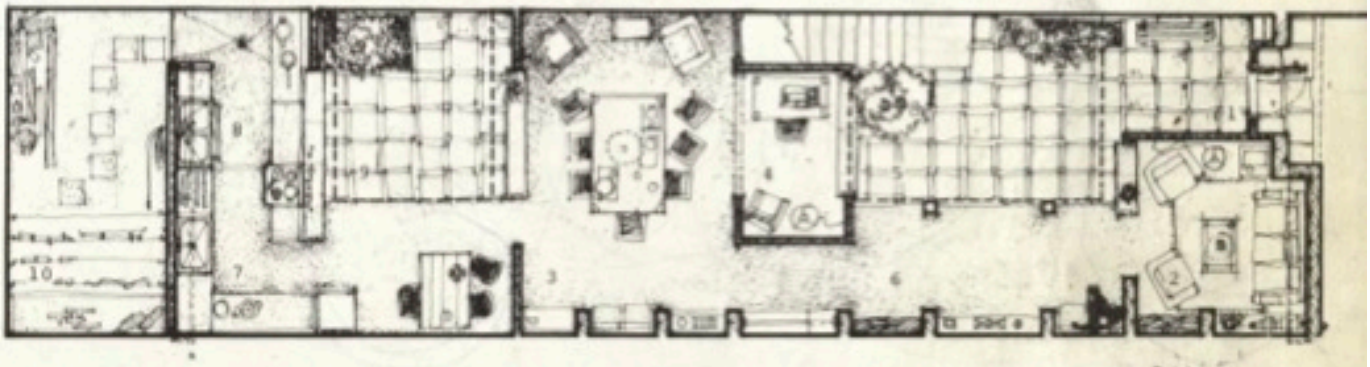








Second Floor

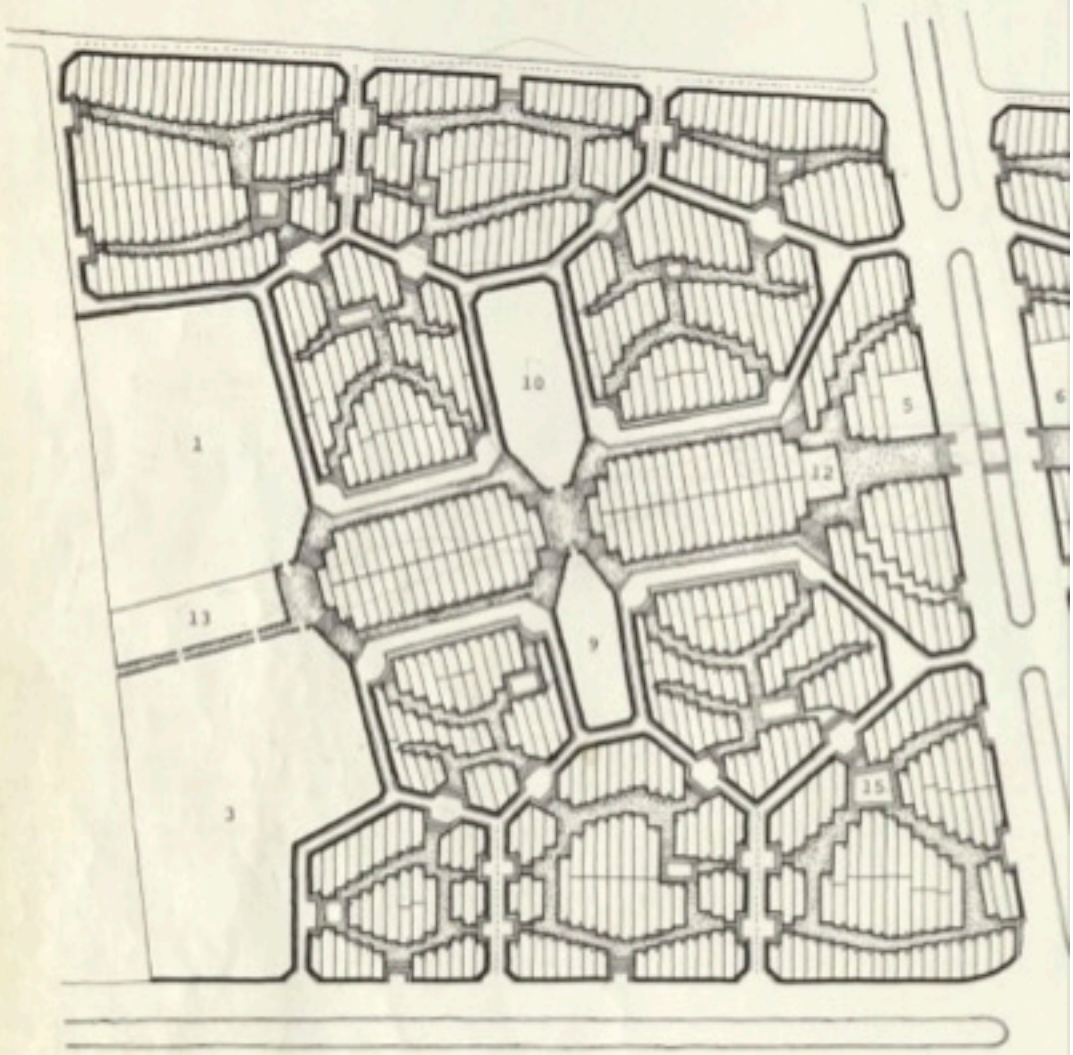


First Floor

0 1 2 3 4 5 Meter

1 Entrance
2 Sala (Parlor)
3 Family Room
4 Family Room Alcove
5 Main Patio
6 Veranda
7 Kitchen
8 Laundry
9 Kitchen Patio
10 Storage Patio
11 Master Bedroom
12 Bed Alcoves
13 Mirador
14 Clothes Drying Closet
15 Shower
16 Toilet

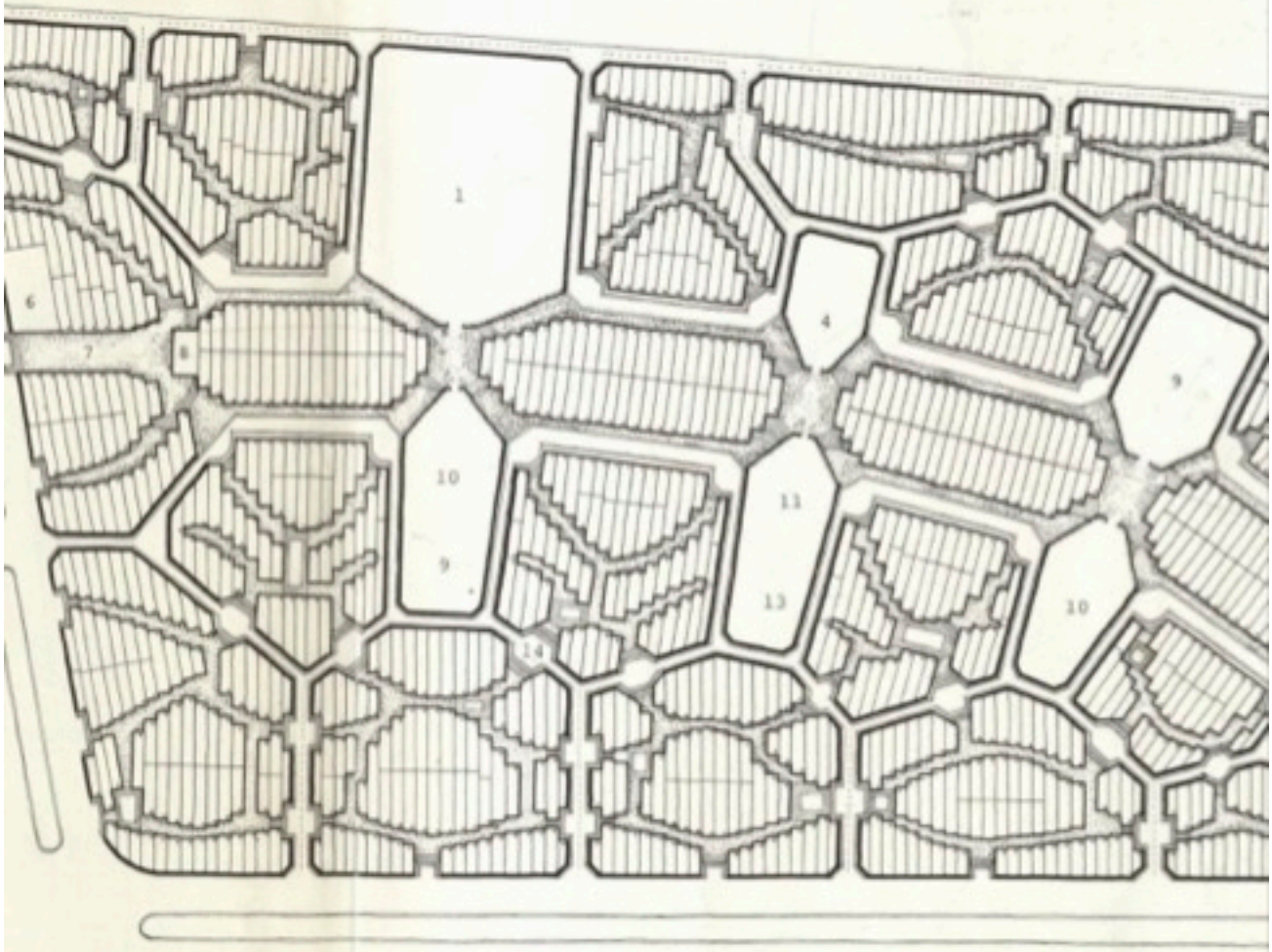
THE GENERIC HOUSE



North

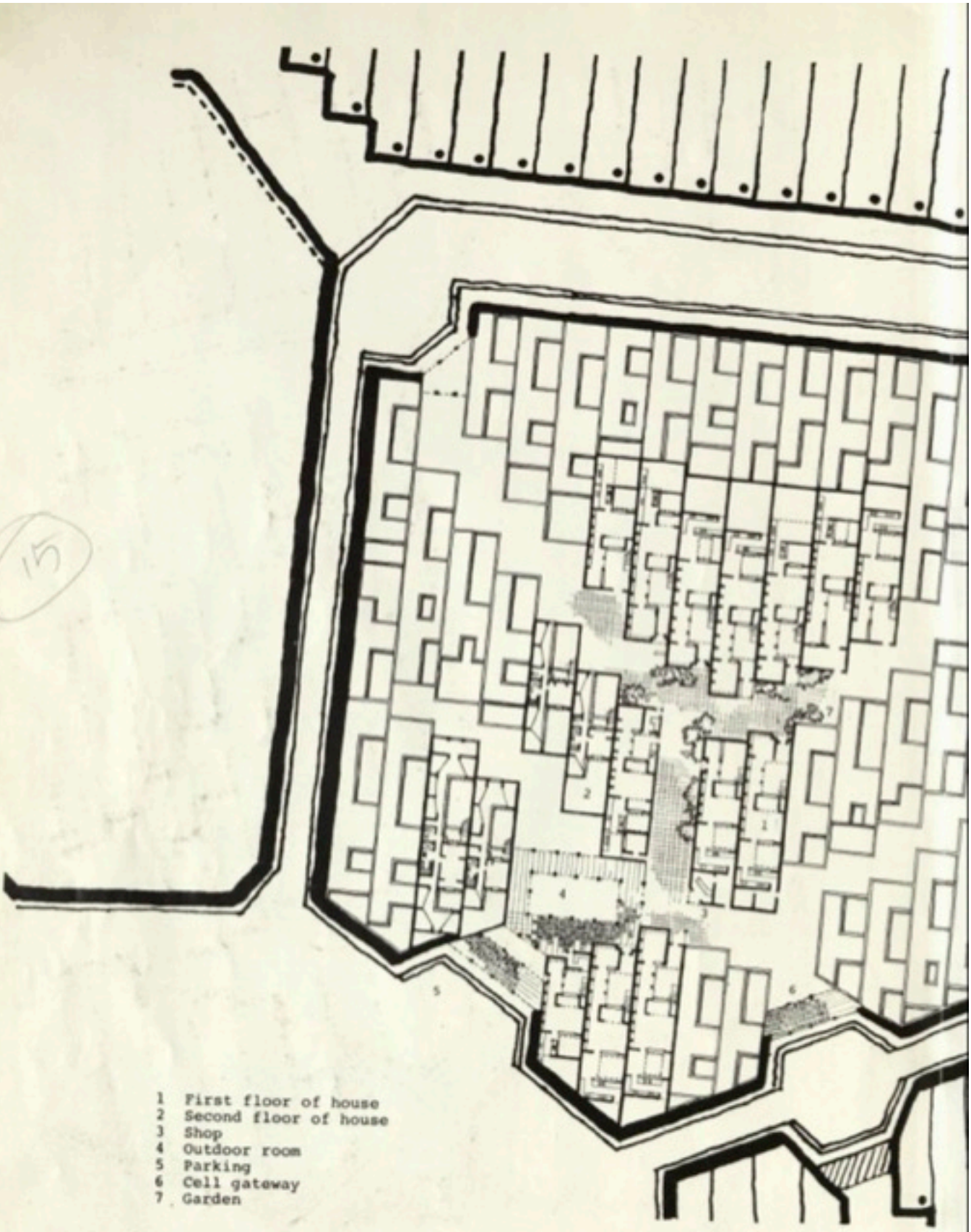
0 50 100 200 Meters

1 2 3 4 5 6 7 8

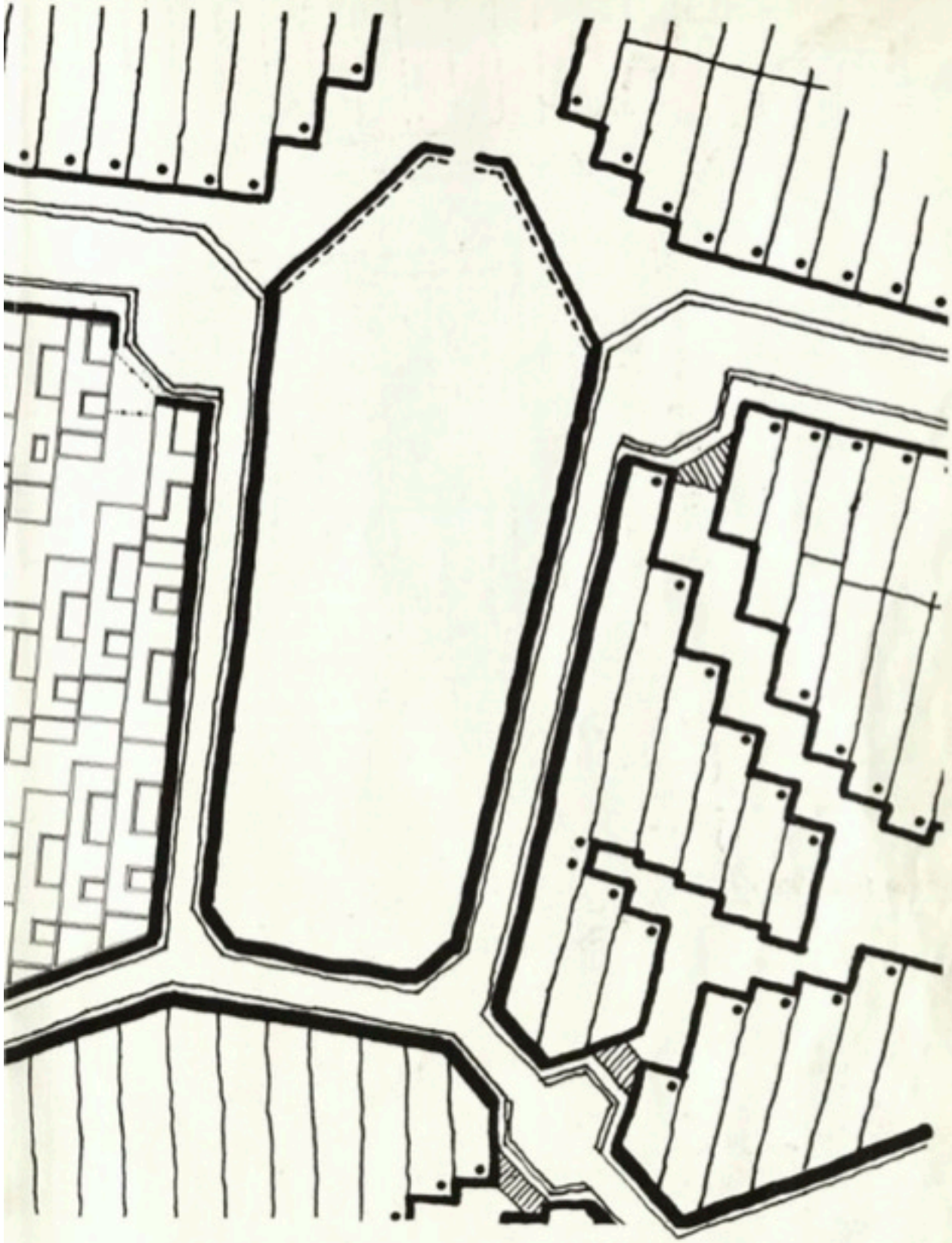


1 Primary School
2 Secondary School
3 Technical Secondary School
4 Church
5 Cinema
6 Supermarket
7 Market
8 Municipal Offices
9 Grové of Trees
10 Kindergarten
11 Clinic
12 Dance Hall
13 Sports Center
14 Parking
15 Outdoor Room

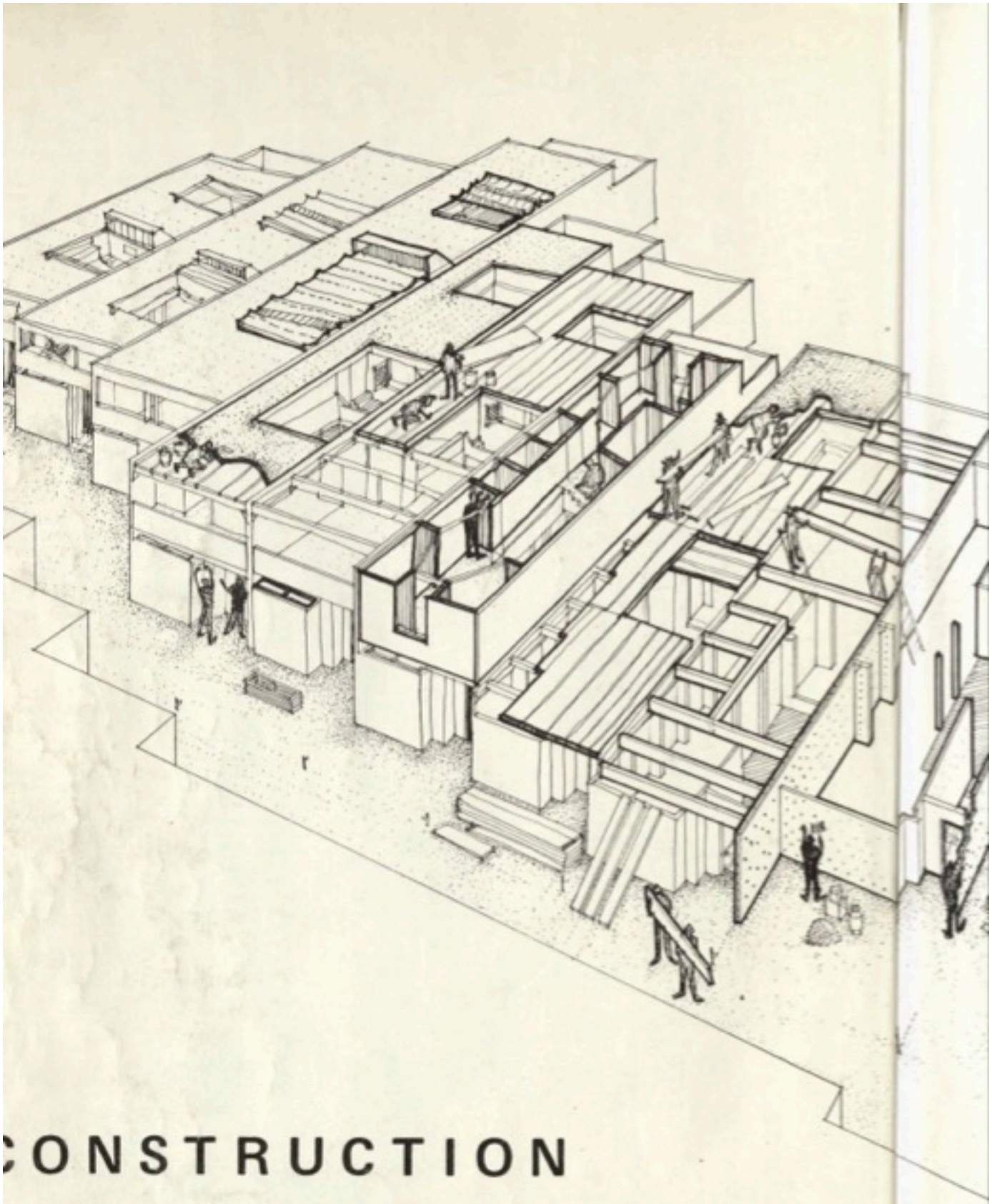
THE S


1 First floor of house
2 Second floor of house
3 Shop
4 Outdoor room
5 Parking
6 Cell gateway
7 Garden
0 5 10 20 50 Meters

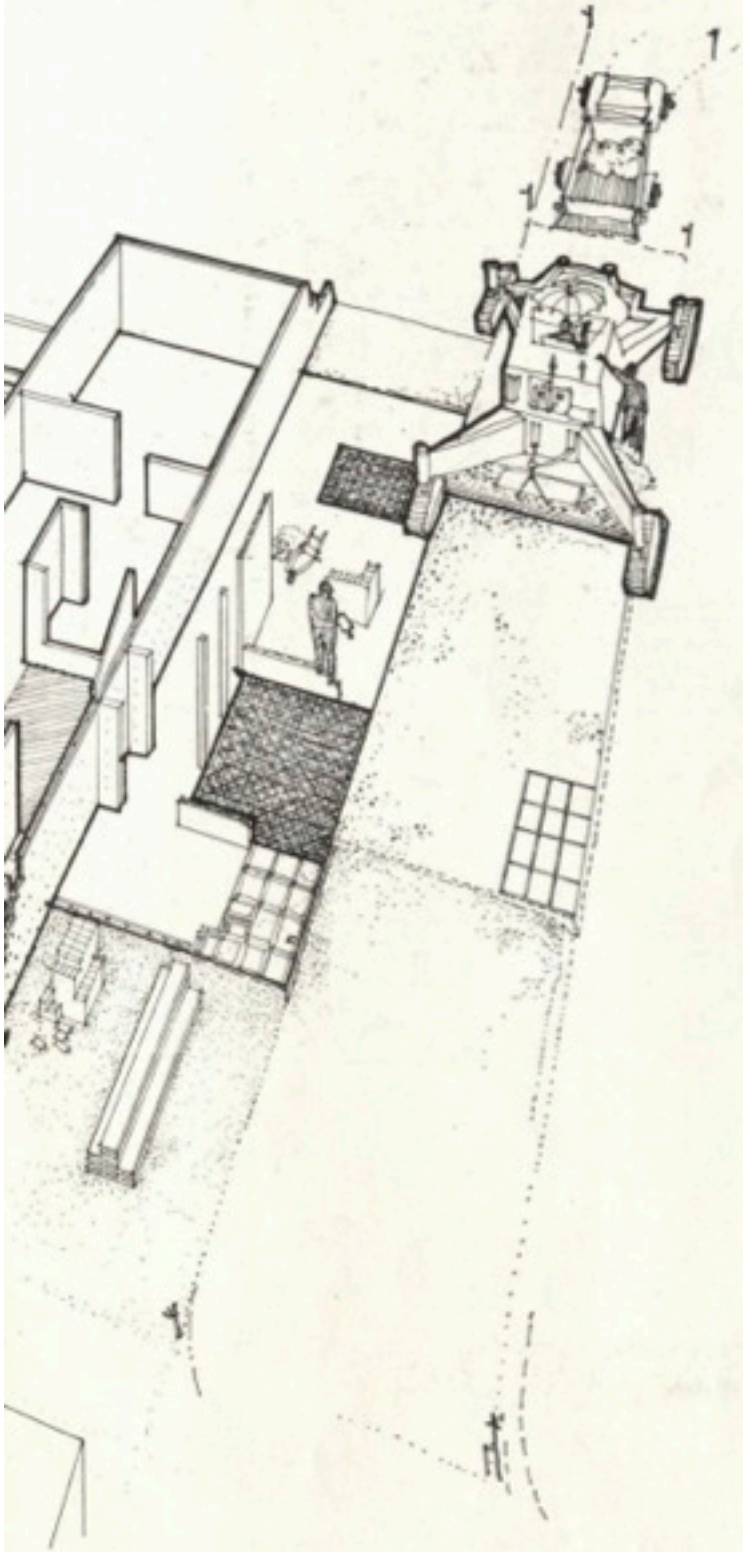
HOU

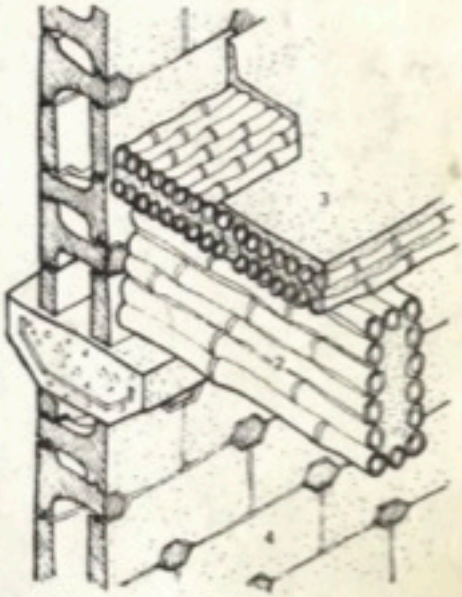


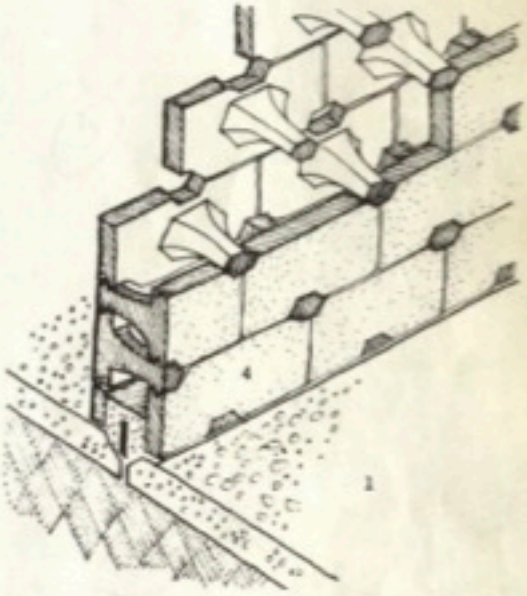
USES IN THE SITE



CONSTRUCTION







1 Floating Slab
2 Bamboo - Urethane Foam Beam
3 Bamboo - Urethane Foam Plank
4 Mortarless Block Cavity Wall

THE SITE

The site contains 1726 houses, at a gross density of 43 houses per hectare. House lots are 5.20 meters wide, and vary in length from 13 to 27 meters.

No two houses are alike. The exact form and length of each house is determined by a choice process which allows families to fit their houses to their own needs and budgets. (This is fully described on pages 29-37.)

Since the lengths of houses in the final site plan will be based on the choices which families make, and are unknown at present, the current drawing of the site plan is only approximate. Once each family has made its choices, it will be necessary to lay out a new site plan. This new plan will have the same morphology as the one shown, but the exact number of houses of different lengths, will reflect the families' choices. The morphology of the plan is fluid enough to adjust to the new lengths.

The site contains a number of cells. Each cell contains 30-70 houses; it is a pedestrian island, surrounded by a sunken one lane road, which feeds small parking lots that surround the cell.

We have designed the cells with the idea that the particular group of people who live in a cell can make an impact on

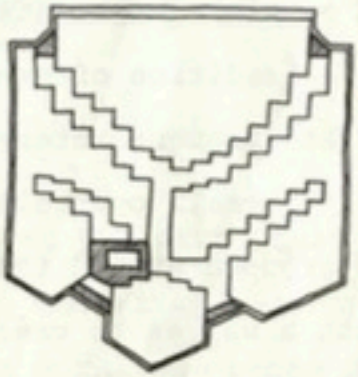
their cell, can give it a unique atmosphere, created by them, and can then, in a real sense "take possession of it".

First, the basic form and circulation of each cell is unique - according to its particular location in the large plan.

Second, during the choice process, people will be asked questions about the location they want for their house. When they are then located according to these choices, people with similar attitudes and interests will be living in the same cell.

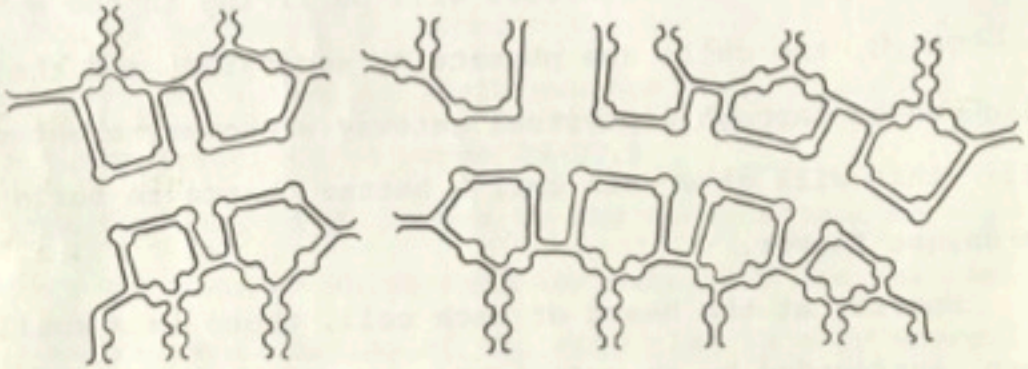
Third, the cells are physically separated, and the pedestrian passes through a physical gateway whenever he enters a cell: this will give each cell a better chance to build up its own unique flavor.

Fourth, at the heart of each cell, there is a small open place, surrounded by an unfinished, roofed arcade. It is our intention that the people who live in the cell will develop this arcade according to those community uses they think most valuable. Detailed discussion of the cell concept, and of the interior organization of the cells, is given on pages 55-61 and 99-112.



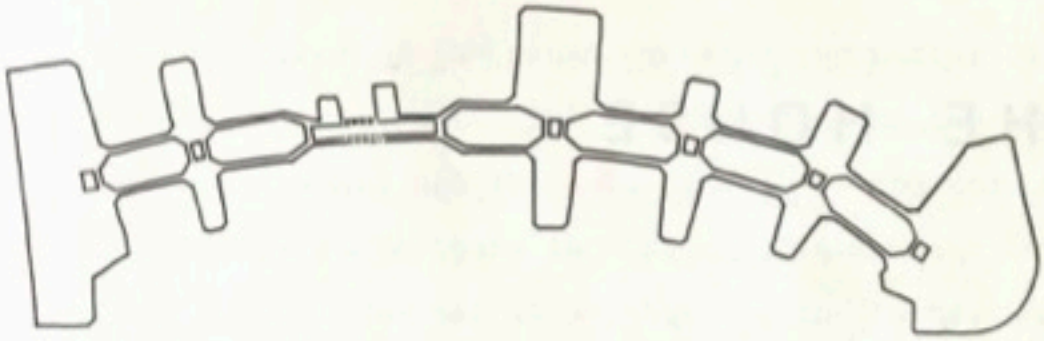
Over and above the cells, the site contains three major overlapping configurations: the road system, the pedestrian network, and the community spine.

Vehicles travel on narrow one-way loop roads, around the cells, with car parking at the entrances to the cells. There are enough parking spaces to provide for 50% car ownership. This figure was given to us by the United Nations: they estimate 50% car ownership in 30 years, and asked us to work to that figure. For details of the road system, see pages 63-70.

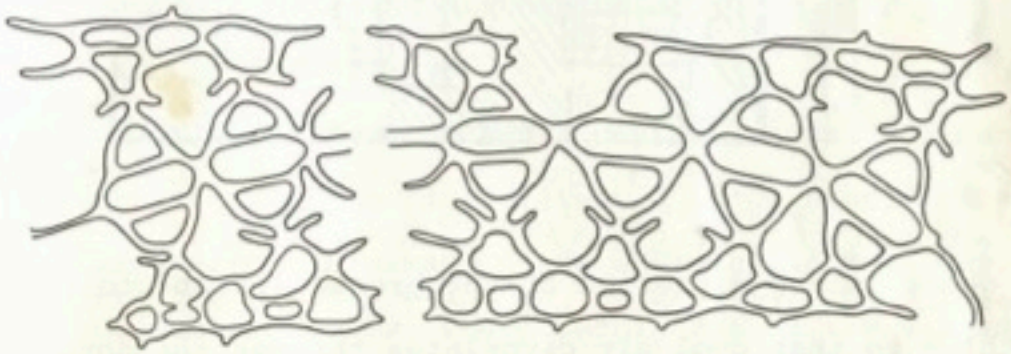


The central spine of the pedestrian system, we call the "paseo". This name is taken from the Latin American habit of the evening and Sunday stroll (paseo in Spanish). The paseo gives people a high density pedestrian spine of looped paths where a tradition of evening and Sunday walks can develop.

At frequent intervals along the paseo, there are "activity nuclei": small open places, with the community facilities and shops grouped around them. The community facilities are grouped in such a way as to create a special character at each of these activity nuclei. For details of the community facilities, see pages 87-97.



The peripheral pedestrian paths connect cells to one another, and connect them to this main paseo. Each cell which is large enough, has a pedestrian loop in it: this will help to create the inner character of the cells, since it will become natural for people to take a walk "around the cell". All

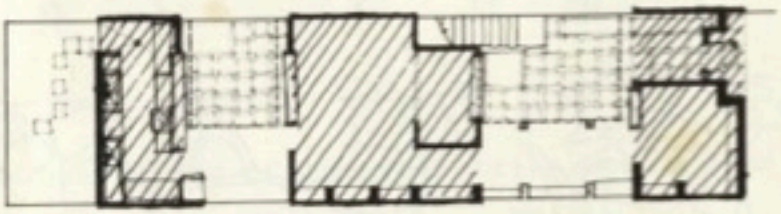


pedestrian paths from the outer parts of the site, lead towards one of the eight activity nuclei: The nuclei will always be full of people. For the pedestrian network, see pages 71-86.

THE HOUSE

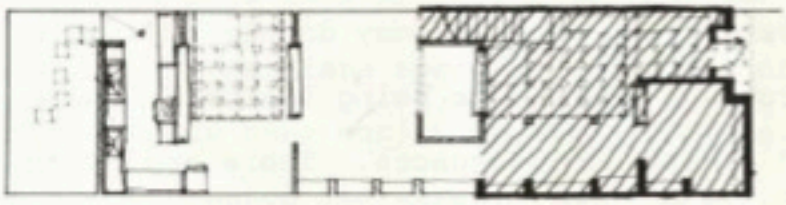
Although the choice process guarantees that no two houses will be exactly alike, all houses are based on one generic house.

This generic house is a two storey house, 5.20 meters wide, and about 20 meters long, which has an alternation of rooms and patios along its length, the rooms connected by deep verandas. This alternation gives every room light and air, and makes the house seem larger. The two main patios are always one behind



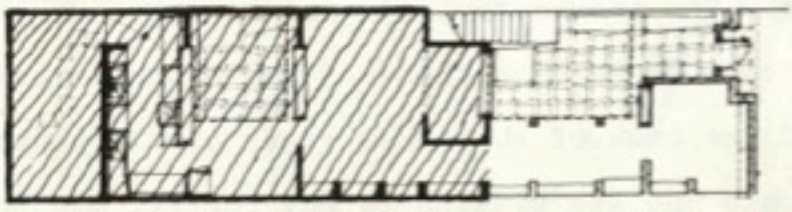
the other in the direction of the breeze (which comes from the south) - so that cool air circulates through the house in summer. In winter, the patios will be covered by dacron sailcloth covers which run horizontally on rods at roof level. They may be controlled from upstairs by cords, and make the patios usable all the year round. Patios are discussed fully on pages 113-123 and 181-190.

The ground floor of the house contains two parts: a public part and a family part. The main features of the public part are the front patio, and the sala (formal living room or parlor). In Peruvian life there is a strong distinction between members of the family, who may go anywhere in the house, and strangers, who must be entertained in the sala. The sala is



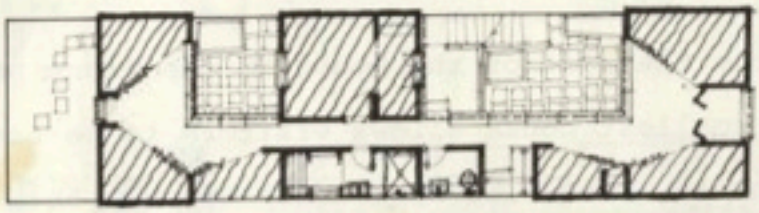
separated from the rest of the house by the front patio, and, even in the smallest house allows visitors to be treated with proper formality. Detailed discussion of the public part of the house is on pages 127-138.

The family part of the house centers around the family room (comedor estar). An alcove (two in large houses) opens off this family room to make a place where children study at night, where women can sew, where people can talk while the TV is on, etc. Behind the family room there is a kitchen, with two service patios, one on either side of it. The one between



kitchen and family room is a pleasant place, where people can eat, and work. The other provides storage for the inevitable building materials, animals, and laundry lines. For details of the family part of the house see pages 139-151.

Upstairs the house contains a master bedroom, bathroom, and a number of tiny individual bed alcoves. These bed alcoves give each child a small space which is his own, for his own things; very young children may double bunk in a single alcove. Since Peruvians don't like being isolated, these alcoves are clustered around common spaces. There are two clusters; one for

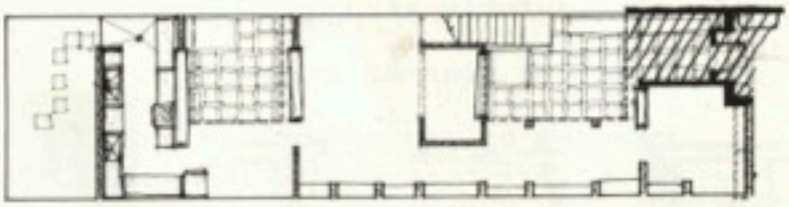


boys and one for girls. Every house, even the smallest, can be extended to make room for as many as eight beds. For detailed discussion of the sleeping areas, see pages 153-165.

Every house can be extended to provide room for a grandmother downstairs near the family room, a sleeping place for a servant, a room at the back which can be rented out, or a small shop. Many low income families try to make extra money by renting out rooms or selling things: These extensions are much easier if the back of the house opens onto a pedestrian way: those people who are willing to pay for it, may choose this

option in the choice process. For details of these extensions, see pages 191-194.

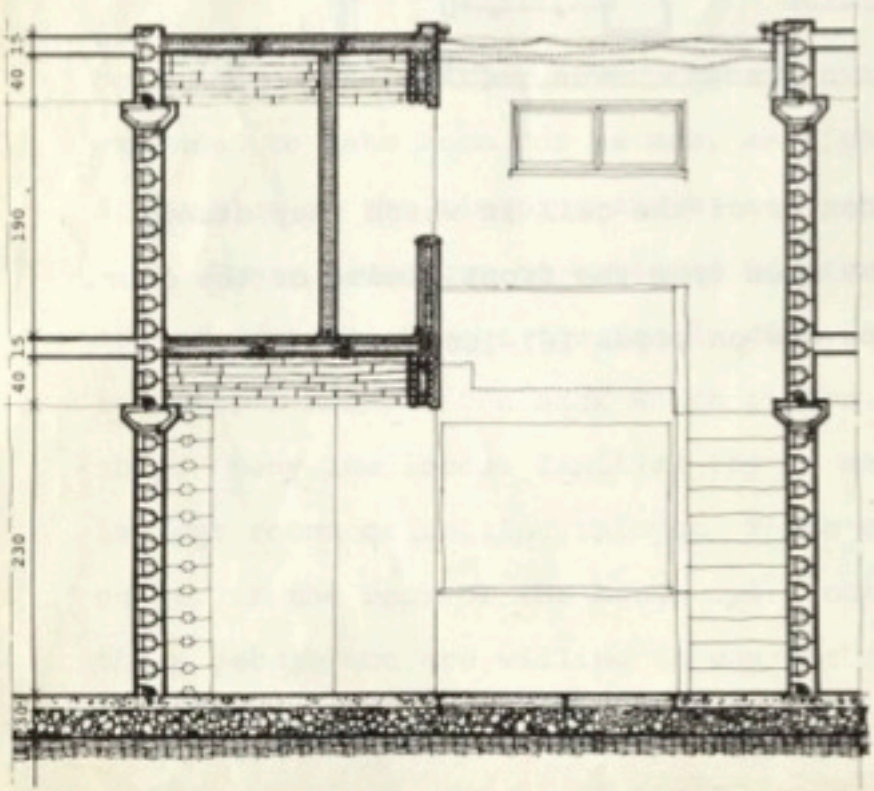
Finally, each house has a very strongly marked entrance, with deep recesses, a seat outside, and a gallery or "mirador" at the second storey. Peruvians spend a great deal of time street watching: people hang out in doorways, sit on benches outside the doors, and watch the street from windows above. They like to be in touch with the street, but from the seclusion of their homes. Most houses in our site plan command a

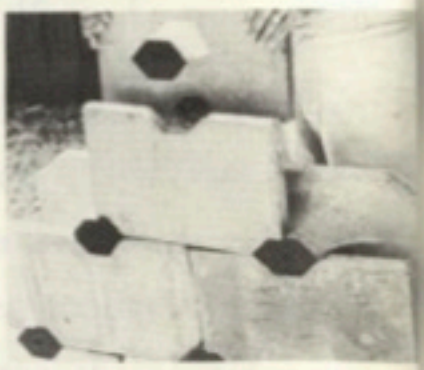


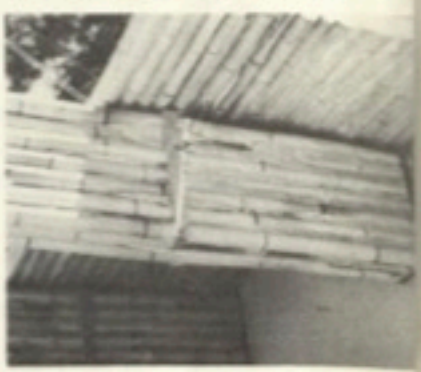
direct view into the center of the cell in which they stand, so that activity can be seen from the front window or the door. Details of the entrance are on pages 167-180.

CONSTRUCTION

The basic structure of the house consists of a floating slab foundation, load bearing walls, and a light weight plank and beam system. This form of construction is conceptually very similar to traditional construction: but each of the components is a cheaper, lower-weight higher-strength version of its traditional equivalent. The floating slab is laid in large sections by a road building machine. The walls are interlocking mortarless concrete-block walls, reinforced with sulphur, with a cavity for plumbing and conduits. The planks and beams are made of urethane foam-plastic and bamboo, reinforced with a sulphur-sand topping.







Experiments

All these building components can be produced in Peru today with available resources and skills. Further, the ideas embodied in these methods and products have the potential for long-range development of natural resources. These, in turn, will directly contribute to the economic growth of the people and the country, a vital factor in creating a national housing policy. Sulphur is available in huge quantities in Peru; current estimates show 50,000,000 tons of sulphur waiting to be mined in the Peruvian Andes. The use of urethane foams has been tested in various parts of Latin America; it is a seed industry of great importance, since foams are now used in many different ways, inside and outside the building industry. A urethane plant, once started, would benefit many sectors of the national economy. Bamboo is widely available in the north of Peru, and may be imported cheaply from Ecuador. Though it is often thought of as a low-prestige material, it will quickly become a material of great value when used together with high performance bonding agents.

These building materials are especially suited to the local earthquake conditions. The mortarless block has been tested in Mexico, under earthquake conditions, and has performed well throughout. Sulphur is now being tested in earthquake zones, and performs as well as steel reinforcing. The floating slab has a long history of success in earthquakes. The urethane-bamboo sandwich is enormously strong - and its

very light weight reduces loads during earthquakes. Technical details and performance data for all building components are given on pages 195-219.

These materials are not merely low cost, high performance materials. The yellow diamonds of the block wall, where it is reinforced with spots of sulphur, the warm texture of the bamboo ceilings, the deep polished red of the oil stained concrete slab, and the translucent white of the dacron sailcloth patio cover, combine to create a house which is far more warm and human than the usual heavy grey of low cost construction.

To simplify building construction, all components are prefabricated, on site. They all conform to the 10 cm module. They are assembled dry. This makes them equally suitable for use by the contractor, when the houses are first built, and by the families who live there, when they want to change their houses later.

We have chosen these components with special emphasis on the idea of future do-it-yourself construction. Peruvian families add to their houses, and change them, continually. They can only do this if the components are extremely small in scale, and easy to work with home tools. We have therefore tried very hard to create a system of components that are easy to work, and can be used at the rather low tolerances that correspond to the realities of home construction. In our opinion, this is more relevant to people's needs, than a system of highly

machined components, which must be built to very fine tolerances. Given the assumption that home construction will always be done rather roughly, with hammer and nails, and fillers where required, our system will allow the homeowner to do almost anything he wants to do."

For example:

On the slab foundation, a new wall can be built anywhere, without needing extra footings. The mortarless block wall can have individual blocks removed or added, at will. The hollow wall makes it easy to add new plumbing fixtures or electrical conduit, cheaply and simply, by taking out a block. A person can make his own blocks, instead of buying them: the block moulds are designed to be operated by one unskilled person. Extra block columns can be inserted at any point. The sulphur joints, unlike cemented joints, need only to be melted by local application of heat, to loosen; when they cool they harden again. The bamboo foam beams are made in five meter lengths which fit across every house; they can sit anywhere along the length, on the continuous impost block. They can be hand cut to frame any desired opening. The bamboo foam planks can also be hand cut to any length and any width. The beams which support the roof are initially designed to carry a minimal live load only: if the house owner wants to make a usable third storey, he may insert extra beams next to the existing ones.

Finally, the components must be easy to get. They will be impossible to get on the open market. To make them available,

we propose that the community contain a new kind of community service, which we call the Community Building Supermarket. This supermarket will start as the on-site factory needed for initial construction. In its later life, it will manufacture components sell them, rent out the equipment needed for assembly, provide skilled labor for those aspects of the construction which involve new techniques, and train members of the community who want to learn these techniques for themselves.

THE CHOICE PROCESS

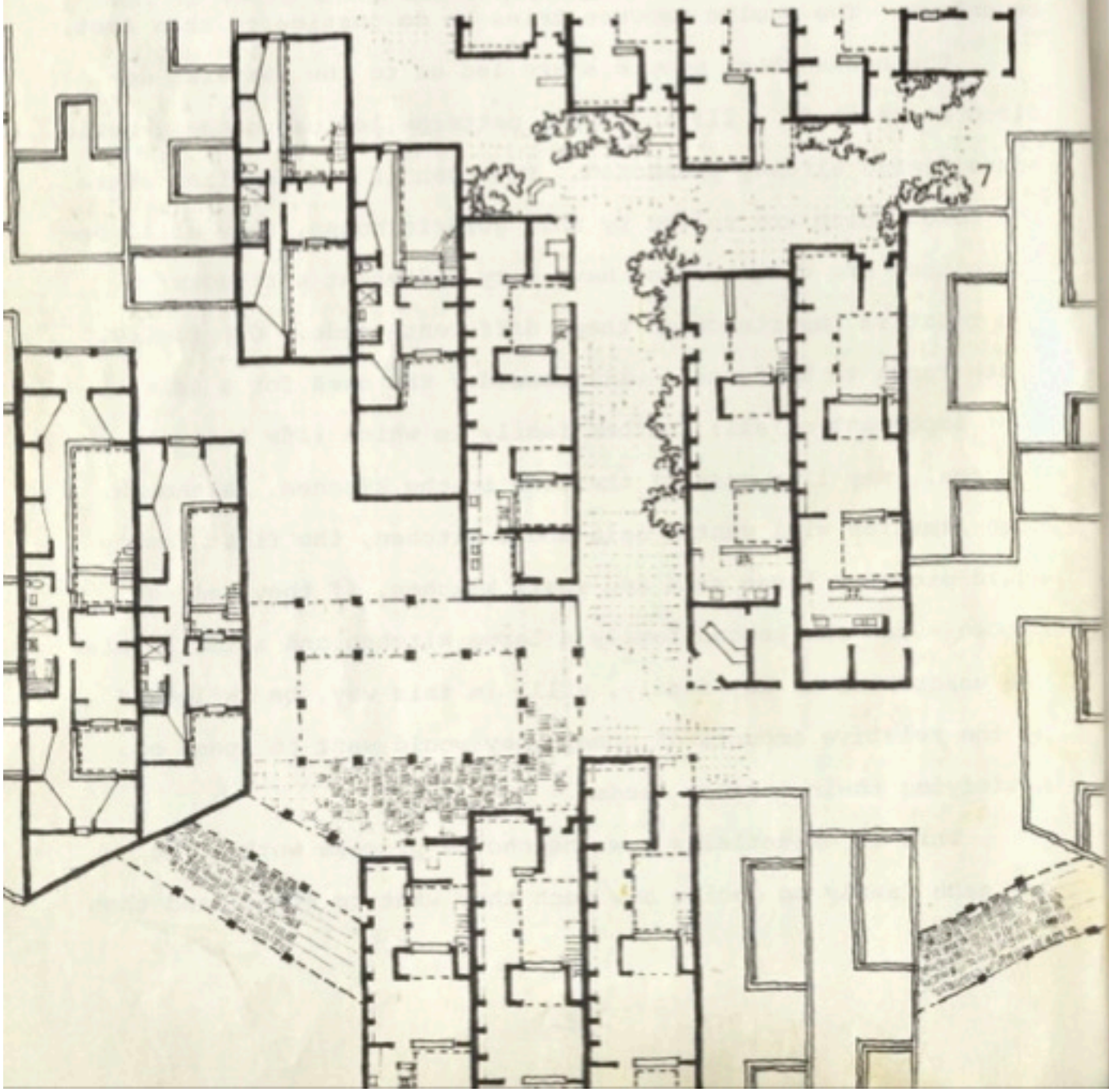
The people who live in our houses will, because they are all Peruvians, share certain needs and all have similar backgrounds. At the same time, each person, and each family, will be unique. The choice process tries to do justice to this fact.

The needs which people share led us to the patterns defined on pages 51 - 219 and these patterns led us to the generic house design already presented. But even if all families share the needs which are solved by this generic house, they will, because they are unique, also have very different attitudes to the relative importance of these different needs. One family, which tends to be formal, will consider the need for a sala most important of all; another family in which life tends to be informal, may live most of the time in the kitchen. Although both families will want a sala and a kitchen, the first family would prefer a large sala and small kitchen, if they had to choose - and the second family a large kitchen and a small sala. The uniqueness of any family, will, in this way, be reflected by the relative amounts of money they would want to spend on satisfying their various needs.

This is essentially how the choice process works. We ask each family to decide how much they want to spend; and then

we ask them to divide this money up among the various parts of the house, in the way that best reflects their individual preferences. The form of the house allows its various parts to vary in size, independently of one another; without disturbing the unity of the whole.

Even though no one part of the house can take more than a small number of different sizes, the total number of combinations



is extremely large - in the neighborhood of a million. In a community of 1500 houses, it is highly unlikely that any two will be the same. This variety is not just visual variety: it is variety which reflects the real variety of attitudes to life which will exist among the fifteen hundred families who live in the Proyecto Experimental.

On the following pages we present the choices which a family would have to make, before buying a house in the Proyecto. These choices would, of course, have to be made before construction starts. To help people make the choices, it would be essential to build one or two model houses ahead of time, and allow people to visit them. Otherwise they would probably not be able to grasp the meaning of the choices.

The combination process, which translates the completed choice sheets into designs, is presented on pages 38-47.

PROYECTO EXPERIMENTAL DE VIVIENDA

LIMA, PERU

FAMILY CHOICE SHEET

By answering the questions on this sheet, you may decide how big to make the various rooms inside your house. Start by deciding how much money you want to spend on the house, altogether. You may choose any amount between 79,000 soles and 163,000 soles.

When you have decided how much you want to spend altogether, you may start making choices about individual rooms and finishes, and about the location of the house in the community. Each of these choices costs money. To make your choices, you will have to decide which things matter most to you.

The available choices are shown below. The numbers which follow each item, show, in thousands of soles, how much each of the various choices costs. Write the number you have chosen for each item, in the column on the right. When you have finished, add up the numbers on the right. You must be sure that the total is the same as the total price you are willing to pay for your house. Thus, for instance, if you want to spend 95,000 soles on your house, the numbers in the right hand column must add up to 95.

On the pages which follow this one, we give you the detailed explanation of these choices one by one, so that you can understand clearly what you are choosing. You should read these detailed explanations before you try to make your choices.

								Your Choice
SALA	Choose one of these			3	8	14	20	
FAMILY ROOM	Choose one of these	22	24	26	28	32	35	
MAIN PATIO	Choose one of these			18	21	23	27	
KITCHEN-LAUNDRY	Choose one of these					13	22	
BED ALCOVES	Choose one of these	6	9	13	16	19	22	
MASTER BEDROOM	You must choose this						11	
GRANDMOTHERS BED ALCOVE	Choose one of these					0	1	
LAUNDRY-STORAGE PATIO	Choose one of these			6	7	8	10	
CAR HOUSE DISTANCE	Choose one of these					0	3	
RENTAL/BACK DOOR	Choose one of these	0		2	4	8	10	
SHOP	Choose one of these			0	8	10	20	
EXTRAS	You may choose more than one of these, or none. Write the total on the right	1	1	1	1	2	3	5
FINISHES	You may choose more than one of these, or none. Write the total on the right					1	1	2
							TOTAL:	

1. SIZE OF SALA

In all houses, the sala is a receiving room, separate from the comedor-estar. The very smallest sala you can have is a tiny alcove just large enough to hold two chairs and a sofa, inside the front door. Or you can have a sala more like an ordinary room.

Choose one:

Tiny sala	COST:	3,000	soles
Tiny sala with option for medium sala later	COST:	8,000	
Medium sala	COST:	14,000	
Large sala	COST:	20,000	

2. SIZE OF FAMILY ROOM

Your family room can have a number of different sizes. All of these rooms have one small alcove off them, where children might do their homework, or a woman might sit and sew. In the smallest one, this alcove is very small. In the larger ones, there is a second alcove.

Choose one:

Small room + one (small) alcove	COST:	22,000	soles
Small room + one alcove	COST:	24,000	
Medium room + one alcove	COST:	26,000	
Large room + one alcove	COST:	28,000	
Medium room + two alcoves	COST:	32,000	
Large room + two alcoves	COST:	35,000	

As you will see on the next page, the master bedroom size is determined by the family room size which you choose. For this reason the costs of the family room shown here include the extra costs created by larger master bedrooms.

3. MAIN PATIO

Every house has a main patio, which contains the stair, is flanked by the sala, the family room, the entrance, and by a veranda which connects the sala and family room. This patio is covered in winter by a dacron sailcloth. The patio is always 3 meters wide, but its length may vary. Especially if you intend to plant things there, you should choose one of the larger ones.

Choose one:

Tiny patio	COST:	18,000	soles
Small patio	COST:	21,000	
Medium patio	COST:	23,000	
Large patio	COST:	27,000	

4. KITCHEN-LAUNDRY

There are two kitchens to choose from. The small one has no sitting space in it, and has the laundry counter out of doors, in the storage patio. The large one is twice as large, has room for a table in it, and has the laundry counter under cover. Both kitchens contain, as an integral part, a small kitchen patio, which will be covered in winter, and gives you extra room to work, room for children to play, etc.

Choose one:

Small kitchen	COST: 13,000 soles
Large kitchen	COST: 22,000

5. NUMBER OF BED ALCOVES

Every house will have a master bedroom; but this is the only conventional bedroom. All the other beds will be in individual bed alcoves, containing a bed, a dressing space, and storage, and nothing more. These bed alcoves will be arranged in two small clusters, one for boys and one for girls.

At least one of the alcoves will be an extra large one, large enough to hold two bunk beds. If you would like to have two of your children sleeping in bunk beds like this, you may choose a number of alcoves which is one less than the number of children in your family.

You may choose how many individual bed alcoves you want (each alcove costs 3,000 soles), and you may also say how you want the alcoves clustered. Choose one of the following. (The first number is the number in the front cluster, the second in the back.)

Two beds:	2,0	COST: 6,000 soles
Three beds:	3,0 or 2,1	COST: 9,000
Four beds:	4,0 or 3,1 or 2,2	COST: 13,000
Five beds:	4,1 or 3,2 or 2,3	COST: 16,000
Six beds:	4,2 or 3,3 or 2,4	COST: 19,000
Seven beds:	4,3	COST: 22,000

6. MASTER BEDROOM, BATH AND STORAGE

The master bedroom and storage are always above the family room. These rooms can vary in size, but their size must always correspond to the size of the family room you have chosen. In this sense, you have no real choice of sizes here, though it may influence your choice of family room size: the bathrooms are always the same size.

The fixed cost of this room is 11,000. All additional costs are included in the costs of family rooms. For all family rooms the master bed costs are:

Master bedroom	COST: 11,000 soles

7. GRANDMOTHER'S BED ALCOVE

Every house has the possibility of placing a bed alcove, on the ground floor, just next to the family room, for an old person. You may choose to have this bed alcove built today, or you may build it yourself, later.

Choose one:

Grandmother's bed alcove built now	COST:	1,000 soles
Not built now	COST:	zero

8. LAUNDRY-STORAGE PATIO

Every house has, at the very back, an extra patio which gives you room for expansion on the ground floor, a place where servant quarters may be constructed, a place to hang laundry, and to store building materials and large objects. If you want to use this patio to build rental space, or a little shop, do not choose the very small patio.

Choose one:

Very small	COST:	6,000 soles
Small	COST:	7,000
Medium	COST:	8,000
Large	COST:	10,000

9. CAR HOUSE DISTANCE

Some houses have parking lots right next to them, others do not. In no case is a house more than 50 meters from the nearest parking lot. If you have a car or if you expect to have a car in the near future, you may want to choose a house near a parking lot. Otherwise you may prefer the quietness and safety of a pedestrian street, especially if you have children who play outside the house.

Choose one:

There is a parking place within 15 meters of your house	COST:	3,000 soles
There is a parking place between 15 meters and 50 meters from your house	COST:	zero

10. RENTAL AND/OR BACK DOOR

If you hope to rent out a small room in the future, or if you are particularly anxious to let your servant have a back door which is separate from the front door, you may have a lot which has a back or a side opening onto a walkway. If you choose a lot that has a second entrance, you may have a small room for rental, built there today, or you may leave it unbuilt, and build it yourself later. If you choose a shop you may not choose a rental unit.

Choose one:

Corner lot with second entrance on side and rental space built today	COST:	10,000	soles
Corner lot with second entrance on side	COST:	8,000	
Lot with second entrance on back and rental space built today	COST:	4,000	
Lot with second entrance on back	COST:	2,000	
Lot with front only	COST:	zero	

11. SHOP

You may want, now or in the future, to open a small shop. In this case you will want to have a location where a shop can prosper - either next to the main market, or at some corner which many people are going past. If you choose a shop location by the market, you will have the shop built now, automatically. If you choose one of the other shop locations, you may have the shop built now, or you may choose to leave it unbuilt now, and then build it yourself later. If you have chosen a rental space, you may not choose a shop.

Choose one:

Market location, with shop built now	COST:	20,000	soles
Corner location, with shop built now	COST:	10,000	
Corner location, shop not built now	COST:	8,000	
No possibility of building a shop	COST:	zero	

12. EXTRAS

If you find that you can purchase adequate space for your family without using all the money that you plan to spend on housing, or if some of these extra features mean more to you than extra space, you may want to choose some of the optional features listed below.

Fiberglass patio covers instead of sailcloth on front patio and middle patio	COST:	5,000	soles
Electric hot water heater, connected to bathroom, kitchen and laundry	COST:	3,000	
Second wash basin for family	COST:	1,000	
Wash basin and WC for servant, enclosed	COST:	2,000	
Colored tiles around the main door	COST:	1,000	
Bench near the main door	COST:	1,000	
5 meter Eucalyptus saplings near front door	COST:	1,000	

13. FINISHES

In Proyecto Experimental the basic finishes are the finishes of the building materials, block and bamboo. If you want to, you can have plaster or white wash in the sala or comedor.

Plastered ceiling in the sala	COST: 1,000 soles
Plastered ceiling in the comedor-estar	COST: 2,000
White washed block walls	COST: 1,000

Finally, you may choose where you want your house to be in the larger community. There are two choices: neither has any cost.

14. QUIET AREA OR BUSY AREA

There are two kinds of housing area to live in. In one kind of area there are many people walking up and down the pedestrian way outside the houses. During the day and in the evening, there will almost always be some people on the street. In the other kind of area there are far less people walking through.

Choose one:

Many people going past your house.
Few people going past your house.

15. NEARBY COMMUNITY FACILITIES

The church, market, clinic, parks, kindergartens, schools, secondary school, technical school, evening entertainment, are all fixed positions on the site, and each has a housing area that is particularly closely tied to it. Choose the one which you would most like to be near:

Church
Market
Clinic
Park
Kindergarten
Schools
High school
Technical school
Evening entertainment

* * *

THE COMBINATION PROCES

The combination process is not unlike the process by which the leaves on a tree are formed. All the leaves are defined by the same morphogenetic rules: the individual leaves are formed by the interaction between these rules and the local conditions which the leaves are subject to. As a result, each leaf turns out unique, according to its position in the whole tree; yet in a generic sense the leaves on the tree are all the same. The combination process works in the same way.

All houses are formed by the same sequence of rules, based on the form of the generic house. But each house has to meet certain particular conditions: those imposed on it by the family's choices, and those imposed on it by its position in the site - orientation, the lengths of next door houses, location of nearby pedestrian walkways, and so on. Each individual house is formed by the interaction of the local conditions which it has to meet, and the generic rules of the combination process.

For example, in order to make the house-form coherent, the shape of the house entrance must be different for houses with a small sala and houses with a medium sala, it must be different for houses on a corner lot and houses on a center lot, it must be different according to the length of the next door

house on the eastern side (since the entrance is always on the east). The rules which form the house entrance (Steps 6, 7, 8 below), therefore depend on the size of the sala, the type of lot, and the position of the next door house on the eastern side.

It is only this high degree of interaction between the rules of the combination process and the local conditions which guarantees that all houses are internally coherent, and that each house fits coherently into the larger site plan. Like the leaves on a tree, all the houses will be different, yet all of them coherent and all of them the same.

It is very important to stress the fact that the rules of the combination process are almost mechanical, and can be carried out by any trained draftsman. The low cost of the houses cannot support any individual design time. We estimate that a trained draftsman will need about one hour per house, to translate the family choice sheet into a set of working drawings and specifications for the contractor.

The draftsman has one master site plan with the house lots shown on it: and one file for each family, containing the family choice sheet, and a blank house plan, which shows the side walls only, 5.20 meters apart, for both floors, and shows no end walls or interior walls. He now builds up the detailed design of each house, by using the following rules, one step at a time:

(19)

STEP 1: Assignment of houses to cells

Assign each family to a cell in the site plan, on the basis of their answers to questions 14 or 15 on the choice sheet. Location across the site is determined by choice 14. If they want to be in a busy area, place them along the paseo. If they want to be in a quiet area, place them far from the paseo. Location along the length of the site, is determined by the community facility they want to be near (choice 15).

STEP 2: Determination of house length

Fix the house length as the sum of the lengths of the chosen sala, patio, family room, kitchen and back patio (choices 1, 2, 3, 4, 8).

STEP 3: Assignment of houses to sites, within the cell

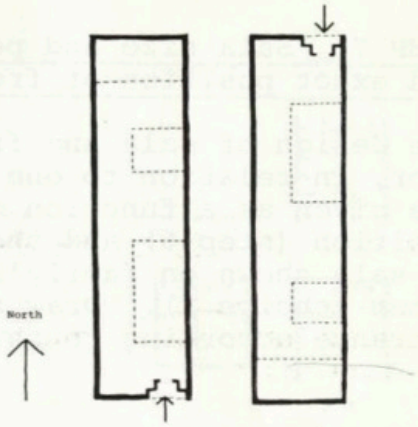
Within the cell fixed by step 1, assign each house to a lot whose length is as near as possible to the length determined by step 2, and which also satisfies the family's choices concerning shop location, rental/back door, and distance from parking lots (choices 9, 10, 11). (At this point the new site plan will be slightly different from the current site plan - since each house will have a slightly different length. It will now be necessary to make minor changes in layout, and arrangement of houses, so that pedestrian paths, loop roads and parking lots still have a coherent form.)

STEP 4: Detailed site conditions for each house

Since the house is now fixed within the site plan, the positions of next door houses, positions of adjacent paths and roads, the front end of the house and orientation of the house are now fixed. Transfer these to the drawing of the individual house.

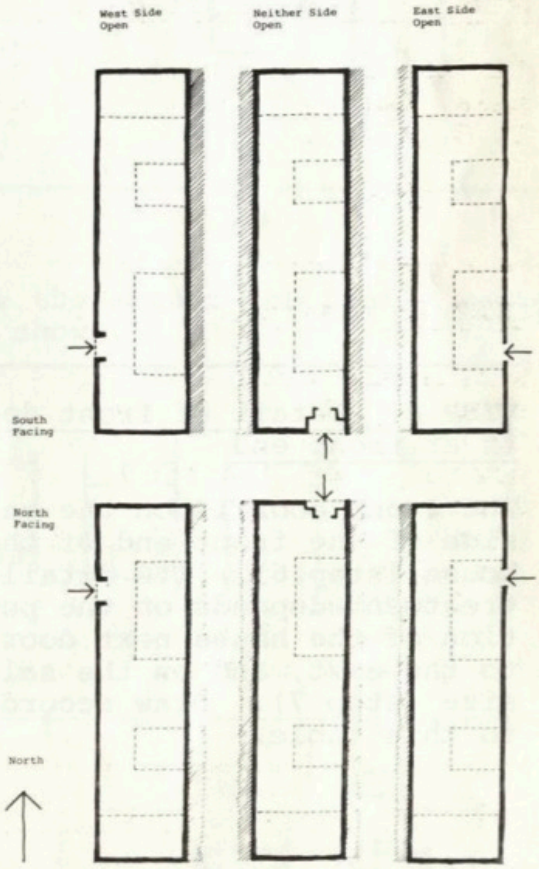
STEP 5: Position of patio openings

The patio openings are always on the east side of the house. Sketch in patios for different orientations as shown.



STEP 6: General position of front door

The position of the front door is given as a function of patio position (step 5), and the presence or absence of adjacent houses. Sketch entry arrows according to this table.

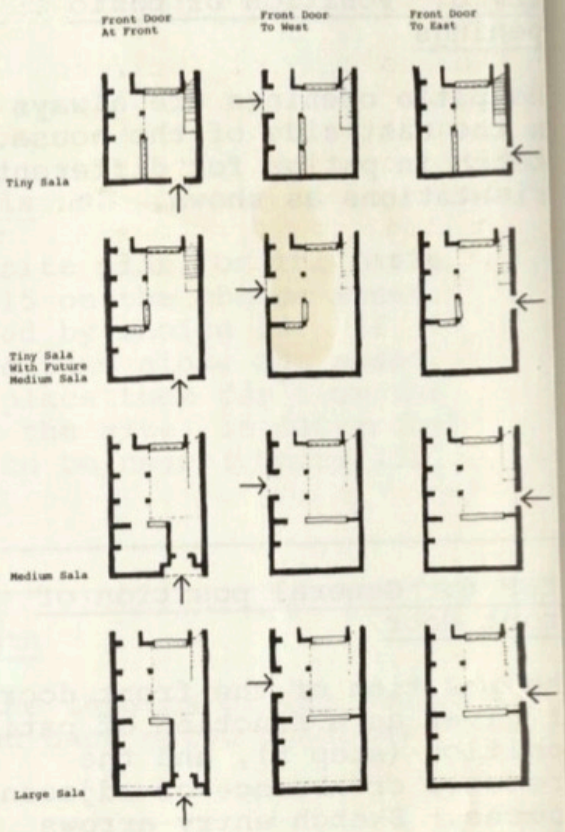


The arrangements for houses facing north are mirror images of the arrangements for houses facing south. To avoid duplication, all future diagrams will be shown for south facing houses only. Arrangements for north facing houses are obtained by taking the mirror images of these arrangements.

(21)

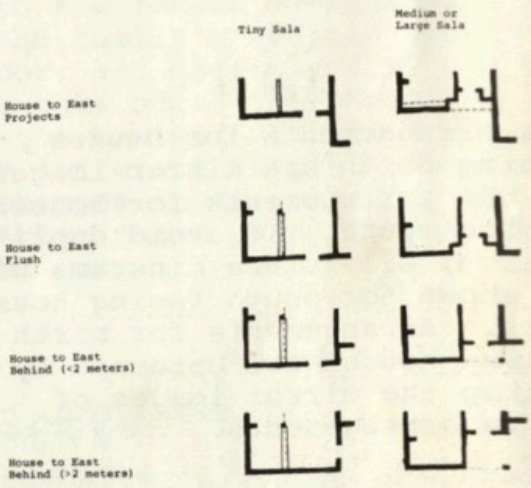
STEP 7: Sala size and position and exact position of front door

The design of sala and front door, in relation to one another, are given as a function of door position (step 6) and the size of sala shown on family's choice sheet (choice 1). Draw sala and entrance according to this table.



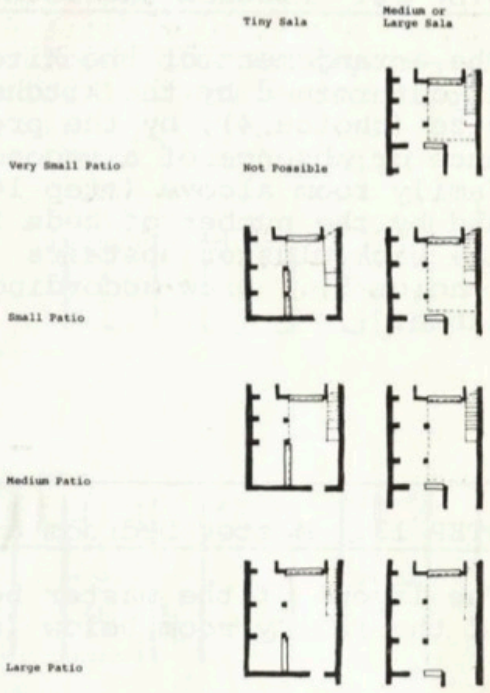
STEP 8: Detail of front door if at front end

The front door is on the east side of the front end of the house (step 6). Its detailed treatment depends on the position of the house next door and to the east, and on the sala size (step 7). Draw according to this table.



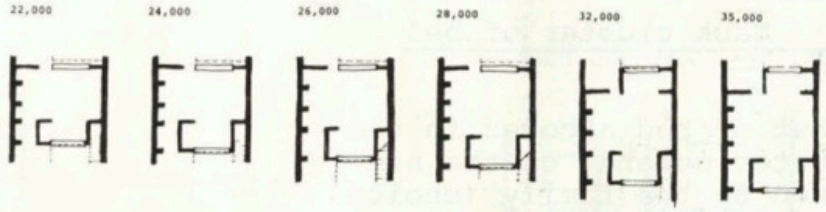
STEP 9: Size of front patio

The position of the front wall of the family room alcove and veranda column positions are fixed according to the family's choice of patio size (choice 3), and the size of the sala (step 7). Draw according to table.



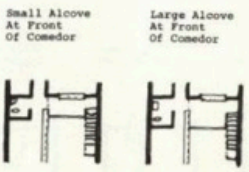
STEP 10: Family room

The family room is fixed directly by the amount the family wants to spend on it (choice 2). Draw as shown.



STEP 11: Stairs

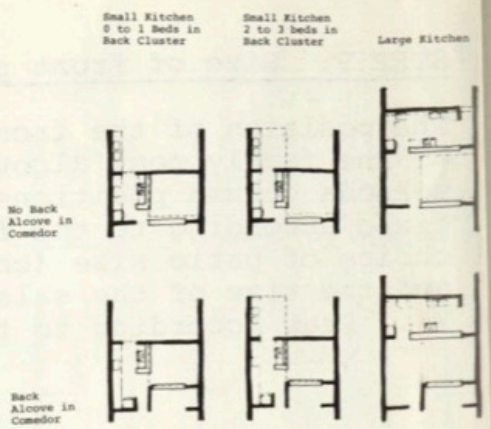
The position and size of the stair landing vary according to the size of the front alcove. Draw as shown.



(23)

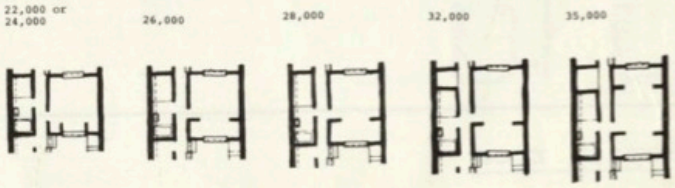
STEP 12: Kitchen and laundry

The arrangement of the kitchen is determined by the kitchen size (choice 4), by the presence or absence of a second family room alcove (step 10), and by the number of beds in the back cluster upstairs (choice 5). Draw according to table.



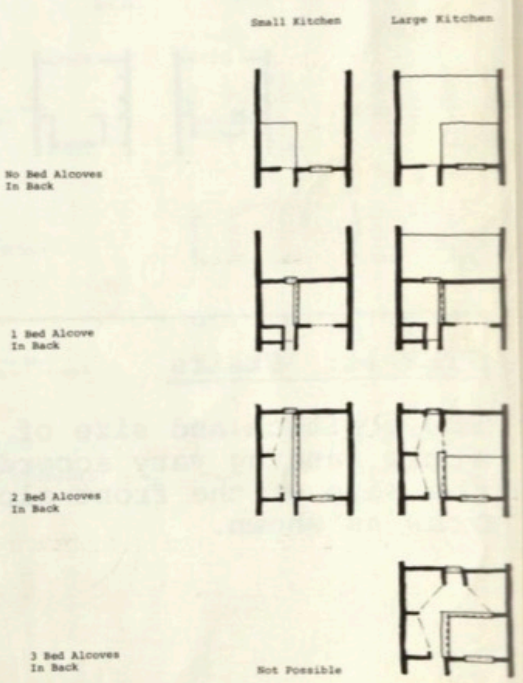
STEP 13: Master bedroom and bathroom layout

The layout of the master bedroom is given directly by the leng of the family room below (step 10). Draw as shown.



STEP 14: Back cluster of bed alcoves

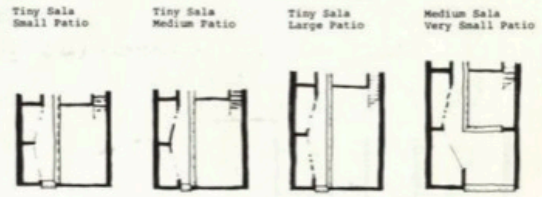
The layout of bed alcoves in the back cluster depends on the number chosen by the family (choice 5), and the kitchen size (step 12). Draw according to table.

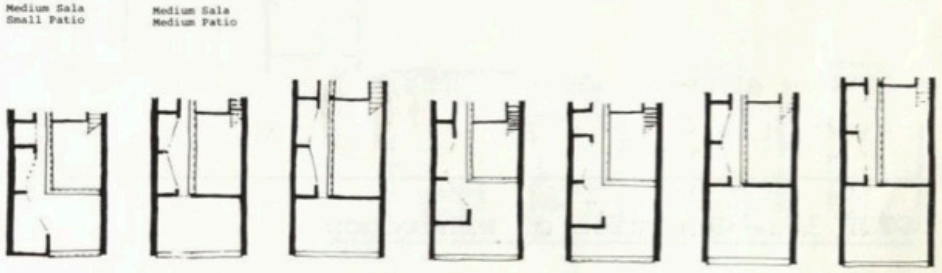


STEP 15: Front cluster of bed alcoves

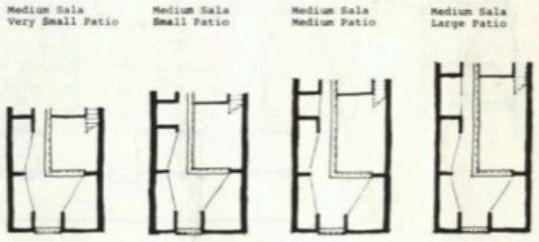
The layout of bed alcoves in the front cluster depends on the number chosen by the family (choice 5). Draw according to table.

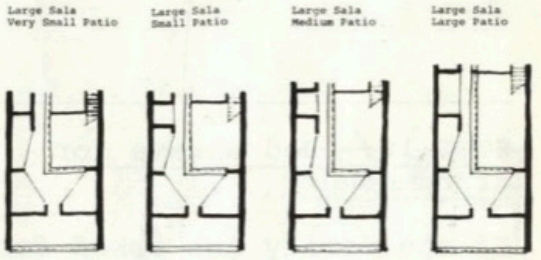
Two front bed alcoves



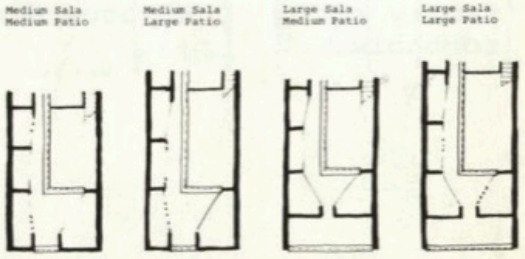


Three front bed alcoves





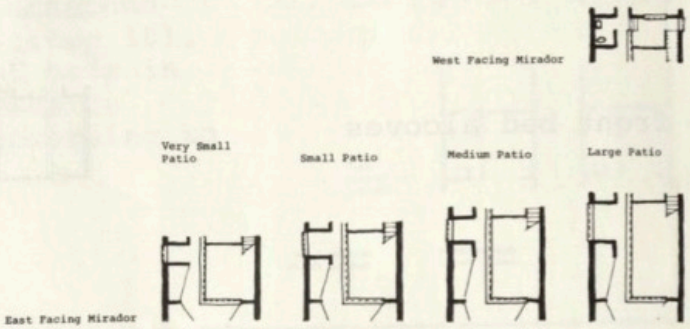
Four front bed alcoves



(25)

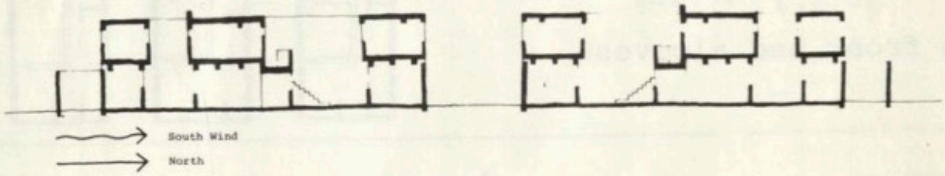
STEP 16: Mirador

Front mirador is given by step 15. Side mirador occurs in corner houses only. Draw according to table.



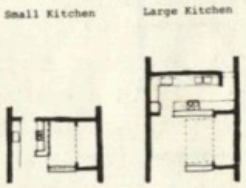
STEP 17: Position of windscoop

The windscoop always faces the south wind. It is on the main patio in a south-facing house, and on the kitchen patio in a north-facing house. Draw in positions shown.



STEP 18: Bed alcove for grandmother

If the family has asked for a bed alcove (choice 7) downstairs, it is placed in the kitchen patio, next to the family room. Draw according to table.

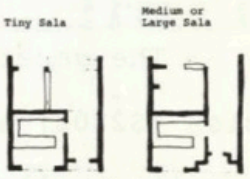


(26)

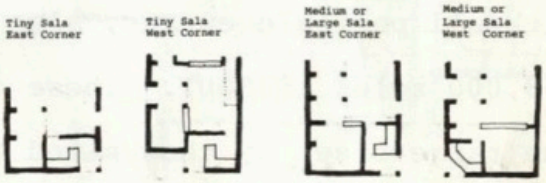
STEP 19: Position of shop

If the family has asked for a shop (choice 11) the house either fronts on the market, or has a corner lot. The exact arrangement depends on the relative positions of the corner, the sala, the kitchen. Draw according to table.

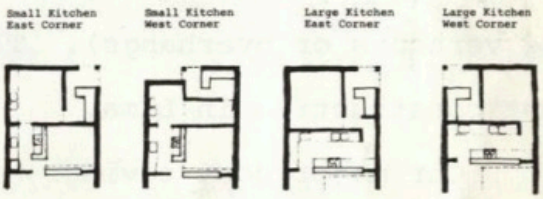
Shop facing market



Shop at front of house

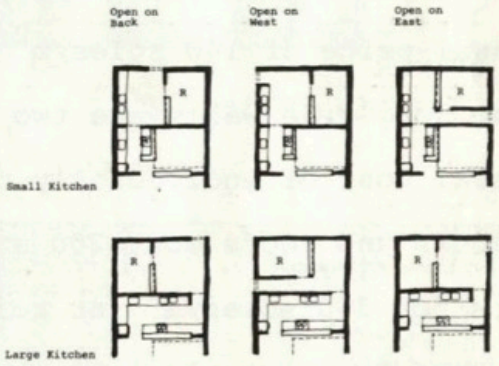


Shop at back of house



STEP 20: Back door and rental space

If the back or the side of the house is open to a pedestrian way, the back door is placed according to the site and the position of the kitchen. If the family has asked for rental space (choice 10) this is built in the position marked R; otherwise this position is left unroofed. Draw according to table.

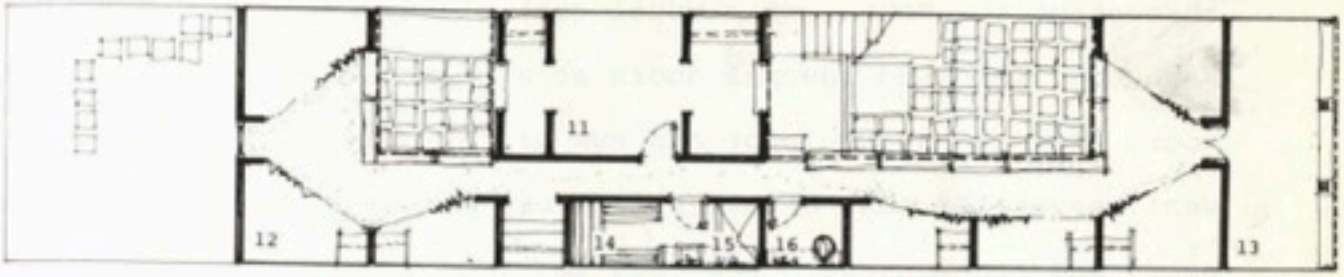


COSTS

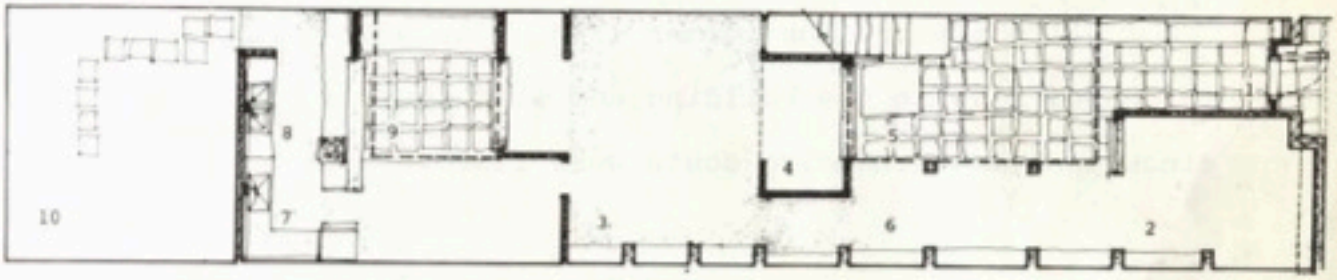
The generic house, shown on pages 8-9, will cost 119,000 soles ($2800) as of summer 1969. The smallest house, shown opposite, will cost 79,000 soles ($1800), and the largest, with all possible extras, also shown opposite, will cost 163,000 soles ($3800). These costs are within 1000 soles of the targets set by the United Nations. They give an average of 1130 soles per square meter of interior space (not including verandas or overhangs). This is 25% less than current low cost construction in Lima.

Our major cost savings have come from the following sources: The foundation slab, without footings, costs 100 soles/m^2, compared with the usual price of 200 soles/m^2 for slab and footings. The mortarless concrete block walls reinforced with sulphur, costs 120 soles/m^2, compared with the usual price of 140 soles/m^2 for a mortared block or brick wall. The long side walls are two leaf party walls, thus halving the usual cost of individually owned walls. The bamboo-urethane floors and roofs cost 200 soles/m^2, compared with the usual cost of 340 soles/m^2 for reinforced concrete slabs. The finish of the mortarless block wall and the finish of the bamboo ceilings make plastering unnecessary, and save the usual cost of 50-60 soles/m^2 for plaster. The dacron sailcloth cover on

LARGE HOUSE

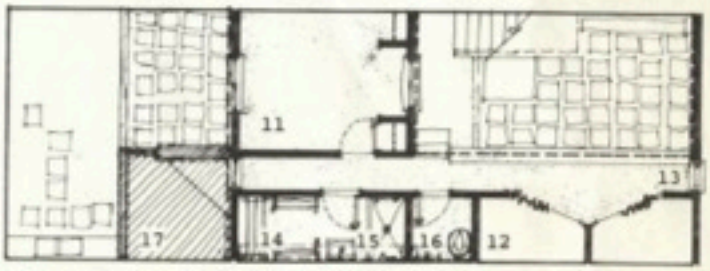


Second Floor



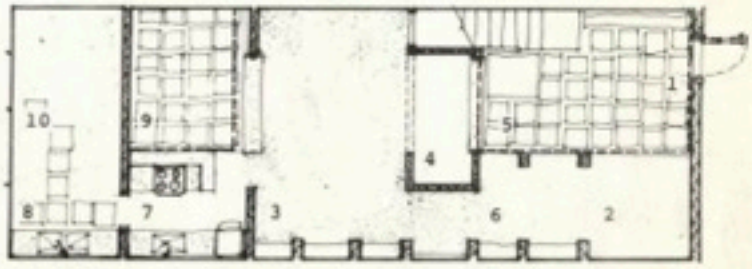
First Floor

SMALL HOUSE



Second Floor

1 Entrance
2 Sala (Parlor)
3 Family Room
4 Family Room Alcove
5 Main Patio
6 Veranda
7 Kitchen
8 Laundry
9 Kitchen Patio
10 Storage Patio
11 Master Bedroom
12 Bed Alcoves
13 Mirador
14 Clothes Drying Closet
15 Shower
16 Toilet
17 Future Bed Alcove



First Floor

the patio, costs 250 soles/m^2 and saves the cost of windows throughout the house, at a usual cost of 500-600 soles/m^2. We have eliminated several doors at a cost of 550 soles per door. The ABS accumulator and use of the cavity wall as a vent, saves the cost of several meters of waste pipe, vent pipe, and connections. The fact that our site plan has 1726 houses, as against the 1500 expected, saves 12% of the cost of site development.

All costs are for summer 1969. The savings are based on innovations in the building and site development only, since land and financing costs were fixed.

THE PATTERNS

INTRODUCTION

We now present the sixty-seven patterns from which we have built our designs. We do not present these patterns merely to explain our designs, but because we believe that each of them expresses a generally valid principle, which can be used over and over again. This is the essential point of the patterns: they are re-usable. Since many of them deal specifically with Peru, we hope that they may be particularly useful to Peruvian architects and builders.

A pattern defines an arrangement of parts in the environment, which is needed to solve a recurrent social, psychological, or technical problem. Each pattern has three very clearly defined sections: context, solution and problem.

The context defines a set of conditions. The problem defines a complex of needs which always occurs in the given context. The solution defines the spatial arrangement of parts which must be present in the given context in order to solve the problem.

If the needs in the problem are correct, and do occur as stated in the given context, then this arrangement of parts, or an equivalent one, must always be included in any design for

the given context. Any design for this context which does not include the pattern, is failing to solve a known problem.

This does not mean, of course, that the patterns are absolute. The rightness or wrongness of a pattern is an empirical matter, and as such is always open to further observation and experiment. For this reason, we have tried to state the observations and evidence behind the patterns as clearly as possible, so that they can be checked by others, and rejected when incorrect.

The evidence we use comes from three sources: the published literature, our observations in Lima, and our laboratory tests and experiments. We spent a month each living with low income Peruvian families in Pampa de Comas, San Martin de Porras, La Victoria and Rimac (districts of Lima) to better understand their way of life. We built and tested each of the major building components, with supportive testing from professional laboratories. Where our observations are hard to support, we have stated them as conjectures.

We preface each pattern statement with a description of the way the pattern enters into our designs. This preface always begins with the words: IN THE PROYECTO EXPERIMENTAL ... The pattern itself follows, beginning with the words: THE GENERAL PATTERN IS ...

CELLS

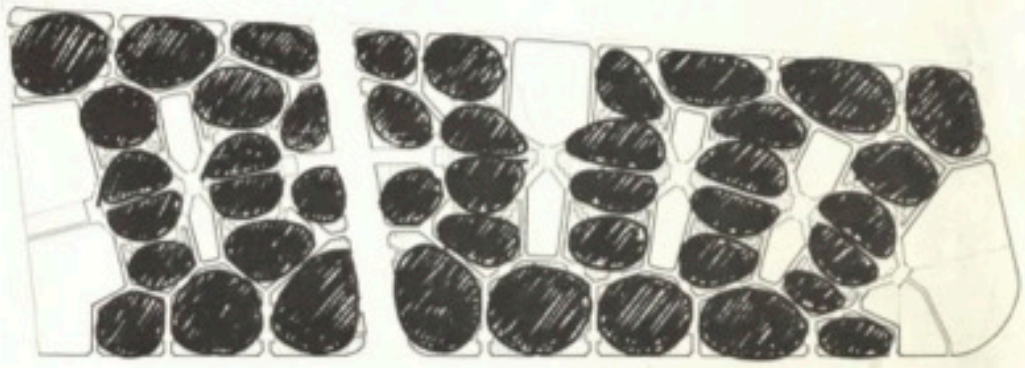
SUBCULTURE CELLS

DEGREES OF PUBLICNESS

SUBCULTURE CELLS

IN THE PROYECTO EXPERIMENTAL, the community is divided into 43 small residential cells, each containing between 25 and 75 houses. The cells are clearly separated from one another. All houses in a cell face inwards, and the outer cells are surrounded by a narrow road sunken 50 cm below grade, so that these cells are elevated pedestrian islands.

Families choose the cell they want to be in, according to its relative "quietness", and according to the community facilities nearby. As a result, the families in any one cell will probably share attitudes and interests; we hope that each cell will develop a unique "character", different from the others.

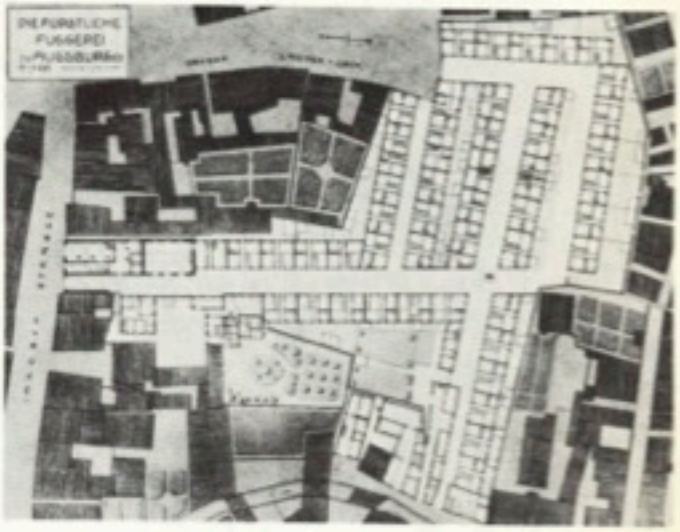


THE GENERAL PATTERN IS:

Context:

Any urban area which contains more than a few hundred dwellings.

Solution:



The area is made up of a large number of small inward focussed residential "cells". The cells are separated as sharply as possible from one another, if possible, by open land, community facilities, or public land.

Each cell is intended, in the long run, to sustain a different way of life: a different subculture. A subculture is defined as a group of people (not necessarily friends) who share certain attitudes, beliefs, habits and needs not shared by others, and who may require special environments, local organizations, or services, to support these special needs. The community facilities which surround any given cell should reflect the particular interests characteristic of that subculture. All community facilities (including roads, schools, hospitals, churches, parks, industry, commerce, entertainment) are placed in the boundaries between cells.

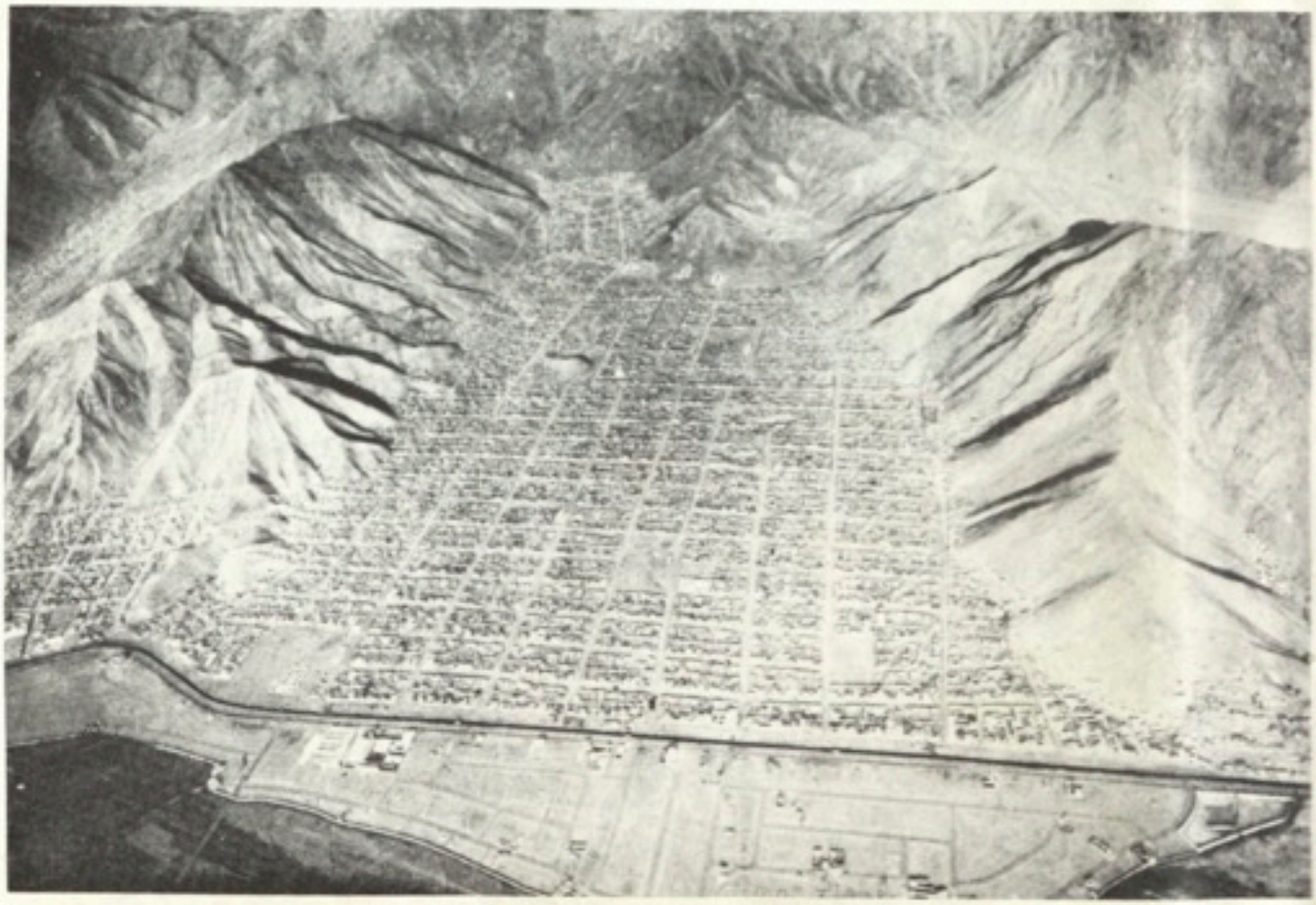
The arguments which define cell size, are not yet fully clear. At present it seems that no cell should contain more than 1500 people, or less than 50, with a mean cell population of about 500.

Problem:

People need an identifiable unit to belong to. They want to be able to identify the part of the city where they live, as distinct from all others. Available evidence suggests that the areas which people identify with are extremely small - of the order between 100 and 200 meters in diameter. They cannot identify these areas, unless the areas are well differentiated from one another: and studies show that areas will not be strongly differentiated from one another unless they support identifiably different ways of life. This suggests that any urban area should be broken into a number of small "subculture cells", each supporting an identifiably different way of life. See Frank Hendricks, "A Situational Approach to Residential Environmental Planning: A Research Framework", unpublished report to the U.S. Public Health Service, March 1967.

Psychological arguments lead to the same conclusion. There is strong evidence to suggest that a person cannot develop his own life style fully, unless he does so in an ambience where others share his life style.

In a homogeneous urban area, differences of life style tend to vanish, and ego-strength, self-confidence and character formation deteriorate. This again, suggests that the



urban area, should, as far as possible, support a large variety of strongly differentiated life styles, each supported by a "subculture cell".

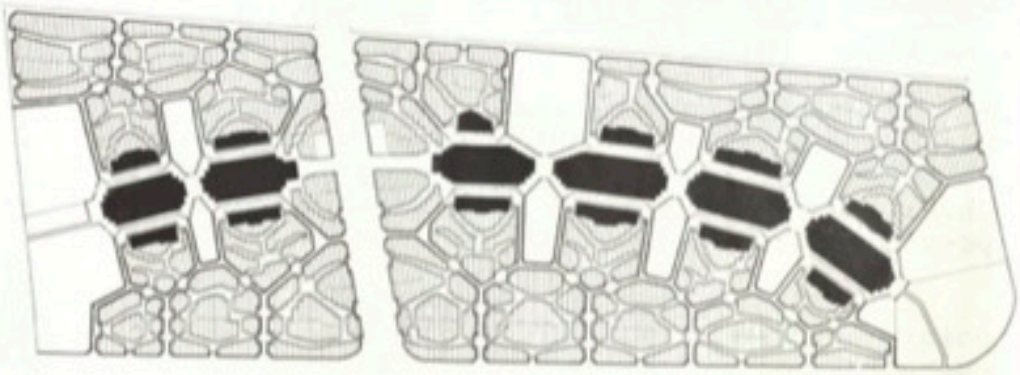
Ecological arguments help to fix the suitable cell size, and the need for radical separation between cells. To develop their own life style, the families in a cell must be able to agree on basic decisions about services, community land, etc. Anthropological evidence shows that a human group cannot maintain the face to face relations required to coordinate itself in this way, if its population is above 1500; many people set the figure as low as 500. (See for example, Anthony Wallace, Housing and Social Structure, Philadelphia Housing Authority, 1952; currently available through University Microfilms, Inc., Ann Arbor, Michigan.)

It has also been shown that the group feeling necessary to support a particular unique life style, is greatly strengthened when that group is physically separated from all adjacent groups. This suggests that cells should be inward looking, and wherever possible separated by community facilities.

The full arguments, and empirical evidence for all these points, are presented in Christopher Alexander, Cells of Subcultures, Center for Environmental Structure, Berkeley, California, 1968.

DEGREES OF PUBLICNESS

IN THE PROYECTO EXPERIMENTAL, 30% of the houses are on heavily travelled pedestrian paths and close to the activity nuclei (see page 75), 30% are in very secluded areas on small pedestrian paths that few people will go on, and the rest are in between.



THE GENERAL PATTERN IS:

Context:

Any local urban area which contains more than a few hundred houses.

Solution:

Houses in different parts of this area, have markedly different degrees of exposure to pedestrian circulation and nearby activities. Some are secluded, far from activity, on narrow lanes, with few people going past. Others are on main pedestrian thoroughfares, within hailing distance of potential activity, with many strangers going past all the time.

Problem:

It has been shown that people vary along a fundamental personality characteristic which may be called "introvert-extrovert" or "privacy loving-community loving". Those at the introvert end of the scale, have a consistent desire to be removed from services, and from passing foot traffic, and enjoy a very small scale in their immediate surroundings. Those at the extrovert end of the scale like to be near services, to have a lively atmosphere outside their houses, and enjoy a larger scale of public spaces. See, for instance, Francis Loetterle, Environmental Attitudes and Social Life in Santa Clara County, dittoed manuscript, County of Santa Clara, County Planning Department, San Jose, California, 1967; and Frank Hendricks, "A Situational Approach to Residential Environmental Planning", unpublished report to the U.S. Public Health Service, March 1967.

While it is of course true in every plan, that some houses are far from services, and others closer to them, the character of the houses at different distances does not always support the psychological needs defined above. To support these needs, the community layout, close to services, should be open to activities and crowds and large in scale, while the community layout further from services, should be secluded and private and small in scale.

THE ROAD SYSTEM

LOOPED LOCAL ROADS

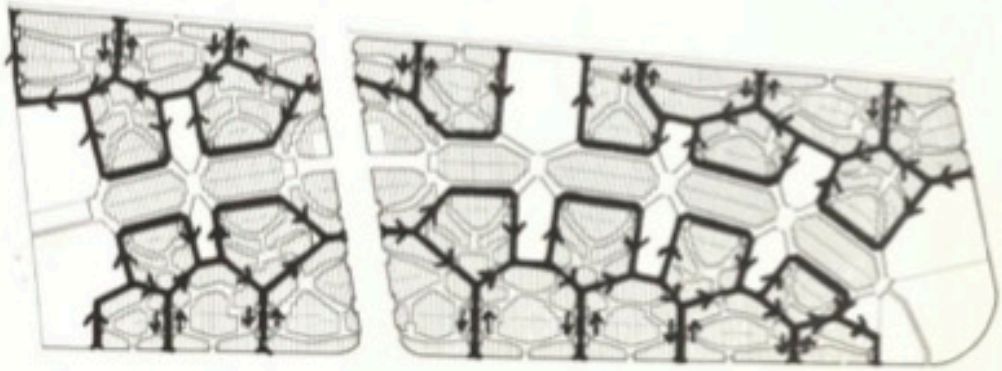
T-JUNCTIONS

DIRECT VISIBLE PARKING

TINY PARKING LOTS

LOOPED LOCAL ROADS

IN THE PROYECTO EXPERIMENTAL, all access to houses is provided by one lane, one-way, loop roads. No one of these loops serves more than 100 houses or 50 parking spaces (at 50% car ownership).



THE GENERAL PATTERN IS:

Context:

Any residential area served by local roads.

Solution:

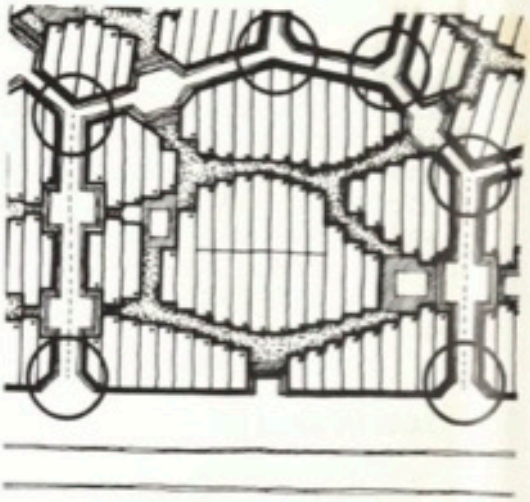
These local roads are narrow one-way "loop" roads serving a maximum of 50 parking spaces. They need be no more than one lane wide, the surface should be rough. A loop road is defined as any road in a road network placed so that no path along other roads in the network can be shortened by travel along the "loop".

Problem:

Through traffic is fast, noisy, and dangerous. At the same time, cars are important, and cannot be excluded altogether from the areas where people live. To safeguard these

areas, the roads must be laid out to discourage all through traffic - hence the loops. The loops themselves must be designed to discourage high volumes or high speeds: this depends on the total number of houses served by a loop, the road surface, the road width, and the number of curves and corners. Our informal observations suggest that a loop is, and feels, safe so long as it serves less than 50 cars. At this level, there may be a car every two minutes at rush hour, and far fewer during the rest of the day. The number of houses served will vary, according to the average number of cars per house. At 1½ cars per house, such a loop serves 30 houses; at 1 car per house 50 houses; at ½ car per house, 100 houses.

T – JUNCTIONS



IN THE PROYECTO EXPERIMENTAL, no two roads cross. All roads meet in T-junctions.

THE GENERAL PATTERN IS:

Context:

Any point in a road network where two roads meet, without a traffic light.

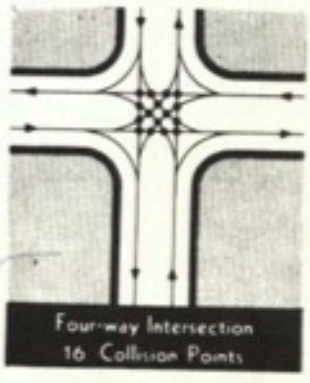
Solution:

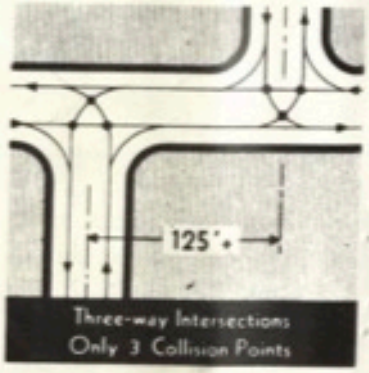
The roads meet in a T-junction, whose angle is as near 90° as possible.

Problem:

Studies show that traffic accidents are far more frequent where two roads cross, than at T-junctions. This follows from the geometry. Where two two-way roads cross, there are 16 collision points, compared with 3 for a T-junction. (John Callendar, Time Saver Standards, Fourth Edition, New York, 1966, p. 1230.)

Further evidence shows that the T-junction is safest if it is a right-angled junction. When the angle deviates from the right angle, vision is less good, and there is confusion about right of way. Accidents increase. (The SCAFTS Guidelines, Swedish National Board of Urban Planning, 1968, p. 11.)

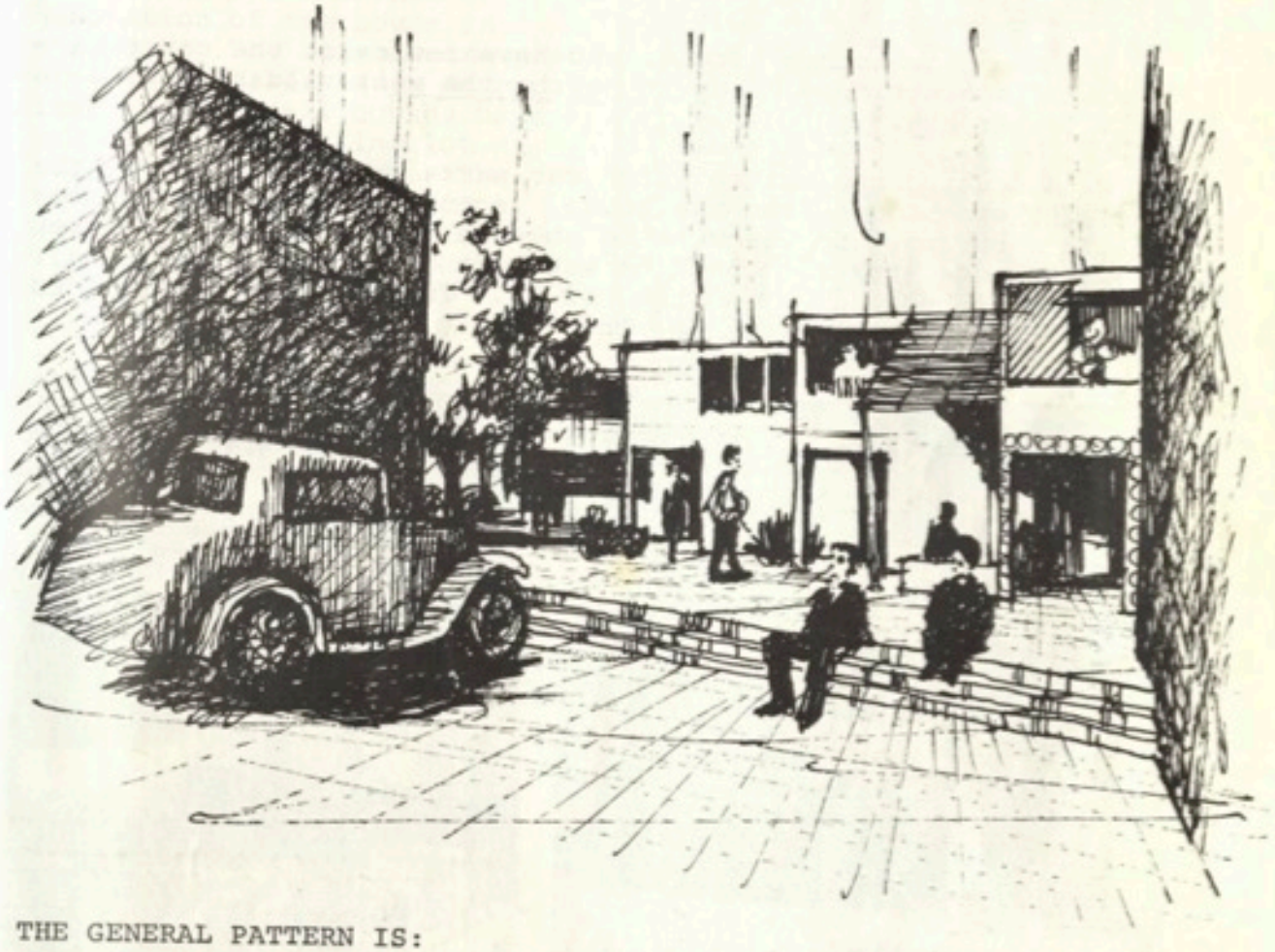




5

DIRECT VISIBLE PARKING

IN THE PROYECTO EXPERIMENTAL, every house is within 50 meters of a parking lot, and in most cases the parking lot is visible from the front of the house.



THE GENERAL PATTERN IS:

Context:

Parking for a housing area where car ownership is unpredictable, and less than one car per house.

Solution:

There is a parking lot directly visible from every house, and less than 50 meters away from every house. If the house has two doors, then the parking lot is closer to the front door than to the back door.

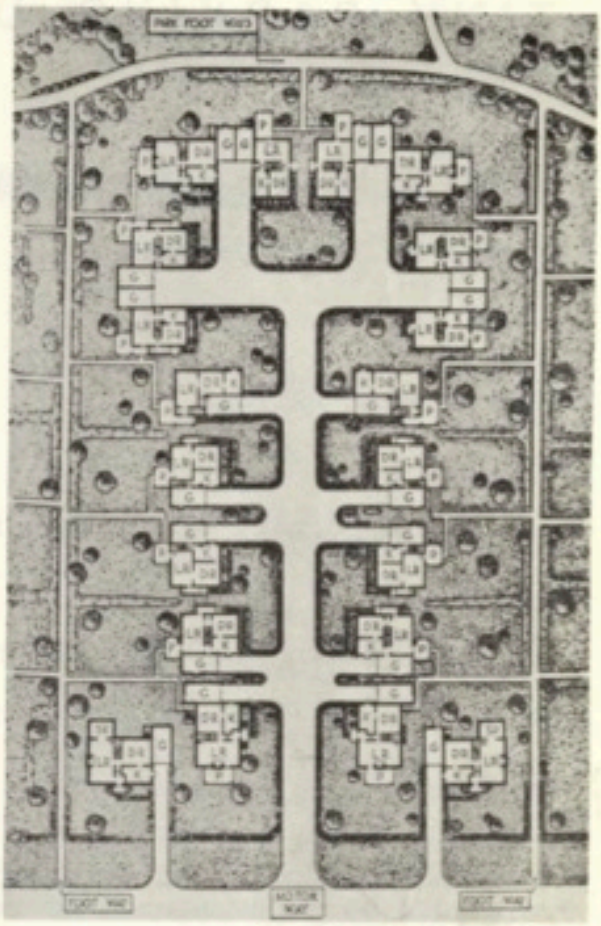
Problem:

Among low income people, who have few cars, the car is a prized possession. Often it may be the most valuable thing its owner has.

A housing project in which car parks are far away from the house, and hidden from the house, is entirely unacceptable to such a person. He wants to be able to watch his car, to make sure no one steals it, and he wants it to be associated with his house because he is proud of it. The car must be close to the house, visible from it, and visibly associated with it.

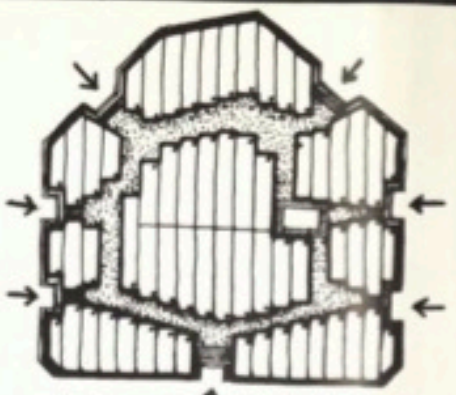
It is also essential that the car be associated with the front door of the house, not the back door. When people have cars, they always come in and out of the house by the door

which is closest to the car. (See, for instance, Vere Hole, et al, "Studies of 800 Houses in Conventional and Radburn Layouts", building Research Station, Garston, England, 1966.) If the relationship between car and house is such that this leads them to use the back door of the house, this turns the internal organization of the house inside out. The classic example of this mistake, is in Radburn itself, where all houses have access to the parking lot through the back door. The back door becomes the front door. Everyone, including visitors, comes into the house through the back door.



In a country like Peru, where the distinction between the front door and the back door is so crucial socially, this kind of mistake would be disastrous. (See Intimacy Gradient and Puerta Falsa Patterns.) The parking lot must be nearer to the front door than the back door. Since people will have to carry heavy parcels, 50 meters is a widely accepted upper limit for this distance. (E.g., Kevin Lynch, Site Planning, M.I.T. Press, 1962, p. 181.)

TINY PARKING LOTS



EVERY CELL IN THE PROYECTO EXPERIMENTAL, is surrounded by a number of small parking lots, each one designed for 3-7 cars.

THE GENERAL PATTERN IS:

Context:

Any open part of a community containing parking.

Solution:

The parking is broken down into separate, tiny parking lots, no one parking lot holding more than 6 cars.

Problem:

Large parking lots create an impersonal, institutional atmosphere, dominated by cars; they separate people from the pleasure and convenience of being near their cars; and, if they are large enough to contain unpredictable traffic, they are dangerous for children, since children inevitably play in parking lots.

It is hard to pin down the exact size at which parking lots become too big. Our informal observations suggest that parking lots for four cars are still essentially pedestrian and human in character; that lots for six cars are acceptable; but that any area near a parking lot which holds eight cars, is already clearly identifiable as "car dominated territory".

This may be connected with the well-known perceptual facts about the number seven. A collection of less than 5-7 objects can be grasped as one thing, and the objects in it can be grasped as individuals. A collection of more than 5-7 things, is perceived as "many things". (See G. Miller, "The Magical Number Seven, Plus or Minus Two: Some Limits on Our Capacity for Processing Information", in D. Beardslee and M. Wertheimer (eds.) Readings in Perception, New York, 1958, esp. p. 103.)

It may be true that the impression of a "sea of cars" first comes into being with about seven cars.

PEDESTRIAN NETWORK

PASEO

ACTIVITY NUCLEI

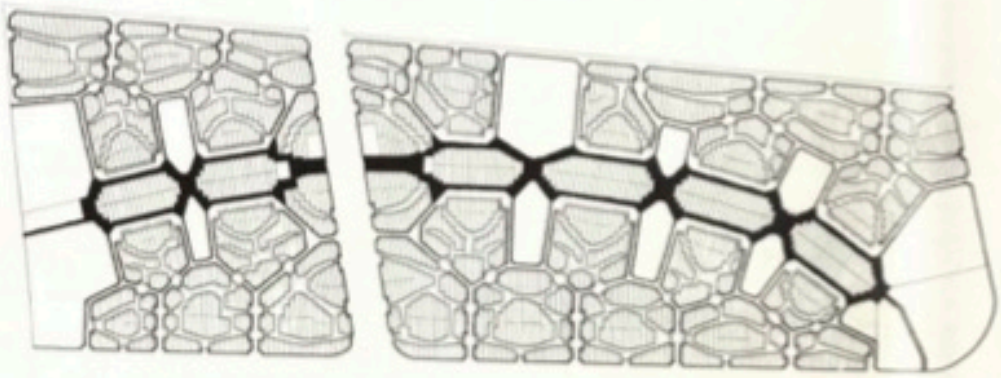
CAR-PEDESTRIAN SYMBIOSIS

PEDESTRIAN 50 CM ABOVE CAR

KNUCKLE AT ROAD CROSSING

PASEO

IN THE PROYECTO EXPERIMENTAL, there is a curving "paseo" down the middle of the site, coming out to the artery at the ends. This paseo is a sequence of looped paths, connected by a sequence of small squares. All community facilities open onto these small squares. Between these squares, the paths pass between terraces of houses. Two-thirds of the houses in the project, are within 100 meters, and all are within 180 meters, of the paseo.



THE GENERAL PATTERN IS:

Context:

Any residential area, in a Latin country.

Solution:

The area contains a "paseo". We define a paseo as a system of looped pedestrian paths, connecting a system of activity nuclei. Those activity nuclei at the ends of the paseo contain facilities which can function as destinations for an evening walk: ice cream parlors, coke shops, church,

volley ball courts, public gardens, movie house, bars, swimming pools. No point on the paseo is more than 50 meters from an activity nucleus, and no house is more than 100 meters from the paseo. Where the paseo is not fronting on activity nuclei, it always fronts on houses - it never fronts on blank walls, or the side walls of houses.

Problem:

In Latin America, Spain, Sicily, Italy, the habit of the evening "paseo" is a very common one. On many evenings, and in the daytime on Sundays and holidays, people go to some central place where they walk up and down, looking out for friends, enjoying the talking as they walk, showing themselves.

Since people come to see people, and to be seen, this place must have a high density of pedestrians using it. It must therefore be associated with the places most likely to attract people: the activity nuclei.

Further, even though the real reason for the paseo has to do with seeing people, and being seen by them, people in general find it easier to take such a walk if they have a "destination" to go to. This destination may be a real destination (like a coke-shop or cafe) - or it may be partly imaginary, like "lets walk round the block" - which again provides a person with a specific goal.

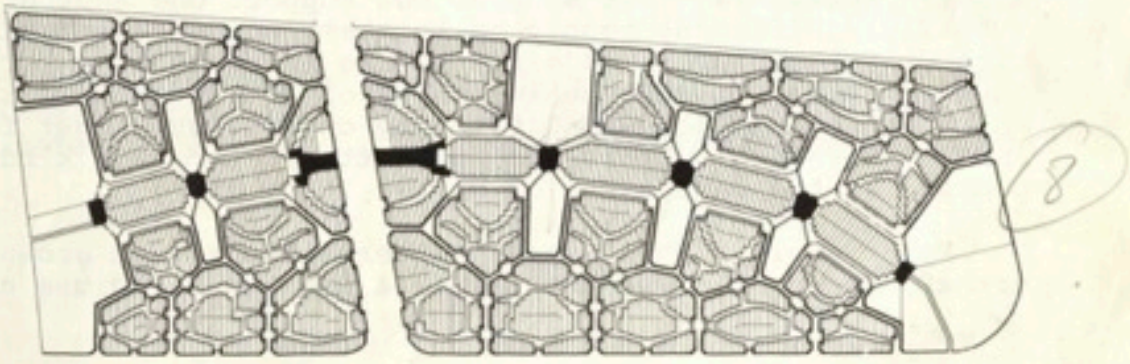
It is also important that people do not have to walk too far between the public activities. Informal observation suggests that any point which is more than 50 meters from activity becomes unsavory and unused. By the same token, no house should be too far from the paseo: if people have to go through deserted streets at night, to get to the paseo, the chances are that they won't go there. 100 meters seems to be a reasonable upper limit.

For a general description of the paseo, see Edward B. Allen, "The Passegiata", Landscape, Winter 1969, pp. 29-32.

ACTIVITY NUCLEI

IN THE PROYECTO EXPERIMENTAL, all community facilities open onto one of eight small squares, and all pedestrian paths in the community, lead towards these eight small squares.

Each of the activity generators is unique, according to the facilities which surround it. The market square is surrounded by small shops, has a supermarket at one end, the artery crossing at the other, and contains market stalls. The evening center is surrounded by cinema, dance hall, and bars, and contains clustered lights for night time activity, and sheltered tables round the edge. The open spaces between kindergartens and walled eucalyptus groves, contain shallow tiled pools, where toddlers can splash and play, with seats around them for mothers. The open space between church and clinic contains flowers, grass and bushes, cared for by the church. The open spaces in front of primary schools, and sports centers, contain a stepped depression, large enough for football in the middle, the steps deep enough to form seats for people who want to watch the games.



THE GENERAL PATTERN IS:

Context:

Any community large enough to support community facilities.

Solution:

The community facilities are clustered round a small number of very small open spaces which we call activity nuclei. The facilities in any one nucleus are clustered in such a way that they cooperate functionally. (See problem statement.) All paths in the community pass through these activity nuclei.

Problem:

One of the greatest problems with new communities, is the fact that the available public life in them is spread so thin, that it has no impact on the community, and is not in any real sense "available" to the members of the community. Yet studies of pedestrian behavior make it clear that people seek out concentrations of other people, whenever they are available, (e.g. Jan Gehl, "Mennesker til Fods (Pedestrians)", Arkitekten, No. 20, 1968.)

To create these concentrations of people in a community, facilities must be grouped densely round very small public open spaces which can function as nuclei - and all pedestrian movement in the community channelled to pass through these nuclei. These nuclei need two properties.

First, the facilities grouped around any one activity nucleus, must be carefully chosen for their symbiotic relationships. It is definitely not enough merely to group communal functions in so called community centers. For example, church, cinema, kindergarten, and police station are all community facilities - but they do not support one another mutually. Different people go to them, at different times, with different things in mind. There is no point in grouping them together. To create intensity of action, the facilities which are placed together round any one nucleus, must function in a cooperative manner, and must attract the same kinds of people, at the same times of day.

For example: When evening entertainments are grouped together, the people who are having a night out can use any one

of them, and the total concentration of action increases. When kindergartens and small parks and gardens are grouped together, mothers and young children may use either, so their total attraction is increased. When schools and swimming pools and football space are grouped together, they form natural centers for school children.

Second, the open places which form the nuclei should be very small indeed. Our observations suggest that 15 x 20 meters is the ideal size; if the space has to be larger, it should be long and narrow, with its short dimension no more than 20 meters.

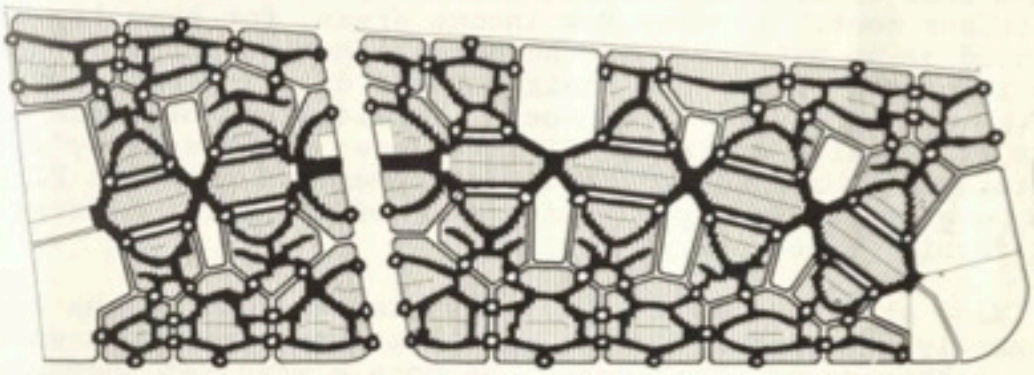
Our observations in Lima showed, again and again, that places which are larger look and feel deserted, and discourage

activity. The reasons for this recurrent observation are obscure, but the following facts may have something to do with it. A person's face is just recognisable at about 20 meters, and, under typical urban outdoor noise conditions, a loud voice can just be heard at 20 meters.

This may mean that people feel tied together in spaces whose diameter is less than 20 meters, and lose this feeling in larger spaces: perhaps a major factor in the development of activity.

CAR – PEDESTRIAN SYMBIOSIS

IN THE PROYECTO EXPERIMENTAL, the car roads form loops, and the pedestrian paths form a diagonal network which crosses these loops at right angles. Where they cross, there are parking lots, cell gateways, and space for pedestrian activity. The two systems form a double gradient: car densities dominate towards the outside of the site, pedestrian densities dominate towards the inside of the site, with a smooth gradient between the two.



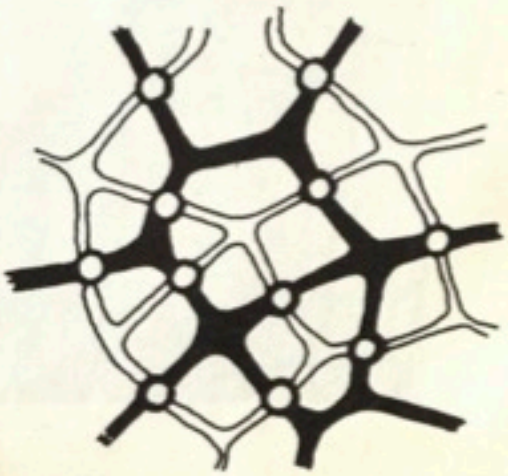
THE GENERAL PATTERN IS:

Context:

Any area which contains pedestrian paths and local car roads.

Solution:

The system of pedestrian paths and the system of roads are two entirely distinct orthogonal systems. They cross frequently; so that no point on either system is more than about 50 meters from



a crossing. Every time they cross, both paths and roads swell out, making room for pedestrian activity and for parking and standing.

Problem:

It is common planning practice to separate pedestrians and cars. This makes pedestrian areas more human, and safer. However, this practice fails to take account of the fact that cars and pedestrians also need each other: and that, in fact, a great deal of urban life occurs at precisely the point where these two systems meet. Many of the greatest places in cities, Piccadilly Circus, Times Square, the Champs Elysees, are alive because they are at places where pedestrians and vehicles meet. New towns like Cumbernauld, where there is total separation between the two, seldom have the same sort of liveliness.

The same thing is true at the local residential scale. A great deal of everyday social life happens where cars and pedestrians meet. In many low income areas, for example, the car is used as an extension of the house. Men, especially, often sit in parked cars, near their houses, drinking beer and talking. (Clare Cooper, "Some Social Implications of House and Site Plan Design at Easter Hill Village: A Case Study", Institute of Urban and Regional Development, Center for Planning and Development Research, University of California, Berkeley, California, 1966, pp. 39 ff.)

Many studies show that conversation and discussion grow naturally out of the communal car lots where men meet when they take care of their cars. Vendors always set themselves up where cars and pedestrians meet; they need all the traffic they can get. Children always play in parking lots - perhaps because they sense that this is the main point of arrival and departure; perhaps because they enjoy the cars.

In Peru, there is a new version of the paseo: the "auto-paseo" - several friends hop into a car, and drive around, visiting their friends, often not even getting out of their cars, but talking from house to car, and back.

None of these things can happen in a plan where car roads and pedestrian paths are separated, unless the two meet frequently, and the places where they meet are treated as minor centers of activity.

PEDESTRIAN 50 CM ABOVE CAR

IN THE PROYECTO EXPERIMENTAL, all local roads are 50 cm below grade. The pedestrian precinct defined by each cell, is an island, floating 50 cm above the road which surrounds it. Where a pedestrian path crosses a local road, there are three steps down.

THE GENERAL PATTERN IS:

Context:

Any area which contains roads with traffic densities of more than a few vehicles per day.

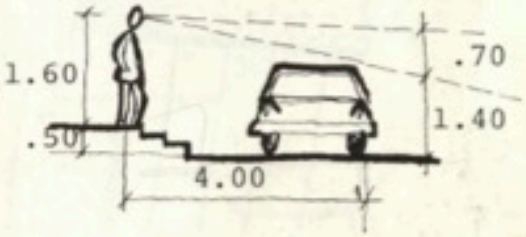
Solution:

These roads are sunk 50 centimeters below all pedestrian paths.

Problem:

In the modern city, the car is king; the pedestrian is made to feel small. This cannot be solved by keeping pedestrians separate from cars; it is in their nature, that they have to meet. But where they meet, the car must be "put down", symbolically, and the pedestrian world given more importance. This is most easily achieved if the car is physically below the pedestrian. Our experiments suggest that the effect first makes itself felt, when the car is about 50 centimeters below the pedestrian paths. There are two possible reasons for this figure.

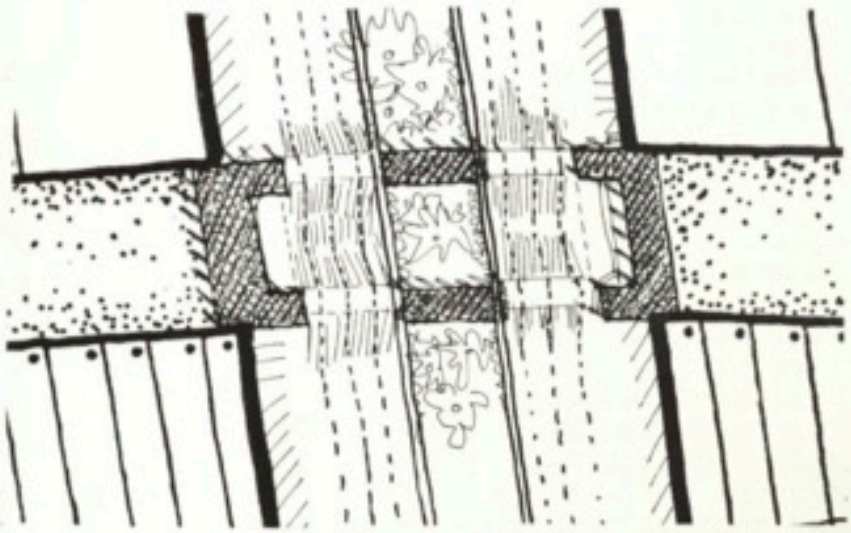
Most people's eye level is between 1.30 and 1.60 meters. A typical car has an overall height of 1.40 meters. Although tall people can see over the cars, even for them the cars fill the landscape, since a standing person's normal line of sight is 10 degrees below the horizontal. (Henry Dreyfus, The Measure of Man, New York, 1959, sheet F.) To get the top of a car that is four meters away, completely below the line of sight, it would have to be standing between 50 and 80 centimeters below the pedestrian.



It may also be that the car overwhelms the pedestrian because of a constant, unspoken possibility that a runaway car might at any moment mount the curb and run him down. A car can climb an ordinary 15 centimeter curb, easily. For the pedestrian to feel certain that a car could not climb the curb, the curb height would have to be greater than the radius of a car tire (30-38 cm): thus at least 40 cm, preferably 50 cm.

KNUCKLE AT ROAD CROSSING

IN THE PROYECTO EXPERIMENTAL, where the paseo crosses the artery, the pedestrian path crosses 50 cm above the level of the roadway, and is marked by a canopy; the artery narrows to through lanes only, and slopes up to the crossing; on each side, the pedestrian path opens out to provide space for commercial activity, with parking bays for loading and unloading.



THE GENERAL PATTERN IS:

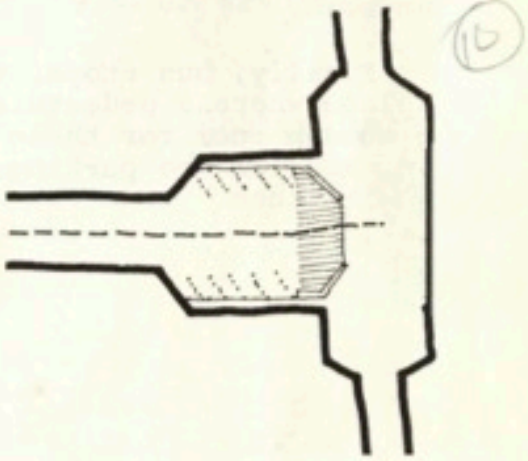
Context:

Any point where a pedestrian path crosses a major road.

Solution:

There is a "knuckle" at the crossing, defined by the following features:

1. The road narrows to the width of the through lanes only and the lanes themselves narrow to 2.40 meters.
2. If the road is more than 3 lanes wide, the roadway is split in two and the island in the middle is at least 10 meters wide.
3. The pedestrian path continues through the crossing 50 cm above the roadway.
4. The road slopes up towards the crossing (slope 1 in 6 max.).
5. The pedestrian path is marked by a canopy, or shelter, except where it crosses the roadway.
6. Immediately next to the point of crossing, there are bays opening off the roadway, providing standing spaces for busses, cars, delivery trucks. There are steps leading to these standing bays.
7. On one, or both sides of the road, the pedestrian path swells out to make space for shops, and vendors.



Problem:

The way a path crosses a road, depends on traffic density. If the traffic density is very low, it is safe to let people cross where they want to. If the traffic density is high, the crossing has to be specially defined.

The main problem for pedestrians trying to cross a heavily travelled road, is the width of the roadway. Buchanan has shown that the average waiting time, and the percentage of pedestrians who are forced to wait, for various levels of

traffic flow, is greatly affected by the width of the road. (Colin Buchanan, et al, Traffic in Towns, HMSO, London, 1963, pp. 203-213.) The road and the lanes themselves, should therefore narrow as far as possible at the crossing. Any crossing more than three lanes wide, should be split in two.

The fact that pedestrian ascendancy over the car will be increased if they are 50 centimeters higher, has already been discussed in "Pedestrian 50 cm Above Car". The same principle applies, even more powerfully, where pedestrians have to cross a road. The pedestrians who cross, must be extremely visible from the road. Cars should also be forced to slow down when they approach such a crossing. If the pedestrian way crosses above the roadway, and the roadway slopes up to it, this satisfies both requirements. Small bumps in the road, to slow cars down at pedestrian crossings, are common in Peru. The slope may not be too steep, since this would be dangerous to traffic, and make the pedestrians invisible as the car nose rides up. A slope of 1 in 6, or less, is safe from both points of view.

To make the crossing even easier to see from a distance, and to give weight to the pedestrian's "right to be there", the pedestrian path should be marked by a canopy at the edge of the road.

Finally, bus stops, vendors, shops, grow naturally around a place where a pedestrian path crosses a road. There must be enough room for these activities on both sides of the crossing, and for the parking, standing, loading and unloading that go with them.

COMMUNITY SPINE

CENTRAL MARKET

EVENING CENTERS

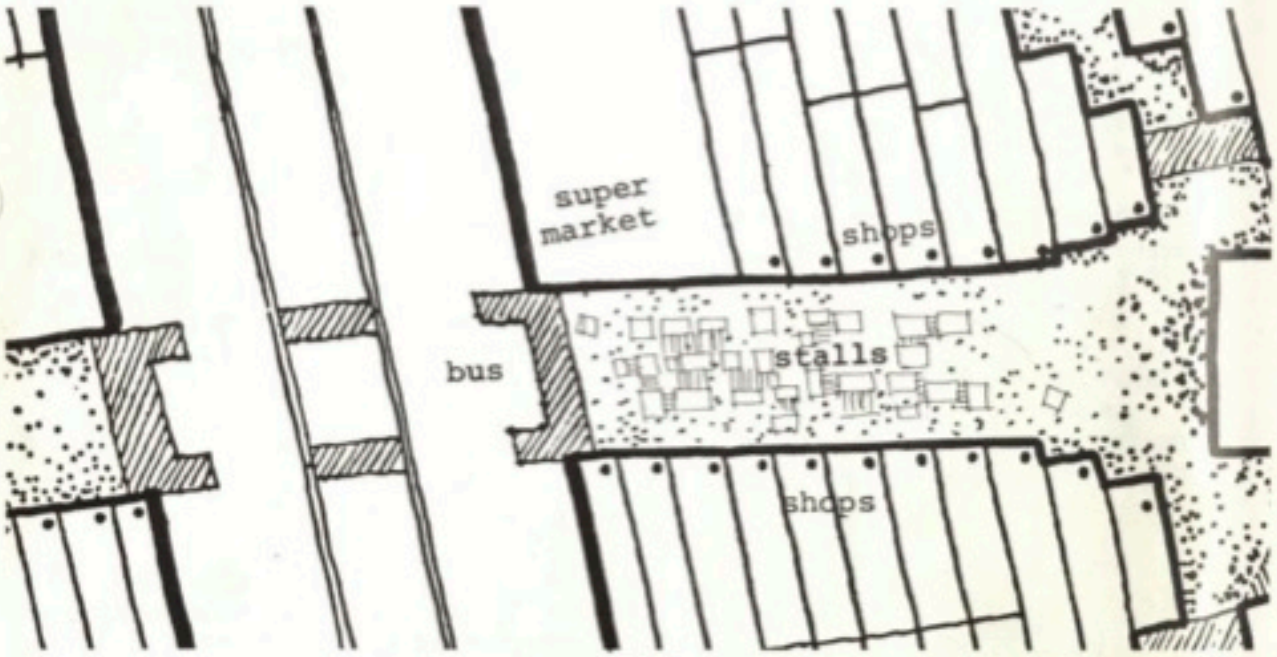
WALK-THROUGH SCHOOLS

VISIBLE KINDERGARTENS

SOCIAL GARDENS

CENTRAL MARKET

IN THE PROYECTO EXPERIMENTAL, the market and supermarket, are placed at that point where the paseo meets the northbound artery which crosses the site. The market itself is in a long narrow open space, lined on both sides by small shops, with opportunities for a double row of open stalls down the middle.



THE GENERAL PATTERN IS:

Context:

Any low income community containing an open market.

Solution:

The market is at the center of gravity of the community, next to a major traffic artery, in a pedestrian area running back from the artery.

Problem:

In areas where there are few cars and few refrigerators, women buy the food fresh, every day, and carry the food home on foot. It is therefore essential that the market be located in the most central position in the community, a position which minimizes total walking distance for the entire community.

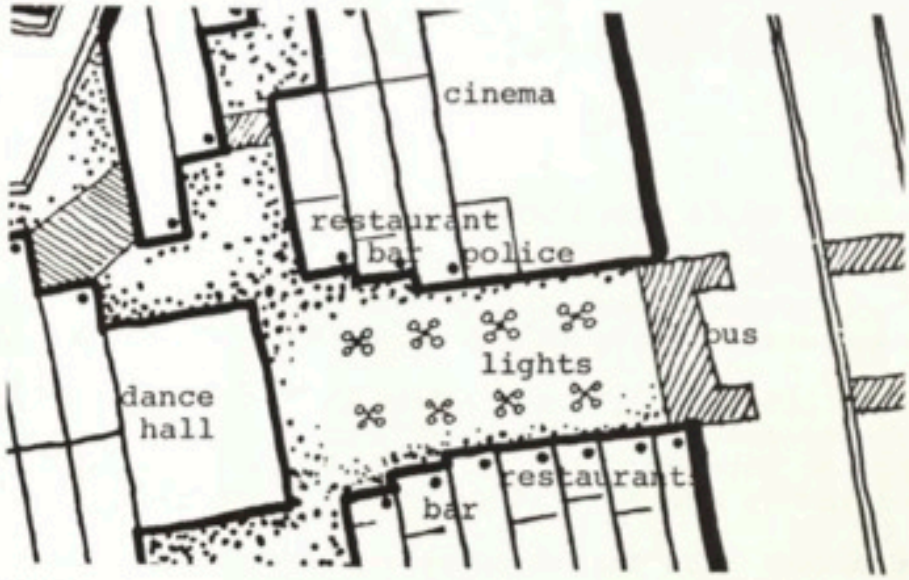
On the other hand, many community market centers benefit from direct access to urban arterials. The central market must therefore be located along that section of an artery which is most central to the community which it serves.

The market area should be at a point of high pedestrian flow, and shops should be oriented alongside the pedestrian flow so as to maximize exposure to potential consumers. The market stalls must also be in a pedestrian area - since most shopping at a market is comparison shopping, and will continue to be so, even when supermarkets take over.

Finally, market shops need easy access of vehicles for deliveries. However, since deliveries are infrequent, trucks and vans can move through pedestrian areas when delivering.

EVENING CENTERS

IN THE PROYECTO EXPERIMENTAL, the cinema, dance hall for Gran Baile Social, bars, restaurants, police station, and main bus stop are clustered round an open space, which is filled with lights, where the paseo meets the northbound artery that crosses the site.



THE GENERAL PATTERN IS:

Context:

Any urban area which contains community facilities that are open at night (including, for instance, bars, restaurants, cinemas, police stations, bus stops, all night gas stations).

Solution:

These evening facilities are aggregated to form clusters, no one cluster containing less than half a dozen facilities.

Problem:

1. People feel unsafe and uncomfortable at night when they are not grouped in large numbers. When large numbers of people are in sight people are comfortable.

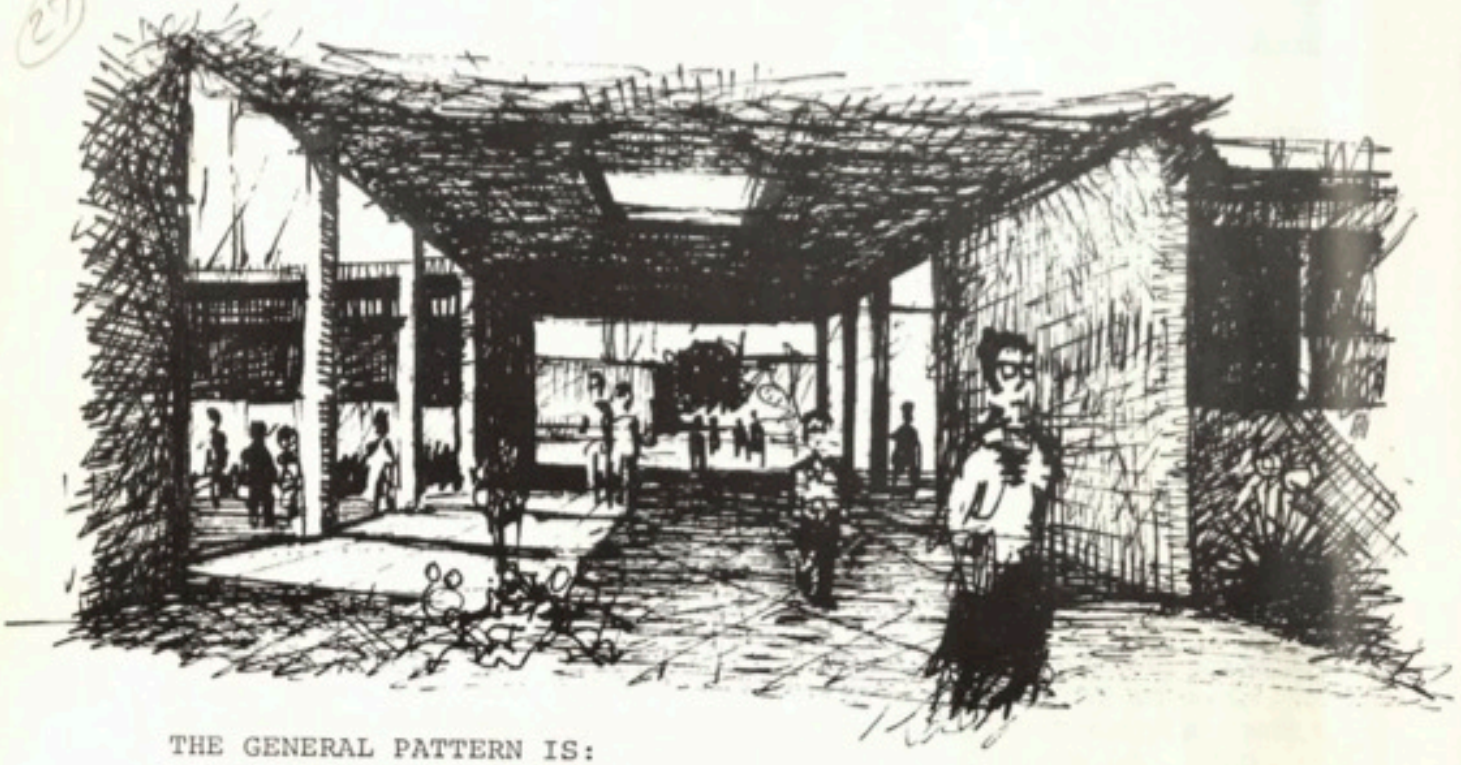
2. If evening activities such as police station, cinema, bars, cafes, ice cream parlors, gas stations and the like are scattered throughout the community, each one by itself cannot generate enough attraction for community members. If activities are grouped, the patrons of one activity are also potential patrons of the others. The total attraction of customers of each activity is thus increased. Furthermore, the nucleation of evening activities, creates larger concentrations of people, and encourages new evening activities to open there.

3. Many people do not go out at night because they feel they have no place to go, and they do not feel like going out to a specific establishment. But they feel like going out. An evening center, particularly when it is full of light, functions as a focus for such people, and by attracting them, again increases its potential for liveliness and action.

The subject of evening centers has been discussed at length by Shlomo Angel, "Discouraging Crime Through City Planning", Working Paper No. 67, Center for Planning and Development Research, University of California, Berkeley, 1968.

WALK-THROUGH SCHOOLS

IN THE PROYECTO EXPERIMENTAL, secondary schools are placed at the ends of the paseo, with main pedestrian arcades running through them. These two schools will be laid out so that all facilities which might possibly become used for adult education, or for invited gatherings in the school, like school plays, will be located along these main arcades.



THE GENERAL PATTERN IS:

Context:

Any school in a community.

Solution:

The schools are laid out so that public pedestrian paths run through them, and those parts of the schools which may

involve the wider public (like playgrounds, auditoria, gardens, workshops) are placed to open directly off these paths.

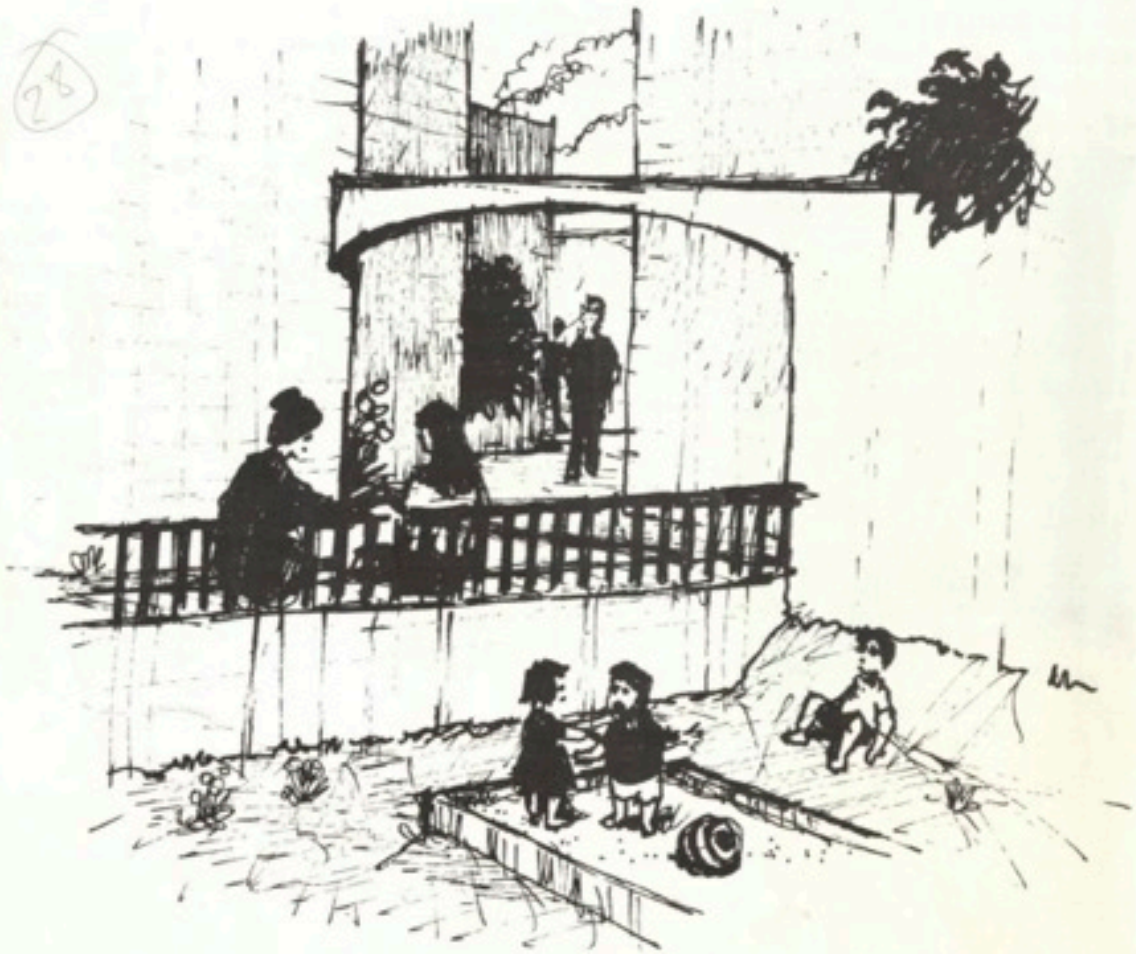
Problem:

There is a general tendency, in modern society, to dissociate the formal education of children from the other processes of society. Children spend the day in a school, which is separate from most ordinary social processes, and then spend the night at home. This contrasts very badly with the situation in a non-urban society, where a child is exposed to all social institutions - work, play, ritual, government - all the time. It is not surprising that many young people in urban society no longer understand their relation to society.

In order to combat this dissociation, it is essential that schools be "opened" in the most literal sense, to the rest of the community. Of course, active participation of community persons, in the daily life of the school, cannot be quaranteed by physical layout. But it will not happen, unless the physical layout helps to encourage it. In order to destroy the self-contained, institutional character of the schools, they should overlap, as far as possible, with public thoroughfares which encourage public use.

VISIBLE KINDERGARTENS

IN THE PROYECTO EXPERIMENTAL, each kindergarten is a walled precinct, containing sunken play areas. Public paths cut through this precinct alongside the sunken play areas, and are separated from these areas by a low seat-height wall.



THE GENERAL PATTERN IS:

Context:

A residential community containing kindergartens within walking distance of the houses they serve.

Solution:

Public paths pass through the kindergartens, and the open areas inside the kindergarten are sunken, adjacent to the paths, and separated from them by a low seat-height wall.

Problem:

There is a general tendency, in modern society, to dissociate the formal education of children from the other processes of society. This dissociation leads, in the end, to a situation where young people no longer understand their relation to society. (See Walk Through Schools.)

The first step of this process is the "trauma" which the young child experiences when first taken off to formal "school" - i.e., kindergarten. Silverstein has indicated that the child's sense of this first school being "separate" from society, can be reduced if the play areas of the kindergarten are open to all passing adults, and to all passing children - not only those who happen to be enrolled. (Murray Silverstein, "The Child's Urban Environment", Proceedings of the Seventy-First National Convention of the Congress of Parents and Teachers, Chicago, Illinois, 1967, pages 39-45.)

To keep the young children safe, and to make it possible to give them this great freedom without losing track of them altogether, the play areas may be sunk slightly, and surrounded by a low wall. If the wall is at seat height, it will encourage people to sit on it - giving them a place from where to watch the children playing, and the children a chance to talk to passers-by.

WALLED GARDENS

IN THE PROYECTO EXPERIMENTAL, there are three small walled gardens containing grass, seats, paved areas and eucalyptus trees. Each one opens onto one of the activity nuclei along the paseo. The eucalyptus will be a fast growing variety, suitable for Peru, and should reach a height of 25 meters in five years. The gardens will be irrigated by the irrigation water that comes in from the northeast corner of the site.

THE GENERAL PATTERN IS:

Context:

Any small park or public garden in an urban area.

Solution:

It is walled, or partly enclosed, yet close to major centers of pedestrian activity.

Problem:

People need contact with trees and plants and water. Their symbolic character is not replaceable. In some way, which is hard to express, people are able to be more whole in the presence of nature, are able to go deeper into themselves, and are somehow able to draw sustaining energy from the life of plants and trees and water.

The small parks and gardens in a city try to solve this problem; but they are usually so close to traffic, noise, and buildings, that the impact of nature is entirely lost. To be truly useful, in the deepest psychological sense, they must allow the people in them to be in touch with nature - and must be shielded from the sight and sound of passing traffic.

In those few cases where there are small walled gardens in a city, open to the public - Alhambra, Morocco, Copenhagen Royal

Library Garden - these gardens almost always become famous. People understand, and value the peace which they create.

This is a particularly crucial problem in desert areas like Lima. In the desert, trees and plants are infinitely precious. Gardens are almost like oases - people flock to sit and talk and lie in them, wherever they exist. In such desert areas it is doubly important to keep at least partial separation between the garden and its surroundings, so that the garden can be fully felt, and the oasis character isn't lost.

At the same time, just because they are so precious, such gardens need to be close to major centers of pedestrian activity, so that people can use them and enjoy them often.

CELL INTERIOR

CELL GATEWAY

MULTIPURPOSE OUTDOOR ROOMS

SHOPS ON CORNERS

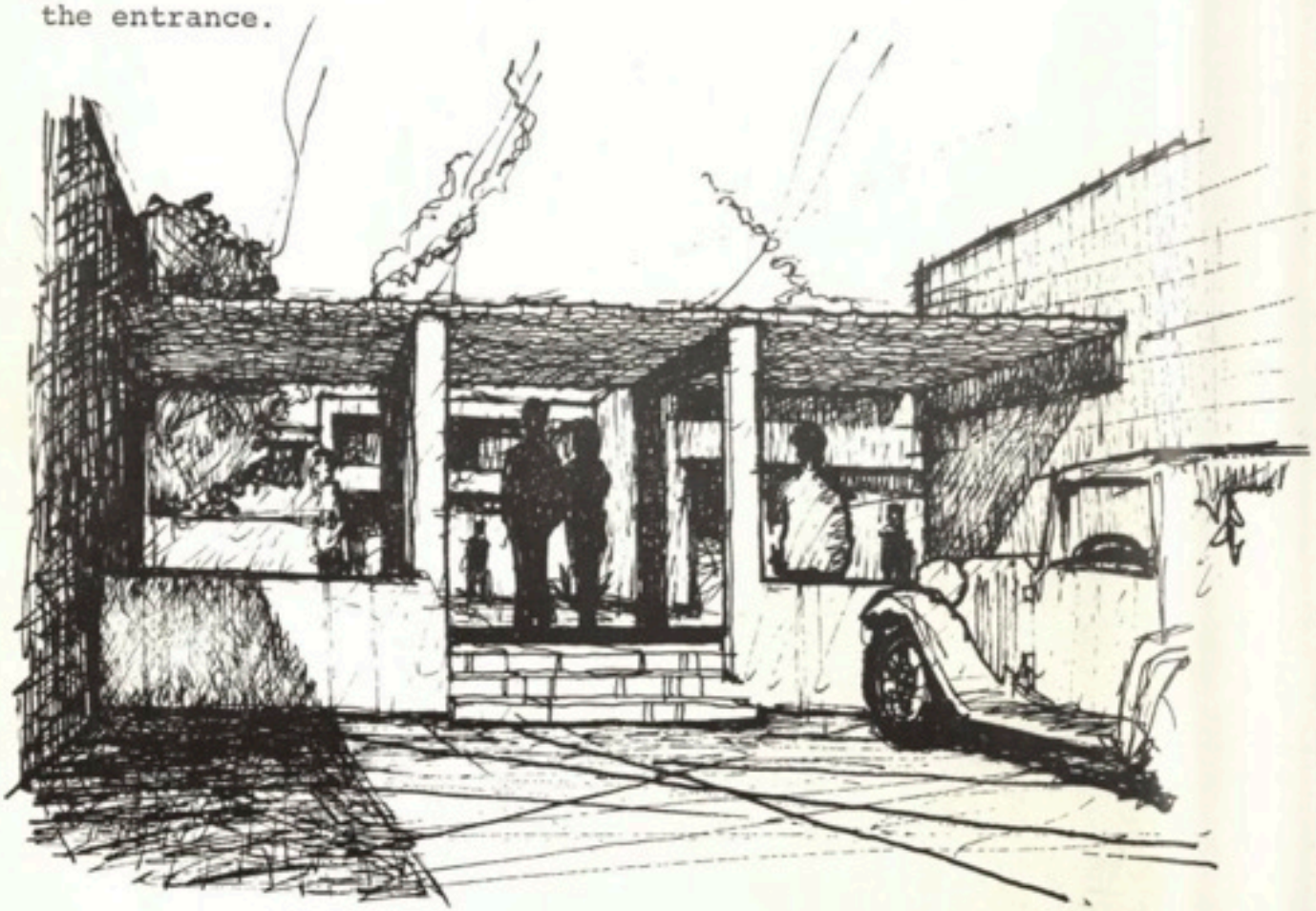
CENTRIPETAL PEDESTRIAN PATHS

STREET FOOTBALL

FLOWERS ON THE STREET

CELL GATEWAY

IN THE PROYECTO EXPERIMENTAL, every cell entrance is defined by the fact that the pedestrian path goes down three steps, to cross a road, then up three steps again, and then passes under a woven bamboo canopy. In many cases the path also narrows at the entrance.



THE GENERAL PATTERN IS:

Context:

Any point where a pedestrian path enters a residential cell, as defined by the subculture cells pattern.

Solution:

The path narrows down, changes level, passes under cover or passes through an enclosure.

Problem:

The arguments in the subculture cell pattern explain that the houses need to be grouped in cells which can develop a strongly individual identity and atmosphere. This will only happen if the people who live there, contribute to this atmosphere; and this in turn, will only happen if they experience the distinctness of their own cell, daily.

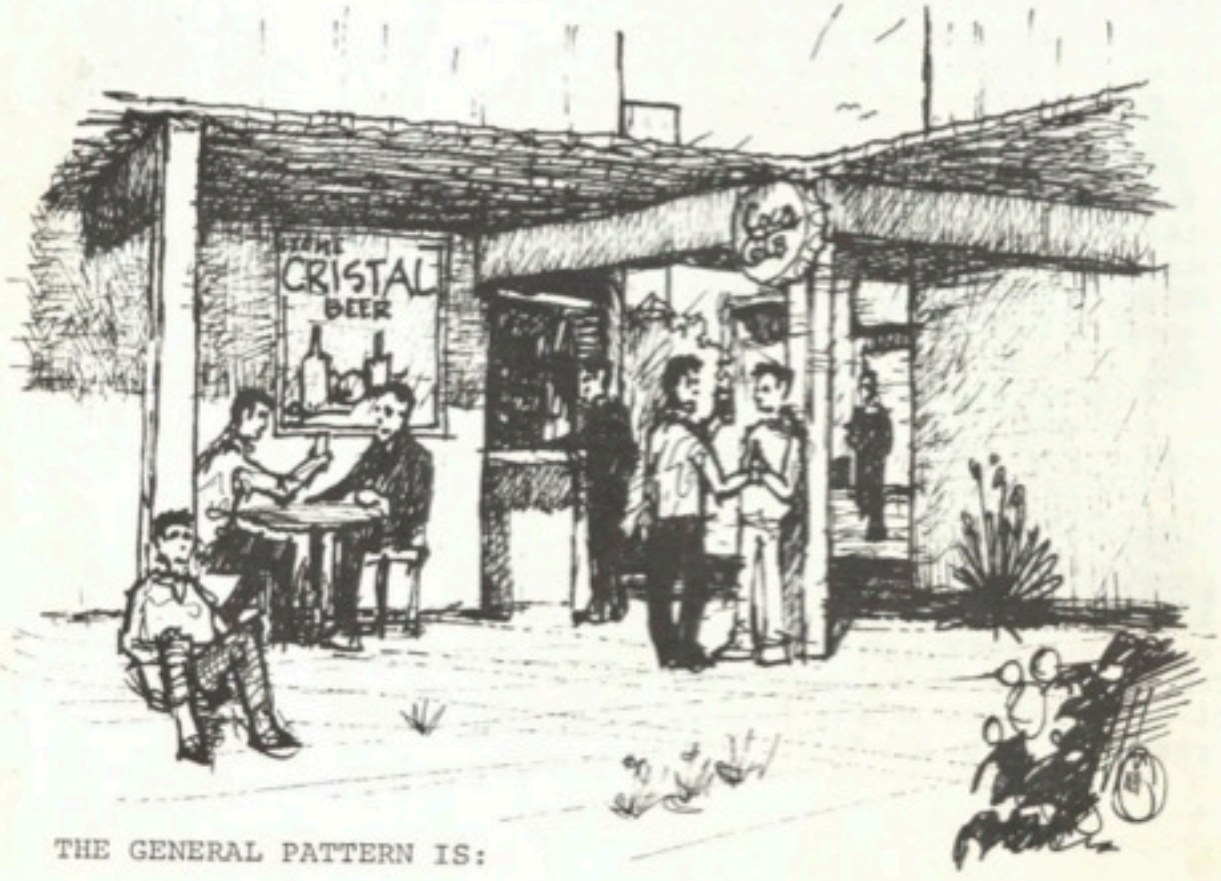
People do not experience the distinctness of an area, unless many different qualities change simultaneously, as they enter that area. This requires a zone of transition, at every point where a path enters the cell, with as many environmental qualities as possible, changing during passage through this transition zone.

If possible the sound of footfall, the view, the feel of the surface, the level, the relative amount of enclosure, the intensity of light should all change together. The transition will be best marked of all, if it is experienced as a "bridge" or a "gate".

There is little published evidence for this phenomenon - though the Japanese, for instance, have made use of it for centuries. The nearest empirical evidence is Kevin Lynch's demonstration that "edges" are major components in the images of cities which people have. (The Image of the City, M.I.T. Press, 1960, p. 62 ff.)

MULTI-PURPOSE OUTDOOR ROOM

IN THE PROYECTO EXPERIMENTAL, each cell contains one open space about 6 x 10 meters, surrounded by a two meter deep, roofed, arcade, and several smaller, non-continuous sections of the same arcade in other places. Each one of these arcades is placed at a node in the system of pedestrian paths. They are left unfinished, with the understanding that community residents may build in games like table tennis, bochas or sapo, sand-pits, seats, water faucets, walls, and small shops or bars, according to their needs.



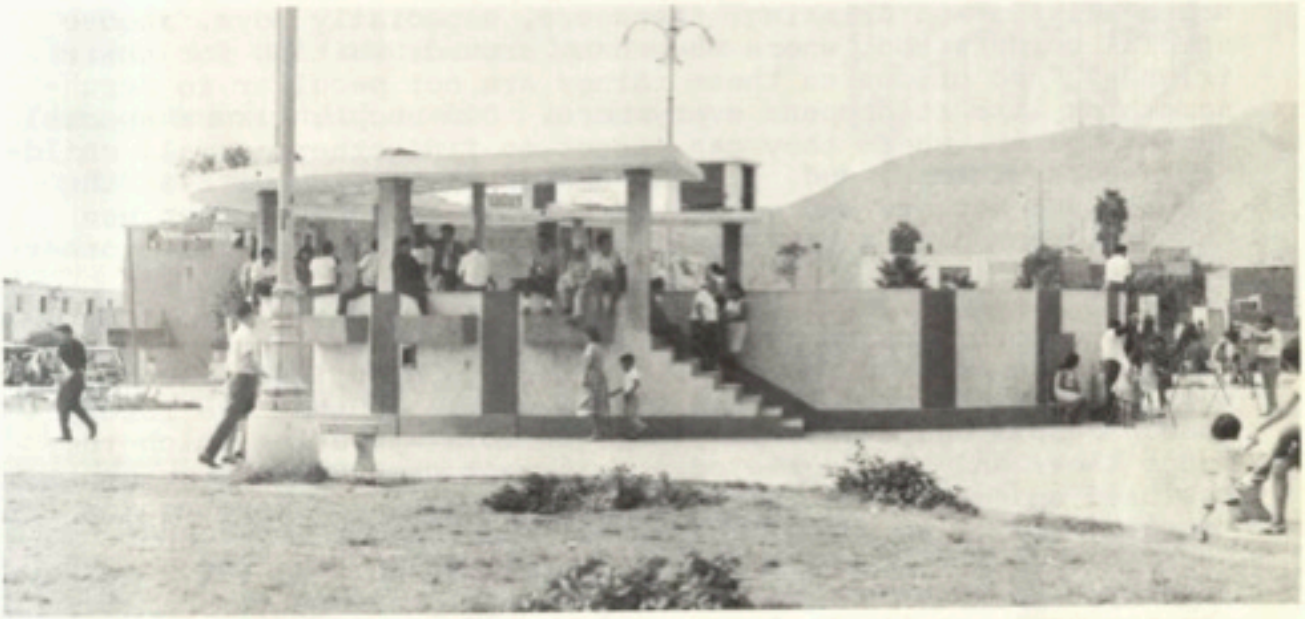
THE GENERAL PATTERN IS:

Context:

Any local part of a residential community.

Solution:

There is, within view of every house, at least one "multipurpose outdoor room" with the following characteristics. It is open to the sky, surrounded or at least partly surrounded by a continuous roofed arcade, always at least two meters deep, and, where possible, built up against the walls of existing buildings.



The outdoor rooms are left unfinished, with the understanding that they will be finished by people who live near them, to fill whatever needs seem to be most pressing. They may contain sand, or water faucets, or play equipment, for small children. They may contain steps, and seats, where teenagers can meet. Someone may build a small bar in a house that opens into the arcade, making the arcade a place to eat and drink. There may be games for old people, like chess and checkers.

Problem:

In existing modern housing projects, people rarely feel comfortable lingering outside their houses. There are few places where it is "all right to be". Yet at the same time, it is clear that almost everyone wants, at some time or another, to linger in some public space. Our observations in Peru show that the men seek corner beer shops, where they spend hours talking and drinking; teenagers, especially boys, choose special corners too, where they hang around, waiting for their friends. And of course these things are not peculiar to Peru - something like it happens everywhere. Old people like a special spot to go to, where they can expect to find others; small children need sand lots, mud, plants, and water to play with in the open; young mothers who go to watch their children, often use the children's play as an opportunity to meet and talk with other mothers.

Few modern housing projects provide for these needs; it is very hard to provide for them. On the one hand, indoor community rooms are too enclosed. When provided, they are rarely used. People don't want to plunge in to a situation which they don't know; and the degree of involvement created in such an enclosed space, is too intimate to allow a casual passing interest to build up gradually to full involvement. On the other hand, vacant land is not enclosed enough. It takes years for anything to happen on vacant land; it provides too little shelter, and too little "reason to be there".

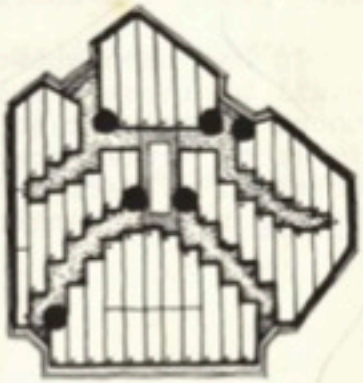
What is needed is a framework which is just enough defined so that people naturally stop there, and tend to stop there; and so that curiosity naturally takes people there, and allows them to stay there. Then, once community groups begin to gravitate towards this framework, there is a good chance that they will themselves create an environment which is appropriate to their activities. Some possible examples of such future developments are given in the solution statement.

We conjecture that a small open space, between 10 and 20 meters in diameter, and surrounded on all sides by an open roofed arcade, may just about provide the necessary balance of "openness" and "closedness". The arcade should be at least 2 meters deep, for the reasons given in "Two Meter Balcony".

Even if this conjecture turns out to be correct in theory, it will undoubtedly be very hard to implement. Only detailed experiments, in communities, will show up the finer points that are needed to make this pattern work in practice.

SHOPS ON CORNERS

IN THE PROYECTO EXPERIMENTAL, all shops which are not located in the central market, and all houses whose owners have expressed a desire to open a shop in the future, are located on key corners which command a view up and down major pedestrian paths.



THE GENERAL PATTERN IS:

Context:

An urban area contains scattered shops.

Solution:

The shops are at points of maximum pedestrian density, on corners.

Problem:

Survival is a key issue for any small shop. The success of a shop depends on its location; it should always be placed at a point where the largest possible number of people are going past, and where it can be seen from many directions.

It has been shown that the rents which owners of small retail businesses are willing to pay, vary directly with the amount of pedestrian traffic passing by, and are uniformly higher on street corners, than in the middle of the block. (Brian J. L. Berry, Geography of Market Centers and Retail Distribution, Prentice Hall, 1967, p. 49.)

CENTRIPETAL PEDESTRIAN PATHS

IN THE PROYECTO EXPERIMENTAL, the pedestrian ways outside houses are convex in plan, have seats and galleries round the edges, and are roofed over by esteras (woven bamboo matting) at the cell gateways and in the middle of the cell.

THE GENERAL PATTERN IS:

Context:

Any pedestrian sheet which houses open off.

Solution:

The street is subtly convex in plan, has seats and galleries round the edges, and is occasionally roofed, perhaps by a "virtual" roof, made only of beams or trellis-work.

Problem:

For centuries, the street provided city dwellers with usable public space, right outside their houses. Now, in a number of subtle ways, the modern city has made streets which are for "going through", not for "staying in". This is reinforced by new regulations which make it a crime to loiter, by the greater attractions inside the house itself, and by streets which are so unattractive to stay in, that they almost force people into their houses.

All this contributes to the fact that people in cities feel isolated, insecure, detached from society. Two recent studies have shown that mental illness, and acute feelings of isolation, are more common among people who cannot reach the street from their dwellings, than among those who can. (D. M. Fanning, "Families in Flats", British Medical Journal, 18 November 1967; and Joan Ash, "Families Living at High Density", unpublished mimeographed report, Sociological Research Section, Ministry of Housing and Local Government, 1965.) The fact that the street drives people away from it, must surely have the same effect.

From an environmental standpoint, the essence of the problem is this: Streets are "centrifugal" not "centripetal": they drive people out, instead of attracting them in. In order to combat this effect, the pedestrian world outside houses must be made into the kind of place where you "stay", rather than the kind of place you "move through". It must, in short, be made like a kind of outside public room, with a greater sense of enclosure than a street. It should be partly enclosed, by convexity, and by partial or virtual roofing; houses should open towards it, not turn their backs on it; and seats should be provided round the edges.

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STREET FOOTBALL

IN THE PROYECTO EXPERIMENTAL, cells contain pedestrian places for football, 8 x 20 meters, protected from the west sun by houses which run alongside.

THE GENERAL PATTERN IS:

Context:

Any housing area in Peru.

Solution:

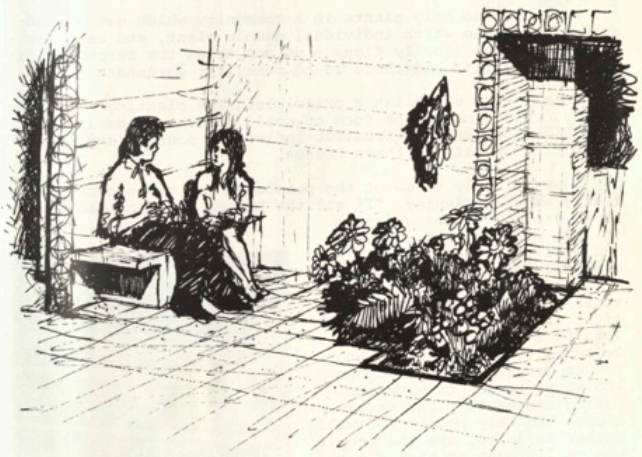
Within hailing distance of every house, there is an open pedestrian space at least 8 x 20 meters, shaded from the west sun, with seats, steps or low walls around it.

Problem:

Most young people in Peru play football, fubito, or volleyball in the streets. Any one of these games needs a space 8 to 10 meters wide and 20 to 30 meters long. In the summer, the games are often played in the afternoon, and need protection from the west sun. Since many of these games draw spectators, they are more enjoyable if surrounded by seats or steps or walls which people can sit on.

FLOWERS ON THE STREET

IN THE PROYECTO EXPERIMENTAL, the pedestrian paths outside houses are paved with large, removable earth-cement paving blocks laid over unfinished earth. It is understood that any homeowner who wants to plant flowers or trees or grass outside his house, may remove these paving stones to do so.



THE GENERAL PATTERN IS:

Context:

Any pedestrian path outside houses.

Solution:

The paths are paved with removable paving stones and it is understood that the people who live in any given house may take up the stones outside their house, to plant flowers, trees and grass.

Problem:

The overall effect of a community, especially in a desert area like Lima, is largely determined by the planting. An area with well kept plants is beautiful; the areas without them seem arid by comparison.

However, the only plants in a community which get looked after, are those which individual people plant, and care for - public planting usually flops - no one takes the responsibility to look after it, and there is no money for gardeners.

We may thus establish a principle: The planting in a community, should be in the form of small gardens, clearly associated with the front of specific individual houses, and planted by the individuals in these houses.

However, only a few of the people in any given community really enjoy gardening. If all the houses are provided with front gardens, three quarters of them will be left unkept - and will very likely end up as dust and weeds. There must be a way of giving gardens to all those people who will look after them, and to no one else. This is easily done. If the walkways are all paved, with the understanding that anyone who wants to can take up the paving stones to plant things there, the only people who will bother to do so, are the people who really want to have a garden there.

HOUSE SHAPE AND ORIENTATION

LONG THIN HOUSE

PERIMETER WALL

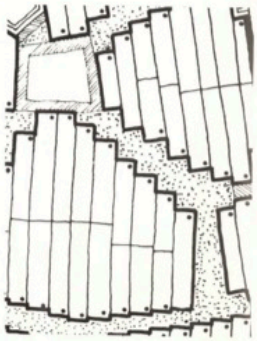
CROSS VENTILATED HOUSE

LIGHT ON TWO SIDES OF EVERY ROOM

PATIOS WHICH LIVE

TAPESTRY OF LIGHT AND DARK

LONG THIN HOUSE



IN THE PROYECTO EXPERIMENTAL, all houses are long and thin. They are always 5.20 meters wide; their length varies from 13 meters to 27 meters.

THE GENERAL PATTERN IS:

Context:

A small house which contains several people.

Solution:

The interior of the house is so shaped that the mean distance between rooms is as high as possible. This means that the inside of the house is, effectively, long and thin, but the outside of the house may take many physical forms: it may be S-shaped, U-shaped, tall many storeyed, or it may itself be long and thin.

Problem:

For a large family living in a small house, the overwhelming problem is one of overcrowding. They feel cramped. Everything seems to be too near everything else. Privacy, for individuals, or for small groups, is almost impossible.

There is widespread evidence to show that overcrowding in small dwellings causes psychological and social damage. (For example, William C. Loring, "Housing Characteristics and Social Disorganization", Social Problems, January 1956; Chombard de Lauwe, Famille et Habitation, Editions du Centre National de la Recherche Scientifique, Paris, 1959; B. Lander, Towards an Understanding of Juvenile Deliquency, New York, 1954.)

The feeling of overcrowding is largely created by the mean point-to-point distances inside the house. In a small house these distances are small - as a result it is not possible to walk far inside the house, nor to get away from annoying disturbances; and it is hard to get away from noise sources, even when they are in other rooms.

To reduce this effect a small house should have a shape for which the mean point-to-point distance is as large as possible. The mean point-to-point distance is low in compact shapes like circles and squares, and high in distended shapes like long thin rectangles.

PERIMETER WALL

IN THE PROYECTO EXPERIMENTAL, every lot is surrounded by a 20 cm masonry bearing wall, two storeys high, except in the back patio where it is one storey high.

THE GENERAL PATTERN IS:

Context:

A house for a low income family, in urban Peru.

Solution:

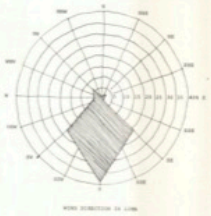
The house lot is surrounded by a thick masonry wall at least one storey high.

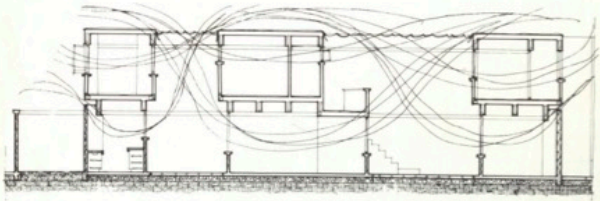
Problem:

Peruvians who live in cities are often mistrustful of their neighbors, and intensely attached to their private property - especially to their homes. They feel a tremendous need for security against the outside world - both against thieves, and against curious strangers. This feeling is so strong that many low income Peruvians spend their money on a fine perimeter wall of brick or concrete, even when they know this means they won't be able to have a roof, or rooms, inside. It is not uncommon to find a family living in a woven bamboo (esteras) shack, inside a masonry perimeter wall. This wall is always at least one storey high; in many cases it is also far stronger than it need be (with extra deep concrete foundation, for example) - apparently for psychological reasons, not structural ones. (See John Turner, "Lima Barriadas Today", Architectural Design, Vol. 33, No. 8, August 1963.)

CROSS VENTILATED HOUSE

IN THE PROYECTO EXPERIMENTAL, where the prevailing breeze comes from the south, all houses are oriented north-south. Since each house has two patios, all living rooms have openings both south (upwind) and north (downwind). The southern (upwind) patio has an angled scoop to direct breeze into the house.





THE GENERAL PATTERN IS:

Context:

Any building in a hot humid climate, like Lima.

Solution:

Each part of the building is one room thick in the direction of the breeze, and each room has windows on the upwind side and on the downwind side.

Problem:

During the summer months in Lima, the heat is extreme, and ventilation needed badly. Many people complain about the heat; few buildings, and especially few small houses, do anything about it.

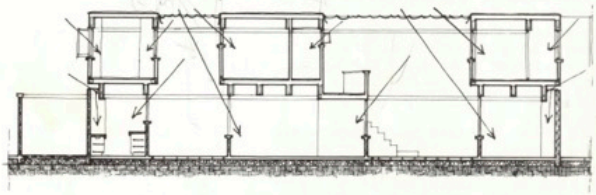
The easiest way to make these buildings comfortable, by non-mechanical means, is to increase the evaporation of moisture by breezes. This means that every room must have two windows, in line with the prevailing breeze - one upwind, the other downwind - so that the breeze blows through the room. (V. Olgyay, Design with Climate, Princeton University Press, 1963, p. 5.)

If these windows open onto patios, the effect of the wind can be intensified by the use of an air-scoop, in the upwind patio, to direct the breeze down into the patio. The effect will also be intensified if the downwind patio is hotter than the other; when the heat in the hot patio rises, it helps to pull the air through. This solution has been used for centuries in North Africa and the Middle East.

Since air movement is extremely sensitive to small changes in profile, the detailed design of the air scoop will depend on the exact configuration of the patio section, and should be designed with the help of wind tunnel tests.

LIGHT ON TWO SIDES OF EVERY ROOM

IN THE PROYECTO EXPERIMENTAL HOUSE, sala, family room and kitchen all receive light from both north and south.



THE GENERAL PATTERN IS:

Context:

Any room which is to be used during the daytime.

Solution:

This room is lit, by windows or sky lights, from at least two directions.

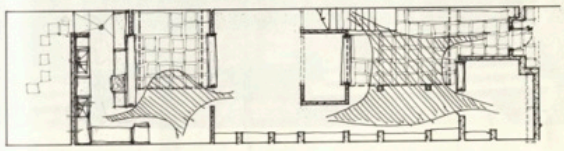
Problem:

A room lit from one side only, is almost always uncomfortable. The light gradient on the walls and floors inside the room is very steep, so that the part furthest from the window is uncomfortably dark, compared with the part near the window. Even worse, since there is little reflected light on the room's inner surfaces, the interior wall immediately next to the window is usually dark, creating discomfort and glare, against this light.

Although this glare may be reduced by supplementary artifical lighting, and by well designed window reveals, the most simple, and most basic way of overcoming glare, is to give every room two windows. The light from each window illuminates the wall surfaces just inside the other window, thus reducing the contrast between those walls and the sky outside. For details, and illustrations, see R. G. Hopkinson, Architectural Physics, London HMSO, 1963, pp. 29 and 103.

PATIOS WHICH LIVE

IN THE PROYECTO EXPERIMENTAL HOUSE, both the kitchen patio and the main living patio are surrounded on three sides by activities, contain a two meter veranda which connects the patio to the house, and are placed so that natural circulation moves through the patio.



THE GENERAL PATTERN IS:

Context:

Any patio intended for active use.

Solution:

1. It has sources of traffic and activity on at least two sides (opposite each other), and functions, at least in part, as a circulation space.
2. It is placed so that you can see out of it, into some other larger space beyond.
3. At least one side of it is roofed, this roofed part being at least two meters deep, and connected to the rest of the building.

Problem:

Many of the patios built currently in modern houses are dead. They are intended to be private open spaces - but often remain unused.

Informal observation suggests that patios are unused for the following reasons:

1. No one ever goes to them when they do not have any natural relation to the activities in the house - this is especially true for those that are dead-ends, off to one side of rooms. To overcome this, the patio should have activities, opening off at least two opposite sides, so that it becomes the meeting point to these activities, provides access to them, provides overflow from them, and provides the cross-circulation between them.

2. They are so enclosed that they become claustrophobic. Patios which are pleasant to be in always seem to have "loopholes" which allow you to see beyond them, into some

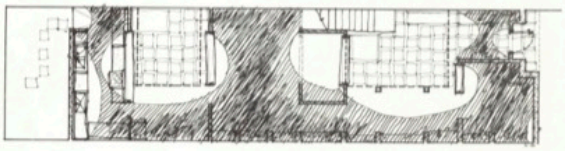
further space. The patio should never be perfectly enclosed by the rooms which surround it, but should give at least a glimpse, of some other space beyond.

3. They are oppressive. No one wants to sit surrounded by blank walls, disconnected from the house, with a little square of sky overhead. To solve this problem, the patio needs to be partly roofed. This provides a sitting space that is less nakedly exposed to the sky, and, if the roofed part is continuous with some interior part of the house, makes the patio seem more like a part of the house, and makes it more likely that people will drift naturally into the patio.

The veranda formed by this overhanging roof will not work unless it has room for a small table and a couple of chairs, so that people can sit there and talk and drink. This requires at least two meters. See "Two Meter Balcony", page 189.

TAPESTRY OF LIGHT AND DARK

IN THE PROYECTO EXPERIMENTAL, each house has a sequence of alternating patios and rooms along its length.



THE GENERAL PATTERN IS:

Context:

Any building where people live during the daytime.

Solution:

Openings and covered areas alternate in such a way that the interior of the building is a tapestry of alternating light and dark spaces, with special emphasis on the boundary areas where dark changes to light.

Problem:

In a building with uniform light level, there are few "places" which function as effective settings for human events. This happens because, to a large extent, the "places" which make effective settings are defined by light. People are by nature phototropic - they move towards light, and, when stationary, they orient themselves towards the light. As a result the much loved and much used places in buildings, where the most things happen, are places like window seats, verandas, fireside corners, trellised arbors; all of them defined by non-uniformities in light, and all of them allowing the people who are in them to orient themselves towards the light.

There is good reason to believe that people need a rich variety of settings in their lives (see Roger Barker, The Structure of Behavior: Explorations of its Structure and Content, Appleton-Century-Croft, New York, 1963). Since settings are defined by "places", which in turn seem often to be defined by light, and since light places can only be defined by contrast with darker ones, this suggests that the interior parts of buildings where people spend much time should contain a great deal of alternating light and dark.

PUBLIC PART OF HOUSE

INTIMACY GRADIENT

BATHROOM POSITION

PUERTA FALSA

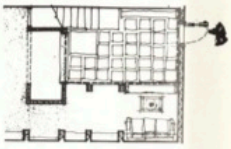
FIESTA

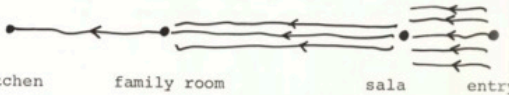
STAIRCASE STAGE

THICK WALLS

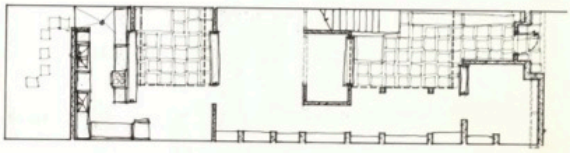
INTIMACY GRADIENT

IN THE PROYECTO EXPERIMENTAL, there is a strict gradient from formal to informal, front to back. Each house contains entry-sala-family room-kitchen in that order. Those houses too small to have a proper sala, have a small receiving alcove, just inside the front door, which functions as a sala.





kitchen family room sala entry



THE GENERAL PATTERN IS:

Context:

A house in Peru, or any other Latin country.

Solution:

There is a gradient from front to back, from the most formal at the front, to most intimate and private at the back. This gradient requires the following strict sequence: Entry-sala-family room-kitchen-bedrooms.

The most important element in this sequence is the sala (parlor). It is essential that the house contain a sala. If the house is so small that cost rules this out, the house should at least contain a tiny receiving alcove immediately inside the front door.

Problem:

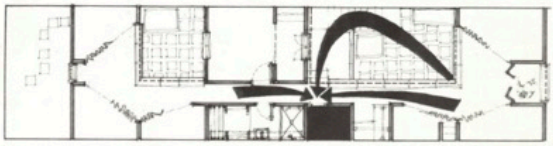
In Latin American countries, such as Peru, friendship is taken very seriously and exists at a number of levels. Casual neighborhood friends may never enter one's house. Formal friends, such as the priest, the daughter's boyfriend and friends from work may be invited in but tend to be limited to a well furnished and maintained part of the house, the sala. This room is sheltered from the clutter and more obvious poverty of the family which are visible in the rest of the house. Relatives and intimate friends, such as compadres, may be made to feel at home in the comedor-estar (family room) where the family is likely to spend much of its time. A few relatives and friends, particularly women, will be allowed into the kitchen, other workspaces, and, perhaps, bedrooms of the house. In this way the family maintains both privacy and pride.

This is particularly evident at the time of a fiesta. Even though the house is full of people, some people never get beyond the sala; some don't even get beyond the threshold of the front door. Others go all the way into the kitchen, where the cooking is going on, and stay there throughout the evening. Each person has a very accurate sense of his degree of intimacy with the family, and knows exactly how far into the house he may penetrate, according to this established level of intimacy.

Even extremely poor people try to have a sala if they can. The photograph shows a sala which a family has made in a barriada shack. Yet many modern houses and apartments in Peru combine sala and family room in order to save space. Almost everyone we talked to complained about this situation. As far as we can tell, a house must not, under any circumstances, violate the principle of the intimacy gradient.

BATHROOM POSITION

IN THE PROYECTO EXPERIMENTAL HOUSE, the bathroom is at the top of the stair in the first patio, directly accessible from sala, and from bedrooms.



THE GENERAL PATTERN IS:

Context:

A Peruvian house which contains only one bathroom.

Solution:

The bathroom is placed "between" the public and private parts of the house, in such a way that the path from sala to bathroom does not pass through kitchen, family room or bedrooms, and the path from bedrooms to bathroom does not pass through any area visible from the sala or family room.

Problem:

The Peruvian household maintains a strict separation between the public part of the house (where visitors are received) and the family part of the house (which is private). This is described fully in the "Intimacy Gradient" Pattern (page 128). If the house has one bathroom, it is very hard to place this bathroom, so that it does not violate this separation.

If the bathroom is in the family part of the house, then a visitor who has to use the bathroom, will be able to see parts of the house which the family would prefer to keep private. If the bathroom is in the public part of the house, then members of the family will have to go to the public part of the house, in various states of undress.

To solve this problem, the bathroom location must satisfy two requirements:

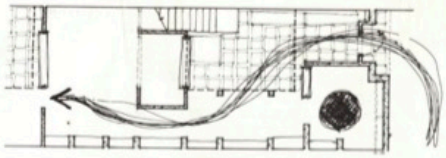
1. A visitor must be able to get from the sala to the bathroom, without passing through the family room, kitchen or bedrooms, or any other private area.

2. All members of the household must be able to pass between their bedrooms and the bathroom, without being seen by anyone in the public part of the house.

These two requirements can be met only if the bathroom is "between" the public and private parts of the house.

PUERTA FALSA

IN THE PROYECTO EXPERIMENTAL, 25% of the houses have back doors. In all houses the path into the house by-passes the sala.



THE GENERAL PATTERN IS:

Context:

Any Peruvian house.

Solution:

Either the house has a back door, or the main path into the house by-passes the sala.

Problem:

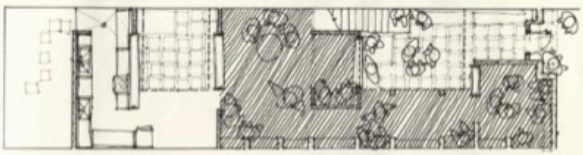
The puerta falsa (second entrance) is a crucial problem in Peru. The nature of Peruvian hospitality, and the formal treatment of strangers, means that while someone is being entertained in the sala, people must be able to come and go without being seen.

The women of the house may send the servant, or one of the children, out for beer, or fruit. In such a case, she does not want the visitor to realise that she is making a special effort on his behalf.

Even more simply - the members of the household want to be able to come and go, without having to involve themselves with the visitors in the sala, since politeness would then require them to stay with the visitors and help to entertain them.

FIESTA

IN THE PROYECTO EXPERIMENTAL HOUSE, the sala, family room, front patio, and veranda, are distinct, but form a continuous space where parties can take place.



THE GENERAL PATTERN IS:

Context:

Any Peruvian house.

Solution:

The sala, the family room, and the spaces which connect them, are distinct, but also form a continuous single space for parties.

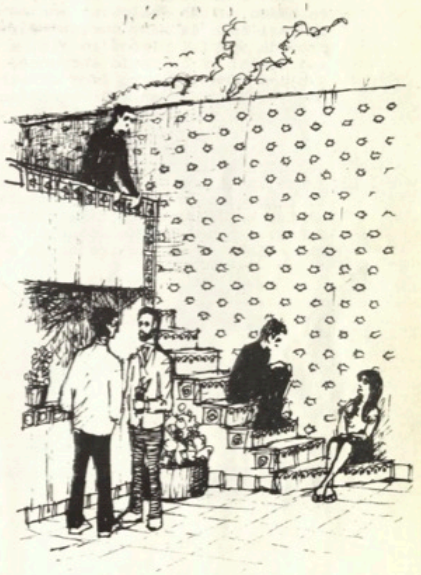
Problem:

In Peru, fiestas (parties) are extremely common. They happen many times a year, in every household - every time there is a birthday, name-day, or any kind of special occasion. Our observations suggest that typical households may have as many as one a month, and that there may be as many as forty or fifty people at these fiestas, even in a small house.

This many people can't drink and dance together, unless the various available living areas (sala, patios, family room,

verandas) form a continuous and sizeable space. It is also necessary that this space be reasonably continuous; the flow of persons from group to group strongly affects the life of a party; distinct rooms will hinder this fluidity. On the other hand, for reasons presented in the "Intimacy Gradient" pattern the sala and family room must be strictly separated during everyday use of the house. These rooms must therefore be distinct, yet capable of forming a continuous whole on special occasions.

STAIRCASE IS A STAGE



IN THE PROYECTO EXPERIMENTAL HOUSE, the staircase is in the front patio. It has a landing on one side of the patio, and the bottom looks towards the veranda which connects sala and family room.

THE GENERAL PATTERN IS:

Context:

Any staircase in the public part of a building.

Solution:

The staircase is connected to those places where social gatherings happen. The stair is curved if possible, has a wall behind it, is lit from above and front, and is slightly flared out at the bottom. The bottom of the stair, and its landings (if any) look out into the gathering place.

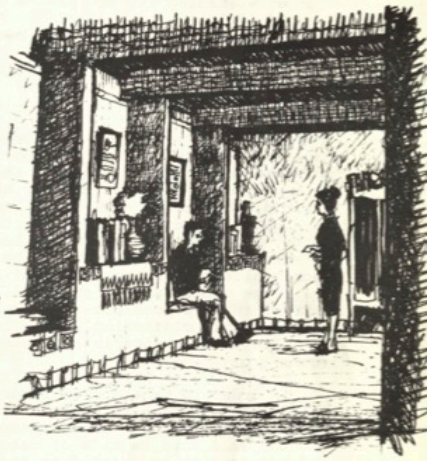
Problem:

There is little empirical evidence for this pattern. It is based on the following conjecture. Changes of level play a crucial role at many moments during social gatherings; they provide special places to sit, a place where a woman can make a graceful or dramatic entrance, a place from which to speak, a place from which to look at other people while also being seen, a place which increases face to face contact when many people are together.

If this is so, then the stair is one of the few items in a building which is capable of providing for this requirement, since it is one of the few places in a building where a transition between levels occurs naturally. Stairs should therefore always be designed to take full advantage of this fact. The features named in the solution are all intended to increase the effect of the staircase as a stage.

THICK WALLS

IN THE PROYECTO EXPERIMENTAL HOUSE, the wall connecting the sala, patio, veranda and family room, has a series of small niches in it, formed by 40 cm stub walls that stick out at right angles to the main wall. Each niche contains a seat, shelves, cupboard or display.



THE GENERAL PATTERN IS:

Context:

Interior wall, in any part of a building which is intended to be personal.

Solution:

The wall has "depth", at least 40 cm, which is created by a hand-carvable rigid space frame, in which a continuous variety of niches, shelves, seats, cupboards, leaning posts, and window seats occur at frequent intervals. This hand-carvable space frame is made of materials which are readily available on the retail market, and easily cut, modified, painted, nailed, glued, replaced by hand, using only tools available at any

hardware store. Possible examples are wood, plywood, fiberglass styrofoam, polystyrene. The space frame is highly redundant structurally: Large sections of it may be removed, without weakening it, and pieces or sections may be added in such a way that these sections become continuous with, and indistinguishable from, the original surface.

Problem:

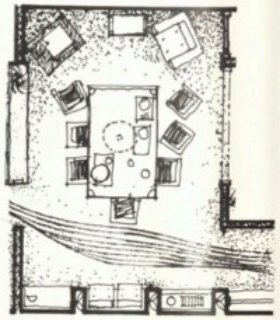
Rooms with large, flat, unbroken wall surfaces almost never have any personal character, and it is very hard for people who live in such rooms to make them personal. A room becomes personal, only when the imprint of its inhabitants is clearly visible, the walls crowded with treasures and belongings (presents, pictures of sweethearts and grandparents, flowers, vases, knick-knacks, books, collections), these teasures built integrally into the fabric of the room, and the surface of the room moulded to the character of its inhabitants. If a room has large unbroken wall surfaces, made of unmouldable materials, none of this is possible. It is hard to store things in the open, without cluttering up the room, and it is not possible to build these things in a personal way into the fabric of the room.

In order to make a room personal, then, its wall surface must be deep enough to contain a variety of niches and recesses, where special things can be placed, without being in the way; and the wall must be made of materials which allow these niches and recesses to be adapted to the idiosyncracies of the things which are to be placed there, and to the habits which go with them. This argument is presented in full, with empirical evidence, in Christopher Alexander,"Thick Walls", Architectural Design, February 1968.

FAMILY PART OF HOUSE

FAMILY ROOM CIRCULATION

IN THE PROYECTO EXPERIMENTAL HOUSES, the main part of the family room (not including alcoves), is 3 - 3.80 meters wide, running across the lot. There is room for a large dining table in the middle, close to the kitchen. Circulation from the front of the house to the kitchen, goes past one end of the table, perpendicular to the room's main axis, and there are seats and leaning niches at this end of the room. The far end of the room is windowless, and contains an electrical outlet for TV.



THE GENERAL PATTERN IS:

Context:

The family room (comedor-estar) of any low income Peruvian house.

Solution:

The room is relatively long and narrow. The dining table is in the middle; traffic in and out of the house goes through one end, and there are seats or leaning spaces at this end; the TV set is at the other end, in a darkened corner.

Problem:

For a low income Peruvian family, the family room (comedor-estar) is the heart of family life. The family eat here, they

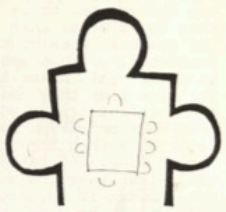
gossip here, they watch TV here, and everyone who comes into the house comes into this room to say hello to the others, kiss them, shake hands with them, exchange news, gossip. The same happens when people leave the house.

The family room cannot function as the heart of the family life, unless it helps to support these processes. The room must be so placed in the house, that people naturally pass through it on their way in and out of the house. The end where they pass through it, must allow them to linger for a few moments, without having to pull out a chair to sit down; this requires "leaning space". The TV set should be at the opposite end of the room from this throughway; since a glance at the screen, is often the excuse for a moment's further lingering. If possible the part of the room for the TV set should be darkened; the family room, and the TV, function just as much during midday, as they do at night.

FAMILY ROOM ALCOVES

IN THE PROYECTO EXPERIMENTAL HOUSES, small family rooms have one alcove opening off them, and the large family rooms have two. These alcoves are 250 cm wide and between 120 and 160 cm deep. Ceiling height in the alcoves is 2.20 meters (compared with 2.70 in the main part of the family room).

THE GENERAL PATTERN IS:



Context:

The family room of any house.

Solution:

There are a number of alcoves off the family room (preferably at least two). Each alcove is between one and two meters deep; the alcoves are all narrower than the walls they open off; and their ceilings are lower than the ceiling of the main room. Each alcove looks at the other alcoves.

Problem:

In modern life, the main function of the family is emotional; it is a source of security and love. But these qualities will only come into existence, if the members of the house are physically able to be together, as a family.

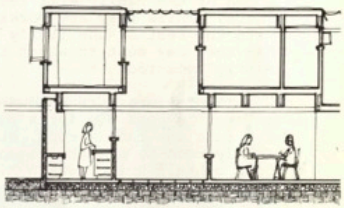
In modern life, this is often difficult. The various members of the family come and go at different times of day; even when they are in the house, each has his own private interests: sewing, reading, homework, carpentry, model-building, games. In many houses, these interests force people to go off to their own rooms, away from the family. This happens for two reasons. First, in a normal family room, one person can easily be disturbed by what the others are doing: the person who wants to read, is disturbed by the fact that the others are watching TV. Second, the family room doesn't usually have any space where people can leave things, and not have them disturbed. Books left on the dining table, get cleared away at meal times; a half finished game can't be left standing; naturally people get into the habit of doing these things somewhere else - away from the family.

To solve the problem, there must be some way in which the members of the family can be together, even when they are doing different things. This means that the family room, needs

a number of small spaces where people can do different things. The spaces need to be far enough away from the main room, so that any clutter that develops in them does not encroach on the communal uses of the main room. The spaces need to be connected, so that people are still "together", when they are in them: this means they need to be open to each other. At the same time they need to be secluded, so a person in one of them, is not disturbed by the others. In short, the family room must be surrounded by small alcoves. The alcoves should be large enough for one or two people at a time: about two meters wide, and between one and two meters deep. To make it clear that they are separate from the main room, so they do not clutter it up, and so that people in them are secluded, they should be narrower than the family room walls, and have lower ceilings than the main room.

KITCHEN FAMILY ROOM RELATIONSHIP

IN THE PROYECTO EXPERIMENTAL HOUSE, the kitchen and family room open towards one another across the kitchen patio; kitchen counters are hidden behind a 1.30 meter wall; a person working in the kitchen can see the family room table and TV.



THE GENERAL PATTERN IS:

Context:

Any house with a family room.

Solution:

The relationship between kitchen and family room follows two rules:

1. A standing person in the kitchen can see into the family room, but the kitchen counters cannot be seen from the family room.
2. Work areas in the kitchen are between 2.5 and 5 meters from the middle of the family room.

Problem:

The kitchen and family room are always near each other. Yet the exact relationship between the two poses a subtle conflict. On the one hand, people in the family room do not want

to see too much of the kitchen. This is especially true when they are eating: they do not want to see food preparation areas, nor dirty dishes; and if there is a servant in the house (as there often is in Peru, even in low income households), they do not want to see the servant in the kitchen.

On the other hand, if the kitchen is too cut off, then the women of the family will feel isolated, when they are working there. While they are working, they often want to be in touch with the rest of the family in the family room, and during the day they may want to watch the TV, which is probably in the family room too.

Two features are needed to resolve this conflict. First, it must be possible for a person standing in the kitchen to see into the family room, but not possible for a person in the family room to see the kitchen counters. This can usually be done by half height walls hiding the counters. Second, the distance between kitchen work areas and the middle of the family room should be between 2.5 and 5 meters. Informal experiments suggest that it is only within this range of distance that people can be involved, or withdraw from involvement, as they wish, which is exactly what is needed if the people in the family room are at some times to feel connected to the people in the kitchen, and at other times not. These figures are supported by Edward Hall's figures for "across the room distance". According to Hall, at distances between 8 and 20 feet, people can talk, but only by raising their voices. (Edward Hall, The Silent Language, New York, 1961, p. 164.)

HOME WORKSHOP

IN THE PROYECTO EXPERIMENTAL, every house contains a family room alcove that has a view to the front door, and can be used as a home workshop.

THE GENERAL PATTERN IS:

Context:

Any low income house in Peru.

Solution:

The family part of the house contains space which may be used as a workshop, with a view to the front door and street.

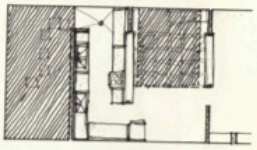
Problem:

In Peru, many women from low income families take in work to supplement their incomes: sewing, mending, ironing, small-time manufacturing. This work needs space.

Women usually do this kind of work, while watching something else: something cooking in the kitchen, the TV set, the children playing. The workspace should therefore be in the family part of the house. Many women also like to watch the street while they are working - partly because the children are likely to be out there, mainly just to be in touch with the social life. They can only do so, if the workspace commands a view of the front door and the street.

TWO SERVICE PATIOS

IN THE PROYECTO EXPERIMENTAL, every house contains two service patios, both connected to the kitchen and laundry. One is the working patio, surrounded by kitchen and family room. This patio contains a veranda, and is covered by sailcloth in winter. The other is the storage patio, for hanging laundry and storing building materials. If extra storage space is needed for building materials, chickens, etc., a back stair can be built from the storage patio to the roof.



THE GENERAL PATTERN IS:

Context:

Any low income house in Peru.

Solution:

The house contains two service patios. One is a working patio: it contains space for table and chairs, and play space for children, and is connected to the kitchen, laundry and family room. The other is a storage patio, also connected to the kitchen and laundry. It cannot be seen from the rest of the house.

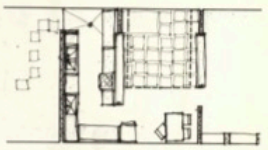
Problem:

Most small Peruvian houses have one service patio only. It is almost inevitable that this service patio will be used for hanging laundry, storing building materials and old goods, and keeping animals. Our observations show few exceptions to this rule. Yet these things make the service patio rather unpleasant to use. The women of the house have to spend a good deal of time in the service patio, washing clothes and doing housework, and the smaller children often play near them.

The house needs both: a place for storing things, and a place for working - but these two places must be separate. When both are provided, then the storage does not contaminate the working area; and the working patio becomes a pleasant place for working and for children's play.

ELBOW ROOM KITCHEN

IN THE PROYECTO EXPERIMENTAL, families may choose between two kitchens: a small one and a large one. The large one has 6 meters of counter and room for a kitchen table and corner seat.



THE GENERAL PATTERN IS:

Context:

Any Peruvian house for large low income families.

Solution:

The kitchen is large enough to contain a kitchen table, and at least 3.60 meters of counter.

Problem:

In a Peruvian household, the kitchen is often used by several people at once. This is especially important during a fiesta, when all the women of the family will crowd into the kitchen to help prepare food and serve guests.

At such times, or if anyone is trying to eat in the kitchen, there must be plenty of room in the kitchen - at least room for a table, and room for three people working (3.60 meters, at 1.20 meters each).

SLEEPING AREAS

INDIVIDUAL BED ALCOVES

BED CLUSTERS

MASTER BEDROOM LOCATION

MASTER BEDROOM DRESSING SPACES

OLD PEOPLE DOWNSTAIRS

SERVANT SLEEPING SPACE

TWO COMPARTMENT BATHROOM

CLOTHES DRYING CLOSET

INDIVIDUAL BED ALCOVES

THE PROYECTO EXPERIMENTAL HOUSE, contains a number of curtained alcoves, each large enough for a bed and storage. There is one alcove for each child - or small children may share an alcove with bunk beds. Each alcove opens off a common space for play and circulation, which itself opens off a patio.

THE GENERAL PATTERN IS:

Context:

A small house with many children.

Solution:

Each child in the house gets a private, curtained alcove, at least 2.00 meters long, and at least 1.30 meters deep. Each alcove contains a bed, and storage space; it is enclosed on three sides, and open to a larger space on the long side opposite the bed, with a curtain to close this long side.

Problem:

In any small house with many people in it, individuals get very little privacy. In Peru, for instance, where families are particularly overcrowded, people complain constantly about the lack of privacy. This lack of privacy centers especially on two issues:

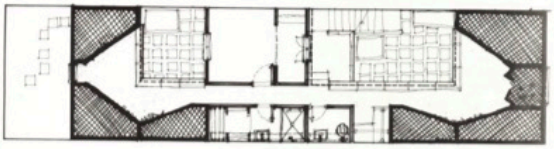
1. Every person in a household needs at least one tiny place which he (or she) can call his own, where he and his things will be undisturbed.

2. People need a place where they can dress and undress in private. Many Peruvians, especially girls, are extremely modest. In a small house, where many people share bedrooms, they often have to dress and undress in the bathroom.

With a large family in a small house, it is obviously not possible to give each child a room of his own. (In fact, it is not even desirable to do so - especially in a country like Peru, where people are uncomfortable when isolated. This is discussed fully in "Bed Clusters", page 156.) The use of small curtained bed alcoves, opening off larger common spaces, is a way of giving each person a reasonable amount of privacy, without using an unreasonable amount of space to do it. In 2.00 x 1.30 meters, there is room for a bed, for clothes, for dressing and undressing, and for personal belongings and decorations.

BED CLUSTERS

IN THE PROYECTO EXPERIMENTAL HOUSE, there are two clusters of bed alcoves - one around the front patio, the other around the second patio. Each may have up to five beds in it.



THE GENERAL PATTERN IS:

Context:

The sleeping areas of a Peruvian house.

Solution:

The children's beds are arranged around common areas, to form strongly inward looking clusters. There are at least two distinct clusters, one for boys and one for girls.

Problem:

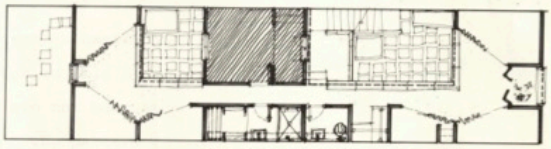
Whether the house contains beds, or bed alcoves (as discussed under Individual Bed Alcoves), it is very important that the beds be grouped in clusters.

Peruvians do not like to feel isolated, and draw a great deal of comfort and security from the fact that they are constantly surrounded by people. It is considered impolite to leave someone alone. They are also unusually afraid of burglars and robbers, and need to feel very secure where they sleep. It is therefore necessary that people sleep "in the presence of others". If the beds are in bed alcoves, then these alcoves must be arranged in a strongly inward looking manner.

The house must contain at least two clusters of beds. In Peru, parents insist on strong segregation of the sexes in the sleeping areas of the house - except for the tiniest children. There should be at least one cluster for boys, and one for girls.

MASTER BEDROOM LOCATION

IN THE PROYECTO EXPERIMENTAL HOUSE, the master bedroom is at the top of the stair. It has a window overlooking the inside of the front door, has direct access to the bathroom, and has no common walls with any other rooms in the house.



THE GENERAL PATTERN IS:

Context:

Any low income Peruvian family house.

Solution:

The master bedroom has a view of the front door, is at the head of the stair (in a two-storey house), is next to a bathroom, and shares no walls with other rooms.

Problem:

The master bedroom's locational requirements are:

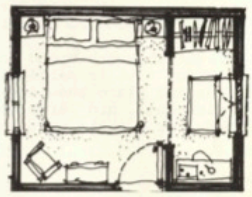
1. Control over children's coming and going - this means the bedroom must be at the head of the stair (in a two-storey house), with a view of the front door.
2. Fear of burglars and robbers - again, control of the front door, so that it is possible to check anyone who comes into the house.

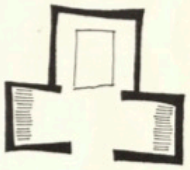
3. Direct access to the bathroom.

4. Maximum acoustic privacy - in a cheap house, where partitions are cheap and insubstantial, this means the master bedroom should not share walls with any other inhabited rooms.

MASTER BEDROOM DRESSING SPACES

IN THE PROYECTO EXPERIMENTAL HOUSE, the master bedroom has, at one end, a small curtained dressing area opening off it, large enough to contain two separate closets, and large enough to hold a baby's crib. We have not been able to include the pattern in its proper form.





THE GENERAL PATTERN IS:

Context:

A master bedroom in any house.

Solution:

The room contains two dressing spaces, one for the man, one for the woman, each with its own closets. The woman's is slightly larger than the man's, and large enough to hold a baby's crib. Under ideal circumstances, these dressing spaces should be tiny rooms, opening off the bedroom.

Problem:

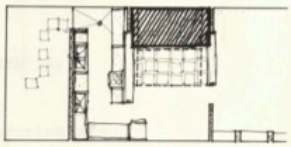
A master bedroom needs two separate dressing spaces in it. Man and wife often disagree in small ways about the use of the master bedroom, whether clothes should be hung up in a closet

or over a chair, and other basically trivial, but potentially annoying issues. These issues reflect the more important fact that each person needs at least a small part of the room set aside for his own things, and his own clothes. In a small house these areas cannot be more than special dressing alcoves. In a larger house, the ideal bedroom has two dressing rooms attached to it, each large enough to take on the full identity of the person who uses it.

Since women spend far more time in the master bedroom than men do, this is particularly critical for the woman. Her dressing place should be large enough for ornaments and personal belongings, and large enough to contain a crib for a new born baby, or a chair where she can sew.

OLD PEOPLE DOWNSTAIRS

IN THE PROYECTO EXPERIMENTAL HOUSE, a bed alcove for a grandmother or grandfather may be built immediately next to the family room, in the kitchen patio. If a toilet is to be built with it, this may be placed in the storage patio, where it can be connected to the plumbing wall.



THE GENERAL PATTERN IS:

Context:

Any low income house in Peru.

Solution:

The ground floor of the house contains a place where a bedroom or bed alcove might be built. It should be close to the family room, close to kitchen and laundry, and reasonably close to a ground floor bathroom (or place where a ground floor bathroom might be built).

Problem:

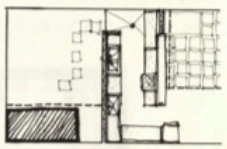
Many low income households in Peru contain an elderly relative. For example, in 1956, 26% of barriada households had a relative who was not a member of the nuclear family, living in. (Jose Matos Mar, "Migration and Urbanisation", in Urbanisation

in Latin America, International Documents Service, Columbia University Press, New York, 1961, p. 181.)

The space provided for an old person needs special characteristics. First, many old people have trouble with stairs. In a two storey house, their room should be on the ground floor, with the possiblity of a bathroom on the ground floor too. Second, many old people are bedridden. They need constant care and entertainment; but if they are stuck in a bedroom far away from living areas, they often get left alone. The old person's bedroom should be near the kitchen and laundry, where much of the daily work goes on, and also near the family room, so that family social activity, and TV watching, are close by.

SERVANT SLEEPING SPACE

IN THE PROYECTO EXPERIMENTAL HOUSE, there is room for a servant to sleep far from the rest of the house, either in the back storage patio or on the roof with access from the patio by ladder-stair.



THE GENERAL PATTERN IS:

Context:

Low income Peruvian house.

Solution:

There is room for easy construction of servant sleeping space, as far removed as possible from the rest of the house.

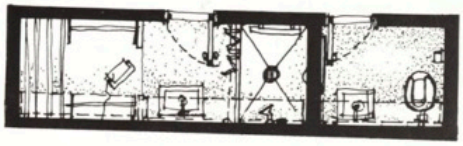
Problem:

In Peru even relatively poor households will often have servants. Many families will not be able to afford special accommodations for the servant, but will allow the servant to sleep on the roof or in a back patio if the servant has no family near by.

Since the servant will not be accepted into the family circle, he (or she) needs a private place of his own. This is especially important for those servants of school age (very common in Lima), who need a place to study; often the chance to study is the only chance these young people have of improving their lives.

TWO COMPARTMENT BATHROOM

IN THE PROYECTO EXPERIMENTAL, even the cheapest house contains two bathroom compartments. One compartment contains the toilet, the other the wash basin and shower.



THE GENERAL PATTERN IS:

Context:

Any house which is to contain many people, and has only one bathroom.

Solution:

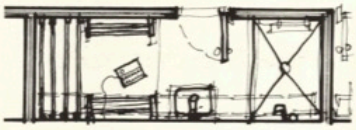
The bathroom has at least two compartments: toilet in one, wash basin and shower in the other.

Problem:

In large families with one bathroom, there is a major queuing problem in the morning. Everyone wants to use the toilet, wash basin, and shower at the same time. Separate, their use is doubled.

CLOTHES DRYING CLOSET

IN THE PROYECTO EXPERIMENTAL HOUSE, a two square meter closet with drying racks and an electrical outlet for a space heater opens into the shower room and is ventilated by a skylight.



THE GENERAL PATTERN IS:

Context:

Any house in Lima without a heating system.

Solution:

The house contains a large, well ventilated closet with open hanging racks, and a heater.

Problem:

In any cool humid climate, like the Lima winter, laundry does not dry fast enough in the open, and it is very hard to keep the family supplied with warm dry clothes. The house should contain a clothes drying closet, with open hanging racks, near to some source of heat. In Lima, many families in small unheated houses buy space heaters and put them in the bathroom: the drying closet should open directly into the bathroom.

ENTRANCE AND FACADE

ENTRANCE TRANSITION

FRONT DOOR RECESSES

MIRADOR

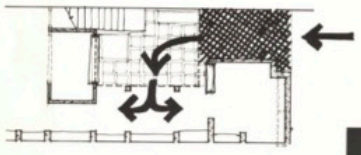
FRONT DOOR BENCH

GALLERY SURROUND

NO GROUND FLOOR WINDOWS ON THE STREET

ENTRANCE TRANSITION

IN THE PROYECTO EXPERIMENTAL HOUSE, there is a dark, covered area, immediately inside the front door, and a well lit patio further in. A person entering thus passes through a dark zone, towards the light of the patio beyond, and then enters the house through the main veranda, between sala and family room.



THE GENERAL PATTERN IS:

Context:

Any house entrance.

Solution:

The path from the street into the house passes through a zone where levels, materials, view, light and other qualities change.

Problem:

There is no doubt that houses which provide a graceful transition space between street and house, are nicer than those which open abruptly off the street. If the transition is too abrupt there is no feeling of arrival, and the house fails to be an inner sanctum.

The following argument may help to explain it. While people are on the street, they adopt a mask of "street behavior". When they come into a house they naturally want to get rid of this street behavior and settle down completely, into the more intimate spirit appropriate to a house. But it seems likely that they cannot do this, unless there is a transition from one to the other, which helps them to lose the street behavior. The transition must, in effect, destroy the momentum of the closedness, tension and "distance" which are appropriate to street behavior, before they can relax completely.

Evidence comes from the report by Serge Bouterline and Robert Weiss, The Seattle World's Fair, Cambridge, Mass.,1963. The authors noticed that many exhibits failed to "hold" people; people drifted in, and then drifted out again within a very short time. However, in one exhibit people had to cross a huge, deep-pile, bright orange carpet on the way in: in this case, though the exhibit was no better than other exhibits, people stayed. The authors concluded that people were, in general, under the influence of their own "street and crowd behaviour", and that while under this influence could not relax enough to make contact with the exhibits; but that the bright carpet presented them with such a strong contrast as they walked in, that it broke the effect of their outside behavior, in effect "wiped them clean", with the result that they could then get absorbed in the exhibit.

There are many ways of marking the transition from street to house: change of view, change of light, change of level, change of surface, change of sound, change of scale, all break the continuity of passage from street to house, and can all be helpful.

FRONT DOOR RECESSES

IN THE PROYECTO EXPERIMENTAL HOUSE, each front door is surrounded on the outside by one or more deep recesses, according to the exact position of the entrance with respect to other houses. The front doors are of the dutch door type.

THE GENERAL PATTERN IS:

Context:

Any Peruvian house which has a front door opening directly off a public path.

Solution:

The front door is surrounded, on both sides, by deep recesses, each at least 50 cm deep - if possible by double recesses. The effect of the recesses is helped by an opening in the door, or a dutch door.

Problem:

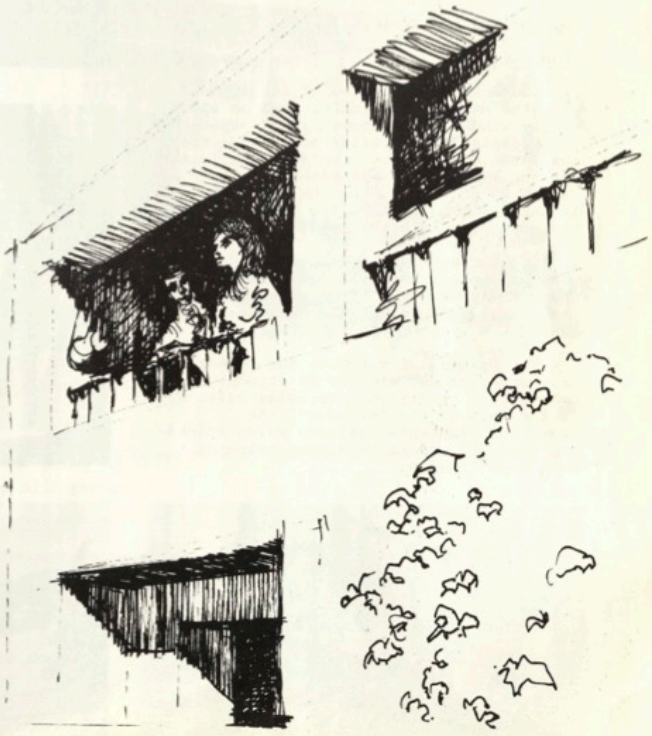
"Hanging out" is a standard part of Latin culture. People like to watch the street. But people do not always want the same degree of involvement with the street. The process of hanging out requires a continuum of degrees of involvement with the street, ranging all the way from the most private kind, to the most public kind. A young girl watching the

street may want to be able to withdraw the moment anyone looks at here too intently. At other times, girls, young men, and the women of the house, may want to be watching the street, near enough to it to talk to someone who comes past, yet still protected enough so that they can withdraw into their own domain at a moment's notice. At still other times, old men, less afraid of real involvement on the street, will actually sit out, in front of their doorways, and feel secure provided that the seat is still clearly identified with their house.

In the most common kind of hanging out, people lean in doorways, half in, half out. They can see what is happening outside, they can talk to anyone they want to - yet they can withdraw in a moment. To invite this activity, front doors need deep recesses, large enough to hold a person (thus at least 50 cm deep), and, if possible, a way of hanging over the door, like that which a dutch door provides. The other two kinds of hanging out are discussed under "Mirador" (page 173), and "Front Door Bench" (page 175).

MIRADOR

IN THE PROYECTO EXPERIMENTAL, a second floor window opens from the front bed cluster, onto the pedestrian street below. Corner houses also have a mirador on the side wall, at the top of the stair.



THE GENERAL PATTERN IS:

Context:

Any house in Peru.

Solution:

A second floor window, with a seat by it, looks up and down the street outside. This window is either in the girl's bedroom, or on the passage between this bedroom and the stair.

Problem:

The most private kind of involvement with the street is watching from an upper storey window. For young girls, especially, this is a favorite activity - they can watch the street, from a window, without any impropriety: something they cannot do so easily from the front door. If anyone looks at them too hard, they can pull back into the window.

To be truly useful, such a window must be closely associated with places where the girls will often be - either the girls' bedroom, or the passage between this bedroom and the stair.

The process of watching the street from upper storey windows is strongly embedded in traditional Peruvian culture, in the form of the "mirador", the beautiful ornamented gallery which sticks out over the street from many colonial buildings in Lima.

FRONT DOOR BENCH

IN THE PROYECTO EXPERIMENTAL, houses have some kind of bench outside the front door, placed so as to create a private space just in front of the door. The benches will vary in position, size, and coloring, from house to house.

THE GENERAL PATTERN IS:

Context:

Any Peruvian house with a front door opening directly off the public path.

Solution:

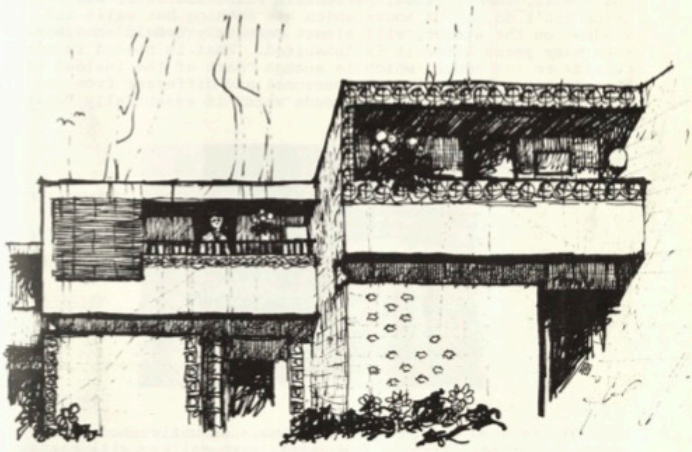
There is a bench outside the front door. This bench may be directly in front of the door, or to one side, but is placed to create a small private space immediately in front of the door.

Problem:

The most public kind of involvement with the street is sitting out. (See "Front Door Recesses" for general statement.) Many people, especially older people, pull chairs out to the front door, or lean against the front of their houses, either while they are working at something, or just for the pleasure of watching street life. Since people in Peru are reluctant to be too public, this activity requires a bench or seat which is clearly private, even though in the public world.

GALLERY SURROUND

IN THE PROYECTO EXPERIMENTAL, each house has an open gallery at the front of the second storey. In the smaller houses, this gallery is very narrow, and runs back into the front bed cluster; in the larger houses, it runs all the way across the house.



THE GENERAL PATTERN IS:

Context:

Mass housing.

Solution:

Each house has an open gallery, at least two meters deep, on its visible sides: This gallery is intended to be filled with furniture, extensions, partitions, plants, seats, decorations.

Problem:

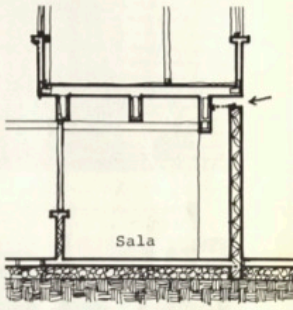
One of the worst features of mass housing is the uniformity of the houses. People want to live in houses which are individual, identifiable, personal. Paint and color and decoration don't do it. A house which has nothing but walls and windows on the street, will almost certainly remain anonymous, even many years after it is inhabited. What is needed is some outside to the house, which is enough "part of the inside" so that it will quickly be made personal and different from the neighbors. This requires a facade which is essentially "deep"

and able to grow and change with time - an unfinished gallery round the house. After a few years, each gallery will contain a unique collection of extensions, planting, furnishing, and decoration - and will be quite different from its neighbors.

The argument is essentially the same as that presented under "Thick Walls", applied to the outside of the house. See page 137. The reasons for the gallery to be two meters deep are given under "Two Meter Balcony", page 189.

NO GROUND FLOOR WINDOWS ON THE STREET

THE PROYECTO EXPERIMENTAL HOUSE, has no ground floor windows onto the street. The sala does get light from the street, but through a horizontal slit at ceiling level, baffled by the beam.



THE GENERAL PATTERN IS:

Context:

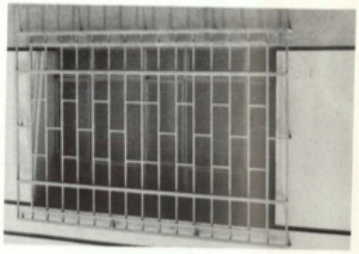
Any Peruvian house.

Solution:

The wall facing the street at ground floor level, is blank, except for the door. There are no windows in it.

Problem:

When Peruvian houses have windows facing onto the street at ground level, these windows are always boarded up, painted with whitewash, heavily curtained and screened. A survey of 60 houses in San Martin de Porras (a part of Lima), showed only two first floor windows which were not completely obscured by curtains, shutters, blinds, paint, or other opaque materials. One of the two opened onto a home workshop; the other into a shop. People are extremely private. They do not want passers-by to see into their house, and want secure protection against thieves.



It is important to take this into account from the very outset, in the way that front rooms are lit and ventilated. If the front room relies on a street window for light and air, the inevitable boarding up will make the room dark and stuffy, and less usable.

PATIO SECTION

TRANSLUCENT OPENING PATIO ROOF

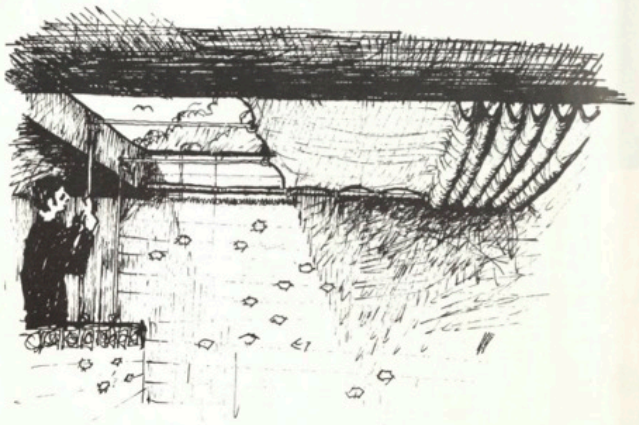
LIGHT FROM TWO STOREY PATIOS

SUNSHINE IN PATIOS

TWO METER BALCONY

TRANSLUCENT OPENING PATIO ROOF

THE PROYECTO EXPERIMENTAL HOUSE, can be completely sealed against wind, cold, and dew, by dacron sailcloth covers on the front patio and kitchen patio. The dacron sailcloth is translucent, and does not stretch or mildew. It is fastened to the roof on one side, and has snap fasteners on the opposite side. On the other two sides, it has rings sewn into it: these rings run on a pair of parallel rods. A person can open and close the cover, or set it to any desired opening, by pulling cords just like those that control conventional draw-curtains. The sailcloth has wires sewn into it at one



meter intervals, perpendicular to the rods, thus creating a tension structure which resists wind loads and prevents tearing and sagging.

Since the house can be completely sealed by this cover, the windows which open into patios have no glass or moving frames in them. For visual privacy, the windows can be closed by curtains.

THE GENERAL PATTERN IS:

Context:

Any patio house, in a warm climate without rain.

Solution:

Patios are covered with a translucent lightweight cover, which can be rolled back in hot weather, and closed in cool weather. The windows which open into these patios need no glass, only screens or curtains.

Problem:

In a warm climate, houses need large openings in summer, and good protection against cold in winter and at night. Yet windows are very expensive. In many houses, especially in low cost houses, the cost of the windows makes it impossible to create the proper relationship between indoors and outdoors.

As a result, the house is unresponsive to the year-round change in climate. This is particularly serious in low cost houses. Newly built low cost houses in Lima, for example, are so tightly budgeted that they often have far too little window area: they are unbearably hot in summer, and dark and gloomy all year round.

It is possible to solve this problem, in a patio house, by roofing the patios with movable, translucent covers. With such covers, the whole house - patios and rooms together - becomes a sealable envelope. Climate control, instead of including rooms only, includes the whole house, inside and out.

In hot weather, the patio covers can be rolled back, and the breeze blows through the house. In cold weather, the patio covers are closed, thus sealing the house - and the patios become usable too. In Lima, for example, there is a winter dew (garua) which normally makes patio floors damp and cold for eight months in the year. The cover on the patios will keep them dry and warm, and will triple their useful life.

If patios are small, the patio roofs can be made of low cost materials like the dacron sailcloth described above. They eliminate the need for windows almost entirely. The windows which look into patios give light to rooms and may be curtained, for visual control - but since the cold is kept out by the patio covers, there need be no glass in the windows, and no expensive moving parts.

LIGHT FROM TWO STOREY PATIOS

IN THE PROYECTO EXPERIMENTAL HOUSE, the front patio opening is 2.90 meters by 4.40 meters or more; the kitchen patio opening is 2.90 meters by 2.40 meters. Both these openings are slightly more than half the area of their respective patios. All space inside the house is within 2 meters of a patio.

THE GENERAL PATTERN IS:

Context:

A two storey patio house in Lima.

Solution:

The patios follow three rules:

1. No part of any room is more than 2 meters from an opening into a patio.
2. In each patio the opening to the sky is at least 2.50 meters in each direction.
3. The patio opening is substantially smaller than the patio itself.

Problem:

In a two storey house, if patios are too small, the rooms are dark and gloomy; if the patios are too open, the light is harsh and unpleasant. It is almost impossible to calculate this effect by means of daylight factors - we therefore made a number of observations to isolate the shapes and sizes of patios which create a pleasant light in the rooms which open off them. These observations were all made in Lima, and depend on the particular sky brightness and light quality characteristic of Lima. It is possible that similar figures apply in other places - but the light in Lima has a fairly unusual haze.

We found that any part of a room that is more than 2 meters from a two storey patio, is gloomy; that in general, the room will be gloomy, if the patio opening is less than 2.50 meters in any direction; and that the light will be too harsh, if the patio opening is not substantially smaller than the patio itself.

SUNSHINE IN PATIOS

IN THE PROYECTO EXPERIMENTAL, houses have a 30 cm overhang protecting all first floor openings. There are no openings facing west. The main patio is always at least 4.40 meters long in the north-south direction. Either sala or family room always gets north (i.e., winter) sun from this main patio.

THE GENERAL PATTERN IS:

Context:

Any patio house in Lima.

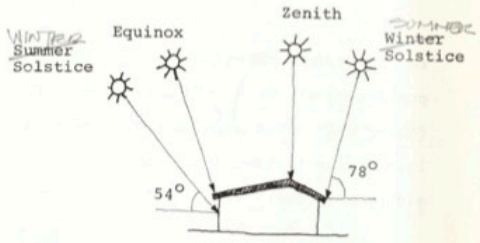
Solution:

Three rules apply:

1. All north and south facing openings are protected by an overhang which is 21% of the height from window sill to overhang.
2. No opening is exposed to the west.
3. One patio is long in the north-south direction - its length at least 73% of the height of the north wall - and one living room faces north into this patio.

Problem:

During the summer in Lima, the overhead sun is fierce, and rooms must be protected from it. During summer months, the sun goes north and south, but never goes below 78 degrees on the



SUN ANGLES

north-south axis. At this angle, overhangs must be 21% of the height of the wall which is to be protected (tan 12° = .21), to keep the wall in shade.

The late afternoon sun is also extremely hot; it is hard to shade against it, and best to avoid openings which face west.

In winter there is very little sun. People enjoy sitting in what sun there is, and, if possible, like to get it into living areas. In mid-winter, the sun is low in the north (54 degrees). At this angle, the north-south length of a patio must be at least 73% of the height of the north wall (tan 36° = .73), to get sun on the ground.

TWO METER BALCONY

IN THE PROYECTO EXPERIMENTAL, each house contains a two meter deep veranda, both in the main patio and in the kitchen patio; the upstairs front gallery, which looks onto the street, is two meters deep; and the arcades which surround the outdoor rooms, outside the houses, are always at least two meters deep.

THE GENERAL PATTERN IS:

Context:

Any habitable indoor-outdoor space, like a balcony, veranda, gallery, porch, deck or arcade.

Solution:

It must be at least two meters deep.

Problem:

Balconies and porches which are less than two meters deep, are almost never used. They are often made small, to save money; but when they are small, they might just as well not be there. They are first used properly, when there is enough room for two or three people to sit there in a small group, with room to stretch their legs, and room for a small table where they can put glasses, cups, and so on. No balcony works if it is so narrow, that people have to sit in a row, facing outwards.

The critical size is hard to determine exactly. It is about two meters.

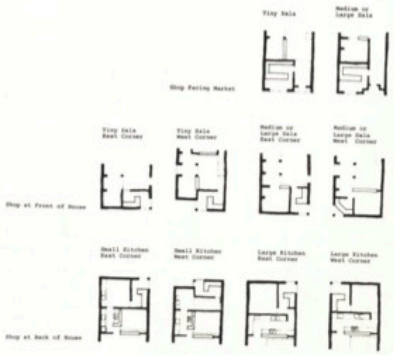
SHOP AND RENTAL

SHOP FRONT POSSIBILITY

RENTAL

SHOP FRONT POSSIBILITY

IN THE PROYECTO EXPERIMENTAL, families who want a shop now or the possibility of a shop in the future, get a house in which there is space for a shop on a suitable exterior corner of the house.



THE GENERAL PATTERN IS:

Context:

House for a low income Peruvian family.

Solution:

The house contains space where the owners can start a small shop if they want to. The space need be no larger than 2 x 3 meters and should be in sight of the family room or kitchen.

Problem:

Many families with low incomes, start a small shop to supplement their income. Figures for low to moderate income sections of Lima, for example, indicate that 10% of the houses contain some type of shop or workshop. (Jośe Matos Mar, "Migration and Urbanization", in Urbanization in Latin America, edited by Phillip Hauser, International Documents Service, Columbia University Press and UNESCO, 1961, page 181.) Our own count gave the same figure. We suspect that government policy may not allow the construction of small shops in public housing. However, a small survey of empleados showed that many of them desire this option, and would in many cases prefer it to the provision of other kinds of space. We strongly urge that they be allowed to build stores if they want to.

From a physical point of view, the problem is rather simple. The house should contain space, at least 2 x 3 meters, on an exterior face of the building, preferably on the corner where the most people are going past. This space must be placed so that the inside of the house will still be private and secure, if there is a shop built there; and if possible, it should be visible from family room or kitchen, so that members of the family can keep an eye on it from the family part of the house.

RENTAL

IN THE PROYECTO EXPERIMENTAL, families who want the opportunity to rent a room now or later, get a corner lot or a lot which is free in the back, so that they can build rentable space there.

THE GENERAL PATTERN IS:

Context:

Any low income household in Peru.

Solution:

The house contains potentially rentable space, with the following characteristics:

1. The space is between 6 and 10 square meters.
2. It has a separate entry.
3. It has no association with the formal part of the house (sala, front door, etc.).

Problem:

It is common for Peruvian families to rent space - even when it is not officially allowed - as a source of extra income.

The usual renters are either single, or couples without children - they need no more than one small room (6-10 square meters). They do not need a special bathroom, and will either share the facilities the servant uses, or will use a chamber pot, pitcher and enamel wash basin.

Families also naturally want to keep their distance from the people they are renting to; they will try to avoid having the renter come and go through the main part of the house, and much prefer it if they can give him a separate entrance, in the back of the house.

CONSTRUCTION

CONTINUOUS FLOATING SLAB

MORTARLESS BLOCK WALL

COMPOSITE BAMBOO/FOAM BEAM

COMPOSITE BAMBOO/FOAM PLANK

SULPHUR REINFORCING AND TOPPING

PLUMBING ACCUMULATOR

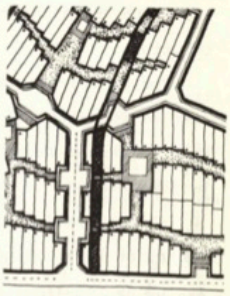
CONTINUOUS ELECTRIC OUTLET

The following seven patterns describe building components or appliances which have a distinctly innovative character, and the contexts in which these innovations are appropriate. Most of them are extensions of traditional technology currently in use in Peru.

Our designs also include several building components that are standard items now in wide use in Peru: gypsum partitions, wooden doors, bathroom fixtures, plastic piping, etc. Since these items are well known, we have not given any general patterns for them.

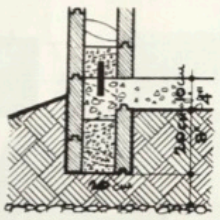
In addition, we are using several standard methods of site development with an emphasis on economy. The internal loop roads will have the minimum amount of paving consisting of two narrow tracks of concrete or asphalt paving with unfinished earth between. Street lights will be strung on cables between buildings, except where buildings or column location allow direct mounting of fixtures on them. Outdoor public rooms (page 102) will be made from concrete block columns supporting bamboo beams and woven bamboo mats in frames. Utility lines will run in trenches down pedestrian paths with laterals to individual buildings - the laterals are as short as possible.

CONTINUOUS FLOATING SLAB

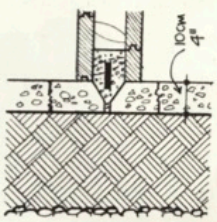


IN THE PROYECTO EXPERIMENTAL, the floors of all houses are 10 cm concrete slabs laid down in 5.20 meter strips (width of houses) by a road building machine known as a slip-form paver. All houses are parallel. The slab is 175 kg/cm^2 concrete on 30 cm of compacted sand. All exposed edges are turned down, filled block (20 cm x 20 cm). Structural pin connections for ties into walls are cast by hand immediately after the slab is laid. The slab is dustcoated and colored with a deep red penetrating oil stain for finish.

Pedestrian walkways and patio floors in the houses are also cast in the same way, but onto prelaid dividers to form 50 cm x 50 cm paving stones inside and 1 meter square paving stones outside.



Slab Edge



Wall Tie

THE GENERAL PATTERN IS:

Context:

Mass housing with slab on grade, on a flat site and on soil with normal bearing capacity.

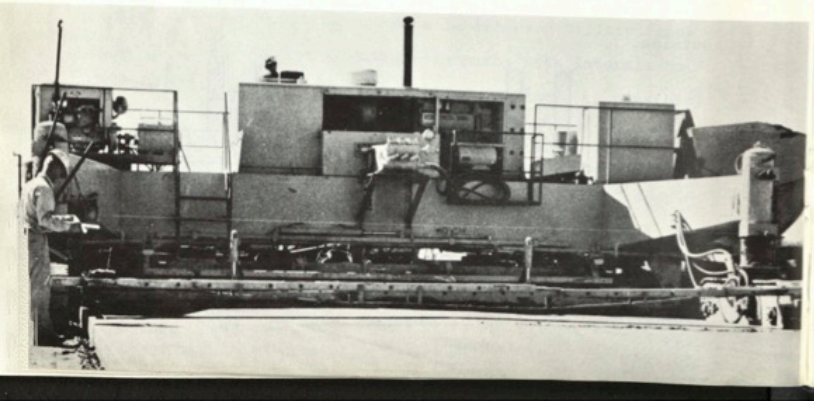
Solution:

The floors are unreinforced concrete slabs with no footings or foundations, laid down by a road building machine. Slab thickness varies according to exact site conditions and building loads.

Slabs should be laid out in continuous strips of constant width, at least 50 meters long. Joints and breaks may be inserted as required. If the slab is laid on a curve, the radius of the curve is not less than 20 meters.

Problem:

Foundations, footings and floors are a major cost in house construction. Foundations and footings usually represent about 10% of the total construction cost, and floor construction another 10%. To eliminate individually excavated and poured foundations, it is possible to use a continuous floating slab, produced by a road building machine, at great speed and low cost. Vertical loads are distributed uniformly over the slab and make footings unnecessary: horizontally, the slab is held by a turndown at the exposee edges - made by pretrenching. If the slab needs reinforcement, mesh is laid by hand in front of the machine. However, in warm climates like Peru, there is little temperature change in the soil, and slabs need no reinforcement. Pins which tie the building to the slab are put into the slab by hand, while it is wet. The system is highly earthquake resistant, since the slab and the building act as a unit, floating on the earth, instead of being tied to the earth by footings and foundations.



Road building machines are available in almost all countries today - wherever high speed roads are being built. In order to use these machines efficiently, the site must be reasonably flat, and a large number of slabs must be laid at the same time. Furthermore, the slabs must be laid in long strips of constant width, adjacent strips must be parallel, and the strips may have a minimum radius no less than 20 meters (the smallest curve these machines can negotiate).

MORTARLESS BLOCK WALL

IN THE PROYECTO EXPERIMENTAL, the bearing walls, shear walls, and ground floor partitions are cavity walls made of interlocking, self-aligning concrete blocks, moulded on site. No mortar is required. The blocks simply interlock to form the wall. Blocks are made of a dry concrete mix, and may be 10

or 20 cm thick: column and corner blocks are made in special moulds. Walls and columns are reinforced with sulphur (see page 214). Plumbing lines and electrical conduits run through the cavity.

THE GENERAL PATTERN IS:

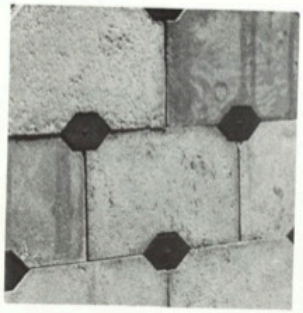
Context:

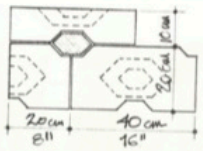
Low cost, low rise building, in any place where concrete is one of the cheapest building materials.

Solution:

Bearing walls, shear walls, columns, partition walls, and foundations may be made from EDI-Thermomod blocks. The block

is self supporting up to a height of three stories. Vertical edges, corners, and horizontal upper edges are either poured concrete, with steel reinforcing, or are reinforced with sulphur-fiber. The EDI-Thermomod system is patented by Educational Design, Inc.





Half Blocks

Problem:

In areas where concrete is the principal building material, concrete block is one of the cheapest forms of wall construction. One of the biggest costs of a concrete block wall is the labor cost: each block has to be placed and mortared by a skilled mason. The EDI-Thermomod block system eliminates almost all these labor costs. The blocks are mortarless and self aligning; they weigh only 5 kg apiece, and are very easy to handle. Two men can build a wall extremely fast, simply by stacking the blocks on one another. Masons are not required.

Another major cost in concrete block construction is the cost of the block itself. Here again the EDI-Thermomod block saves money. The block can be hand-manufactured on site in a simple mould, or machine manufactured. One mould produces about 400 blocks in 8 hours; a battery of five moulds will produce about 2,000 blocks a day - enough for the walls of an

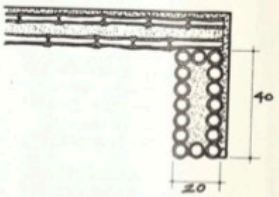
average 100 square meter house. Half blocks and blocks of different thickness can be made from the same mould. The blocks are cured after 24 hours. On site manufacture eliminates expensive storage and trucking.

The wall has several other advantages: The system is light, and earthquake resistant. The dry construction allows the blocks to move during a quake, thus preventing fracture of the wall. Since there is no mortar, blocks can be removed at any time to make new openings in the wall. The cavity can be made to serve as a conduit for plubming and electricity - because the blocks can be removed, the conduits are easy to reach. Finally, like any cavity wall, the wall has good thermal and acoustic insulation.

The EDI block has been used to build very low cost buildings in Mexico and the south-eastern United States. Many of these buildings were built entirely by self-help; the buildings are performing well in use; those in Mexico have successfully withstood major earthquakes.

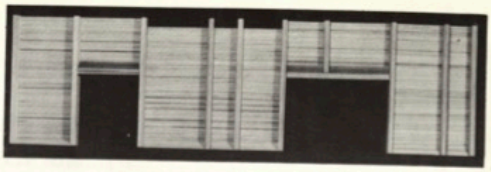
COMPOSITE BAMBOO FOAM BEAM

IN THE PROYECTO EXPERIMENTAL HOUSE, all beams are rectangular section boxed beams, 20 cm wide, 40 cm deep, and 5 meters long. The beams are made of 6 cm bamboos, placed over plywood templates, with a core of two lb. density polyurethane fire-retardant foam, foamed in place. The bamboos are pinned and and spot glued together at 50 cm intervals, with epoxy glue and wooden dowels.

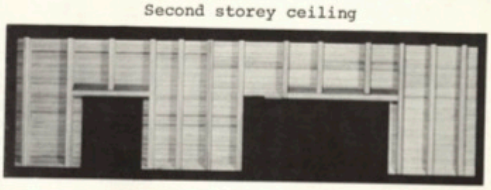


The framing model is shown below. The second storey floor beams are all supported by interior partitions or columns, and have clear spans of 3 meters or less - except in the family room, where they span 4.50 meters between shear walls and impost blocks, and are spaced close together to make up for the long span. The roof beams span the full 4.80 meters between impost blocks, and are spaced at intervals ranging from 1.50 to 2.40 meters.

The second storey floor is designed to carry 200 kg/m^2 (bamboo foam plank 15 kg/m^2, sulphur cement topping 45 kg/m^2, second floor partitions 50 kg/m^2 and live load 90 kg/m^2). The roof is designed to carry 80 kg/m^2 (bamboo foam plank 15 kg/m^2, thin topping 20 kg/m^2 and live load 45 kg/m^2). To put a third



Second storey ceiling



First storey ceiling

storey on the house, additional beams will need to be inserted (they can be slipped onto the impost block easily), and the topping on the roof increased.

At these loads, the beams have a deflection of less than 1/360 of the span, and can safely be plastered. (See table on page 207 below). Families who do not like the appearance of the exposed bamboo can plaster them.

THE GENERAL PATTERN IS:

Context:

Short spans and light loads in countries where bamboo is abundant and cheap.

Solution:

Beams may be made of bamboos (pinned and glued with epoxy) to form a box which is filled with plastic foam. Spans may

range from 3 to 5 meters with corresponding variation in beam spanning. Allowable loads are shown in the problem statement.

Problem:

Concrete beams are expensive, very heavy, hard to move around, and hard to work. In many buildings, especially those where people will be building for themselves (as in self-help housing) beams need to be light weight, and easy to work. In earthquake zones, it is also necessary to reduce dead loads as far as possible. If bamboo is locally available and petroleum resources allow local manufacture of urethane foams, then it is possible to make lightweight bamboo/foam beams, with excellent structural characteristics.

We have built three different beams of this type, and tested them. It is clear from our tests that bamboo/foam beams of this type are about as strong as softwood beams of the same size. The most serious problem is deflection. Bamboo is extremely strong in tension, and the urethane foam makes the beam section rigid; but the bamboos tend to slip past each other in horizontal shears.

In the third of the three test beams, we pinned and spot glued bamboos together with epoxy glue and dowels. This test beam was 20 cm wide, 40 cm deep. We tested it over a clear span of 3.50 meters. At a uniformly distributed load of 1300 kilograms the deflection reached 0.8 cm after an hour, and showed no sign of further creep 24 hours later.

We may use the formula:

$$\text{Deflection}_{Max} = (5/384)WL^3/EI$$

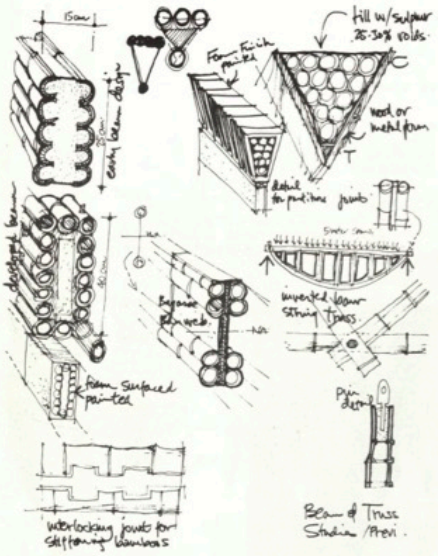
to obtain a value for EI, and extrapolate the following figures for maximum allowable uniform loads, at various spans:

Clear span between supports (meters)	Maximum allowable uniformly distributed load, for beam deflection less than L/360 (kg).
3.00	2200
3.50	1620
4.00	1240
4.50	980
5.00	800

(where the design criterion is L/240, for unplastered conditions, these loads can be increased by 50%)

These beams will cost 100 soles per meter (compared with about 200 soles per meter for comparable reinforced concrete beams), and weigh about 20 kilograms per meter (compared with 50 kg per meter for a reinforced concrete beam of similar strength). Furthermore, these beams can be cut with simple tools: they can easily be lifted and installed by two men.

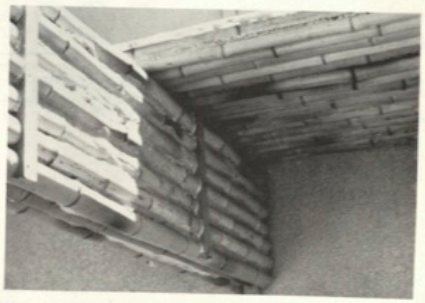
It is important to note that the beam type described here is by no means the last word in composite bamboo/foam beams. Much development is needed to explore others which use different indigenous materials in place of bamboo, other foams like high-density sulphur foams, and new glues and bonding agents. The sketches illustrate some of these possibilities. For discussion of urethane foam manufacture, see page 213.



COMPOSITE BAMBOO FOAM PLANK

IN THE PROYECTO EXPERIMENTAL HOUSE, the second floor and roof structure are bamboo/polyurethane foam sandwich planks laid over beams. The outer skins of the plank sandwich are made of 6 cm bamboos, and the core is two lbs.density polyurethane. A sand-sulphur topping is poured after planks are in position to form the upper walking surface, and the jointing between planks (see page 214).

The planks are 15 cm thick (including the topping), 50 cm wide and 5 meters long. They are supported by similarly constructed beams (see page 204) spaced at intervals between 1



meter and 2.40 meters, according to position in the structure. Since planks are 5 meters long, they act as continuous members over at least two supports after the topping is poured over them. If families do not like the exposed bamboo, the plank will readily take plaster.

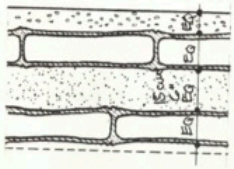
THE GENERAL PATTERN IS:

Context:

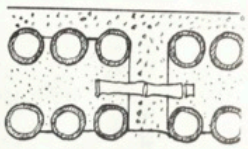
Short beam spacings and light loads in countries where bamboo is abundant and cheap, compared to other materials.

Solution:

Floor and roof planks may be made from bamboo/polyurethane foam sandwich. Maximum span for this system is approximately 2.50 meters unless panels have additional thickness and reinforcing. Allowable loads are shown in the problem statement.



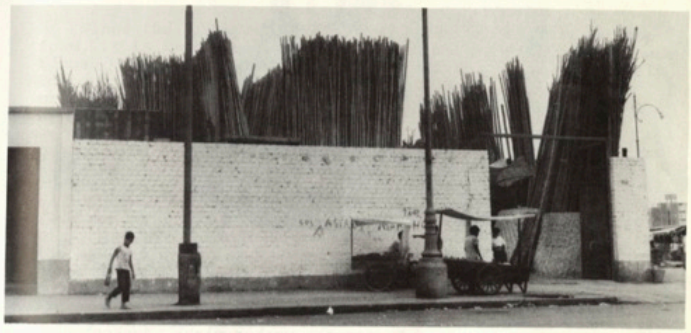
Plank Section



Plank Joint

Problem:

Conventional reinforced concrete beam and plank is expensive and heavy. A number of recent experiments have shown that sandwich planks with plywood, gypsum or cement asbestos skins and polyurethane foam cores have enough strength to span 2-3 meters with normal live loads; they have been widely built and tested in many parts of the United States. In a country where bamboo is readily available, and wood expensive, it seems natural to use bamboo as the outer skin of the sandwich instead of plywood.

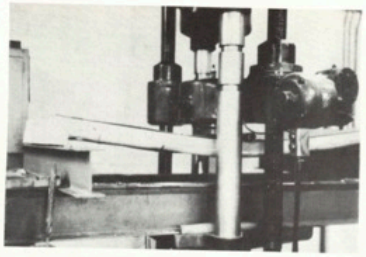


We built a test plank, with half bamboos for the lower skin, and 3 mm fiber board for the upper skin. This plank performed very well in tests. At final failure the upper skin failed, in shear; the bamboo held. The following table shows the deflection test data.

These figures are for a center load, on a plank 70 cm wide, over a span of 170 cm.

Load (kg)	Deflection (cm)
45	.25
91	.50
136	.75
182	.95
227	1.15
272	1.30
318	1.50
364	1.70
409	1.90
454	2.10
546	2.55
636	3.00
729	3.50

This rudimentary plank, which has half bamboos in the lower skin, and very little in the upper, is too weak. We recommend a stronger plank, which has whole bamboos top and bottom.



By means of the formula

$$\text{Deflection}_{Max} = (1/48)WL^3/EI$$

we may obtain a value of EI for the weaker plank. Reckoning that the moment of inertia will be tripled in a plank with whole bamboos top and bottom, we estimate that the stronger plank will support the following loads, at the stated spans:

Clear span between supports (meters)	Maximum allowable uniformly distributed load, for plank deflection less than L/360 (kgs/m^2)
1.00	2000
1.50	590
2.00	250
2.50	128
3.00	74

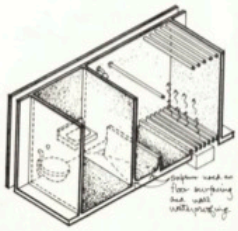
These planks are extremely light: they weigh about 1.3 $kilograms/m^2$, they can be hand carried, and laid by two men. Since they can easily be made in long lengths, it is advisable to lay them over several supports, thus getting the benefit of the negative moments. The urethane core gives them excellent thermal and acoustic performance. The foam can also be used as base for applying plaster or can be painted when desired.

Since the plank relies heavily on the use of polyurethane foam, it is important to add a note on the manufacture of these foams: particularly since the countries which are most likely to benefit from the use of bamboo, like Peru, will have to create urethane manufacturing capacity from scratch.

Capital equipment will cost $50,000 to $100,000. The organization of the factory and one year's operation will cost $200 000 - $250,000; with $100,000 of this amount going for the initial inventory of raw materials. At these costs it will be important to use polyurethane foams for other purposes too. They can be used for beams (see page 204) e.g., for interior partitions, and in a slightly different chemical formulation, for the manufacture of furniture, bedding and soft seating. For a general discussion of urethane foams in building, see Structural Potential of Foam Plastics for Housing in Underdeveloped Areas, Architectural Research Laboratory, University of Michigan, Ann Arbor, Michigan, November 1965.

SULPHUR REINFORCING AND TOPPING

IN THE PROYECTO EXPERIMENTAL, the connecting surfaces of blocks which make up shear walls, bearing walls and columns are coated with molten sulphur and fiberglass for tensile reinforcement. Sulphur mixed with sand is placed 2.5 cm thick on the bamboo/foam planks to create a walking surface, to create simple joints between the planks and between planks and beams, and to give continuity to the structure. Sulphur is also used as the waterproofing agent in wet areas such as shower and toilet, sink backsplashes, etc.



THE GENERAL PATTERN IS:

Context:

Low cost dry block construction and/or panel construction.

Solution:

Sulphur may be used as a reinforcing agent or bonding agent, wherever tensile strength is required in block walls, shear walls,

planks and beams. It may be used by itself or with chopped fibers, applied hot, or as part of a sulphur-sand grout.

Problem:

Jointing and reinforcing is a major part of the cost of a block wall, particularly in a high earthquake zone. In 1969 in Peru, the cost of a mortarless block wall with sulphur jointing is 20% less than the cost of a block wall with mortar and reinforced concrete corners.

Test results show that the sulphur jointing has considerable tensile strength and that a sulphur jointed wall performs at least as well as the standard block wall in low rise construction. Data are presented in John M. Dale and Allen C. Ludwig, "Sulphur Aggregate Concrete", Civil Engineering, December 1967, pp. 66-68; in Allen C. Ludwig, Utilization of Sulphur and Sulphur Ores as Construction Materials in Guatemala, Southwest Research Institute, San Antonio, Texas, March 1969; and in John M. Dale, "Sulphur-Fibre Coatings", The Sulphur Institute Journal, Fall 1965.

Sulphur adds color and texture in those areas where it is used. It may be tinted to produce colors other than yellow.

PLUMBING ACCUMULATOR

IN THE PROYECTO EXPERIMENTAL HOUSE, two accumulators above the floor line provide traps, vents and waste disposal - one for bathroom fixtures, and one for kitchen/laundry fixtures. These accumulators are made of A.B.S. injection moulded plastic and are designed to receive plastic piping, as used for all plumbing pipes in the house.

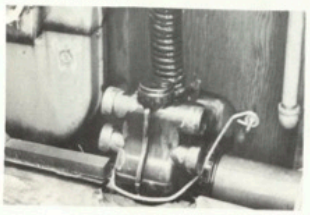
THE GENERAL PATTERN IS:

Context:

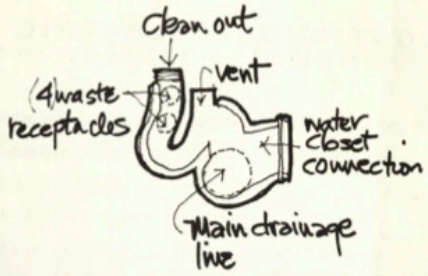
Conventional water supply and waste system in any building.

Solution:

Accumulators are used to trap, vent and dispose of waste. One accumulator serves as many as five fixtures - the fixtures must be grouped close together. Currently available accumulators are made of A.B.S. injection moulded plastic, and are designed to receive plastic pipes. (Patents are held by the Roth Russell Corporation.)



Accumulator in place



Problem:

In traditional plumbing systems, a great deal of money, labor and materials, goes into the construction of vents, traps and clean out fixtures for waste disposal. Furthermore, once they are installed, conventional waste disposal systems are expensive to maintain and repair. An accumulator replaces all the functions of conventional plumbing in one item with the additional advantage that it allows above-floor installation (good for slabs and future renovation). Fixtures can be plugged in easily, the accumulators may be used with left or right hand fixture locations, and they may be relocated and reused. Accumulators installed in Mexico and the United States have been in use for at least four years.

CONTINUOUS ELECTRIC OUTLET

IN THE PROYECTO EXPERIMENTAL HOUSE, the electrical system is a continuous elastomer strip, mounted onto the surface of the walls.

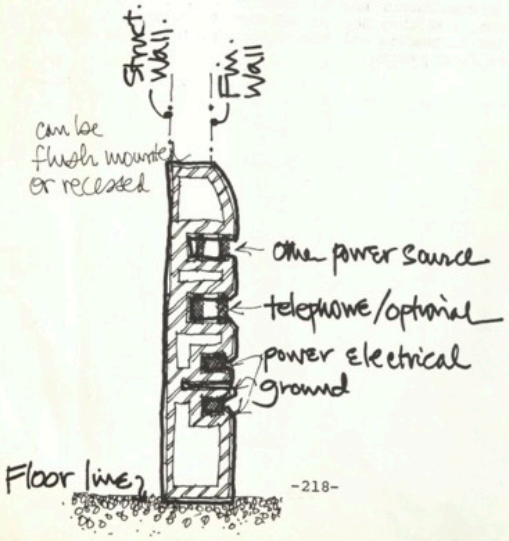
THE GENERAL PATTERN IS:

Context:

Any house with normal electrical requirements.

Solution:

The electrical system is a continuous strip of highly conductive elastomer, and can be mounted directly on wall surfaces.



It requires no special outlet boxes, but is a continuous female connector: Fixtures and appliances can be plugged in at any point. A special two pin plug connects appliances to the strip. The system is called Power Distribution System, and has been developed by International Technology, Inc.

Problem:

Traditional installation of electric wiring and outlets is complicated and expensive, both in labor and materials. The system described above is more convenient to use, and cheaper to install. It allows appliances to be plugged in at any point along the line. It is safer than the conventional system, since it has a non-arcing plug to reduce the danger of electric shock or fire, and the system is inherently water resistant. As far as installation is concerened: There are no outlets, and no in-wall wiring. The strip can be glued to any surface. It takes less time to install than a conventional wiring system, and the installer needs less technical competence to do it.