DESIGNING ADAPTABLE HOUSING

The Specific Case of INFONAVIT

by

ANDREA M. MARTIN
B.Arch., National University of Mexico, 1979

Submitted in Partial Fulfillment of the Requirements for the Degree of

Master of Science in Architecture Studies.
at the Massachusetts Institute of Technology

June 1981

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May 7, 1981

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MAY 28 1981
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ABSTRACT

The traditional way of designing housing of the Mexican government agencies, obliges the population they serve (mostly working class people), to live in rigid dwellings that have little or no flexibility to be adapted to the dweller's changing needs throughout time, or to the technological and economic improvements. The increasing participation of the Government agencies in the production of housing in Mexico, and the critical housing shortage, makes urgent a restatement of the design guidelines that have been used up to now.

The purpose of this thesis is to emphasize the need of adaptable housing and to suggest some changes to the standards traditionally used by public developers in order to make their housing design more adaptable. Taking as a case study the main public housing agency in Mexico (INFONAVIT), first I made a survey in one of the oldest and biggest housing complexes of INFONAVIT (el Rosario), in order to clarify certain issues about the use of spaces and the kind of needs that make dwellers modify their dwellings. Afterwards, I analyzed these changes to find out patterns of modification, looking for the changes that are most likely to occur and in what ways these changes can be facilitated. In the final part of the thesis, I make some suggestions of alterations that could be done to the standards of design in order to produce more adaptable housing.

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I also thank Professor Sandra C. Howell, who made me aware of the importance of social and psychological concern in designing housing, for her encouragement and advice to accomplish this thesis.

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In Mexico I am very grateful to the people of INFONAVIT, especially Hilda Araiza, whose help and contribution was indispensable for the accomplishment of this work.

Finally, I would like to deeply thank the inhabitants of "El Rosario," whose patience and collaboration made possible the field research.
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Exposed to a fast urbanization process, Mexico has been changing from a predominantly rural to a predominantly urban society. This phenomenon is partially due to the high rates of population and economic growth but, more importantly, to the attraction exerted by the big cities, which causes important migratory currents from rural to urban areas.

One quarter of the population is concentrated in three big cities: Mexico City (which has 20% of the total), Guadalajara, and Monterrey. In 1979, the population increased to 68 million, of which 44.2 million lived in the urban areas while 23.8 million live in rural areas. For 1982, a population of 73.3 million is estimated.

According to the 1970 census, there were 9.1 million families and only 8.3 million dwellings. Thus there was an absolute deficit of 800 thousand dwellings, 8.8% of the total gap that is worsening year by year because of the population growth, immigration and deterioration of the existing dwellings.
The housing deficit has increased along with the concern and involvement of the Mexican government in housing matters. The production of housing by the public sector has increased steadily since 1972.

The traditional internal spatial organization of the dwellings that are usually designed by public agencies produce dwellings that have little or no flexibility to accommodate modification required by the dweller's changing needs or economic improvements and do not adapt to the technological advances throughout time, reducing the "useful" life of the dwelling's physical structure.

This, in addition to my exposure to the SAR methodology and to the overall Housing Group experience; made me aware of the importance of designing adaptable housing in order to facilitate user participation and change according to people's needs and desires, and led my interest to the design process of high density housing developers, mainly those that take care of public housing.

The general goal of this thesis is to focus attention on the need to design adaptable dwellings and a more specific objective is to suggest alternatives or changes to the current INFONAVIT standards of design in order to produce more adaptable dwellings with the possibility of easy transformation.
The information on which the statement of the need of adaptability is based, was gathered on a field research project done in one of INFONAVIT's biggest and oldest housing complexes. The research gave insights into the kind of modifications the dwellers perform, and therefore provided a better understanding of the changes most likely to take place. This was particularly useful to understand the internal spatial organization of INFONAVIT prototypes to see where it restricted or allowed transformation. This was an essential step in order to criticize the adaptability of prototypes.

This study is an attempt to draw attention to the importance of housing adaptability, that tends to be jeopardized by public sector developers, in their attempt to maintain a "state housing" image. I hope this thesis will be of some help for those who are interested in the design of mass housing, by giving some information on modifications dwellers tend to perform and on some general criteria to follow in the design of housing to make it more adaptable.
1. BACKGROUND

1.1 Public Housing in Mexico

There has been an increasing participation of the Mexican State in housing matters, for the last 20 years. It is mainly due to the housing problem magnitude--critical because of the high rate of population growth--along with an outstanding economic growth and social trends imposing the State guidelines regarding the popular housing policies.

"The State has valued indispensable its intervention in the housing market from the conviction that its free play will not respond in an adequate way to the social requirements. However, for the State, the problem's solution is essentially of a financial and administrative kind". (1).

From 1970, to the present time, the State's participation in housing has been characterized by the creation of new financial mechanisms (Funds) to benefit those workers with minimum wages; by an outstanding increase in the annual production of housing and by the growing importance of the INFONAVIT (National Housing Fund for Workers).

According to the National Housing Program, from 1977 to 1978 the participation of the State in the production of housing increased from 28% to
Table 1.

PARTICIPATION IN HOUSING PRODUCTION BY SECTORS (2) 1950-1982

<table>
<thead>
<tr>
<th>Year</th>
<th>Informal Sector</th>
<th>Private Sector</th>
<th>Public Sector</th>
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<tbody>
<tr>
<td>1950</td>
<td>65.8%</td>
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<td>1951</td>
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<tr>
<td>1982</td>
<td>65.8%</td>
<td>9.3%</td>
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</table>
31%, and is likely to increase to 45% in 1982. (See Table 1.) This means that the Government's policy is to cover almost half of the total housing production of the country. This, along with the oversaturation of the land in the cities, makes the production of public housing a very important issue to be carefully planned and designed, so that the physical structure of the newly produced housing can be adaptable enough to last and overcome economic and technological development.

1.1.1. Government Housing Agencies

There are several government housing agencies out of which we can distinguish three main types: the ones of a banking nature (BNOPSA, FOVI); the ones that constitute public decentralized organisms (INDECO, INFONAVIT, FOVISSTE); and a special department of the Federal District Government that only takes care of local problems (DGHP) (3).

The oldest one is BNOPSA (National Bank of Public Works and Services), which has operated 45 years; then comes the FOVI (Housing Fund of Operation and Bank Discount) that has operated 15 years; and, the recent ones that rose in the period of 1970 to 1973 (4).

Two agencies, BNOPSA and INDECO (National Institution for Rural Community Development and Popular Housing) do not limit themselves to housing:
the former aims its action mainly to the realization of public works, while the latter intervenes also in social promotion plans and urban planning. The others basically give housing credits, promote and finance new construction units, and to a lesser extent improve the existing ones. The DGHP (Popular Housing General Direction) and INDECO also participate in urban renewal programs (5).

### Table 2. Public Sector Investment in Housing

<table>
<thead>
<tr>
<th>Agencies</th>
<th>Total 1978-1982</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>INDECO</td>
<td>4,372,573</td>
<td>4.6</td>
</tr>
<tr>
<td>INFONAVIT</td>
<td>56,772,998</td>
<td>59.1</td>
</tr>
<tr>
<td>FOVISSSTE</td>
<td>20,392,315</td>
<td>21.2</td>
</tr>
<tr>
<td>FOVI PROGRAMA FINANCIERO</td>
<td>7,566,897</td>
<td>7.9</td>
</tr>
<tr>
<td>BANOBARAS</td>
<td>2,938,470</td>
<td>3.1</td>
</tr>
<tr>
<td>D. D. F.</td>
<td>1,636,028</td>
<td>1.7</td>
</tr>
<tr>
<td>FOVIMI</td>
<td>1,833,320</td>
<td>1.9</td>
</tr>
<tr>
<td>DIRECCION DE PENSIONES MILITARES</td>
<td>474,915</td>
<td>0.5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>95,987,516</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>
The single largest producer of housing in INFONAVIT (See Table 2), operating with a 5% tax over all wages of non-government employees (paid by the employers). The counterpart of INFONAVIT for government employees housing is FOVISSTE (Housing Fund of the Social Security Institute of the Government Employees), its financial base is analogous to the one of INFONAVIT (7).

We chose INFONAVIT as the case study of this work because it is the main public institution that provides housing. However, the intention of this research is such that the design guidelines suggested in this work will be broad enough as to be useful for all housing agencies.

1.1.2. INFONAVIT

INFONAVIT is an organism created in 1972 with the purpose of giving credits to the workers, so that they can be able to buy a dwelling, improve or extend the owned one, or else to pay debts contracted by the previous acquisition of a dwelling. It is also an organism in charge of the administration and promotion of new housing to be acquired by the worker. It covers all workers, except those who work for the government, and a few other minor exceptions.

The internal organizational structure is characterized by the tripartite and egalitarian participation of the representatives of the labor and private sectors, as well as by the Federal Government; the three sectors implied in the
decision-making of housing policies (a unique case where workers participate).

INFONAVIT functions basically with the resources of the financial fund created with the contributions of the private enterprises. It also relies, to a lesser extent, on the contributions of the Federal Government in services or subsidies and on the assets from inversions realized with its resources.

To be eligible for a credit, some general requirements must be fulfilled; the enterprise or employer where the worker works has to be contributing the 5% over the worker's wage; the worker has to fill out an information card with general data (familiar, economic, of housing, etc.). The allocation of the credit depends on the geographical location, the enterprise contribution, the workers income level and the type of program.

INFONAVIT had two ways of producing housing: by internal "promotions", with its direction and supervision, and by external "promotions", when it buys housing already built or to be built from developers representing the labor, private sector or the government.

In the case of internal "promotions", as in big housing complexes, INFONAVIT was directly involved in acquiring and developing the land and in contracting important architectural firms for the urban and housing design. The design had to be in accordance with the Institute guidelines and general standards of design. INFONAVIT has a wide range of prototypes for different
income levels and climatic characteristics used as standards. The Institute was involved also in the construction granted to a private enterprise selected by a Committee from a poll of contractors according to their economic capacity and solvency, giving preference to the local ones; and in the management of the whole process of production.

In the case of external "promotions" the design and construction of housing is under the direct control of the developer and INFONAVIT only finances and supervises. The developer provides: the land with services; the urban and housing design according to INFONAVIT standards approved by the city; the construction company; a socio-economic study of the population that will be served; and a feasibility study.

INFONAVIT, at the beginning, produced housing mainly by internal "promotions". However, since 1975, the external "promotions" have increased steadily to the point that INFONAVIT does not make internal "promotions" anymore. The long and complex process of building big housing projects, the gap between the finishing and occupancy of the dwellings as well as strong pressure from the labor sector has inclined INFONAVIT towards the production of housing by external "promotions".

The large spectrum of housing typologies that INFONAVIT has utilized as standards has changed considerably over time. Changes have been made to
simplify and reduce the housing typologies as an initial step to establish a design feedback mechanism: first evaluating the housing types performance over time; and second changing the type design wherever the type does not meet the desired levels of performance. This has the purpose to achieve a dynamic set of prototypes to be used as standards of design. The present housing typology has been reduced to seven prototypes. These prototypes forsee some future modification to be made by the user. However, in spite of the efforts to allow some future modifications, the initial design of the seven prototypes is still traditionally conceived.

The seven prototypes include 3 single family types (tapanco, one and two story row houses) and 4 walkup types (two apartments per access and four apartments per access). See plans on pages
1.2 Method of Research:

In this part of my thesis I will describe the overall strategy of the research, from the selection of the place for the survey to the informal interviews with the residents.

It was a one month research trip to Mexico City spent in the following way:

During the first week, the investigator began interviewing INFONAVIT officials about the general characteristics of the projects they have produced, general aspects of the patterns of design, policies of housing production, rapport between the Department of Design and Social Promotion, etc. Officials from the Department of Social Promotion suggested that "el Rosario" or "Iztacalco" housing complexes were the most likely to have a great percentage of modifications because they are the oldest. However, they advised me to talk to people in another department arguing that they were theorists with no experience in field work to recommend to me an adequate site to perform the interviews. The other department was CODIFE (Federal District Coordination) which is in charge of the different housing complexes of INFONAVIT in the Federal District, enforces INFONAVIT regulations, is responsible for maintenance until the municipality takes over and receives complaints from the tenants of INFONAVIT housing.
The Director of CODIFE recommended "el Rosario" housing complex as an adequate site for the survey of tenants for the following reasons: it is one of the oldest and the biggest; it has a great variety with respect to mix of housing units; being so huge, INFONAVIT regulations restraining change were difficult to control, so modifications spread out in all the complex; and the last reason was that they have an office on the site, with the plans of the project, with social workers that have organized the tenant administration within the complex and some other facilities for the research.

I was introduced to the social workers of "el Rosario" and began the second week of investigation on the site. Talking with the social workers, I began to get acquainted with the main social problems that exist there, many times created because of the design of the units. Several times, I had the occasion to hear tenants complain about modifications their neighbor had done, that in some way disturbed them. In the company of a social worker, I went around the complex to get acquainted with the local characteristics of the place, and to identify, through selective observation, the sector that showed more exterior modification. In identifying the sector in which I was going to perform the interviews, I made copies of the plans of the different types contained in that sector (apartments, triple and single family).
I decided to get geographically concentrated samples from one relatively circumscribed sector (sub-neighborhood), rather than from several scattered ones all over "el Rosario" community, because the variety of typologies within one sector was even broader within sectors, and because I thought I might be able to see any influence of residents' mutual relationships on the modes of modification.

I asked to be introduced to each of the three tenant representatives of the chosen sector (one for apartments, one for triplex and one for single houses). Carefully explaining to each representative the purpose of the research, and the researcher's status as a student, I got their consent and support to interview the people. I also had their opinion on the design problems of the project and on the need of adaptability. They handed me a list of the representatives of each building within their sector, in the case of apartments and triplex. In the case of the single houses there is only one representative per sector.

In this week I also went through the data that exists on the historical, political and design aspects about "el Rosario". I also learned the purpose of the work of INFONAVIT's local personnel, their organization, the way they solve problems, etc. (To be described in the next chapter).
The second and third weeks were spent on the survey. With a checklist of minimum questions which I had to ask each person interviewed, in order to receive coherent data, a plan of each type, and the list of representatives, the process of interviewing began.

In the case of the apartments and the triplex, the interview samples were located throughout the natural networks systems. Having the name of the family to be interviewed and the name of their representative, the attitude of the people was more likely to be cooperative than to refuse the interview. At the end of the interview, I would ask for acquaintances that had made modifications to their dwellings. If they knew anybody, I would write down the name on a new list. The next interview would be with the family added to the new list. When this network was broken, I would select the next name on the list of representatives to proceed with the interviews.

In the case of single family houses the procedure of selecting the samples was different from the one used for apartments and triplex. It was hard to select the samples through natural networks because people in single family houses had almost no acquaintances within their neighborhood. The easiest way to select the samples was through selective observation, although it was not the easiest way to get the interview. It was not easy because there is a natural hostility against any "outsider" intrusion into their
community, and because modifications are forbidden by INFONAVIT regulations. And in addition to these two negative factors, at the time in which the interviews were performed, the municipality was about to be in charge of the complex, so people were afraid of city tax inspectors coming to fine and tax them for their extensions. However, refusals were the exception, although I had to spend much time explaining the purpose of the work in order to make them confident and willing to help.

1.2.1. The Interviews:

Thirty-two residents were interviewed. Nine owners of apartments, ten of triplex and thirteen of single houses. (See Table 3.) Almost all interviews were done inside the homes and varied from half an hour of conversation to two hour interviews over coffee and complaints. (As I told them I was an architect, they wanted to show me all the architectonic problems they had, as well as ideas they had for future modification.) In the cases where small businesses were added to the houses (four cases) the interviews took place in the business because generally the person in charge was the lady owner, who could not leave the business unattended to show me their house.

In all interviews I asked the questions from my checklist, drew the modifications and furniture arrangement in the matching plan and made notes of
relevant comments. Only in few cases (in single houses) I was able to go to
the upper floor, so I asked the interviewee to draw the modifications and
furniture arrangement of the second floor on the plan. I also took some
interior and exterior photographs of the homes. The majority of the interviewees
were housewives (about 4/5), the rest were both, husband and wife, and if this
was the case, the husband would be the one to answer the questions.
Interview Form:

Length of Residency: ____________________________

Age: ____________________________

Occupations: Father ____________________________ Mother ____________________________

No. of Children: _______ MALES _______ Ages _______

FEMALES _______ Ages _______

Approximate Income: ____________________________

MODIFICATIONS DONE TO THE HOUSE:

Exterior: patio ____________________________

Front yard ____________________________

Interior: kitchen ____________________________

bathroom ____________________________

closets ____________________________

storage area ____________________________

other ____________________________

Number of Bedrooms and number of people that use them: 1. ____________________________

(for parents, children)

2. ____________________________

3. ____________________________

4. ____________________________

Use of: living room (tv, sleep, read, socialize) ____________________________

kitchen (work, eat, iron) ____________________________

patio (wash, dry, storage) ____________________________

FUTURE PLANS OF MODIFICATION: ____________________________

__________________________

__________________________

OTHER OBSERVATIONS: ____________________________
### Table 3. Characteristics of Sampled Families in “el Rosario”

| FAMILY CASE NUMBER | FAMILY LENGTH | FAMILY TYPE | FATHER | MOTHER | M1 | M2 | M3 | M4 | M5 | M6 | F1 | F2 | F3 | F4 | F5 | F6 | F7 | F8 | F9 | F10 | F11 | F12 | F13 | F14 | F15 | F16 | F17 | F18 | F19 | F20 | F21 | F22 |
|-------------------|---------------|-------------|--------|--------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| 1                 | Al (Ap)       | 3 years     | 33     | 36     | 10 | 12 | 15 |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 2                 | Al (Ap)       | 4 years     | 34     | 27     | 6  | 7  |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 3                 | Al (Ap)       | 4 years     | 35     | 30     | 5  | 10 | 11 | 13 |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 4                 | Ao (Ap)       | 4 years     | 27     | 25     | 5  | 7  | 1 | 3  |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 5                 | Ao (Ap)       | 4 years     | 45     | 40     | x  | x  |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 6                 | Ao (Ap)       | 4 years     | 26     | 23     | 7  | 3  |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 7                 | Z (Tri)       | 4 years     | 43     | 31     | 7  | 9  |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 8                 | Z (Tri)       | 6 years     | 47     | 45     | 17 | 20 | 24 | 26 |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 9                 | Z (Tri)       | 4 years     | 50     | 45     | 14 | 18 | 20 | 26 | 8  | 8  | 24 | 22 |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 10                | Z (Tri)       | 2 years     | 50     | 45     | 14 | 17 | 21 | 8  | 12 | 25 |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 11                | Z (Tri)       | 4 years     | 29     | 25     | 2  | 6  | 2 | 55 | 29 | 19 | 12 |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 12                | Z (Tri)       | 6 years     | 55     | 30     | 8  | 10 |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 13                | Z (Tri)       | 4½ years    | 55     | 50     | 35 | 30 | 14 | 20 | 23 | 27 | 30 | 8  | 7  |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 14                | Z (Tri)       | 4 years     | 48     | 45     | 5  | 9  | 17 | 8  | 11 |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 15                | A (SF)        | 5 years     | 45     | 40     | 3  | 8  | 16 | 10 | 12 | 14 | 19 |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 16                | A (SF)        | 6 years     | 47     | 43     | 8  | 9  | 10 | 12 | 14 | 16 | 18 |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 17                | A (SF)        | 5 years     | 40     | 35     | 8  | 11 | 13 | 14 | 7  | 9  |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 18                | A (SF)        | 5 years     | 50     | 45     | 5  | 9  | 16 | 18 | 20 | 22 | 7  | 12 | 14 |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 19                | C (SF)        | 6 years     | 35     | 30     | 6  | 9  |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 20                | C (SF)        | 4½ years    | 50     | 45     | 14 | 18 | 23 | 20 |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 21                | C (SF)        | 5½ years    | 50     | 45     | 16 | 20 | 23 | 14 |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |

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plaza with fountain at "el Rosario"
2. MODIFICATION IN "el Rosario"

2.1 General Characteristics of the Housing Project

The main institutional goals for this project were: to give the workers mass housing of "good quality," besides communal equipment and public services; and to solve transportation problems, locating the housing complex in one of the most important industrial areas of the country where presumably the majority of the residents of "el Rosario" would work. (1)

2.1.1 The Site

The housing project of "el Rosario" is located between the Federal District (Atzcapotzalco municipality) and the State of Mexico, to the north part of Mexico City. It is surrounded by industrial and residential areas. It occupies a surface of two million four thousand square meters.

2.1.2 Demographic Data

From a survey conducted in "el Rosario" in 1976 (2), some relevant demographic data of the population of "el Rosario" was extracted:
**Origin:** Only about 30% of the household males were born in the Federal District. About 50% of the household females were born in the Federal District. However, immigration to the Federal District is not recent; 73% have been living there for more than 15 years.

**Family Composition:** The 161 families interviewed had as an average 5 children per family; 31% of the families had less than three children, but since most of these are young families, more children are expected. The average number of people per dwelling was 7.1. There were 43% of the dwellings with 4 to 6 dwellers; 33% with 7 to 9; and 16% with 10 to 12. The age-structure pyramid is typical of a high fertility population: very broad base and narrow vertex (55% below age 15, 43% are ages 15 to 60, and only 1.2% are over 61. Twenty percent of the households were extended family.

**Occupation:** 42% of the household heads were non-skilled workers and 32% were skilled workers; 15% were employees and 5% were technicians.

**Income:** Most of the workers (42%) had wages ranging from 1 to 1.5 times the Minimum Official Wage (MOW). Twenty-seven percent of the workers earned 1.5 to 2 times the MOW, and 26% earned 2 to 5 times the MOW. Very few (1.8) of the workers received salaries below the MOW.

**Former Dwelling:** 38% of the dwellers used to live in tenements and 6% in shacks before moving into "el Rosario." Twenty-seven percent used
to live in single houses and 26% lived in apartments. Almost half of the
former dwellings (45%) had only one room; 35% had two rooms; and 10% had
three rooms. The majority (78%) rented their former dwelling; 11% lived
in borrowed dwellings; 5% in owned dwellings and 4% in a shared dwelling.
One out of six dwellers used to live in extended family households.

2.1.3 The Design and Social Problems

In the original project, 17,500 dwellings were planned with an average
of six inhabitants per dwelling (approximately 105,000 people) (3).

Land Utilization: Circulation 15%
Parking Area 7.3%
Green Areas 18%
Dwelling Coverage 40%.

The rest of the area is occupied by other services and equipment
such as: plazas, lakes, sports centers, hospital, urban centers, schools,
cemetery, and social centers.

With respect to the units, this project has the greatest variety
of housing typologies (apartments, triplex, duplex, single houses). The
floor areas of types vary from 54 to 99 square meters and are interpolated
between themselves in the site with the purpose of mixing income groups in
the neighborhood.
The apartment buildings are five stories high with 8 dwellings per entrance. They are composed of common areas: entrance hall, basement, double loaded staircase and roof; and private areas which are the dwellings. All the common areas of the buildings give economic and social problems to the residents because of the difficulty in defining responsibility for their use and maintenance.

The triplex buildings are three stories high with 2 dwellings on the ground floor and 4 dwellings per staircase. Triplex and apartment buildings are generally mixed in the site.

The single house units surveyed (types A and C) are two stories high and were mixed with other single house types.

The main problem derived from the design that tenants of apartments and triplex pointed out were: indefinition of common areas; lack of staircases illumination; insufficient size of the patio and kitchen (not the case in ground floor triplex patio); and the leakage of upper floor patios to the ones below.

The problems of social integration and maintenance of "el Rosario" housing complex were so critical two years ago, that INFONAVIT had to create a permanent office on the site, to give advice and technical assistance to
the design of the patios in apartment buildings creates problems among residents.
The urban design considered generous communal spaces (green areas, parking spaces, plazas, fountains, pedestrian corridors) for the apartments and triplex sites. The maintenance of these spaces and its urban equipment along with the imprecise physical definition of subneighborhoods or sectors in which the neighborhood is legally subdivided (the Federal District condominium law applies to apartments and triplex) has created many problems in the tenants' self-administration organization, because of the difficulty in defining responsibilities.

Between the sidewalk and the front part of single house units, green areas were left, in order to provide each block with some common green areas, and to be used as parking space (originally stepstones were provided to park the car) for each unit. However, people decided to enclose the common area in front of their dwellings and to use it as a private space, despite the regulations forbidding it. This was the case in most single houses of all "el Rosario," and that space was used in very different ways. Some cases of the smallest single house types, intended for low income families, had not appropriated the common green area. This was mainly due to economic reasons and generally their spaces were very poorly maintained.
the tenants. The Office is divided into two sections: Social area and the Technical area. The technical area deals with technical or maintenance problems of the dwellings, and the social area is in charge of orienting the tenants on how to organize their administration; organizes social integration programs (their cultural or sport activities); and tries to solve problems among tenants.

 insufficient area in patios obliges residents to dry their clothes in public areas.
2.2. HOUSING TYPES
(only surveyed types)

- APARTMENTS
- TRIPLEX
- SINGLE FAMILY
  (row house)
APARTMENT AO

Structure: load bearing wall system made out of brick

Living and Dining Room:
vinylic tiles in floor
plaster in walls
plaster in ceiling

Bedrooms:
same as living and dining room

Bathroom:
tiles in floor and walls
plaster ceiling
furnished with basin, wc, and shower

Kitchen:
same as living and dining room
furnished with sink

Patio:
concrete walls
cement floor
furnished with washing sink

Others:
Two interior wood doors provided (bathroom and master bedroom)
Entrance wood door
Iron gate to patio

BUILT AREA 49.0 m²
Living and Dining Room
Kitchen/Patio
bathroom
1 Bedroom/1 alcove
APARTMENT A1

Structure: load bearing wall system made out of brick

Living and Dining Room:
- vinylic tiles in floor
- plaster in walls
- plaster in ceiling

Bedrooms:
- same as living and dining room

Bathroom:
- tiles in floor and walls
- plaster ceiling
- furnished with basin, wc, and shower

Kitchen:
- same as living and dining room
- furnished with sink

Patio:
- concrete walls
- cement floor
- furnished with washing sink

Others:
- Two interior wood doors provided (bathroom and master bedroom)
- Entrance wood door
- Iron gate to patio

BUILT AREA 63.80 m²
Living and Dining Room
Kitchen/Patio
bathroom
2 Bedrooms/1 alcove
TRIPLEX Z (ground floor)

Structure: load bearing wall system made out of red brick

Living and Dining Room:
vinylic tiles in floor
brick in walls
tirol in ceiling

Bedrooms:
same as living and dining room

Bathroom:
tiles in floor and walls
plaster ceiling
furnished with basin, wc, and shower

Kitchen:
same as living and dining room
furnished with sink

Patio:
cyclone fencing walls (ground floor)
cement floor (2nd and third floors)
furnished with washing sink
concrete sheet over washing sink

Others:
All interior doors made out of wood
Entrance door made of asbestos

BUILT AREA 62.0 m²
Living and Dining Room
Kitchen/Patio
bathroom
2 Bedrooms
single family house
SINGLE HOUSE

Structure: load bearing wall system made out of red brick

Living and Dining Room:
vinylic tiles in floor
brick in walls
tirol in ceiling

Bedrooms:
same as living and dining room

Bathroom:
tiles in floor and walls
plaster ceiling
furnished with basin, wc, and shower

Kitchen:
same as living and dining room
furnished with sink

Patio:
cyclone fencing walls (ground floor)
cement floor (2nd and third floors)
furnished with washing sink
concrete sheet over washing sink

Others:
All interior doors made out of wood
Entrance door made of asbestos

TYPE A

BUILT AREA 74.38 m²

First floor:
Living and Dining Room
Kitchen/Patio
Second floor:
bathroom
2 Bedrooms
SINGLE HOUSE TYPE C

BUILT AREA 104.0 m²

First floor:
- Living and Dining Room
- Kitchen/Patio
- 1 bathroom
- 1 Bedroom

Second floor:
- 1 bathroom
- 2 Bedrooms
- 1 family room
2.3. DESCRIPTION OF TRANSFORMATION

- EXTERIOR MODIFICATIONS
- INTERIOR MODIFICATIONS
**Exterior Modification in Apartments**

**Entrances and Staircases:**
- Iron gates with locks added to the entrance hall
- Iron grates added in opening of the stair landing between ground floor and first floor
- Iron grates added to the roof of ground floor patios
- Iron grates on windows of the ground floor apartments
**Interior Modifications in Apartments**

**Kitchen:**
- Doors or curtains added to openings between kitchen and living-room
- Ceiling, floor and/or wall finishings changed

**Patio:**
- Translucent ceiling (to protect clothes from the water leakage of the upper patio and/or to use it as a storage place)

**Bathroom:**
- Removal of wall between toilet and basin; door moved to the other wall between basin and living area
- Ceiling, floor and/or wall finishings changed

**Bedroom:**
- Doors or curtains added to alcove entrances
- Closets added
- Wall finishings changed

**Living and Dining Room:**
- Removal of the wall that separates living room from bedrooms (type A1)
- Ceiling, floor and/or wall finishings changed
1. Family: 5 members
   Occupancy: 4 years
   Modification:
   - Finishings
   Future modification: to remove wall to increase living and dining room area
   To enlarge bathroom

2. Family: 4 members
   Occupancy: 3 years
   Modification:
   - Removed wall to increase living and dining area
   - Ceiled the Patio
   Future modification: to enlarge bathroom door in kitchen and bedroom

3. Family: 6 members
   Occupancy: 4 years
   Modification:
   - Removed wall to increase living and dining room area
   - Removed wall and changed door to increase bathroom area
   - Door in kitchen
   - Sliding door in alcove
   - Closet in alcove
   - Finishings
   Future Modification: None
4. Family: 5 members
   Occupancy: 4 years
   Modification: Finishings
   Future Modification: None

5. Family: 6 members
   Occupancy: 4 years
   Modification: Window of living room changed
                 Living room subdivided with partition to make small store
   Future Modifications: None

6. Family: 4 members
   Occupancy: 4 years
   Modification: None
   Future Modification: to make a bedroom either in the common green area or in the kitchen, moving the kitchen to the patio
Exterior Modification in Triplex

Entrances and Staircases:
- Dwelling entrance door changed (for security reasons) into iron gates
- Iron gates with locks added to staircase entrance
- Balconies added to first or second floor
- Iron grates added to windows

Triplex of Ground Floor:
- Walls, roof, floor and door (to make an extra room) added in front of unit
**Interior Modification in Triplex**

**Kitchen:**
- Removal of the wall between kitchen and patio; wall with windows added; door and laundry sink changed in place (to increase the kitchen area)
- Ceiling, floor and/or wall finishings changed

**Patio (only in ground floor):**
- Walls to enclose patio
- Cement floor
- Brick or wood walls added to the back part of the patio; Concrete or asbestos added as a ceiling; doors or curtains added to the entrance (to make an extra room)

**Bathroom:**
- Ceiling, floor and/or wall finishings changed
- Bathroom furniture replaced

**Bedrooms:**
- Wall finishings changed

**Living and Dining Room:**
- Wall and/or floor finishings changed
7. Family: 4 1/2 members  
   Occupancy: 4 years  
   Modification:  
   Cement floor in patio  
   Entrance door changed  
   Finishes  
   Future Modification: Make another bedroom either in the patio or in the front part of the dwelling

8. Family: 8 members  
   Occupancy: 6 years  
   Modification:  
   Cement floor in patio  
   Entrance door changed  
   Future plans of modification:  
   Make another bedroom in the back part of the patio

9. Family: 10 members  
   Occupancy: 4 years  
   Modification:  
   Cement floor in patio  
   Additional washing sink  
   Future plans of modification:  
   None

10. Family: 8 members  
    Occupancy: 2 years  
    Modification:  
    Additional bedroom in the front part of the dwelling  
    Cement floor in patio  
    Future plans of modification:  
    None
11. Family: 4 1/2 members + 3 siblings  
Occupancy: 4 years  
Modification: Kitchen enlarged towards the patio  
Bedroom added in the front part  
Cement floor in patio  
Finishings  
Future plans of modification: None

12. Family: 4 members  
Occupancy: 6 years  
Modification: Bedroom added in back part of patio  
Kitchen enlarged towards patio  
Cement floor in patio  
Finishings  
Future plans of modification: None

13. Family: 6 members + 3 siblings + 3 visitors  
Occupancy: 4 1/2 years  
Modification: Bedroom added in back part of patio  
Cement floor in patio  
Entrance door changed  
Finishings  
Future Modifications: None

14. Family: 7 members  
Occupancy: 4 years  
Modifications: Room for storage space added  
in back part of patio  
Cement floor  
Bathroom furniture  
Entrance door changed  
Closets added  
Finishings  
Future Modification: Make a bedroom in storage space
Exterior Modifications in Single Family Houses

Common green area and entrances:
  - Lateral walls added; concrete sheets over main entrances; iron gates and/or garage entrance doors added to the front (to make garage); cement floor
  - walls, roof, floor and door added in front of unit (to make an extra room)
  - columns and balconies

Back yard:
  - Walls, roof, floor and door added (to make an extra room or garage)
  - Walls to enclose back yard
  - Cement Floor
I, single house type C front transformed into a restaurant
**Interior Modifications in Single Family Houses**

**Kitchen:**
- Window replaced by back entrance door
- Ceiling, floor and/or wall finishings changed

**Patio:**
- Lateral wall removed
- Ceiling added

**Bathroom:**
- Ceiling, floor and/or wall finishings changed
- Bathroom furniture replaced
- Opening and door to enter bathroom changed (type C) ground floor bath

**Bedrooms:**
- Ceiling, floor and/or wall finishings changed
- Closets added
- Window replaced by door
- Complete kitchen installed in ground floor bedroom of type C

**Living and Dining Rooms:**
- Ceiling, floor and/or wall finishings changed
**TYPE A**

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**n.15**

- **Family:** 9 members
- **Occupancy:** 4 years
- **Modification:**
  - Wall removed from patio to make storage for the store
  - Part of front yard ceiled and lateral wall added to make store
  - Walls to enclose backyard
  - Cement floor in backyard
  - Finishings
- **Future Modification:** to make a bedroom in the front yard

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**n.16**

- **Family:** 11 members
- **Occupancy:** 5 to 6 years
- **Modification:**
  - Lateral walls in front yard
  - Part of front yard ceiled to make store
  - Walls to enclose backyard
  - Cement floor in backyard
- **Future Modification:** to make a bedroom in the backyard
**TYPE A**

**n.17**

**Family:** 8 members  
**Occupancy:** 5 years  
**Modification:**  
- Lateral walls in front yard  
- Wall and ceiling added to make stationary in front yard  
- Walls to enclose backyard  
- Cement floor in backyard  
**Finishings**  
**Future Modification:** to change the stationary asbestos ceiling into concrete sheet to make bedrooms in the second floor  
To ceil the patio to enlarge the kitchen  
To move the washing sink to the backyard

**n.18**

**Family:** 11 members  
**Occupancy:** 5 years  
**Modification:**  
- Lateral walls in front yard  
- Walls and ceiling added to make bedroom in backyard  
- Opening and door in second floor bedroom to use that roof as drying clothes area  
- Cement floor in backyard and front yard (garage)  
**Finishings**  
**Future Modification:** to make a skylight in ground floor bedroom
19. Family: 6 members
   Occupancy: 6 years
   Modification:
   - Lateral walls, cement floor and iron gates in front yard
   - Walls to enclose backyard
   - Balcony with columns
   - Finishings
   Future modification: to tear down the house and build another one with a more solid structure

20. Family: 4 members
   Occupancy: 5 to 6 years
   Modification:
   - Lateral walls and iron gates in front yard
   - Walls to enclose backyard
   - Opening in lateral wall and ceiling in backyard to make garage
   - Finishings
   Future modification: they were remodeling the dwelling at the time of the survey
Family: 6 members
Occupancy: 44 years
Modification:
- Lateral walls, cement floor, entrance
door and canvas ceiling to make restaurant
Walls to enclose backyard
Bathroom door changed of place
Ground floor bedroom transformed
in kitchen for restaurant
Opening and back door in kitchen
Door to patio closed and storage area
made in that corner
3. ANALYSIS OF THE TRANSFORMATION

3.1 Patterns of Change in "el Rosario"

From the research done in "el Rosario" housing complex as well as from the experience of other studies done in different parts of the world (1) we can observe some patterns of change that are most likely to occur:

1. Changes in function.
2. Changes in floor area.

In the case of "el Rosario," even though INFONAVIT regulations did not formally allow transformation, a wide variety of site and house changes have been made in all the neighborhoods. (2)
APARTMENTS

CHANGES IN FUNCTION:

Living area

Commercial use

AO

Original

AI

1

2

3

4

5

6
APARTMENTS

PHYSICAL CHANGES:

Increase of space ____________
Internal walls ________________

AO

AI
TRIPLEX Z (ground floor)

CHANGES IN FUNCTION:

Kitchen area

Washing and Drying area
TRIPLEX Z (ground floor)

PHYSICAL CHANGES:

Increase of space
Internal walls
Internal equipment
SINGLE HOUSE TYPE A

CHANGES IN FUNCTION:

Washing and Drying area
Commercial use
SINGLE HOUSE TYPE A

PHYSICAL CHANGES

Increase of space
Internal walls
SINGLE HOUSE TYPE C

CHANGES IN FUNCTION:

Sleeping area

Commercial use
SINGLE HOUSE TYPE C

PHYSICAL CHANGES

Increase of space
Internal walls
Internal equipment
Apartment Buildings in which the physical structure did not allow any adaptability to increase the floor area, modifications were done to improve the quality of interior space. Interior modifications generally took place prior to exterior ones, except when security gave reason to give exterior modifications priority over interior ones. Bathroom and kitchen usually got high priority in improvements and enlargements.

However, none of the six tenants of apartments surveyed in "el Rosario" had enlarged the kitchen. This has to do with the impossibility of expanding to the patio (the most usual solution in other types) or to expand to the living-dining area imposed by technical barriers and by the internal circulation pattern. Most of the dwellers interviewed complained about insufficient area of kitchen and of the impossibility of enlarging it.

The bathroom in five cases out of six was not modified nor enlarged. Nevertheless all the dwellers of apartment type A1, expressed their desire to modify it when economic resources were available. The single modified case (no. 3) removed the wall and moved the door that enclosed the W.C. and shower, in order to make a single space including the basin; and enlarged the shower by moving the boiler to the patio and removing the wall in order to use that space for the extension (see fig. 1). Tenants
of apartments type A0, because of physical and area constraints, could modify only the bathroom. Their plans were to move rather than modify, when economic resources were available.

Tenants have changed the use of some spaces despite the fact that adaptability to changes in function is also very restricted by the nature of the physical structure (load bearing wall system) and by the internal spatial arrangement. In case no. 5 (ground floor apartment) living-dining area was subdivided to allocate a small business. In case no. 2 and no. 3 living-dining area was enlarged by removing a wall between this area and a small hall anteceding the bedrooms. This part became part of the living room in one case and part of the dining room in the other.

The case of the triplex is similar to the apartments regarding the inflexibility of increasing the floor area. Only in the ground floor triplex could we find both functional and area changes.

In the ground floor triplex units where there was space available to expand, the priority modifications were increases in floor area.

The kitchen had priority in improvements, modernization and enlargements in most cases. In case no. 11 and no. 12, the tenants had not only improved the kitchen but had enlarged it towards the patio. They removed the exterior wall and door, moved the washing sink and added a
wall with windows to enclose the space intended for washing. This area was originally covered by a roof, facilitating in this way the enlargement. The extension of the kitchen was limited to that possibility, but at least there was one, that came out to be technically feasible and only represented a small investment of money (see fig. 2).

Bathrooms were in some cases improved, but not enlarged due to the technical constraints.

In four cases (no. 10, no. 11, no. 12, and no. 13), extensions to provide more sleeping space were made; two occupying half of the patio area and two in the front part of the dwelling, invading exterior common area. Another extension was to provide storage space, made by tenants in case no. 14, in the back part of the patio. The addition of a room in the back of the patio was a feasible and economic modification because the three existing walls would be employed usefully and only another wall of partition and a roof had to be placed to enclose the space. The addition of a room in the front part was a less economical solution and carried out many problems among INFONAVIT, the neighborhood and the tenants because the extensions were invading common land. Front extensions were done only when all the area of the patio was needed for washing and drying. Some extensions were temporary: the family of case no. 13 had a married daughter.
with her husband and two children living with them for the time being; the family of case no. 14 was looking to rent a storage space to transform the additional room made in the patio into a bedroom for the eldest children.

Regarding changes in function, the patio of the ground floor triplex proved to be a very adaptable space. The rest was used as intended because the physical structure as well as the spatial organization of the type restrained the possibility of changes in use. Only the living room had a different use at nights. It was used as living area in the day and as sleeping area by the night in many cases.

The patio was used by tenants in various ways, depending on their priorities, needs and economic possibilities: in one case (no. 10) washing and drying area had the same priority as sleeping space, so the patio was used as intended and an extension for sleeping space was made in the front. In other cases sleeping or storage space had priority over washing and drying space so a room was added, changing the use of half of the patio (3). In cases no. 11 and 12 the area for washing was used to enlarge the kitchen. In cases no. 9, no. 13, and no. 14 the area for washing was used as an extension of the kitchen as in the previous cases, but without making any physical changes. Tenants of cases no. 7 and 8 have plans to add an extra bedroom in the patio when they have the economic possibility.
The definition of the exterior territory received high priority in the case of single houses, because of the common nature of the open space (the lots where the houses are placed are supposed to be common areas). Expansions for commercial and economic reasons were very common and received high priority, mainly in type A single houses. Expansions for other purposes had different priorities depending on the size of the family, and their lifestyle and economic needs. Modification for the purpose of beautification and self-expression always have lower priority than those for practical purposes. However in single houses, especially those of type C, many modifications were done as means of personalization and self-expression.

In the four cases of single house type A (intended for low income families) expansions had been made to the houses. Changes in floor area for non-residential purposes received high priority. Three of the families (cases no. 15, no. 16, and no. 17) had made extensions for commercial purposes. These expansions were made towards the front green area. The family of case no. 18 transformed the backyard into a bedroom by adding a roof to that space, extending in this way the sleeping area (4).

Changes in function were not common for the same reasons as in the types analyzed before, being even more difficult to perform in type A because of the narrow and deep shape of the dwelling. However in most
cases, the patio intended for washing and drying is only used to wash, and the back yard is used to dry clothes. All tenants complained about the insufficient size of the patio. In case no. 15 the patio became part of the small business added to the front of the house and the backyard became the washing and drying area.

In single houses type C modifications to improve the quality of internal and external space were done in two cases. Only one case changed the floor area for commercial purposes, a small proportion compared with single houses type A. Single houses type C were intended for medium income families. This kind of modification seems to be strongly related to the economic level of the family.

Family of case No. 19 had enclosed the common green area in front of the house, as in most cases in single family houses, transforming it into a private garden. As this was a corner house, the back yard was being modified at the time of the survey. A big opening to make a car entrance and a roof were being added to transform the backyard into an enclosed garage.

Family of case no. 20 had made a modification for practical purposes: a parasol to protect the living room furniture from the sun, that was used as a balcony on the second floor.
Family of case no. 21 enclosed the exterior green area and added a roof to it, in order to transform it into a restaurant. The room intended as a bedroom on the ground floor became a kitchen for the business and the ground floor half-bath was used for the restaurant.

Changes in function in this type were easier than in the other types because of the size, shape, and the spatial disposition of the dwelling elements.

3.2 The Need for Adaptability

Adaptability in the short and long run is important not only to the people that live there, but also for the "useful life" of the building physical structure.

As we learned from the previous analyses, people change their dwellings because of several reasons and needs. From people's opinion, my own interpretation, and from previous similar research, we can say the main reasons are: (5)
3.2.1. **Changes in the size of the family**

This is a very important issue in the context of working class families in Mexico where changes in the size of the family can be very drastic, and the extended family is very common.

From statistics of INFONAVIT on the need and demand for housing of their eligible population, we know that: (6)

- Average family is 5.24 (less than the national figure due to the worker's age);
- For nuclear family the average family size is 4.3 and for extended family it is 6.33 (extended families represent 45.59% of the total).

This means that from the original couple, almost half of the families will grow three times their original size.

It is very important to support the extended family because it establishes natural networks oriented to improve the family economy mainly in low income families, and not only because of economic reasons but because Mexican society puts high values on family links.

This should be a reason enough to encourage the design of adaptable dwellings in the short run.
3.2.2 Need for Identification

Although normative changes within the family are a very strong reason for considering the need for adaptability, most residents appear to have great concern for providing "identity" markings in exterior changes. This was made very obvious in the single family units at "El Rosario" where an amazing variety of entrances disguised the uniformity of the houses.

Even though changes are restricted by law, space or structure of the building, people will find ways to express themselves through modifications.

3.2.3 Changes in Life-style

Life-style variations and evolution are very important in considering adaptability in the long run.

Working class people come from very different places and have different backgrounds, or have incipient urban culture that makes them change their values and behavior while adapting themselves to dense urban situations. This process of adaptation would be easier in a dwelling that can be adapted as the tenant's social status and educational exposures change.
Families have a lot of income variations, mainly with an upward tendency. Workers that were unemployed at the moment of the interview had to transform their dwellings in order to make a small business to earn the family living. Others had their grown up children already studying and working to make extra money (higher education in Mexico is free).

3.2.4 New Technological Possibilities

In addition to the changes in life-style within the life span of a family, new technology will permit modifications in the use of available spaces. For example, the use and dimension of the patio will change dramatically when families can afford to buy a clothes dryer.

As we said before, in the case of the ground floor triplex, the patio was an adaptable space. The dimension and position of the patio allowed different uses; washing and drying space for a family of 10, washing and drying space for a smaller family and a storage space or another bedroom, washing and drying space for a big family that bought a washing/drying machine to save space for another bedroom.
4. SUGGESTIONS OF DESIGN

4.1 Design Criteria of INFONAVIT

As we said in chapter one, INFONAVIT wants to base its future production of housing on 7 prototypes (1) derived from previously tested prototypes. Criteria for choosing these prototypes as the better ones is based partially on the following reasons: they are the simplest and more functional prototypes of the set used by INFONAVIT; their design is based on types that have been used by private developers more successfully, being the most economical within the square meters provided.

The standards for total areas are based on comparative charts (fig.3) and on the municipality regulations for minimum basic elements (2).

They use different types of kitchens (see fig.4). All but prototypes D and F are enclosed kitchens.

The design of the bathroom is the same in all prototypes. The basin is outside the bathroom (see fig.5).

The kitchen and bathroom always share a wall, where the installations are placed (fig.5).
### FIG. 3

**COMPARATIVE CHART OF MINIMUM HOUSING AREAS OF SOME EUROPEAN REGULATIONS**

<table>
<thead>
<tr>
<th>COUNTRY</th>
<th>2 Bedrooms</th>
<th>3 Bedrooms</th>
<th>DIFFERENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>GREAT BRITAIN</td>
<td>65m²</td>
<td>82m²</td>
<td>17</td>
</tr>
<tr>
<td>FRANCE</td>
<td>63m²</td>
<td>76m²</td>
<td>13</td>
</tr>
<tr>
<td>BELGIUM</td>
<td>55m²</td>
<td>76m²</td>
<td>21</td>
</tr>
<tr>
<td>GERMANY</td>
<td></td>
<td>90m²</td>
<td></td>
</tr>
<tr>
<td>NETHERLANDS</td>
<td>60m²</td>
<td>82m²</td>
<td>22</td>
</tr>
<tr>
<td>ITALY</td>
<td>70m²</td>
<td>90m²</td>
<td>20</td>
</tr>
<tr>
<td>PORTUGAL</td>
<td>45m²</td>
<td>58m²</td>
<td>13</td>
</tr>
<tr>
<td>SPAIN</td>
<td></td>
<td>65m²</td>
<td></td>
</tr>
<tr>
<td>MINIMUM</td>
<td>58m²</td>
<td>72m²</td>
<td>14</td>
</tr>
<tr>
<td>PROPOSITION</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OPTIMUM</td>
<td>68m²</td>
<td>83m²</td>
<td>15</td>
</tr>
</tbody>
</table>

**SOURCE:** ESTUDIO DE LAS FUNCIONES Y DE LAS NECESIDADES DE AREA DE HABITACION (MINISTERIO DE OBRAS PORTUGAL).
In addition to the living-dining area, bedrooms or alcoves should be provided. They should accommodate at least the furniture shown in figure 6.

A recent survey on preferential analysis was done by INFONAVIT Social Department. These are some of their conclusions about the design (3).

Regarding the services: The enclosed kitchen is the most accepted one; the dimension of the patio is always considered insufficient; private patios are preferred; the distribution of the bathroom is very accepted because of the flexibility in use.

Regarding the security: Dwelling security is deficient because of the window design and materials of the doors; staircases are insecure because of lack of illumination and because the steps are very narrow.

Their suggestions for design given at the end are: to give more security to the dwelling by providing bars in windows and better locks; to place windows in such a way that they allow more privacy; to improve size and position of the patio; and to use better finishings.

This research, as many others done before, have been made to improve the design of the types. However, up to this point, these studies have not been considered for the design. One of INFONAVIT's psychologists told me, "the design is not the problem; the problem is of an economic nature."
4.1.1
INFONAVIT PROTOTYPES
SINGLE HOUSE

A. tapanco
B. one floor
C. two stories

future growth

floor plan
first floor
second floor

In the next part of the thesis I will show some examples of small changes in the single house prototypes that have the purpose of improving their adaptability, using the same standards of INFONAVIT.

4.2 **Criteria for Adaptability**

Agreeing that the potential for adaptation should be enhanced rather than constrained, either by physical barriers or regulations, the question is what should be flexible or adaptable.

In summary, from the previous analysis of the transformation in "el Rosario," we can say that the most common modifications were:

1. enlargement and/or improvement of kitchen and/or bathroom;
2. Changes in floor area for commercial or sleeping space;

The suggestions for further developing single house prototypes will be based, then, on the following criteria:

It should be possible to have different layouts within the area provided, mainly allowing the possibility of a commercial space in the front of the dwelling.
It must allow the enlargement of the kitchen and/or bathroom, either by additional construction or by changing the boundaries within the area originally provided.

For apartment buildings, prototype changes in floor area are not possible, without changing the concept of the prototypes. However, enlargement and/or improvement of kitchen and bathroom should be facilitated.

4.3 Suggestions for Further Development of the Prototypes

In this part of the thesis, some suggestions for further development of the single house prototypes to improve their adaptability are made. The most relevant changes that could be done are:

1. Reducing the load bearing structure;
2. Dimensioning the patio to allow different layouts;
3. Changing the position of bathroom and/or kitchen in some cases.

By minimizing the load bearing structure and providing additional openings, besides doors and windows, the physical structure should allow different possibilities: the enlargement of kitchen and bathroom towards interior or exterior space (see pp. 88, 90); the transformation of the front part of the dwelling into an independent area, so as to accommodate a small business or extended family; and in general to have different possibilities...
PROTOTYPE A
Variations reducing the load bearing structure, using patio to increase floor area

KITCHEN:
1. Enlargement into dwelling
2. Enlargement towards patio

BATHROOM:
3. Enlargement into dwelling
4. Basin changed
5. Addition of \( \frac{1}{2} \) bath

INDEPENDENT ROOM:
6. Extended family
7. Non residential use

COMBINATIONS:
8., 9 and 10
PROTOTYPE B
Variations reducing the load bearing structure, using patio to increase floor area

KITCHEN:
1. Enlargement towards patio

BATHROOM:
2. Enlargement towards patio
3. Basin changed
4. Addition of \( \frac{1}{2} \) bath

INDEPENDENT ROOM:
5. Extended family
6. Non residential use

COMBINATIONS:
7 & 8

---

*bearing wall*

*non removable material*
PROTOTYPE C
Variations reducing the load bearing structure, using patio to increase floor area and changing position of kitchen and bathroom

KITCHEN:
1. Enlargement into dwelling
2. Enlargement towards patio
3. Enlargement into dwelling

BATHROOM:
4. Enlargement into dwelling
5. Enlargement towards patio
6. Addition of $\frac{1}{2}$ bath

INDEPENDENT ROOM:
7. Extended family
8. Non residential use

COMBINATIONS:
9.
in spatial arrangements (see pp.89, 91). If the dwelling is to be produced "finished," then the additional openings should be filled out with materials that are easily moved or removed, in order to facilitate the modifications.

Dimensioning the patio according to a previous space and function analysis, the area of the patio should adapt to: enlargements of kitchen and/or bathroom, or to extensions for sleeping or living area, without consuming all the area provided for washing and drying (see fig.7).

Bathroom and kitchen are fixed to one wall in all cases so the position of this wall is very important for the adaptability of both. They should be placed in such a way as to permit enlargements towards interior or exterior space (see pp.92, 93).
space and function analysis
of patio

K       KITCHEN
A       ALCOVE
B       BEDROOM
W/D     WASHING AND DRYING
4.4 Conclusions

We already saw in the previous examples that by making some changes we are giving the user some choice in spatial arrangements and the possibility to change the floor area by additional construction. The physical structure will allow some different layouts and will be adaptable to non residential functions.

These changes considerably improve the adaptability of single house prototypes but not the adaptability of apartment prototypes. Much can be done within the same criteria utilized in the design of INFONAVIT prototypes by foreseeing different possible layouts. But other solutions should be sought if we want to give more adaptability to the physical structure.

An alternative design solution to further improve adaptability is the idea of the "supports" and "detachable units" (4) first introduced in 1961, by J. N. Habraken.

According to S.A.R., there are "three principles for the design of supports (5):

1. Each dwelling unit in a support must allow for a number of different layouts.
2. It must be possible to change the floor area, either by additional construction or by changing the boundaries of the units within the support.

3. In the third place, supports or parts of a support have to be adaptable to non residential functions."

I wanted to mention the supports as a further step in the solution of mass housing adaptability, because the main concern of this thesis is to seek design solutions that make variation in layouts possible. Further research on the feasibility of supports (6) and exploring other design solutions should be done to find out a better solution to the adaptability of the prototypes than the one proposed here.

This work was done partially as my own exploration to understand people's needs and changes in order to have a better idea of what an architect, public housing agency or any develop should provide in the design of the physical structure of a dwelling.

Another motivation was to explore different ways to provide more adaptability in the design of housing. This study provides only some examples of changes that could be made, restricted to INFONAVIT prototypes. However, I hope this thesis will somehow contribute to those who deal with housing design in giving some ideas of ways to provide adaptability.
NOTES AND REFERENCES

CHAPTER ONE:

2. Table 1 modified from "Desarrollo Urbano," Programa Nacional de Vivienda, Secretaria de Asentamientos Humanos y Obras Publicas, 1980, p. 282.

CHAPTER TWO

1. Information taken from a special INFONAVIT publication referring to "el Rosario" housing complex.

CHAPTER THREE

2. All the information on "el Rosario" case study is based on the field research described in Chapter 1, done between January and February by the author.
3. Family of case No. 10 had bought a washingdrying machine so their need of space for drying clothes was minimized.
4. This mode of modification, adding a room in the backyard, was not adopted in the other cases because of its consequences. It made the living room very dark and humid.
CHAPTER FOUR

1. These 7 prototypes were provided by the Direction of Urban Design, and are still subject to approval by the General Assembly of INFONAVIT.

2. The criteria stated here were extracted from: "Criterios para el diseno de vivienda." Technical Document No. 5, INFONAVIT.

3. This "Housing Preferencial Analysis" was done in 1978, by the Coordination of Social Promotion of INFONAVIT. It is a pilot program performed in "Pedregal de Carrasco" housing project, with a sample of 105 units.

4. "By definition a detachable unit is any physical element about which the user can make decisions -- whether they are traditional materials or industrially made components -- that he can choose, put in their place or take away again. This means that support is everything about which the individual user cannot make individual decisions. The support is the built environment that makes it possible for the user to act and to house himself. The concept of support and detachable units therefore is based on decision making. It is an organizational concept and not a technical concept." N. J. Habraken, "Toward Support Housing."


6. Recent research on this topic has been made by Jose A. Aldrete-Haas, "Implications of implementing the "support" idea in the Mexican context; the case of INFONAVIT." MIT Thesis, 1981, Cambridge, MA.
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