

(ST/RCLA/CONF. 27) DI.19

Information Document N°19

ECONOMIC COMMISSION FOR LATIN AMERICA  
LATIN AMERICAN SEMINAR ON PRE-FABRICATION OF HOUSES  
(Copenhagen, 13 August to 1 September, 1967)

SQUATTER HOUSING: CRITERIA FOR EVALUATION  
DIRECTION FOR POLICY

by Prof. Neal B. Mitchell, Jr. and  
Ian Donald Terner



TABLE OF CONTENTS

	<u>Page</u>
I. INTRODUCTION.....	2
1. The target population.....	2
2. The settlement process.....	3
3. New public policy.....	6
4. Maturing settlements: slums or suburbs?.....	8
II. CRITERIA.....	10
1. Low cost.....	10
2. Expandability and up-gradeability.....	13
3. Flexibility.....	15
4. Cultural and environmental sensitivity.....	16
5. Urban context.....	16
III. SYSTEM EXAMPLE.....	19
APPENDIX: Evaluation of two prototypical housing schemes.....	26
BIBLIOGRAPHY.....	30



## PREFACE

This monograph has two goals: first it proposes eleven criteria by which the seminar delegates can evaluate various low-cost housing systems proposed for their countries. Second, it describes a housing system which has been derived directly from these criteria.

In the introductory section of this paper, the authors <sup>1/</sup> focus on squatter populations as the group most in need of new housing systems and programmes. This contrasts with large, publicly-aided housing programmes which traditionally have concentrated on the somewhat more stable elements of the populations. The process of squatting is discussed in terms of the needs, priorities, resources, and potentials of the squatter at different stages in the course of his urbanization.

The second section translates the squatter's needs and resources directly into criteria for an optimal housing system. These criteria may be used to evaluate proposals for housing programmes from the points of view of both squatters and government. Some of these criteria represent positive qualities of squatter housing which should, with some modification, be encouraged. Others direct attention to some of the failures of squatter settlement, such as lack of safety and disorderly urban development.

The third section describes a housing system that has been specifically designed to respond to the proposed criteria; and the final Appendix evaluates two examples of prototypical housing schemes in terms of these criteria.

---

<sup>1/</sup> The authors were assisted in the preparation of this text by Jon Pynoos, Robert C. Herz, and Paul C. Reyelts.

## I. INTRODUCTION

### 1. The target population

Urbanization in developing countries has been accompanied by large-scale migration into the city from either rural areas or from secondary cities.<sup>2/</sup> Typically, the urban migrant has lived either in conventillos in centre city slums, or in squatter settlements on the city's periphery. Beyond providing accommodation that is inadequate to the needs of the residents, these areas are inimical to the sound development of the city. The situation is bound to be aggravated in the future as population continues to increase. For example, in 1940, only 5 per cent of the population of Lima, Peru lived in squatter settlements; in 1966 when the city had tripled in size, 25 per cent of the population lived in such areas - a fifteen-fold increase. Squatters totaled one-fifth of Manila's population in 1963, and currently comprise nearly half the population of Ankara.<sup>3/</sup>

Legal prohibitions have failed to stop the growth of such housing because squatting has become a concomitant of urbanization and cannot be prevented without offering a viable alternative programme. Sound housing policy must be based on the identification of those key aspects of squatting which can be the focus of a more effective and less expensive public programme.

---

<sup>2/</sup> Bruce Herrick, Urban Migration and Economic Development in Chile, finds that migration in Chile, for example, is predominantly an inter-urban occurrence, with little direct movement from rural areas to the capital city.

<sup>3/</sup> Statistics from John C. Turner, a book review entitled "Squatters and Urban Policy", in Urban Affairs Quarterly, March 1967, p. 111.

## 2. The settlement process

John Turner, in his studies for the United Nations,<sup>4/</sup> has described the process of squatting on the basis of extensive interviews in the barriadas of Peru and the shanty slums of other developing countries. He has found that urban immigrants have three priorities by which they evaluate their living requirements: (a) location, (b) land tenure and security, and (c) amenity. With the immigrant's increasing urbanization and affluence, the relative importance among these priorities shifts (see figure 1).<sup>5/</sup>

Initially, "location", is of first priority to the "bridge-header", or recently arrived migrant. Virtually his only requirement for housing is that it be located in or near an urban centre, close to the market, where food and jobs are most readily available. If he is not what Charles Abrams calls a "sleeping squatter", whose only home is in a doorway or underneath a bridge, his quarters are the conventillos of the downtown slums.<sup>6/</sup> Here, in return for relatively high rents, he obtains crowded and unsanitary conditions with high accessibility to the urban core.

If his income becomes reasonably steady and he accumulates some savings, the new urbanite becomes concerned with consolidating what he has obtained.<sup>7/</sup> He is no longer willing to tolerate the expenditure of a

---

<sup>4/</sup> John C. Turner is a research associate of the Harvard-MIT Joint Centre for Urban Studies, and a consultant to the United Nations on Urban Development and Housing in Developing Nations. He delivered a paper for the United Nations Inter-regional Seminar on Developmental Policies and Planning in Relation to Urbanization, entitled, Uncontrolled Urban Settlement: Problems and Policies, Autumn, 1966, and is presently working on a forthcoming book.

<sup>5/</sup> John C. Turner, "Barriers and Channels for Housing Development in Modernizing Countries". Journal of the American Institute of Planners, May 1967, p. 167-181, passim.

<sup>6/</sup> John C. Turner, "Lima's Barriadas and Corralones: Suburbs vs. Slums", Existences, March 1965, p. 153.

<sup>7/</sup> Ibid., p. 154.

major portion of his income on rent. It is usually at this point that he will trade the convenience of a central location for tenure on the land. The rent money saved is now applied to transportation to and from the central city, and to materials with which to build his house. It is estimated that, at this stage, the squatter has the equivalent of approximately \$300 dollars which can be applied to his house and, as shown in figure 1, is living at about three times subsistence level.<sup>8/</sup> Although his shelter may be primitive, it is usually "free", in that it requires no currency outlay. As long as he feels secure in the possession of his land, he will attempt to expand and improve his house as his circumstances permit.<sup>9/</sup>

As the squatter gains economic security, amenity in his living quarters becomes the dominant criterion. This shift generally occurs at an income of approximately eight times subsistence, as shown in figure 1.<sup>10/</sup> At this point he may begin to up-grade his dwelling by substituting permanent materials for temporary ones, by improving interior finishes, or by installing plumbing.

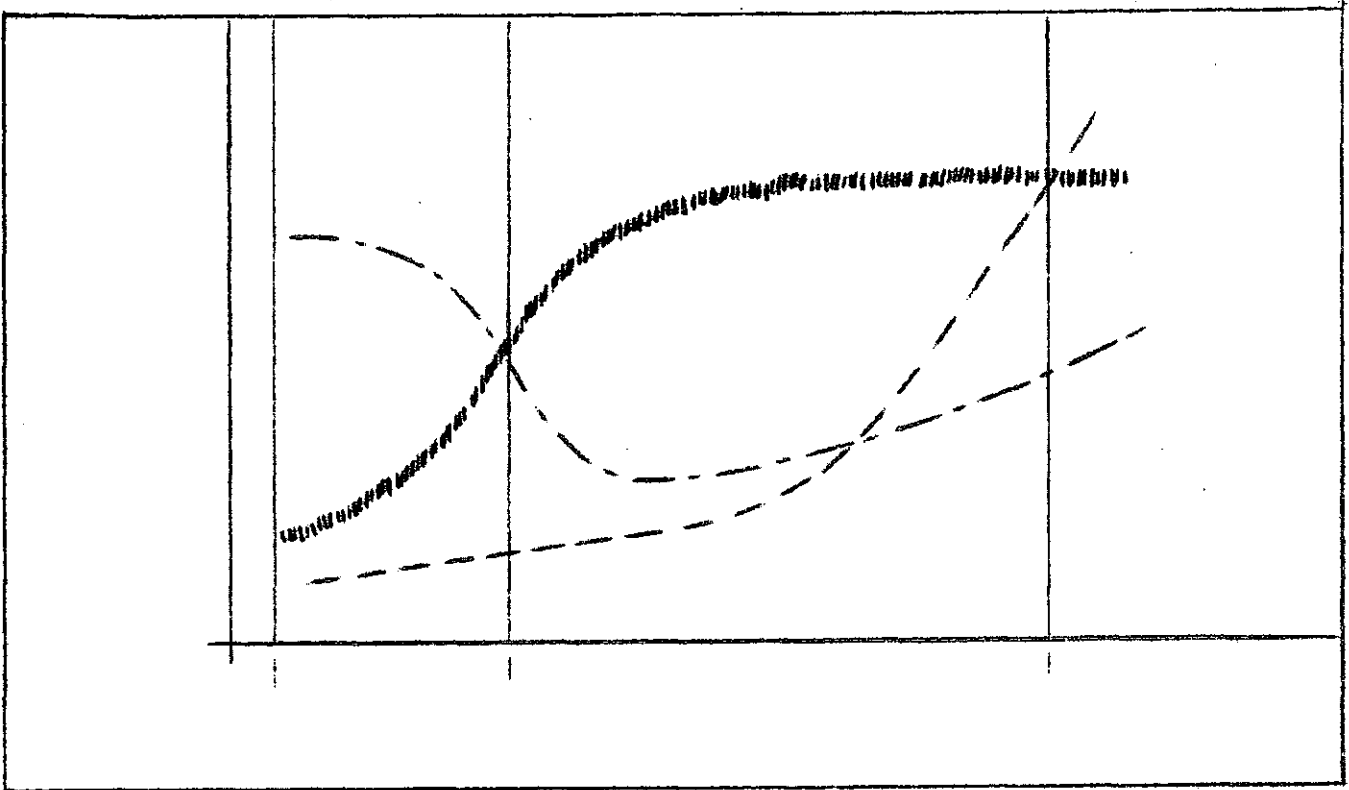
---

<sup>8/</sup> John C. Turner quoted income parameters in an address delivered to a Housing Seminar at Harvard University, directed by Assistant Professor Chester Hartman, on 11 April 1967.

<sup>9/</sup> "Lima's Barriadas", p. 154.

<sup>10/</sup> Address delivered to a Housing Seminar at Harvard University on 11 April 1967.





The graph illustrates priority shifts that accompany increasing urbanization and affluence of urban migrants. Three points on the "income" axis are particularly significant. The first, the subsistence level of income, is the point where virtually the only priority for housing is "location". The settler's shelter must be located in or near an urban centre, where food and jobs are most readily available. At approximately three times subsistence, the urban settler's top priority becomes tenure, and he places less emphasis on location. His status changes from "bridge-header" to "squatter" and he moves out of the central area. At eight times subsistence, the amenity priority becomes dominant, and he begins to value significant improvements in his house.

This graph is derived from an address delivered by John C. Turner to a seminar at the Harvard University Department of City and Regional Planning on 11 April, 1967.

### 3. New public policy

Charles Abrams points out in Man's Struggle for Shelter in an Urbanizing World, that most publicly-sponsored housing programmes are aimed at that segment of the low-income population for whom amenity is the dominant priority. Only this segment of the low-income population can afford the responsibility of the relatively costly houses of \$1,000 dollars or more, which are the standard offerings of public programmes. Such policies ignore the benefits that might be derived from what Albert O. Hirschman terms the "latitude in substituting quantity for quality".<sup>11/</sup> Assuming that a government can devote a given portion of its budget toward alleviating the problems of squatter housing, the number of people affected by the programme can be greatly increased if a house of lower initial quality is produced. What is needed is more partially completed, very low-cost (approximately \$300 dollars) houses that will be structurally safe and that will offer some control of the settlement pattern. Less costly programmes will increase the productivity of housing resources by increasing participation in the overall programme. Such a policy would not significantly reduce the satisfaction of the individual participants in the programme, and in some cases would even increase it. Hirschman points out that, in fact, quantity-quality substitutions "...have been carried out directly, if chaotically, by those who needed them, namely, by the immigrants themselves. Through the building up of favelas, ranchos, barriadas, and similar shantytown settlements, these immigrants are, in effect, diverting the capacity of the building materials industry towards a quantity-quality mix that is socially more appropriate than the one that would prevail without their initiative, while indicting, at the same time, the building industry and public housing officials for their failure to push through, in a more orderly manner, such changes in the mix as are clearly in the public

---

<sup>11/</sup> Albert O. Hirschman, in chapter "Latitude in Substituting Quantity for Quality" from a forthcoming book entitled Development Projects Observed.

/interest".<sup>12/</sup>

interest".<sup>12/</sup> The public officials, however, are in a difficult position. They expose themselves to criticism and potential political embarrassment if they sponsor programmes which are below the "traditional" standards of quality. Their problem is aggravated by the fact that the very low-cost schemes that do exist, often preclude four and five story walkup construction, and can achieve urban densities only by intolerably dense land coverage. (Section III describes a system that attempts to overcome these limitations.) Public officials must realize, however, that their token number of middle-class houses has little effect on eliminating the miserable conditions in squatter areas. If the government is sincere in its attempt to solve the problem, it must explore further the possibilities of supporting "unfinished" housing systems that initially are below traditional standards.

An effective public housing programme must not only meet the needs of the low income immigrant, but must also seek to anticipate the increasing needs of new-family formation, which, as Kingsley Davis points out, will soon out-weigh immigration.<sup>13/</sup> Davis argues that urban immigration is only a temporary source of increased population, and will diminish as the rural population falls to a size consonant with rural economic activity.<sup>14/</sup> At that time, urban population increase will be derived from the excess of births over deaths, principally through the reduction of infant mortality and increased life expectancy. Additions to the housing stock to serve this population increase will have to be aimed at young married couples who have little money and who are establishing new households. In their requirements for shelter and a secure basis from which to plan their future, they resemble the initial squatter.<sup>15/</sup>

---

<sup>12/</sup> Ibid.

<sup>13/</sup> Kingsley Davis, "The Urbanization of the Human Population", Scientific American, September 1965, p. 48.

<sup>14/</sup> Ibid.

<sup>15/</sup> Lowdon Wingo, Jr., "Recent Patterns of Urbanization Among Latin American Countries", Urban Affairs Quarterly, March 1967, pp. 81-107, discusses rural immigration to cities, and growth of the cities by natural increase in terms of stages of growth for particular Latin American countries.

Although squatter settlements are often unsafe and unhealthy, housing policy should recognize that they represent a positive and constructive attitude on the part of the squatter which can be exploited. An attempt to eliminate squatting must recognize that squatter settlements at least provide shelter for people who otherwise would have none, or who would be forced to divert their limited resources from programmes of economic betterment. In this context, it should be recognized that a squatter shack is an important way a poor man can capitalize his labour in a labour surplus economy where wages are low. His house is also a potential source of revenue to the extent that it can be enlarged to include a store or a place for lodgers.

A squatter settlement expands the effective boundaries of the city while making very limited demands for services. If the city is to keep abreast of the demands for space occasioned by urbanization, without exceeding its financial limitations, it will have to grow incrementally. When a poor man commits himself to the fixed investment of time and money that a squatter house requires, that commitment represents a willingness to work within the framework of the society toward an orderly economic and social development. That commitment is an important resource for the country's development.

As the city develops subcentres, the squatter developments may prove to be of additional value to society, in that they may become future reception areas for bridgeheaders. This could lead to a reduced demand for slum housing in the prime downtown area, and could permit bridgeheaders to be assimilated and acculturated among people who are more responsive to their needs. Immigrants at the squatter level can provide an understandable and sympathetic model to the newly arrived and culturally disoriented bridgeheader.

#### 4. Maturing settlements: slums or suburbs?

To function effectively as an instrument of the process of urban development, a squatter settlement must be capable of continual improvement so that it does not permanently blight the surrounding areas and thus impede growth. Turner maintains that most squatter settlements, if left

/undisturbed with

undisturbed with title to property assured; will be up-graded to no less than minimum standards by the residents themselves over a period of time.<sup>16/</sup> In effect, Turner implies that squatter settlements have more in common with suburbs than with slums. However, since squatters must use fairly crude structural systems and are constrained in the kind and amount of materials they employ, the dwellings they construct have only a limited capacity for improvement. Often a squatter house is destroyed in an attempt to add a second story, the load of which exceeds the bearing capacity of its walls or roof.

Any housing system which cannot be up-graded to some minimal level necessitates demolition and replacement in order to integrate the area into the larger metropolitan context. Demolition constitutes a luxury that few developing areas can afford. It represents an absolute loss of the current value of the structure, of the unamortized portion of the original construction cost, and of the cost of tearing it down. It is a commitment of resources to destruction, and reduction of the housing stock where too little housing is available.

If, however, demolition and replacement are not undertaken, present squatter areas will remain a blighting influence on surrounding property. Because the dwellings are unable to respond beyond a fixed level to the upward economic and social mobility of the residents, the most successful residents are effectively forced to leave the community, thus depriving it of valuable social models and making it a homogeneously lower-class settlement. In trying to solve this problem, the government erroneously assumes that the needs and resources of the squatter are so specialized that any solution to his immediate problems would be unrealistic in terms other than some temporary housing solution. However, a system which involves low initial cost, maximum flexibility, and high potential for expandability and up-gradeability could house the urban migrant through all phases of his development. These criteria, and others, will be developed in the following section.

---

<sup>16/</sup> John C. Turner, "Barriers and Channels for Housing Development in Modernizing Countries", pp. 176-179.

## II. CRITERIA

In general, any housing scheme which addresses itself to the squatter problem must at least embody those aspects of squatter housing which are of value to the squatter and to society. Specifically, such a scheme must meet the following criteria:

1. Low cost
  - (a) Self-help
  - (b) Rapid assembly
  - (c) Indigenous materials
  - (d) Standardization and mechanization
2. Up-gradeability and expandability
3. Flexibility
4. Cultural and environmental sensitivity

Many of these criteria are related, although each is individually important as well.

As a second step, a housing scheme designed to provide a more desirable alternative to squatting should go beyond these criteria, and attempt to mitigate or eliminate the weaknesses of squatter settlement such as overcrowding, disordered and unhealthful settlement patterns, lack of amenity, and unsafe structures. These additional criteria are developed under the following heading:

5. Urban context
  - (a) Safety
  - (b) Site control

### 1. Low cost

In order to reduce costs, a housing system should employ:  
(a) self-help labour, (b) indigenous materials, (c) rapid assembly techniques, and (d) standardized components. These characteristics acknowledge the squatter's self-interest and resourcefulness, both of which have been demonstrated in squatter settlements around the world.

(a) Self-help techniques, beyond reducing the labour costs for a house, permit the capitalization of the future owner's time and effort,

/increasing his

increasing his effective contribution. It also gives him the opportunity to employ his ingenuity in the construction of his own home and promotes a sense of dignity that is often missing in totally subsidized programmes. Furthermore, the dwelling will be more responsive to the particular needs of the owner if he is able to participate in its construction. It is also more likely that the owner will be motivated to systematically and regularly improve his house if such an effort is contingent primarily on his own efforts, and if the emotional commitment to the home is made at the outset.

Implicit in an optimal self-help programme is that future work should not jeopardize the structural safety of the house, nor severely reduce the degree of guidance over the total community's development. Within these broad limits, there are several specific characteristics of self-help that should be noted. First, the system should be designed for people who are unfamiliar with construction techniques. Second, it should be assumed that only few and simple tools are available. Therefore, it follows that the structural elements must be designed for obvious and simple assembly procedures requiring a minimum of instruction. Third, components should be light-weight, assuming that one man can lift no more than 35 to 40 kilogrammes. Fourth, the self-help process should be incremental so that the dwellers build up increasing competence and confidence over time, the easiest tasks coming first.

(b) By using indigenous materials the probability of success of a self-help programme is increased in that the dwellers deals with materials which are readily available and with which he may have some familiarity. The relative availability of local materials reinforces and sustains the dweller's desire to add to or improve his home, and thus supports the objective of long-term betterment of the settlement. Through the use of indigenous materials, transportation costs, which can be especially high in underdeveloped countries, are reduced. Furthermore, the chance of frustration and loss of spontaneity engendered by not having materials immediately available is reduced by the use of local supplies.

From the national viewpoint, the use of indigenous materials eliminates currency losses on imports. In general, the use of plastics,

/ steel, modern

steel, modern synthetic and other secondary and finished goods should be kept to a minimum. Many countries have been heavy importers of these materials in the past and have faced painful shortages and delays.

(c) Speed of assembly is an important characteristic of squatter settlements. Squatters often invade, plat the land, and erect minimal houses in one night. Such speed is necessary because of the clandestine nature of the operation. It does reveal, however, certain other advantages which may accrue to both the settlers and the government. Storage costs for supplies and components, and depreciation and time costs for machinery are reduced. The settler's desire to improve his dwelling is reinforced because the results of his efforts can be obtained quickly and are highly visible. Charles Abrams criticizes self-help projects for taking too much of the homeowner's time from economically productive activity, and thus incurring high indirect costs.<sup>17/</sup> A system capable of rapid assembly minimizes these costs without sacrificing the advantages of self-help. Because urban densities can be achieved quickly, the community facilities which the squatter requires soon after obtaining minimal shelter on his own piece of land, can be reasonably supported. Perhaps the most important advantage to be derived from rapid assembly techniques is the symbolic value of a system that can respond to a settler as soon as he is ready to make the transition from the "bridge-header" to the "consolidation" phase of his settlement.

From the national viewpoint, a rapidly assembled system can respond quickly to unpredictable occurrences such as natural disasters. It also can provide on-site temporary housing for workers on large construction projects such as the new cities of Brasilia or Ciudad Guayana. In some cases, this temporary housing can become a stock of used, partly-amortized housing for low-income residents after the initial construction phase ends.<sup>18/</sup>

---

<sup>17/</sup> Charles Abrams, Man's Struggle for Shelter in an Urbanizing World, M.I.T. Press, Cambridge, Massachusetts, 1964, p. 171.

<sup>18/</sup> This idea has been advanced for Columbia, Maryland, U.S.A., a new city being built between Washington, D.C., and Baltimore, Maryland by James Rouse, a private developer.



(d) Standardization and mechanization: The United Nations Report of the Study Tour of Building Technologists, 1963, points out that "subject to limitations of transport, the greatest economies appear to lie in standardization of structures which can be broken down into inter-changeable standard assemblies for mass production."<sup>19/</sup> Four categories are listed as possibilities: (a) integrated structures, (b) integrated space units or self-contained rooms, (c) integrated structural assemblies, and (d) integrated utility systems. In terms of the basic needs of the squatters, the most appropriate set on which to concentrate initially is the integrated structural system. The other systems must be available when needed, but they are not of the first priority. The U.N. Report recommends the immediate standardization of roofs and intermediate floors.<sup>20/</sup> This monograph suggests in Section III, however, that a complete set of framing elements may be appropriately standardized at the outset.

Low capital investment was specifically mentioned by the Latin American delegates in the U.N. Report as a prerequisite to mechanization in their countries.<sup>21/</sup> The equipment for mechanization should therefore be small and preferably mobile, thereby reducing transportation costs, and allowing rapid amortization. In addition, it should be operable in areas of difficult terrain. If the equipment is fairly simple, it is possible that it and its replacement parts could be produced locally, reducing the need for imports.

## 2. Expandability and up-gradability

Charles Abrams strongly recommends the use of core housing in public programmes in order to make costs consonant with a government's financial resources.<sup>22/</sup> Such a programme can move unit costs in the

---

<sup>19/</sup> United Nations, Report of the Study Tour of Building Technologists from Latin America, Asia, and the Middle East to the Union of Soviet Socialist Republics, United Nations, New York, 1964, Section 35, p. 13.

<sup>20/</sup> Ibid., Section 240, p. 83.

<sup>21/</sup> Ibid., Section 218, p. 73.

<sup>22/</sup> Abrams, op. cit., pp. 175-180.

direction of the \$300 dollars target limits which approximates the total initial assests of many squatter families.<sup>23/</sup> Since the single most important element in the first stage of a squatter house is space, a minimum-cost unit must be designed with expansion in mind. In effect, this is the process that squatters use, enlarging their dwellings as affluence increases. Squatter houses now have, however, limited expandability in terms of space. At the ground level, expansion is limited by extremely dense lot coverage, while major changes such as adding a second floor may endanger the structure itself. A solution to this problem would provide an independent structural system capable of sustaining the loads of a four or five story walk-up. It also should be expandable horizontally so that ground-floor additions such as revenue-producing stores, workshops, and their subsequent conversion to family use can be easily and inexpensively achieved.

Up-gradeability, in terms of improving items such as wall finishes, or installing conveniences or plumbing, also has been an attribute of squatter housing; although like expandability, it has been limited by the physical structure and site layout of squatter homes. A structural system independent of walls and partitions would allow maximum flexibility and discrete improvements. Non-bearing walls and plumbing and electrical systems that are self-contained and capable of incremental growth should be designed to be installed on a self-help basis to remain within the cost constraints as the resident seeks to up-grade his house. The availability and inter-changeability of standardized units in sufficient volume could create a viable market of second-hand components which would reduce the investment needed for a resident to achieve a modicum of comfort and amenity.

A housing system that responds successfully to the criteria of expandability and up-gradeability makes an important social contribution to squatter communities. Rather than moving to another area to improve

---

<sup>23/</sup> John C. Turner, in an address delivered to a Housing Seminar at Harvard University on 11 April 1967.

or expand their homes, financially successful residents can make these changes within their original dwellings, keeping those families with rising incomes within the community, as leaders, consumers, social models, and links to the larger urban society.

### 3. Flexibility

An optimal housing system should be flexible enough to be expanded from one to four or five stories without over-design in the lower floors when used alone. Such a system should be applicable to both primary and secondary cities, and, in some cases, to rural areas. From a national and commercial point of view, the system should be adaptable to higher income housing as well. There are obvious savings in such flexibility; but a more subtle advantage is the effect on the acculturation of rural migrants, whose first urban residence is often in secondary cities.<sup>24/</sup> When these citizens move on to major cities, they should find it easier to adjust and adapt, having had prior experience with a similar housing programme.

While squatters often defer improvements of their homes, they require and demand community facilities such as schools, fire and police protection, and commercial establishments.<sup>25/</sup> A flexible housing system would have an additional advantage if the basic construction were adaptable to these non-residential uses as well. The ability to modify buildings to other uses further tends to make them a more liquid asset and thus more valuable. Furthermore, since housing needs themselves change through time, the system should provide for expansion, conversion, and reconversion. A family, for example, may alter its house by the construction of an abasto, subsequently convert it to a bedroom, and after some of the children have left home, reconvert it to a rented apartment.

---

<sup>24/</sup> Ibid.

<sup>25/</sup> "Barriers and Channels for Housing Development in Modernizing Countries", p. 174.

#### 4. Cultural and environmental sensitivity

An optimal housing system should respond to the traditions of its intended occupants, whose cultures differ from region to region. The ethnic character of a house may be expressed in the uses and sizes of rooms; designs, finishes, and materials for walls; patterns of improvement; and desired orientation.

Squatter housing is generally successful in expressing the culture of the resident, while public projects have been conspicuous for their failure in this regard. A notable example of such a failure is the housing provided for the Nubians resettled from the Aswan Dam region in Egypt. The new units were characterized by uniform appearance, arbitrary grouping, and insufficient size.<sup>26/</sup> In order to particularize their houses and make them resemble their previous dwellings, the Nubians plastered the facades with mud on which to paint designs, added china plates above the doors, and built low benches along the front. Inside, space for animals was separated from human quarters, the area for entertaining visitors was enlarged and enclosed, and sheltered space was increased. This extensive effort to make the houses respond to cultural and social needs required large expenditure of time, effort, and capital which had to be diverted from economically productive activity.

A post and lintel structural system of framing is well suited to the criterion of cultural sensitivity. The requirements for individual and regional cultural expression can be met in the characteristics of the walls and fenestration, and the arrangement of interior spaces. The frame would be standardized in conformity with structural needs, while non-bearing walls and partitions could be particularized.

#### 5. Urban context

Squatter housing fails essentially because it is a rural housing solution to an urban problem. While it can achieve urban densities, it

---

<sup>26/</sup> Carla Okigwe, "Culture and Public Housing in Underdeveloped Countries", unpublished paper, pp. 12-20.

does so with excessive land coverage. Structural systems adapted from rural areas are often unsuitable to the city. They create problems of safety and site control.

(a) Safety. One of the greatest weaknesses of squatter housing is lack of safety. Structures are highly susceptible to damage and destruction by rain, wind, or earth tremor. Furthermore, alterations and additions may weaken and threaten the house.

In addition, little or no planning leads to inadequate provision of streets and utilities so that fire and disease become menaces. Prevention of death and injury are the first and most obvious results of any remedy to the situation. Greater safety also reinforces security and land tenure, crucial needs in the early stages of squatting. Similarly, it increases value and encourages improvement. In the long run, safety lowers ultimate costs as the life of the building is extended. A more subtle result is the potential change in the owner's attitude from fatalism to confidence in his ability to cope with his environment.

Safety can be promoted by the provision of strong, durable structural elements, and carefully built foundations, two essentials of any optimal programme.

(b) Site control.

(i) The location of nearly all squatter communities is presently unrelated to the plans for future growth of urban centres. These communities often spring up overnight on land that has been reserved for future use as parks, recreation areas, roads, and public facilities. As a result, squatter communities often block the rational extension of the city and wrap the direction of its growth, leaving many areas unserved by needed amenities and services. Other communities are densely grouped on steep hillsides and even minimal services such as roads and utilities are precluded. During rainy seasons, these communities are threatened by slides and erosion. There is obviously a great need for control over the direction of development for the benefit of both the squatters and the city as a whole.

/Legal means,

Legal means, employed in a prohibitive fashion, have not been able to control the location of squatter communities, and, in many cases, have increased tension and political conflict. An approach with a greater chance for success would respond to the squatters' initial concern for security and land tenure. Efforts so far have tried to direct settlement by providing services such as water and roads. A more direct solution might also include the provision of the structural foundation, thus adding safety and underwriting a cost of immediate concern to the squatter. In addition, an element of site control is introduced into the development.

(ii) The lack of internal planning in squatter communities makes it very difficult and expensive, if not impossible, to extend utilities from the central city. Because squatters do not realistically expect utilities to be supplied for a long time, they often ignore reservations of rights-of-way for roads, sanitary drainage, electric power, and water mains during their initial rush to acquire and secure a plot of scarce land. In addition, the units are poorly located in relation to one another, and lack adequate drainage and sufficient light and air. It is difficult to either rearrange land use patterns, or reclaim occupied land for public uses because of the squatters' deep commitment to their tenure on the land. An optimal housing system would, as an integral part of its design, reserve land for future utilities and rights of way, and orient the location of individual dwellings along streets in careful relation to drainage, light, and microclimatic factors.

(iii) Site preparation which causes erosion is often characteristic of large low-income housing efforts. This can be avoided by a system which is highly adaptable to varying terrains and which requires minimal site preparation or excavation. Furthermore, reduced site work is an important cost saver, and helps to preserve shade and other amenities provided by vegetation.

### III. SYSTEM EXAMPLE

One example of a housing system designed to meet the needs of squatters and to respond specifically to the proposed criteria is described below. It is, however, only one of many systems which could meet these criteria.

The system is based on prefabricated light-weight structural components that can be rapidly assembled into the frame of a single or multi-story building.

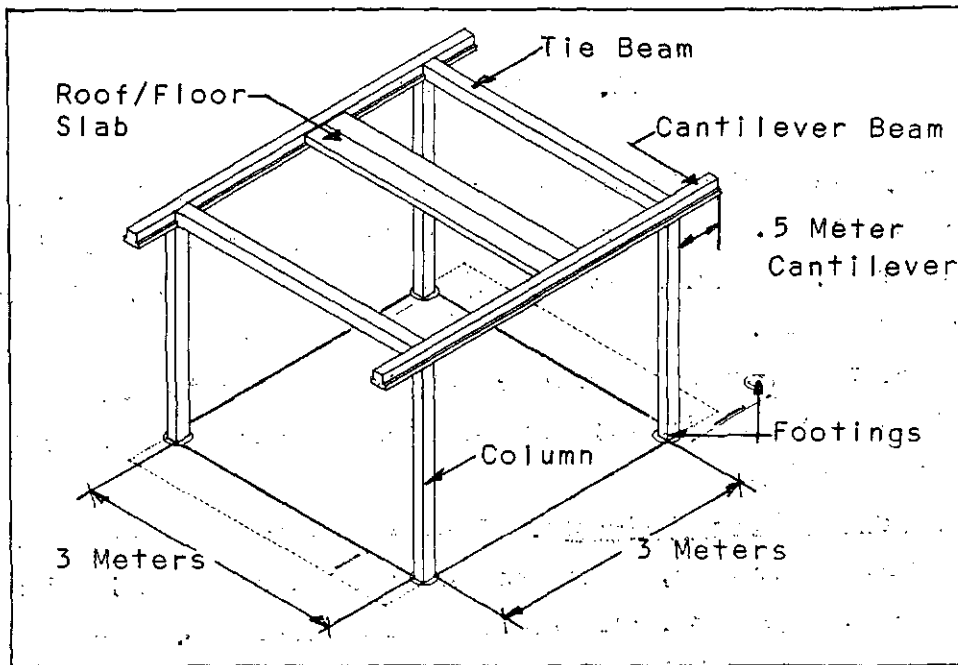
Standardization - Self-help. There are four such components: a column, a cantilever beam, a tie beam and a slab, as shown in figure 2. All are made from precast, reinforced cellular concrete. The components can be erected at a building site by people who have no prior construction experience. No construction machinery is required since all components weigh less than 70 kilogrammes and thus can be set in place by two men.

Expandability - Flexibility. The system is designed so that a one-room building can be expanded incrementally into a multibay four-story structure. It is therefore possible to construct a wide range of building types - from small homes, to apartments, offices and stores.

Indigenous materials - Cultural sensitivity. Since the frame bears the total load of the structure, the walls may be supplied and erected by the dweller in accord with his means and requirements at any point in time. The structural frame permits the use of non-bearing wall material that functions merely as a climatic barrier, and provides the required privacy and security. In addition, the frame allows the dwellers to choose any locally-available and culturally appropriate material for low-cost walls, without regard to their structural or load-bearing properties. Within the modular dimensions set by the framing system, the walls can also be panelized and mass-produced under plant conditions, and can be attached to the frame at the job site.

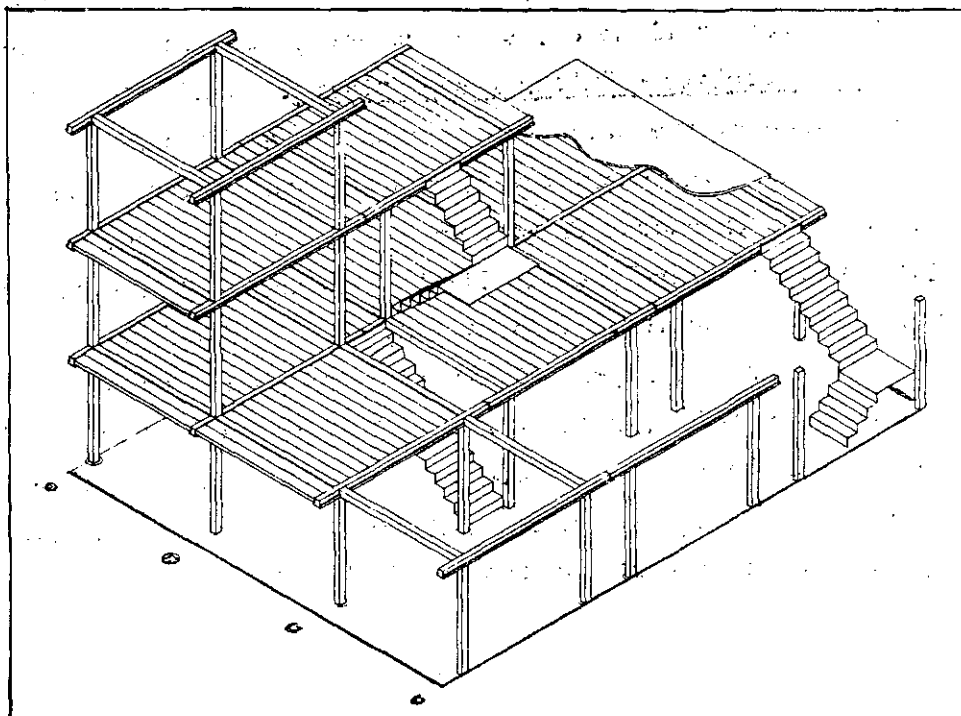
# BASIC COMPONENTS

FIGURE 2



## MINIMUM UNIT

The system consists of four reinforced precast concrete components: a column, a cantilever beam, a tie beam, and a roof/floor slab. The components are erected on concrete footings to form a 3 meter by 3 meter structural bay. The 3 meter span may be enlarged up to 4½ meters if desired.



## MULTI-BAY EXPANSION

The bays may be massed in any configuration up to a maximum height of four stories.



The programme presented here could be set in the context of a government housing programme, a private development programme, or some combination of the two.

#### Phase one

The first step is the careful planning of the entire development site, with particular respect to drainage, community circulation, and micro-climate. In this case, 16 footings are drilled and poured for each lot by a trained construction team, as shown in the lower right corner of the phasing diagramme. This is the only step at the construction site which requires trained labour. A stock-pile of the prefabricated components may then be delivered to each lot.

The stock-pile may consist of as little as four columns, and four beams, - enough to build one structural bay. Technical assistance may also be provided which includes a set of complete assembly instructions and sets of step-by-step plans leading to several alternative multi-story homes.

Erosion - Prevention. A time lag between the placement of the footings and the erection of the first homes is possible because the footing excavations do not require destruction or stripping of the vegetation or top soil, and the footing holes are immediately filled with concrete to prevent erosion. Furthermore, the footings do not protrude above the surface of the land to hamper continued cultivation or other use of the area.

#### Phase two

The first frame can be erected in less than half an hour by two men who can lift every component into place without mechanical aid. The joining system is easy and fool-proof, and the men need have no construction training or experience. The product of their effort will be a safe and secure structural frame - resistant to heavy rains, winds and seismic loads. This frame will form the basis of their rudimentary dwelling.

The initial programme, depending on available resources, may include as many optional accessories to the frame as desired. These may range

/from stock-piles

from stock-piles of local roof and wall material to any number of additional finished frames with installed electricity, water, and sewerage.

### Phase three

#### Expandability - Flexibility - Up-gradeability - Phased utilities.

The house can expand one bay at a time, perhaps with a small shop in the front. Marginal cultivation continues at the rear of the house, and around the unused footings. In this phase, the outdoor privy has been replaced by indoor plumbing. This phased introduction of utilities is made possible by laying the lines under planned roadways or easements. This avoids the politically dangerous consequences of massive government displacements that would have to accompany extending utility services through an uncontrolled and intensively settled area. Furthermore, the non-structural nature of the scheme's wall system is such that the walls may be replaced and up-graded, and plumbing may be installed in the individual homes without costly modifications and without a threat to the structural safety of the building.

### Phases four and five

The house continues to expand, as a second row of bays is built back from the street, joined to the first, in this case, by a trellis. The second unit may be rented or used by relatives of the first family; or it may simply provide more spacious quarters for the original group.

### Phases six through nine

Low coverage - Urban density - Standardization - Site control - Low-cost. In Phase 6, the owner may choose to permanently join the two units, and in Phase 7, a second floor is added. In Phases 8 and 9, third and fourth floors may be added, forming a series of roof terraces and gardens. These variations and alternatives are made possible because of the modular character of the frame, the planned configuration of the footings, and the designed development of the total land tract. The programme, as described above, would, in many cases, require initial subsidy; but the costs of the minimal programme, including the cost of

/site planning

site planning and plotting, 16 footings (12 more than initially needed), and technical assistance, would range between \$200 and \$400 dollars per dwelling, depending on local conditions. This should be compared with minimal housing programmes in Latin America and the Middle East which cost upward of \$1,000 dollars per unit.

Mechanization. A manufacturing plant capable of producing the kind of structural components may be set up in nearly any area. It requires a relatively level and well-drained site of approximately 4,000 square metres with access to pure water and electric service, although the latter can be produced with a portable generator. The plant is staffed with eight semi-skilled production workers, an engineer, a salesman, and a secretary/bookkeeper.

The production capacity of the plant is at the level of 30 single-bay units per day, or approximately 6,000 to 9,000 annually, assuming a working year of 200 or 300 days, respectively.

The cost of such a plant is approximately \$100,000 dollars, the concrete batching and casting machinery and the plant building constituting the main capital expenses. Approximately half of this cost may be saved by adding these facilities to an existing concrete block plant, using some of the same equipment and facilities while diversifying its product.

The amortization of such a plant may be calculated by assuming a production of 6,000 single-bay units per year. The entire plant cost of \$100,000 can be written off at a charge of less than \$17 dollars per unit. This figure may be halved by allowing an amortization period of two years, or by assuming that the plant is capitalized as an addition to an existing concrete block plant. The amortization cost may be halved again to approximately \$4 dollars per unit assuming resale of the used plant equipment after production has ceased. The minimum charge per unit based on a production of 9,000 single-bay units in a 300-day work year, would be less than \$3 dollars per unit. Furthermore, the plant and its output can be doubled for 35 per cent less than double the original investment, thus further reducing the amortization costs per unit to approximately \$2 dollars.

/The plant

The plant is designed to be completely mobile, with all production components mounted on flatbed trucks and transportable by airplane. This mobile unit could be used for emergency housing, and would be operable within twelve hours after arrival at the scene of a disaster.

In the proposed programme, the dweller initially receives less than the completed units of more costly programmes. But the same commitment of resources can now be stretched to embrace from two to five times as many families. Furthermore, although the minimal programme does not provide a completed house, neither does it commit a large fixed investment to a rigid and inflexible unit built for a specific set of needs which may soon be out-dated. Rather, it represents a challenge to the idea of "fixed construction". It starts with a minimum yet safe basis for shelter, but is specifically designed for easy and incremental enlargement and improvement, if and when the needs of the dweller dictate.

Expandability - Site control. The element of hope in the future is an essential ingredient in the programme. The family's twelve unused footings serve as an incentive and a reminder of the ease with which they can expand their homes while exercising subtle control over the direction and location of expansion on their parcel of land. Use of the system thus attacks the problems of squatting; not because unhealthfully dense lot coverage or unsound building conditions are forbidden by law, but because it is in the dweller's self-interest to build and maintain the structure within the system and on the footings provided. It is easier, cheaper, and safer than to build free-standing columns or load-bearing walls.

The programme as illustrated here is minimal, and would depend upon the occupants' initially buying or scavenging for wall infill, as they do now for their entire buildings in squatter settlements throughout the world. However, since the walls in this system are non-structural, they may be of simple reed or bamboo mats, mud, or adobe brick, tar paper, scrap wood, gypsum, or even specially manufactured modular panels made from honey-combed and impregnated papers, vinyl plastics, or metal. The infill serves merely as an environmental barrier, and is determined according to the cost, needs, and cultural traditions of the dwellers.

/Although completing

Although completing the house under this kind of minimal programme depends on the resourcefulness of the dweller, the proposed programme is a far cry from the traditional squatter settlement. Using the proposed system, the safety and structural integrity of every dwelling is assured. Circulation and drainage are planned. Each structure can grow and mature with the fortunes of the dweller without destroying the investment in the original frame. Infill materials can be simply and systematically up-graded from temporary to permanent quality within the matrix of the pre-fabricated structure.

If this kind of housing programme, unlike more costly existing programmes, can reach significantly large numbers of people, some hope remains for constructively channeling the resourcefulness and the productive energies of squatters toward the development of the city and society. If the potential squatter is offered a programme whereby he has a chance to acquire secure land tenure coupled with an immediate minimum shelter, and the ultimate and reasonable hope of entirely adequate housing, the schemes stands a vastly better chance of succeeding than the futile legislation and exercise of police power that has characterized land control efforts to date.

/APPENDIX

## APPENDIX

### Evaluation of two proto-typical housing schemes

The preceding discussion has established comprehensive criteria for evaluating low-cost housing systems and discusses an example of a housing system specifically designed to meet these criteria. This Appendix will demonstrate how the previously discussed criteria can be used to evaluate other housing systems. The criteria will be applied to examples of systems which have been used for squatter populations. Such an application of the criteria will begin to illustrate the trade-offs involved with each system with respect to cost, flexibility, self-help labour, etc. This discussion is illustrative rather than thorough, and is meant only to demonstrate an application of the criteria.

#### Monolithic cast concrete

Standardization and mechanization. Full-cell cast concrete building systems require special forms for casting, powerful cranes for the placement of the heavy units, and skilled workmen to operate this relatively sophisticated construction equipment. The prefabrication plants often require heavy imported machinery for the storage, processing, handling, and transportation of both the raw materials in bulk, and the finished products.

Cultural sensitivity. In general, monolithic cast concrete systems seem appropriate to countries that have rather extensively developed industrial sectors and a shortage of inexpensive labour. In addition, the weight and bulk of the pre-assembled units would often preclude their shipment over long distances where transportation costs are significant. On-site plants therefore, have distinct advantages, but the applicability of the system to projects of a relatively small scale, or projects on inconvenient sites then becomes sharply limited. In such instances where the volume of production is likely to be relatively small, it would be almost impossible to amortize the high over-head cost required for cast concrete construction.

/ Expandability.

Expandability. In order to achieve urban densities, vertical expansion beyond two stories must be possible. Most prefabricated concrete structures which go beyond two stories need considerable steel reinforcing and if this steel must be imported, a country's balance of payments may be adversely affected. Furthermore, if the ground level units have the same design as those at the top of the structure, (which is essential if cost reductions are to be realized by mass producing identical units), the load-bearing elements of the upper level units will be over-designed for the weight they carry. Since some such structures exceed ten stories in height, such as the Habitar project at Expo 67, the cost of such over-design can be very high.

Site control. Because of the tremendous weights involved and the amount of machinery required to cast and assemble full-unit concrete elements, considerable site preparation is required even if excavation is unnecessary. The concentration of heavy equipment often destroys the natural amenities of the site, causing erosion, and disrupting micro-climate.

Flexibility - Up-gradeability. Although this system can be used for a variety of housing types, once the unit is cast, all are exactly uniform in appearance and plan. They are unresponsive to the varying needs among families and the changing needs within families. Because all walls, interior and exterior, are cast at once and are often load-bearing, the unit is very difficult to expand or alter. Similarly, it is difficult to add utilities unless plumbing and wiring has been provided in the original structure, which again, increases cost.

However, the most severe obstacle to achieving a very low cost solution with a monolithic full-cell system is the fact that like the high rise apartment, the programme totally fails to tap the ingenuity and resources of the settler. He loses his opportunity to capitalize his labour and can play only a small part in controlling his environment. In addition he cannot gain the dignity and commitment that comes with participation.

### High-rise apartments

Urban context. The high-rise apartment building has frequently been proposed as a solution to the housing problems of the squatter. It provides an eminently urban solution, in that it conserves scarce land, by creating high densities and permits the provision of community services and utilities at a reasonable scale. Complexes of multi-story apartments also provide highly visible symbols of the government working to solve the problems of the urban poor.

Low cost. High-rise apartments have proven to be relatively costly and thus answer the needs of only a limited portion of that population unserved by the private housing market. Because facilities such as bathroom fixtures and electrical appliances must be built into the original structure, the initial cost of each unit increases. Capital costs also include expenditures for special and often imported construction equipment such as cranes and power shovels as well as such items as elevators which are not necessary for walk-up units.

In addition, maintenance and operating costs tend to be high, not only because of the presence of special or imported equipment, but also because the residents have shown tendencies to abuse the facilities. In some cases, recent migrants are unfamiliar with modern urban life styles; and in others, the residents, having had no sense of participation in the construction process, seem to demonstrate a lack of commitment to the building.

As a result of all of these high cost factors, the family living at three times subsistence level is priced out of the market, unless there is nearly total subsidy.

Large buildings also require good soil bearing conditions and relative freedom from steep topography. Thus, high-rise construction for low-income family housing must compete with other intensive uses for a city's prime building sites. But it is at this point that low-income families have demonstrated their willingness to trade prime location for a chance for home ownership and land tenure. They are willing to move to peripheral and rugged areas where high-rise construction would

/be extremely



be extremely difficult and costly. Thus, high-rise construction, characteristic of central cities and offering amenity and location, does not fit the priority patterns of the low-income urban settler.

Furthermore, the capital expenditure in apartment construction occurs before any revenue can be realized from the development, therefore making carrying costs substantial.

Cultural sensitivity. The high-rise apartment is an inappropriate dwelling for the recent rural migrant to the city. The problem of adjusting to a radically different way of life is aggravated by an unresponsive and inflexible dwelling place. While high density urban living did not require a major adjustment of the Hong Kong housing developments, the 15-story superbloques in Caracas have been plagued with problems of acculturation. This may have been due to the fact that many of the Hong Kong squatters were refugees already accustomed to high density urban life.

Space is also at a premium in this type of housing project, because of the expense of construction. Therefore, no extra room can be made available for use in a revenue-producing capacity to supplement the family's income. If the apartment is rented and the family has reached the stage where tenure is important, the rent payments may constitute an intolerable economic drain, thus promoting rather than alleviating squatting.

Flexibility. Finally, since the high-rise apartment building offers a relatively inflexible environment, it is appropriate only for those people whose living patterns are fixed. If it is used to house expanding families or socially mobile elements of the population, other forms of housing must be provided for other phases of their development.

BIBLIOGRAPHY

- Abrams, Charles. Man's Struggle for Shelter in an Urbanizing World. MIT Press, Cambridge, Massachusetts, 1964.
- Boyer, M. Christine. "Low-Income Residential Settlements in Rapidly Urbanizing Countries with Transitional Economies". Unpublished paper submitted for Planning 1-2a, Harvard Graduate School of Design, Cambridge, Massachusetts, 23 May 1967.
- Davis, Kingsley. "The Urbanization of the Human Population", Scientific American, Vol. 213, N° 3, September 1965.
- Herrick, Bruce. Urban Migration and Economic Development in Chile. MIT Press, Cambridge, Massachusetts, 1966.
- Hirschman, Albert O. Forthcoming book entitled, Development Projects Observed.
- Hirschman, Albert O. The Strategy of Economic Development. Yale University Press, New Haven, Connecticut, 1966.
- Okigwe, Carla. "Culture and Public Housing in Underdeveloped Countries". Unpublished paper submitted to Assistant Professor Chester Hartman for Planning 1-2a, Harvard Graduate School of Design, Cambridge, Massachusetts, 23 May 1967.
- Turner, John C. "Barriers and Channels for Housing Development in Modernizing Countries". Journal of the American Institute of Planners, May, 1967, pp. 167-181.
- Turner, John C. "Squatters and Urban Policy". Book review in Urban Affairs Quarterly, Sage Publications, Beverly Hills, California, Vol. II, N° 3, March, 1967, pp. 111-115.
- Turner, John C. "Lima's Barriadas and Corralones: Suburbs vs. Slums", Ekistics, March, 1965, pp. 152-155.
- United Nations. Report of the Study Tour of Building Technologists from Latin America, Africa, Asia, and the Middle East to the Union of Soviet Socialist Republics, United Nations, New York, 1964.
- Wingo, Lowdon. "Recent Patterns of Urbanization Among Latin American Countries". Urban Affairs Quarterly. Sage Publications, Beverly Hills, California, Vol. II, N° 3, March 1967, pp. 81-110.