

THE INDUSTRIALIZATION OF HOUSING:
AN EVALUATION OF THE POTENTIAL OF INDUSTRIALIZED
HOUSING AS A RESOURCE FOR THE LOW INCOME MARKET

by

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The Industrialization of Housing: An Evaluation of the Potential of
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ABSTRACT

The need for vast quantities of new housing in the lower income markets in the U. S. constitutes a pressing national problem. This study undertakes to assess the role of industrialized housing in meeting that need. The post-war experience in the U. S. is reviewed and analyzed in an effort to discover why the attempts to introduce industrialized methods into housing production have not succeeded and to identify the prerequisites to a successful industrialized housing system.

The operation of the critical variables, identified in this investigation, are then tested against the programs outlined in the "Housing and Urban Development Act of 1968" to reveal first, the impact of the Act upon the key issues of industrialized housing as stated in this analysis, and, secondly, the way in which the Act would need to be modified if it were to encompass an industrialized approach to fulfilling its housing goals.

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CHAPTER ONE

The Need for Housing

There is an established need to improve the quantity and the quality of urban housing in the United States.¹ The new housing required in order to replace the substandard stock and satisfy the continuing need amounts to approximately 1.8 million units each year for the next ten years.² The lower income market for this new housing, defined as units priced below \$12,000, is expected to account for 500,000 of these units each year.³ In 1966, however, only 120,000 new housing units were produced, other than mobile homes, that sold for less than \$12,500.⁴ The lower income housing market has always been the least satisfied in its demand for both quantity and quality housing.⁵

The pressing need for housing in the lower income markets has been well documented; the problem now facing us is to produce housing to satisfy the lower income markets. Currently, the housing industry produces only 1.3 million units each year. The problems which are internal to the industry and characteristic of the housing market make it highly unlikely that the industry would be capable, or even willing to expand their scale of operations to that

¹See Kaiser, *The President's Committee on Urban Housing*; President Johnson's message to Congress, *New York Times*, 23 February 1968; also the U. S. Housing Census, 1960, which reports that 4.3 million, or 10% of the nation's housing stock was substandard.

²The Kaiser report estimates this need at 2.3 million units yearly, however, even a conservative estimate, adding yearly losses and aging (470,000), net family formations (900,000) and replacements for the existing substandard stock (430,000), will yield the 1,8 million unit figure.

³Kaiser, *Ibid.*

⁴ASCE News, January 1968, page 48.

⁵Refer to Wilson, "The War on Cities," *The Public Interest*, Spring 1966; Banfield and Grodzins, *Government and Housing*, chapter 10; and Meyerson, *Housing, People and Cities*, chapter 5.

point at which the lower income demand for housing could begin to be satisfied.⁶ The present inability of the housing supply to meet lower income needs has precipitated several strategies whose aim is to increase the housing stock available to the lower income market. One such proposal is to raise the incomes of the consumers in this market, thereby allowing them to move into better quality housing. Incomes would be increased either by job training for better employment opportunities or by direct subsidies, such as rent certificates or a negative income tax.⁷ Other proposals center upon manipulation of the credit and financing structure for housing, either through subsidizing the interest rate on construction loans or through the provision of mortgage insurance. More comprehensive strategies have been offered by Senator Robert F. Kennedy⁸ and by Senator Charles Percy⁹, both of which include a broad approach to the social problems associated with the housing problems of lower income families. There is another possible strategy, one which relies less on subsidies to the market and concentrates instead upon lowering the cost of housing by making it less expensive to produce. This approach relies upon introducing innovative changes into the existing home building industry, changes in both the housing product and its method of production, which will increase the productivity of the industry. The concept of the industrialization of housing has formed the basis of technical advances in this area.

⁶Refer to Kelly, Design and Production of Houses; Meyerson, Housing, People and Cities, chapter 7; and Grebler, Production of New Housing.

⁷See New York Times, November 1:4, 1967.

⁸See New York Times, July 5:1, 1967.

⁹See Congressional Record, April 20, 1967.

Industrialization

This paper will focus on the industrialization of the production process as the most promising strategy for bringing about the necessary efficiencies which will raise productivity within the industry so that an increased quantity of housing may be provided for lower income families. Industrialization, it has been argued, appears to promise the lowest housing costs because it is recognized as the most efficient means of large volume production.¹⁰ The industrialized production process is characterized by 1) an extended division of labor, 2) the use of non-human/non-animal energy, 3) a standardization of product and 4) an emphasis upon the search for technological change. These elements, properly combined, should lead to greater productivity.¹¹ We should keep in mind, however, that industrialization is a dynamic concept in that there are varying degrees to which these characteristics can be applied to the techniques of production and that, as the process continues, there is a continual refinement of design and technological application.

The expected productivity increase in the housing industry would come from both the tremendous initial benefit due to the reorganization of the production process as a more complete industrialized system and from the continuing trend towards incorporating technological innovations and refinements into the process. The initial benefits in efficiency can be expected to be quite high for, as Denison has pointed out, "it would be difficult to find technological innovations with an impact on production exceeding that of the introduction of interchangeable parts, or of the assembly line, or of time and motion study

¹⁰See Adam Smith, Wealth of Nations; or Gill, Economic Development.

¹¹Smith, Ibid., see also Needleman, Economics of Housing, chapter 5.

and all that has flowed from it."¹² The increase in productivity should lead to lower unit costs and this, reflected in the sales prices, would enhance the marketability of an industrialized housing system. In evaluating such a system we must be continually aware of the fact: "in a market economy, the test of feasibility is profitability."¹³

The pressures that have generated the current interest in industrialized housing systems have not come from the middle or higher income housing markets, for these markets are being satisfied.¹⁴ It is the lower income market, in desperate need of new low-cost housing, that has been neglected and, as the demand becomes more vocal, new ways are being sought to satisfy it. To produce large quantities of dwelling units which would be available for below \$100/month requires changes in the existing housing market, changes in the market structure as well as changes in the product and the way it is produced. Attempts to reduce housing costs have met with varying degrees of success and failure but none have yet produced solutions on a scale commensurate with the problem.

The industrialization of housing is a solution at a suitable scale yet it has encountered great obstacles. In this paper we shall seek to identify these obstacles and analyze them with a view toward discovering a successful production and marketing strategy. The question, as Gunnar Myrdal has phrased it, is "why has it been - and why is it still - so difficult to apply the principles of industrial production to building?"¹⁵

¹²Denison, Sources of Economic Growth in the U. S., page 232.

¹³Colean, Residential Rehabilitation, page 13.

¹⁴The luxury urban apartment rental market, for instance, is an example of an overresponse to market demands. Some of Boston's luxury apartments are only 30% rented after two years of occupancy.

¹⁵Myrdal, "Towards Industrialized Building," Congress of Industrialized Building, 1965.

The Problem Range

The problems most frequently associated with industrialized housing proposals are rarely technical. In fact, Gunnar Myrdal has written that, "I believe - indeed I am convinced - that some of the major obstacles on the road towards industrialized building are not of a technical nature but rather economic, organizational, and political in character."¹⁶ These problems range from questions concerning the organization of a responsive market to the relationships between industrial production and the existing industry. How, for instance, if one wishes to produce housing through a highly capital-intensive process, does one insure the large scale, continuous production necessary to amortize the large capital investment? Continuity of operation is also dependent upon consumer demand which, among other problems, raises questions of design, standards, and financing. And if increasing economies of scale are implied by industrialization, what level of production will elicit the most favorable market response, thereby balancing costs and sales volume?

Industrialized Housing

For housing to be produced efficiently by the industrial process it must be redesigned with that production process in mind. There are two general approaches to the design of an industrialized housing system. The first is through the development of many individual standardized components which can be variously combined to form a wide variety of housing types.¹⁷ The second approach concentrates on the production of complete housing units or rooms or parts of rooms which can be joined in a variety of combinations to meet

¹⁶Myrdal, "Realizing the Promise of Industrialized Housing," *Journal of Housing*, September 1967, page 430.

¹⁷See Wachsman, The Turning Point of Building, for a designer's approach to this problem.

differing requirements.¹⁸

Within these two general approaches, two methods of design are employed. One is to assemble the best available parts and pieces, making use of existing products and technology, into an optimal housing system; the other method is to develop new assemblies of basic materials, usually starting with a set of performance criteria or standards, and often designing new combinations of products to meet these criteria.¹⁹ This facet of industrialized housing, concerned primarily with the design of hardware systems from which housing units will be assembled, concentrates upon the control of quality, reducing each element to an optimal functional efficiency. Within a given standard of building, the choice of the level of quality and the degree of control are the basic parameters in varying the cost of the finished product. The dilemma which has arisen is that all too often these systems designs are far more expensive to produce than conventional housing and only the high volume of industrialized production can bring the unit costs back down into a competitive price range. Industrialized housing for the lower income market requires that unit costs be extremely low, generally within the \$6000 to \$10,000 per unit price range or from \$5 to \$7 a square foot in total costs. No system, produced on a large scale, has yet been able to satisfy this requirement.

To convey a sense of what industrialization is capable of, where it has failed and where the critical points in its development are to be found, this paper will examine a series of cases, drawn from the past experience in the United States, of several industrialized housing systems. The conclusions

¹⁸For a more detailed discussion of this approach refer to the Journal of Housing, September 1967.

¹⁹For an example of this method see the description of the development of the Mouton system in the Journal of Housing, September 1967, page 431.

that are reached from this analysis will hopefully give us a better understanding of the role of industrialized housing in solving the problem of producing low cost housing.

The Range of Experience

Attempts to produce industrialized housing in the United States have taken several directions. These may be placed into five general categories:

- 1) The prefabricated house. These are individual single-family frame houses, produced and packaged in quantity and shipped to prepared jobsites where they are erected with a minimum of time and effort. Visually, there is little to distinguish prefabricated homes from those produced by more traditional methods. Sales account for approximately 20% of the new home market.
- 2) The componentized metal house. Although the homes resemble, in form, the traditional single family homes, they are constructed of standardized metal components, often quite sophisticated in their fabrication and installation. They have not been produced in quantity because they have never been commercially successful.
- 3) Componentized structural systems. These systems have concentrated upon multi-family housing, emphasizing the structural aspect of this type of construction. Both steel frame and precast concrete systems are being used with increasing frequency in low rise and high rise apartment construction and attempts are being made to expand the componentized system to include more of the building parts.
- 4) Space unit systems. This approach to multi-family housing makes use of prestressed concrete technology in order to produce great boxes, or parts of boxes, ranging from room to apartment size, which, through optional stacking arrangements, allow a standard unit to meet a variety of requirements. Further development is necessary before these systems can compete economically with conventional alternatives.
- 5) The mobile home. The traditional house trailer has begun to evolve into an imaginative and highly sophisticated dwelling unit, whose sales

now account for 75% of the market for new homes priced below \$12,500.

There are problems as well as solutions inherent in these approaches to an industrialized housing system. Some of the problems, as well as the successes, are common to all of them while others are peculiar to an individual approach. An examination of particular examples, characteristic of these approaches, will serve to clarify both the problems and the promise of industrialized housing.

The Prefabricated House

National Homes

The classic example of prefabricated home production is represented by the nation's largest producer, National Homes, Inc., a nationwide franchise organization of independent fabricators. The National production line organizes time and motion and makes efficient use of materials; it does not invest in specialized machines to replace labor. The system requires 18 man-days to produce one house plus 5 men each day at the site to erect the house. The franchise organization included an extensive sales program, complete with national advertizing, and a training program for its member builders. The management, by placing emphasis upon a standard product and complete service was able to put the company on top of the industry during the post-war building boom. Recently sales volume has fallen considerably. In 1945 National was producing 200 homes a day and in 1967 that had dropped to 5 homes a day. Gross revenues have fallen from \$53 million in 1965 to \$32 million in 1967 as the housing market has grown increasingly competitive and prefabrication techniques have been widely adopted by other builders.

Techbuilt Homes

Techbuilt homes compete in the \$20,000 to \$30,000 range, offering a home built to very high contemporary standards, and it is also competitive in

the second home and vacation home markets, ideal for building in rural areas where local contractors and building supplies are not readily available. The house is most popular in New England and sales are now averaging one home per day.

Techbuilt, also operated on a franchise system, has proven to be more competitive in today's markets because it was designed specifically for use by the smaller, independent builders and contractors. They are able to order the packaged home for delivery on a specified date and know that it will not be difficult to put together when it arrives, thus relieving them of the design and detailing problems and allowing them to concentrate on construction profits.

Vacation Homes

A third example of the prefabricated house is found in the growing market for vacation homes, evidenced by the sale of over 10,000 vacation homesites in the last year in the New England area. Stanmar, Inc., of Sudbury, Mass., is the largest producer of vacation homes for the New England market. In 1960 they sold 100 homes and in 1967 sales had grown to between 300 and 350 homes. They have estimated their continuing growth rate at 30% annually. Stanmar supplies local builders with the factory-produced parts to the homes, which currently include 25 complete models ranging in price from \$6,500 to \$35,000. The central factory is capable of producing two homes a day but management inefficiencies in sales organization and seasonal market variations have limited production to an average of one home per day.

The Componentized Metal House

Lustron

The prime example of this system is the Lustron House.²⁰ It was

²⁰See Koch, At Home with Tomorrow, chapter 6.

designed and developed in 1949 as an industrially produced metal house; production at the factory in Columbus, Ohio, was expected to be 40,000 homes a year. Although the component system was quite sophisticated in its design, the finished house bore a striking resemblance to the traditional frame house. Organizational difficulties, involving problems between design and production, created major problems within the company and eventually led to a halt in production. It began when the original design had to be reworked in order to reduce soaring production costs. For example, the great press which stamped finished bathtubs from sheet steel was capable of producing three times the amount of tubs that were required because the lowest unit costs were obtained at that higher level of output. The excess production was expected to be sold on the open market until it was discovered that the Lustron bathtub was $1\frac{1}{2}$ inches longer than standard tubs and could not be used in standard house construction.

The delay in marketing, along with some local union obstruction and neighborhood zoning obstacles, resulted in the erection of only 3000 units before the company was forced into bankruptcy. Besides production problems, Lustron had failed to organize an efficient marketing and distribution system, counting on consumer demand to solve that problem. The initial market, therefore, was so scattered that distribution costs eliminated the competitive pricing and reduced the expected profit margin. At last report the factory is still in Columbus, encased in cosmoline and awaiting market conditions more favorable to another try.

Componentized Structural Systems

The majority of componentized structural systems are based upon the use of precast concrete and have certain common features: full storey-height columns, concrete beams, precast floor slabs, wall infill panels and some

method of grouting the joints. They differ in the specific shape, scale and dimension of the parts and the joint details. The fact that this approach is usually limited to the structure is sometimes both an advantage and a drawback, for the gain in the flexibility of layout and individuality of facades is often at the cost of inefficiencies in transforming the structural frame into a habitable dwelling unit by adding walls and hardware in the conventional manner.

Techcrete

Two unique systems are attempting to overcome some of these drawbacks but are still largely incomplete. Techcrete, being developed by Carl Koch in Boston, uses storey-height precast wall panels and long-span (32') prestressed floor planks in a simple bearing wall system.²¹ The key to the structure is a post-tensioning system which locks the walls and floor panels into place. Techcrete has already been used in quantity in Boston (870 units erected and another 2500 under construction or in the planning stages) and has proven to be less expensive than conventional construction techniques. The system currently includes only the structural elements although Koch hopes to begin incorporating more and more of the construction into an industrialized system that will eventually include 75% of the completed building.

The Mitchell System

Another example, under development by Neal Mitchell Assoc., Inc., of Cambridge, is of the more familiar post, beam and floor slab system.²² Mitchell's system was originally designed as self-help squatter housing for Latin America and is being adapted for low-cost housing in the U. S. Although

²¹ Architectural Record, March 1967; Civil Engineering - ASCE, January 1968.

²² Journal of Housing, August/September 1967; Squatter Housing, UN seminar on prefabrication, document No. 19.

the structure and the design are quite ingenious, the system has two failings which stem from its origin: as self-help housing it was not designed to meet the requirements nor the standards of U. S. construction and it is proving difficult to superimpose upon the simple structural system a componentized wall and hardware system that works within the cost restrictions.

Space Unit Systems

Habitat

The most well-known example of this type of construction is HABITAT '67, Moshe Safdie's imaginative but costly creation for the Montreal Expo '67.²³ By using the concrete box as the principle of construction, all the surface planes contribute to the structural rigidity, eliminating the need for a separate framing system. Flexibility of design is found in the additive characteristics of the elements which achieve variety, both visually and in apartment layout. The capital investment necessary for the extremely large machines capable of producing and moving the large 90 ton units makes high volume production a necessity if costs are to be lowered, yet even if Habitat had been able to produce in those quantities, the costs could not have been brought to below \$40,000 per unit.²⁴ Due to the size and weight of the elements the factory must be located at the construction site to be efficient and this would limit the number of units that could be produced at any one place before the factory had to be moved to a new location.

Uniment

Another example of this type of fabrication is the UNIMENT system,

²³Journal of Housing, Volume 8, September 1966, page 444.

²⁴Journal of Housing, September 1967, page 437.

being produced in Richmond, California.²⁵ By using lightweight concrete and extremely thin sections (2 inches) the unit weight has been reduced to 20 tons, a weight which can be transported on flatbed trucks. This project is still experimental and, as such, has high unit costs associated with it. Further development has yet to prove such a system to be economical for anything but luxury housing. The nature of space unit systems requires large, and often specially designed equipment in order to handle the units, and this additional cost must somehow be offset by the savings gained in transferring almost all of the fabrication into the factory, leaving only the final placement of the units to be completed at the jobsite.

The Mobile Home

The mobile home phenomenon in the U. S. is a fairly recent development. In 1960 mobile home production was 90,000 units and accounted for 6.2% of all additions to the housing supply. By 1966 production had grown to 220,000 units yearly and they accounted for 14.8% of all additions and 22% of all additions to private, non-farm single-family housing.²⁶ Beginning with an eight foot width in 1950, the mobile home had evolved by 1962 into the "twelve-wides" which now account for 35% of all production. This means that at standard lengths of 60-64 feet, the average unit encloses over 700 square feet. Expandable "double-wides" are twice this size when in place. The average retail price of a mobile home, complete with all furniture and fixtures, is only \$10 a square foot. These homes appeal primarily to young marrieds, looking for an inexpensive way into suburbia while saving for something better, and to the elderly

²⁵Ibid., page 437.

²⁶See Blair, "Mobile Homes, A New Challenge," Law and Contemporary Problems, 32:286, Spring 1967.

retired. The rapidly expanding market for mobile homes is not based upon a demand for mobility,²⁷ but upon a demand for low-cost quality housing.²⁸

²⁷The average mobile home is moved only once every three years usually as a result of change on ownership. See Blair, Ibid.

²⁸See French and Hadden, "An Analysis of the Distribution and Characteristics of Mobile Homes in America," Land Economics 41:131 May 1965, or Blair, Mobile Homes and the General Housing Supply.

CHAPTER TWO

The case studies, confined to the post-war attempts at industrialization, offer a considerable range of experience for study. In spite of the efforts that these cases represent, none of them has been successful in producing an acceptable industrialized solution to the nation's housing problems. Further analysis of these examples will hopefully provide us insights into the industrialized housing issues by pointing out what the prerequisites for an industrialized housing solution might be and the extent to which these prerequisites might realistically be satisfied.

This analysis can be structured according to external and internal considerations. In the former category are those considerations which concern the relationships of an industrialized housing industry to the external forces in the environment. The latter category of considerations are those which pertain to structural relationships within the industry itself.

External considerations are:

- I) The relationship of industrialized housing production to national economic policy and national housing policy;
- II) The relationship of industrialized housing to its political environment;
- III) Resident participation in housing production;

Internal considerations are:

- IV) The economics of industrialized housing production and the existing housing industry;
- V) The relationship of industrialized housing to building codes and housing standards;
- VI) The restructuring of the lower income housing market.

These headings cover the salient features of the industrialized housing experience and, while not all the examples under study will contribute to the

discussion of each issue, collectively the case studies provide practical experience from which we can reach conclusions concerning the future of industrialized housing.

I. The Relationship of Industrialized Housing Production to National Economic Policy and National Housing Policy

Problem

Cyclical fluctuations in our national economy have a serious effect upon the volume of new residential construction.²⁹ Traditionally a seller's market, housing production attempts to adjust volume to accord with an elastic consumer demand. During periods of economic recession and reduced financial security, however slight, consumers are less likely to assume the long term debt of homeownership.³⁰ It is the lower income families who first feel the impact of rising unemployment during a recession and whose financial futures are the least secure. Smaller incomes are also most severely affected by rising interest rates and the finance charges associated with the purchase of a new home. During periods of economic instability these costs are usually sufficient to price many lower income families out of the new home market.

The financial considerations are further sensitized by the activities of the Federal Reserve Bank, which, by acting as the regulator of the national economy, effectively changes the amount of money that is available for mortgage investment during a given period, thereby raising or lowering the interest rates and the cost of financing a new home.³¹

²⁹For a more detailed discussion of this relationship, see Meyerson, Housing, People and Cities, chapter 2. Also Grebler, Housing Issues in Economic Stabilization Policy, p. 101.

³⁰See Houthakker, Consumer Demand in the U. S.

³¹See generally Federal Reserve Bank, Federal Reserve System - Purpose and Functions. For a discussion of these issues refer to Grigsby, Housing Markets and Public Policy, or Meyerson, Housing, People and Cities, Chapter 2.

The experience with industrialized housing, as represented in the previous cases, reveals that continuous production was not achieved because there was no dependable market for the housing. Economic conditions which cause demand to fluctuate resulted in a fluctuating level of production, entirely unsuited to the industrialized process.

Another result of the economic forces is to make investment in the residential construction industry less stable than investment in other industries. In terms of further industrialization this means, as Myrdal has pointed out, the "industry cannot risk highly capital intensive methods of production if the Federal government uses housing construction as the regulator of the national economy."³²

Experience

The prefabricated houses produced by organizations like National Home or Techbuilt are based upon an efficiency of time and motion plus a carefully programed used of materials. They are not produced by expensive, specialized machines but by skilled labor wielding relatively inexpensive, general-purpose tools. The organization is a loose federation of franchised builders, each operating on a small scale with low overhead costs. Not only has this meant a lower level of capital investment but it has also provided a larger degree of flexibility in altering the product to meet changing markets. Vacation homes, for instance, are rarely produced as identical units but allow the purchaser to make a considerable number of individual changes at no extra charge. The lower fixed operating costs associated with this type of prefabricated production has enabled the industry to respond fairly easily to changes in the business

³²Myrdal, "Realizing the Promise of Industrialized Housing," Journal of Housing, September 1967.

cycle. When it became necessary to reduce production, as in National's case, it was not difficult to release labor or turn to other forms of construction-related services to reduce the fixed operating costs of the industry.

Lustron, by contrast, invested heavily in production machinery.³³ The first homes reached the market during the first-quarter recession of 1949 and by the end of the year, with only 3000 homes sold out of a planned production of 40,000, the company was forced into bankruptcy with a loss of over \$30 million. The large capital investment in plant costs made continuous production necessary in order to support the interest and amortization charges. Halting or delaying production, even for a short period, wiped out the cash reserves and only the injection of more capital, at best a risky proposition, would have given the company any chance of recovery. The uncertainty of market conditions make it imperative that housing producers maintain a flexible market position, for the greater the fixed operating costs the larger must be the cash reserves to carry these expenses during market lapses.

Mobile home sales have not been as affected by business cycles and tight money markets as has traditional housing. This is due, in part, to their lower relative costs, averaging \$5000 to \$7000, and extremely flexible financing arrangements.³⁴ Since mobile homes represent the lowest cost portion of the new home market, it may well be that many families are forced down into the bottom level of the market during a recession, thereby maintaining sales volume. The industry is also more competitive than the conventional market

³³The Lustron factory near Columbus, Ohio, was so large that when all of the machinery was in operation, the plant drew as much electric current as the city. See Koch, At Home With Tomorrow, chapter 6.

³⁴See Blair, Mobile Homes and the General Housing Supply, and Jung, "Dealer Pricing Practices and Finance Charges for New Mobile Homes," Journal of Business, 36:430, October 1963.

since its products are not tied to a locational base and can therefore be sold over a wider area.³⁵ These factors give the industry greater immunity to minor economic disturbances by allowing a flexible response to changing market conditions.

Immunity from economic fluctuations can also be obtained by building with federal financing or aid. The large commitment to housing that gave Techcrete its impetus came from the availability of 221(d)3 financing. Unfortunately, once that aid is withdrawn because of government budget considerations, the industry can no longer sustain operation at a large scale, as is the case with Techcrete today. Traditional government subsidies to lower income housing, such as public housing or rent supplements, are also prone to this overdependence upon Congressional budget approval for funding.

Experience has shown that the unforeseen vacillations of national economic forces work against efforts to industrialize the production of housing. Flexibility in response to changing conditions has proved to be the best approach for the industry but this has not helped the lower income consumer to obtain new housing.

Summary

The central issue of economic stabilization therefore appears to have two parts: first, the need to insulate the lower income housing consumer from these larger cyclical fluctuations in order to produce a more uniform or at least predictable market demand which will be able to support a minimum given level of continuous industrialized production, and, secondly, the need to

³⁵ See Jung, Ibid., for an analysis of deal price flexibility in the sale of mobile homes. Since dealer price mark-ups are normally 25% and their financing charges less than automobile dealer's, they are able to offer the prospective customer prices tailored to the market situation.

insulate the producers' investment in the production equipment. Although solutions to these two problems will go far in aiding the development of an industrialized housing system, there are other considerations which will bear on this issue and which must also be examined.

II. The Relationship of Industrialized Housing to its Political Environment

Problem

That there exist serious political and social problems associated with the current shortage of lower income housing in the U. S. need not be argued.³⁶ There may also be, however, major political and social problems associated with public attempts to provide, within a short time, large quantities of lower income housing to meet these needs. The difficulty of finding adequate building sites for new lower income housing serves as a focus for many of these issues.

Housing produced by industrialized methods is predicated upon a fairly continuous level of production and this implies a sufficient number of sites on which to erect these housing units. There are two major obstacles to finding such sites. The first concerns the existing pattern of zoning restrictions which permit only particular types of housing to be located in various residential areas. An industrialized housing system which depended, for instance, upon the use of attached housing units would find itself largely excluded from suburban sites because of zoning provisions requiring detached housing on separate lots. This problem is compounded by the second consideration which involves the attitudes of local residents towards lower income housing. Zoning ordi-

³⁶ Refer to the President's Commission on Civil Disorders, February 1968, for a dramatic view of this problem.

nances have traditionally been used to enforce economic and, by association, racial discrimination in residential areas,³⁷ and any widespread attempt to introduce low-cost industrialized housing into these communities may bring violent political repercussions. Even in neighborhoods where zoning ordinances do not prohibit lower income housing or high density housing, opposition has been effectively mounted against proposals for new housing developments intended for residents of a different economic class or race.³⁸

The greater the number of sites required, the greater will be the magnitude of this problem. Industrialized housing systems, capable of a relatively high volume of production, will only exacerbate this problem by trying to force low-cost housing into areas where it is not wanted. The alternative may be to build the new housing on marginal sites that are unacceptable to the lower income market.

The realization that this situation may arise could, in itself, prevent a metropolitan area from endorsing a large scale industrialized housing system. Industrialized housing production does not require any minimum housing densities nor prescribe particular sizes for construction sites. Cost considerations do, however, dictate a fairly intensive use of urban land which implies densities considerably higher than are found in most suburban communities. Techcrete, for example, has been employed in sites ranging from 2.6 acres to 13 acres at densities of 27 units/acre. The Mitchell system can be constructed as a single family house or as attached, multi-story housing.

³⁷ See "Snob Zoning, A Look at the Economic and Social Impact of Low Density Zoning," 15 Syracuse Law Review 507, Spring 1964.

³⁸ An example of this situation is found in the Boston Housing Authority which, because of these pressures, has been able to locate only 482 units of housing for the elderly and no public housing for families since 1954.

Flexibility in size and density is a characteristic of most industrialized systems; these variables are generally determined by political requirements and would be expected to vary in almost every locale. The choices of location and density, if decided purely on political grounds, may result in unwanted consequences, since a poor choice may be reflected in the social behavior of future residents.³⁹ Some balance should therefore be sought in developing a decision-making process for site selection to accompany the industrialized production process.

Experience

The case studies do not adequately reflect the potential magnitude of this problem. The solutions which involved high production and a multitude of building sites were not aimed toward a market which might have generated a middle class political backlash. Solutions which are specifically meant for the lower income markets, such as the Mitchell system, have not yet advanced far enough past the experimental stage to have encountered the problem. Techcrete, which was developed and produced as a solution to the relocation needs of moderate income families in the Washington Park renewal area, has been employed on only two 221(d)3 housing sites in Boston. Both sites were located on vacant land within the same neighborhood as the occupants formerly resided and both were chosen and approved well before any commitment was made for the production of the housing components. Thus the scale of the operation was clearly defined prior to undertaking the projects and the problems associated with the continuing flow of housing components were avoided. No plans have been advanced by the city for extending this system to meet lower income housing needs.

³⁹ See Gutman, "Site Planning and Social Behavior," *Journal of Social Issues*, 22:103, October 1966.

Mobile homes, as a solution to low-cost housing, have largely been excluded from the central city and inner suburban areas by restrictive zoning ordinances.⁴⁰ All too often these zoning restrictions are intended to accomplish social ends, rather than land use control, by preserving the economic homogeneity of a residential area by discriminating against lower income housing.⁴¹ Actually mobile homes have been found to be much less likely to be substandard than conventional housing, and it has been reported that 88% of all mobile homes are owner occupied as compared to only 62% of other housing.⁴² Those homes which are located within city boundaries are generally found on marginal sites, often outside of residentially zoned areas and it is the resultant poor site conditions which are primarily responsible for the widely held image of mobile homes as a form of inferior or substandard housing. In spite of this inability to secure adequate or desirable locations within the metropolitan areas, there has been a continually growing demand for mobile homes as a preferable alternative within the lower income housing market.

If mobile homes were to grow to the size of conventional housing, and, in truth, some of the "double-wides" have already reached that size, they might become less distinguishable from their more permanent counterparts and thereby ease objections to allowing them entrance to existing residential areas. Between 1950 and 1962 when the mobile home grew from eight-wides to ten-wides and then to twelve-wides, the industry twice managed to push

⁴⁰French and Hadden, "An Analysis of the Distribution and Characteristic of Mobile Homes in America," *Land Economics* 41:131, May 1965.

⁴¹See the celebrated case of *Vickers v Township Commission of Gloucester Township*, 37 N. J. 232 (1962) in which such discriminatory zoning was upheld, yet the dictum found in the dissenting opinion of Judge Hall has since carried greater weight than the majority decision.

⁴²French and Hadden, *op. cit.*

through legislation in all states, changing the maximum allowable width of trailers for highway transport. Therefore it may be possible to again raise these restrictions, including height limitations, to permit even larger homes to be transported and it is also feasible that new forms of mobile homes may someday be more readily accepted with the urban core.

Summary

In view of past performance and in light of persistent local opposition to economic and racial integration of lower income housing in established residential neighborhoods, it appears unlikely that an entirely satisfactory solution for the immediate location of large numbers of new low-cost housing units will be readily found. Yet without some guarantee that a sufficient number of sites will be available, it will be virtually impossible to commence production of any industrialized housing units. This locational obstacle in the form of zoning laws and local attitudes must be overcome if any progress is expected to be made in using the industrial process to meet the demands for lower income housing.

III. Resident Participation in Housing Production

The extension of social efforts into the entire environment of the lower income market in conjunction with an industrialized housing program could go far in finding solutions to problems other than the provision of low-cost living space. There exists a vast untapped potential in housing production that can reach into the lives of its occupants to affect job training and employment, changes in social behavior, environmental maintenance and community organization. These potentials have been largely unexplored in the past experience with industrialized housing.

The design of an industrialized system to offer the greatest possibilities

for employment and training of low-skilled labor would open opportunities for local unemployed to take part in the building of new housing in their neighborhood and, by making provision for self-help housing, it would allow residents to contribute their "sweat equity" towards a downpayment on a new home. The Mitchell system, originally designed as self-help housing, hoped to make this experiment in Detroit with the erection of 17 dwelling units. Unfortunately local unionized labor opposition has effectively prevented the project from getting started. They fear that once self-help housing is introduced into the city, it will result in the loss of many jobs for the skilled construction workers and the outcome has been that no housing has been built. If employment opportunity is to be an accompanying goal of an industrialized housing system, it will be necessary to first gain some measure of support from the building trades unions in order to use it, for as in Detroit, lack of cooperation from the Teamster's union can effectively halt any construction schedule.

No industrialized housing system has yet offered the advantages of a complete community to accompany its product, with the possible exception of Techbuilt's first venture, Conantum, and, to a lesser extent, Levittown. Techbuilt's attempt at a cooperative community proved impractical because of the added costs of overhead in planning and coordination and the confusion generated by the residents in trying to decide among too many design alternatives. But the idea of resident participation and involvement in the development of the community was instrumental in selling the homes, and a tighter management organization might have been able to control it. Habitat is the most conspicuous attempt at developing a complete community image as opposed to a series of individual units, and the reaction to the prototype at the fair was enthusiastic. The identification with a larger community image is

an important response to be evoked in a prospective buyer.⁴³

The most serious failure to pursue the community development idea has occurred in the mobile home industry and it is especially tragic when one considers the range of possibilities that could have been created. Only recently have new departures from the traditional trailer court pattern begun to be expressed, including proposals for high-rise structural frames which the mobile home would be able to "plug-in" for service connections. These concepts may go far to eliminate the stigma that has become attached to the mobile home as an inferior dwelling unit and allow a wider acceptance of their use. It is ironic that these innovative proposals have not originated from within the industry but have come from outside.

Summary

It seems important, in view of the recognition given to the social problems of lower income groups, that any large scale attempt to produce low-cost housing for this market should become involved in the social environment of its market. The question that remains concerns the form and degree of this involvement and how it might be justified in terms of increased unit costs. Although these issues are largely dependent upon the type of industrialized system and the local situation, some determination can be reached as to whether such considerations should or should not be given priority in the development of a low-cost housing system.

IV. The Economics of Industrialized Housing Production and its Relationship to the Existing Housing Industry

The characteristics of the industrial process, as described earlier,

⁴³The Menninger Foundation, Human Needs in Housing.

produce certain economies of scale related to a high volume of production. Generally speaking, lower unit production costs are obtained as larger quantities of standardized items are produced. Besides the scale economies attributable to production, there are also scale economies associated with the supply of raw materials, operation and management, sales and distribution of products and the installation and servicing of them. A widely held notion concerning industrial production is that these economies are only obtained at very high levels of production. This is not necessarily true, for the optimal level of production depends upon many variables, including the degree of industrialization, the design of the production equipment, the design of the product and the quality of management control. Under certain circumstances, economies of scale can be obtained at relatively low levels of output.

Volume of Production

The experience with industrialized housing has shown production volume variations from the 1 to 200 homes a day produced by the relatively unsophisticated methods of the prefabrication industry to the 150 homes a day which were expected to roll out of the Lustron plant. The precast concrete components employed in the Mitchell house require seven hours to produce. Their mechanical casting beds are designed to cycle three times a day and the components, after another two days of steam curing, are ready to be shipped to the construction site. Since the system requires more floor planks than framing members, the ratio of plank casting beds to other types is higher in a factory operation. The minimum level of efficiency, however, is still one complete unit every seven hours, for at that rate all the mechanical equipment will be in continual operation. Limitations to higher levels of production are imposed by materials supply, distribution, installation and management control. Experience has indicated that the technology of production does not pose a

problem. The real difficulty is in deciding upon an optimal level of production which will best balance total costs against the expected sales volume at a given unit price level, usually equal to the expected marginal costs of production.⁴⁴ Production capacity should neither exceed sales, as was the case with Lustron, nor should it lag demand, particularly if a higher level of production would further lower costs and stimulate demand. This latter situation is common to most of the cases discussed in that they have been produced in such small volumes that the true production cost of the units can only be estimated. Techcrete, which has produced several thousand units has brought its actual costs down to \$10.70/square foot although estimates of costs at higher levels of production are between \$7 and \$8 a square foot. Habitat's \$100,000/unit price could be lowered to \$40,000 if enough of the units were to be built.

Vertical Integration

Large scale purchases of materials can be another source of economy. Levitt and Sons, a large scale producer of conventional housing, organized the North Shore Supply Company through which all of their purchases were made, and because they bought in large quantities, they were able to realize significant savings. Vertical integration of the supply function also results in better scheduling of materials receipt, essential to a highly organized production process. Techcrete, by contrast, must rely upon one company to supply the precast components and another to install them. This arrangement led to problems in the past; four suppliers were tried before the San-Vel Corp. proved it could satisfy the standards which were specified in the contract.

When production is centralized in a single factory location, the distribution

⁴⁴For a discussion of pricing and production see Dorfman, Prices and Markets.

of the components or units, because they are generally bulky and have a low cost-to-weight ratio, can account for a significant percentage of the cost of the product. The further the construction site from the factory, the more expensive the units will be. Since there will exist some geographical radius of supply beyond which the system would be priced too high relative to competitive alternatives, this will tend to limit the area which could be reached by any given factory. It is important that the market demand within this area be high enough to sustain the proposed level of output, a fact apparently overlooked by the Lustron management.

Mobile home producers have integrated all of these functions into their organization; their distribution system, averaging 20¢ a mile per unit, adds only \$200 to the price of a home manufactured in Ohio and sold in Boston. Other industrialized systems, Techcrete and Mitchell, for example, find distribution costs a considerably greater proportion of their total costs because they produce and transport only a portion of the cost of the completed unit; acquisition and development of land, assembly and interior work make up the rest of the cost. Techcrete, primarily a structural system for the present, accounts for only 26% of the total construction cost, exclusive of development, although Koch has plans eventually to raise this to 77%. By contrast the mobile home is 100% completed at the factory, including the interior furnishings. If bulk distribution rates are roughly the same for all industrialized housing systems, those systems which are more completely pre-assembled enjoy a larger market radius since distribution costs will comprise a smaller percentage of the price of the system. This is the principle that has given mobile homes such a wide market surrounding their small midwestern manufacturing base. Site installation has generally been considered a separate function, removed from the immediate control of production management. Although National

Homes, in some instances, did erect their own homes, this task was usually left to the local contractor or buyer. Techbuilt and the vacation homes follow this same principle. The use of local labor, under the auspices of local builders, is generally more favorably viewed by both local labor unions and building inspectors. Resentment directed towards the use of outside installation crews can add costly delays to the erection schedule. Even the more sophisticated housing systems have held to this formula. Lustron furnished assembly guides with their housing packages and Techcrete relied upon a local contractor, DCA, to install components which were cast elsewhere. This arrangement can also be a result of the inability of either company to do both jobs, but it lacks organizational efficiency and could probably be discarded if production volume were high enough to permit one company to specialize in both operations on a year-round basis.

Efficiency in all phases of the process, from production to installation, is best illustrated in the Habitat example. Here, on a single site, were combined all the necessary functions, resulting in the construction of over 200 units in about a year. It would appear that to create an efficient industrialized production system it is necessary to centralize management and control. The franchise organizations created by the prefabricators sacrificed the economies of scale and efficiency in return for greater flexibility in operation and more responsiveness to changes in the market. Economies of scale production, however, are a prerequisite to lowering unit costs sufficiently to reach the lower income housing markets. The greater costs associated with overhead, distribution and lack of flexibility in these larger organizations must be offset by a high volume of production, sustained by a continuing market demand.

The Housing Industry and Industrialization

The effect of industrialized housing technology upon the traditional housing industry will, to a large extent, depend upon how the technology is introduced into the housing market. William L. Hooper, a technical assistant to President Johnson's advisor on science and technology, has identified three possible ways in which an innovative industrialized housing system might come into being:

- 1) "The traditional housing industry will meet the challenge."
- 2) "The mobile home sectionalized housing industry will apply its talents to manufacture of fixed-site urban housing."
- 3) "Firms not now in the housing field, and perhaps not now in existence, will be attracted into the field to exploit the housing market which is not now being satisfied. This possibility is characterized as innovation by invasion."⁴⁵

All three of these conditions are already developing and serious attempts will undoubtedly be made by each of these sectors. The question is which will prove to be the most effective in satisfying lower income housing needs and at the same time profitable.

The traditional housing industry has already produced large scale producers of conventional housing like Levitt and Sons and gone beyond that into the relatively unsophisticated industrialization found in the production process of National Homes. Prefabrication generated no significant opposition within the industry when it was introduced after the war because market demand was so large that no other builders were displaced by prefabrication techniques. In fact, the franchise system permitted quite the opposite to happen; builders, by

⁴⁵Journal of Housing, September 1967, page 431.

buying prefabricated components and homes, were able to rapidly expand their own scale of operations without risking their own capital. The more lucrative middle income, custom home market remained virtually unaffected by prefabrication. Similar conditions exist today in the markets in which Techbuilt and the vacation homes operate since there are not the types of residential construction for which custom builders are competing.

The introduction of innovative production techniques aimed at the lower income housing markets is likely to produce the same indifference among builders engaged in other markets. Techcrete's development for use in the largely unmet Negro moderate income market is one indication that this conclusion is correct. Although the builders and the industry in general may readily accept industrialized housing, they are also well aware that without the support of the construction trades' labor unions they are helpless to proceed.

Organized Labor and Industrialization

The organization and structure of the construction trades' unions within the industry is a complicated subject.⁴⁶ Unionized labor has a reputation for opposing the introduction of innovative techniques in building, particularly those which tend toward industrialized methods, because of their fear of either the loss of jobs as labor is displaced by new construction processes or their fear of competition from non-unionized labor employed in manufacturing items which were formerly built on the job site. This reputation is undeserved according to Professor Dunlop of the Harvard Economics Department. He contends that although local conflicts have developed, the vast majority of the unions have gone

⁴⁶See Kelly, Design and Production of Houses, chapter 6; also Dunlop, "The Industrial Relations System in Construction," in Weber, The Structure of Collective Bargaining.

along with innovative practices; those unions which have opposed change have continually backed a losing cause as ways have always been found to get around their obstructionism. Wages have not been found to differ significantly between union and non-union labor employed in various phases of the building process.

Although union opposition to non-union produced building products has been ruled to constitute an unfair labor practice under the Taft-Hartley statutes,⁴⁷ the unions' fight to retain their jobs against the encroachment of new techniques, by including "work preservation" clauses in their contracts, has been upheld by the courts.⁴⁸ Although builders are free to eliminate these clauses from the contracts, the unions are also free to refuse to sign them. Labor may also resort to indirect pressures on builders, usually applied through building department officials. In Detroit, for instance, the city engineer refuses to approve an application for a building permit to construct 17 Mitchell houses on the grounds that the structural members are too small to meet code requirements. To make them larger would eliminate the possibility that they could be placed by unskilled or self-help labor, a particularly sensitive issue in the unions' view.⁴⁹

Although these practices are annoying to the innovative builder, they are becoming less and less effective in holding back the development and the use of new technologies and products. The structure of the industry is apparently flexible enough to accommodate change, and this change will be forced as the development of new industrialized housing systems continues to threaten challenge from outside the industry and to promise greater profits within it.

⁴⁷ *Cosentino v United Brotherhood of Carpenters, et al.*, 265 F 2d 327.

⁴⁸ *National Woodwork Manufacturers Association v NLRB*, 87 Sup Ct 1250.

⁴⁹ *Supra*, page 22.

The Challenge from Outside

The second category of industrialized housing development referred to by Hooper is the mobile home industry and to a large extent this method of entry into the field has already become an accomplished fact. The minor obstacles which prevent this industry from developing a larger market are being rapidly overcome such as the design of workable multi-unit structures and the development of the image of mobile home units as socially acceptable housing.

The third alternative posed by Mr. Hooper, "innovation by invasion," has also begun. The National Steel Corporation developed over 10 years ago a steel house intended for mass production for the middle income market. Currently such industrial giants as General Electric, TRW, Reynolds and Ford are investigating industrialized housing production. Their efforts are continually being frustrated however, by the common impediments to immediate large scale innovation; union practices, building codes, land prices and financing costs.⁵⁰ Because of the high costs of research and development apparently little can be done in the area of introducing major technological advances in low-cost housing within the next few years. Longer range contributions of industry are expected to come from changes in power, waste disposal, heating, water supply and foundations systems rather than as complete housing packages. As outside industries continue to advocate changes in the structure of the market that would allow them an easier entrance, legislators are beginning to take notice of these proposals.⁵¹ It is more likely though, that as incremental

⁵⁰See the Kaiser Commission report op. cit.

⁵¹The Advisory Committee on Intergovernmental Relations concluded a study in January, 1966, entitled "Building Codes: A Program for Intergovernmental Reform," which recommended changes extremely favorable to the "innovation by invasion" concept.

changes are made in the market structure, they will be fully exploited within the existing industry before they can be used to competitive advantage by outside industries.

Summary

The cost efficiencies of industrialization and the volume of production which will be required to offset the introduction of new housing technologies argue for a large, highly centralized production process, designed for a metropolitan regional market. In view of the obstacles presented to the immediate formation of such a large scale industry, it appears highly unlikely that one will develop. Opposition to industrialization from within the existing industry is largely concerned with preserving conventional housing markets and jobs. Thus the adoption of a strategy which created an industrialized housing system exclusively for introduction into the lower income market would greatly ease the strains of accommodation. Yet the process of developing new housing technologies is, at best, highly unorganized and efforts to test and produce innovative concepts are not confined to systems aimed at the lower income markets. Additional direction is needed in guiding the development of industrialized housing if it is expected to soon reach a point from which it may begin to contribute to satisfying the demand for low-cost housing.

V. The Relationship of Industrialized Housing to Building Codes and Housing Standards

The detrimental impact of local building code restrictions upon housing technology and economics has been well documented.⁵² Efforts to develop low-cost housing systems are especially hindered by restrictive building codes

⁵²See U. S. Office of Science and Technology, Better Housing for the Future.

since the codes are generally not flexible enough to accommodate new cost saving techniques which are so essential to the success of industrialized housing systems. Codes require the designer to produce a less efficient, and therefore more expensive, designs by forcing him to use specified materials and traditional construction technologies.⁵³ The same is true of housing standards which set dimensional and layout requirements in such a way as to force the designer into a conventional pattern or solution that may not be the most efficient use of interior space or well-suited to the needs of the occupants. The designer argues that building codes should recognize and encourage the use of performance criteria rather than code specifications for such a change would facilitate the development of low-cost housing by permitting the use of new technological advances in design.⁵⁴

Performance Codes

Much of the early industrialized housing experience shows a greater concern with the fabrication process rather than the design of a new product. The prefabrication techniques of National Homes achieved its economies by industrializing the production process, not by introducing new technology. They went through great pains to redesign the traditional house so that it could be prefabricated without changing its appearance or its content and therefore seldom ran into conflicts with rigid building codes. Lustron, in meeting most building codes, paid heavily through an inefficient and expensive overdesign of the steel structural system. Techcrete meets the code requirements only because all of its proposed innovations have not yet been introduced into the sys-

⁵³See the Advisory Committee report on building codes.

⁵⁴See Beyer, Housing: A Factual Analysis, pages 112-114.

tem. The 27% of the building which is included in the system is hardly a radical departure from code requirements; the additional 50% of the building which is proposed to be included would require significant changes in codes to permit the use of most of it as it includes pre-packaged utility cores and plumbing connections, preassembled interior work and similar innovations in materials and details not currently sanctioned by building codes.

Habitat, because it was constructed for the Montreal Expo, avoided the necessity of code compliance, which, if enforced, would prevent its construction in every city in the United States since it does demand the use of highly innovative technologies.

Because it is generally difficult to obtain waivers, the building codes tend to compel adherence and therefore restrict research and development in many valid problem areas of housing design.⁵⁵ Mobile homes, manufactured beyond the jurisdiction of building codes and FHA housing standards, have made significant technological advances in some of their mechanical and plumbing systems as well as in areas of functional use layout. In spite of the fact that the homes have continually become larger, better equipped and better engineered, the square foot production costs have actually fallen since 1950.⁵⁶ Mitchell Associates, engaged in the development of low-cost housing based on performance criteria, have estimated their present construction costs at \$8 a square foot and have visions of lowering this to \$6. The only way they can build is to obtain substantial building code waivers, a hurdle which has yet to be overcome.

⁵⁵ Archaic plumbing systems, sustained by code requirements, are a major cost problem in housing today. Industrialized production of utility cores and the redesign of the bathroom and the kitchen plumbing systems could reduce the plumbing costs by more than two-thirds. Although many proposals have been made, none have ever actually gone into production testing.

⁵⁶ Blair, op. cit.

The real struggle, as they see it, is to reduce costs to within the bounds necessary for profitable production in the lower income market and in this attempt they appear to have found a direct correlation between the amount of code deviation and the cost savings. If the system can be proven profitable to produce without the necessity of subsidizing production or sales, this will go a long way toward convincing the political sphere to take some action on code waivers to get the housing into production.

Development

New solutions or innovations which result from the research and development efforts of the housing designers run the risk of being unacceptable in present use, regardless of the merit of the proposal. This is the problem which faces Habitat. While not all of the design concepts would want to be repeated in other housing developments, certain of the more outstanding cost saving innovations, such as the mass-produced bathroom units and the utility core packages, are not currently allowed in the U. S. building practice. Union opposition to the innovative structural frame of the Mitchell system has managed to block construction in Detroit. Since the extensive research and development necessary to produce these systems requires extensive investments, and the ultimate returns from untried housing systems are so unsure, private capital sources for this work are just not available.

Although a great deal of the research and development work already in progress has been carried out by private enterprises such as Mitchell and Koch, this does not mean that these companies will be able to see their projects through all phases of development without additional sources of financial aid. Most of the leaders in the field of industrialized housing research are continuously seeking additional grants and funds from public sources, primarily through HUD. So much remains to be done in research and development before any

system would be capable of mass production on a low cost basis that it is not reasonable to assume that private enterprise will be able to carry this burden in the hope of eventually finding a return on the investment. In addition to the research and development of hardware systems and the concern with the rather explicit housing standards set forth in various codes, designers must also reconcile the image of innovative housing systems with the implicit standards which have been developed by builders from their experience in observing customer preferences in the housing market.⁵⁸ This second set of standards, concerned with good design, must meet the psychological and physical requirements of its users, and is just as critical to the production of successful lower income housing as the first set.⁵⁹ Housing produced for the lower income market must pay particular attention to the needs of its tenants and its image must be suited, not to them, but to their aspirations. By incorporating new codes and standards and new technologies, the design must not make the mistake of creating a form of deviant architecture that will physically and psychologically set its future residents apart from the norm of society.⁶⁰

Summary

Designers, in attempting to develop design strategies which permit flexibility in meeting building codes and housing standards as well as accommodating labor union work rules, are finding it extremely difficult to lower the unit costs of the housing enough to build a convincing argument for mass production of their systems. Even if these constraints cannot be removed, the

⁵⁸For an almost explicit formulation of these standards refer to any recent issue of House and Home magazine.

⁵⁹Meyerson, op. cit., page 137.

⁶⁰See Glazer, The Public Interest, Spring, 1967.

large investment requirements of research and development are enough to limit rapid creation of a housing system. So much remains to be done, both in the field of technical research and in resolving the ultimate image of industrialized housing, that without additional encouragement it will be many years before a successful system can evolve.

VI. The Restructuring of the Lower Income Housing Market

The large market for lower income housing has remained unsatisfied because little or no housing has been produced which can competitively priced to reach that market. Instead, the market has had to rely upon either subsidies to sustain housing production or the extension of the economic life of sub-standard housing. If the costs of new housing production are lowered, larger quantities could be produced, and it is reasonable to assume that within some range of price and financing combinations a significant portion of the lower income housing market could be satisfied by private enterprise, thereby eliminating the subsidies now proposed for that market and also reducing the level of subsidy which may be required if the government seeks to reach all housing consumers at the bottom of the market.

Market Guarantees for Production

The need for stabilizing the lower income housing market by insulating it from cyclical changes in national economic activity has been discussed. This in itself, however, may not be sufficient guarantee against investment loss. Producers will also want some assurance that the high volume of industrialized production can readily be sold on the market. In order to get this assurance, industrialized housing systems are currently seeking ways to organize the lower income market to favor large scale production. The classic approach is summarized in the following quote:

"To reach a successful marketing situation, the prefabricated house has to break a vicious cycle. It is competitive only when produced in large quantities. Costs are brought down through mass-production, but this can only be marketed through a mass-distribution network in response to an engineered need. The prerequisite for demand is low cost. The cycle can be broken in two ways: first by the injection of an enormous amount of capital to tide over the product through the market building phase. The alternative, in the situation presented by the New Towns, gives the product a monopolistic situation, a large immediate market for an immediate amortizing return."⁶¹

The proposals being made today are avoiding these solutions and concentrating upon the development of the Federal government as an intermediary to act on behalf of both the producers and the consumers by guaranteeing the market for lower income housing production. Efforts have not yet been successful, primarily due to Federal reluctance to become involved in the accompanying political conflicts. HUD has recently encouraged designers and developers to submit proposals for a large scale housing effort. Called the Experimental Housing Research and Development Program, it is aimed at promoting the "rapid construction of large amounts of low-cost housing suitable for meeting the needs of lower income residents." Traditionally, the Department of Defense has also let contracts for industrialized or prefabricated housing for its military needs and is currently working with General Electric on a proposal. The Federal government through these devices and through special FHA sponsored programs, is beginning to give more support to industrialized housing solutions, but until private investors can be assured of a reasonable chance at market success and a reasonable profit margin, they will not be willing to commit themselves to large investments.

⁶¹Koch, A New Town Project, page 24.

Private Investment in Production

The production of industrialized housing remains a highly risky gamble though the lure of tremendous potential profits has interested many investors. It has been suggested that a highly-capital-intensive production system, if it is expected to make significant changes in the cost and technology of housing, might require the investment of \$250 to \$500 million and would need to market 50,000 to 100,000 homes a year for ten years.⁶² Private investment sources are not willing to take that large a plunge into industrialized production. The only significant investment of private capital in industrialized techniques has been limited to the simple prefabrication process of single family homes and to the mobile home industry. Both of these systems require the least investment and offer the least risk when compared to the other examples.

The franchise system upon which National Homes and Techbuilt rely, attracts new capital for expansion from participants already involved in production and allows them control over their own investment. Mobile home production has expanded to its present size over a period of years during which it had to show profits and a growing market to attract new investment. Both systems were dealing in a proven product and a proven market, exactly the opposite case from current industrialized housing proposals. Given the conservative tradition of lending institutions it is natural to expect them to be hesitant to invest in an industrialized production process which has yet to show that it will be successful in a field which has been characterized by a notable lack of success.

⁶²John Eberhard, Director of the Institute for Applied Technology, National Bureau of Standards, in conference with members of the Research and Technology Subcommittee of the Kaiser Commission, 13 February 1968. Eberhard also pointed out the necessity for tax purposes, of writing off the cost of the plant and equipment within ten years and doubted the government's willingness to support such a project.

Flexibility and Change

A large capital commitment to a relatively inflexible production process is to be avoided since the rise of competitive systems or the introduction of new technologies may rapidly make a single housing system too obsolete in terms of changing consumer demands. The experience of National Homes illustrates this dilemma. They priced their products low enough to guarantee a rapidly growing market and expanded production to meet it, but the inevitable change in consumer demands and the rise of competition forced them to contract. Had they invested heavily in production equipment the cutback would have been fatal. Techbuilt and the vacation homes are now expanding production to meet a growing market but are also widening the choice to the consumer by offering alternatives. Thus they remain in a flexible position and are able to keep their homes competitively priced for their particular submarkets.

Lustron, by contrast, invaded a well established market. Since success depended upon the displacement of 40,000 conventionally constructed homes in favor of an untried innovative home, and this was to occur in a conservative middle-class market, the chances of success were slim. The production process was too rigid to adapt to a lower volume of production to sustain the company while it built a market and so the expected clash between the Lustron home and the conventional homes never really materialized.

Public Investment in Production

Most attempts at industrialized housing have not depended upon private capital to finance production. Lustron, in contrast to the gradual development process followed by National Homes and the mobile home industry, was conceived and created as a fully grown giant, ready for instant production. The venture was financed largely through the government's Reconstruction Finance Corporation and when it finally closed, it took almost \$30 million in public money with

it. Consequently the government can hardly be blamed if it is reluctant to provide financial backing for similar industrialized housing schemes today.

A more fruitful approach to federal funding of experimental housing systems is represented in the development of Habitat for Expo '67. This type of project circumvents the objections which stem from the Lustron experience and is not prone to the charge of government participation in what should be a private business venture. The 1975-76 World's Fair will undoubtedly contain some featured housing exhibit, however as showpiece housing it will probably not be of the low-cost variety. This is an excellent method for funding research and development techniques that could later be incorporated into housing types better suited to the needs of the lower income markets.

Direct government funding of industrialized housing projects is rare, although HUD has granted \$216,000 for the construction of 17 Mitchell houses in Detroit.⁶³ In 1963 the City of Boston's contract for the development of a low-cost housing system to be used in renewal development resulted in the Techcrete system. Development cost \$89,200, quite reasonable considering the money the system was expected to save future developers and the time it was expected to save the city in implementing its renewal plans. A series of problems prevented Techcrete's immediate acceptance by developers although it is beginning to gain more favor now that costs have been lowered. Funds for further development of Techcrete into a more comprehensive system have not been found in spite of appeals by the architect to the city and to HUD.

⁶³Journal of Housing, September 1967.

Consumer Financing

A distinct investment situation is found in the provision of funds to the housing market in order to finance individual consumer purchases and to finance speculative or rental construction projects by developers.

The private investment market in housing is mainly a mortgage market. A mortgage is a loan secured by property so that, in the case of default in repayment of the loan by the mortgagee, the mortgator receives the property as his compensation. This means that the "basis of mortgage security is the assumption that the underlying property may readily sold for enough to cover the amount of the loan."⁶⁴ This implies that the market itself is the most important factor in considering the mortgage investment. Another consideration in mortgage lending is that "eventual repayment is not determined by the due date of an obligation but by the income from which that repayment must be expected."⁶⁵ With the exception of the mobile home financing arrangements, these principles have also been applied to the marketing of industrialized housing, yet the pattern does not fit the needs of the lower income market. Instability of consumer income and inability to make equity downpayments has made traditional mortgage lending in that market a high-risk investment and therefore the cost of financing in that market is often considerably higher. The 221(d)3 program, aimed at the moderate income rental housing market, replaced private funds with federal money and provided special tax advantages to the developers in an attempt to bring down the rental levels for new housing in the moderate income range.⁶⁶

⁶⁴Watson, Housing Problems and Possibilities, page 62.

⁶⁵Ibid., page 64.

⁶⁶Refer to rent analysis, Fig. 1.

Figure 1

Project Example: Hester Gardens (Washington Park)

Number of units:	54
Total cost:	\$854,555
Average cost/unit:	\$ 15,800
Average monthly rent:	\$ 104

Monthly rent allocation

Debt service: [†]	\$ 57	55 %
Operating expenses: [‡]	25	24 %
Taxes:	15	14.5%
Vacancy distribution: [‡]	<u>7</u>	<u>7.5%</u>
TOTAL	\$104	100 %

[†] Principle and interest, 3-3/8% for 40 years

[‡] Includes water, heat and maintenance

[‡] Allowance for 7% average vacancy

A great deal more effort will have to be made if financing is ever to be made favorable to the lower income market.

In the lower income market, defined earlier as units priced below \$12,000, rent levels might be expected to range from \$60 to \$95 a month for an industrialized housing unit. With rent levels this low there is little room for error in any of the phases of marketing and financing. Conservative lending institutions have never been able to develop a policy that was sympathetic to this market. Mobile home financing, evolved from automobile financing, is not hampered by the considerations of the mortgage market and is arranged through the dealers or through banks as the sale is made.⁶⁷ Since financing charges are low, monthly payments, spread over a 7 year period, are generally below \$100 a month plus an initial downpayment. Parking space rental and utilities still do not raise the cost above the average 221(d)3 rental levels. Owners seldom retain their new homes long enough to pay them off, preferring to trade them in on newer models, much as cars are continually traded upwards. This process contributes to the filtering down of used units to even lower income markets. Because of the rapid accumulation of ownership equity in the mobile home, the actual cost the owner is less than the payments would indicate, for when he wishes to trade or sell the home, he will recoup a portion of the investment.

Summary

The restructuring of the financing terms for new lower income housing is the key to several market objectives. Flexible financing arrangements as opposed to the conventional rigid mortgage formula will allow developers to

⁶⁷Supra, note 35.

construct rental housing without the necessity of inflating the rent levels to insure at least some semblance of a steady flow of income to meet amortization demands. Many more lower income families could become home-owners under similar arrangements, an objective which should be given the highest priority. The higher effective demand of low-cost housing generated by a more active market will allow for the continuous level of production required by investors and producers and by the industrial process. All of these changes are so inter-related with one another and with the conventional financial structure that a shift of such great magnitude will require an extraordinary effort.

CHAPTER THREE

The important issues affecting the future of industrialized housing have been identified in the previous analysis and we can now see that many of the problems, associated with both the external and the internal considerations, are, to a great extent, dependent upon one another for successful resolution. Our next step will be to see how the problems which have been raised might be resolved by fitting the issues together into a comprehensive program. For this purpose we shall look to the "Housing and Urban Development Act of 1968," the most recent legislation proposed for a new national housing program, and evaluate the role which industrialized housing might play in bringing the program to fulfillment.

National Housing Goals

The "Housing and Urban Development Act of 1968" constitutes a concrete proposal addressed towards finding solutions to the lower income housing problems as they have been outlined in this paper. That industrialized housing could be utilized in helping to meet the goals of this proposal is evident from the volume of housing which is expected to be produced. The Act aims at implementing President Johnson's call for the construction of 6 million new dwelling units in 10 years to replace existing substandard housing as part of a broader program to provide a total of 26.2 million new dwelling units within the next 10 years, of which 4 million units would be publicly assisted new construction and 2 million units would be publicly assisted rehabilitation.⁶⁸ The scope of

⁶⁸President Johnson's message to Congress, February 22, 1968. In the preceding 10 year period only 14.4 million new dwelling units were constructed of which 12 million were publicly assisted housing and 25,000 were publicly assisted rehabilitation projects.

the President's program encompasses new means of encouraging homeownership for lower and moderate income families, new provisions for rental and cooperative housing in the lower and moderate income markets, financial assistance to non-profit sponsors of housing developments, expanded access to mortgage funds, increased rehabilitation activity and a proposal for the formation of "national housing partnerships" to construct large quantities of lower and moderate income housing. In the first 5 years of the program, 2.35 million of the proposed 6 million lower and moderate income housing units are expected to be constructed at a cost to the federal government of \$2.34 billion.

The program represents a fantastic increase in the volume of new residential construction. The problems which characterize the homebuilding industry, and in particular the present shortage of skilled labor,⁶⁹ have combined to limit new home production to between 1.3 and 1.5 million units annually. To increase production to the proposed 2.5 million units annually will call for a great rise in the productivity of the homebuilding industry, a rise which may well be accounted for only through the introduction of industrialized housing technology. Let us therefore review the obstacles to large scale industrialized production of housing with a view to incorporating the process into the President's housing program, in particular those sections of the program which attempt to encourage the production of 4 million federally-assisted new housing units for lower and moderate income residents.

⁶⁹See Wall Street Journal, May 1, 1968.

External

I. The Relationship of Industrialized Housing Production to National Economic Policy and National Housing Policy

Guaranteed Markets

Both the consumer and the producer of low-cost industrialized housing will need to be insulated from economic fluctuations in the housing market. Removing the threat of instability from the lower income housing market would make the consumer market more predictable since the market would be able to absorb a fairly constant level of new housing production. The investment in production equipment will thereby be protected, the continuous cash return from sales volume being used to meet the long-term amortization commitments. The question of instituting special changes in the lower income market structure which would facilitate the absorption of the new housing will be examined in detail later since it is also a problem internal to the industry.⁷⁰ For the moment then, let us first turn to the problem of providing market guarantees for the producer of industrialized housing units.

The establishment of guaranteed regional markets for the sale of large quantities of low-cost housing could be a function of either State or Federal government because they are in the best position to coordinate a wide distribution of the housing and they also command the greatest resources with which to back up their guarantees. Although Boston, in developing the Techcrete system, was able to provide an assured market for a limited number of housing units, such action by a local government would be an exception. Local politics coupled with a lack of adequate resources might prevent most cities from fol-

⁷⁰Intra, page 75 .

lowing this lead, especially on a regional scale. Regional markets have been created however, the prime example being the California innovative school systems program. By securing the cooperation of 13 different school districts, each pledged to the purchase of a similar school building if the cost could be sufficiently lowered, the program created a large enough market to induce producers to develop new low-cost construction and mechanical systems. The guaranteed volume allowed these component systems to be mass-produced in large quantities which resulted in lower costs and higher quality for the completed schools than any of the districts could have achieved on their own. The success of this program indicates that producers can be prompted into action if they can be assured of a market and that they are capable of developing new cost-reducing technologies to meet the demands of that market.

The Role of Government

No market guarantees, per se, are envisioned in the 1968 Act which works, instead, upon the assumption that if enough federal assistance is provided, both to the producer and to the consumer, the price of the housing will be so low as to create the market demand large enough to justify production. Industrialized housing, because it must depend upon a relatively large initial investment in production equipment, may not find sufficient assurance in this arrangement especially if the initial subsidies were not great enough to create an instant demand. In order to be certain that the full volume of industrialized housing production will find its way into the lower income market, the State or Federal government should assume the responsibility for purchasing any surplus housing units which could not readily be sold in the market. This need not be a direct purchase agreement but rather a promise to subsidize the price of the surplus units for sale to local public housing authorities, to local governments for use as relocation housing in conjunction with urban renewal

programs or to other public agencies which have a need for government-assisted housing. Such a subsidy grant for the purchase of the housing units might be in lieu of current housing assistance given to these organizations. During the first years of industrialized housing production, the federal government, through a market guarantee program, might be the largest purchaser of the units. Once the production and installation process has been refined and costs lowered, the new industry may no longer have need of the federal guarantees.

The initial market guarantees could be provided through the Turnkey Construction program.⁷¹ By allowing local authorities to contract for a fixed quantity of industrially-produced units at a subsidized price, the federal government would stimulate an immediate high volume of production. Additional units, certified to be surplus production, would be further underwritten for sale under Turnkey or to other housing organizations, including local non-profit groups such as now sponsor 221(d)3 housing. Once the risk of marketing large volumes of industrially produced housing is removed and the producer can be relatively certain of a large market and a return on his investment, it should not be difficult to attract private capital into the industrial production process.

II. The Relationship of Industrialized Housing to its Regional and Metropolitan Political Context

Locational Choices

The choice of sites for new lower income housing will have an effect upon the public image and the market acceptability of low-cost industrialized housing as well as form a basis for future social consequences arising from the spatial

⁷¹The Administration, in the next 5 years is asking more than \$800 million to fund the Turnkey program, plus the authorization to borrow up to \$1.5 billion from the Treasury for the construction of 775,000 low rent dwelling units.

patterns and locations of the new housing.⁷² Building sites should therefore be carefully chosen in order to impart to the new housing the best possible public image. Economic and racial bias cannot continue to be a primary determinant in the location of lower income housing sites for this bias results in the use of marginal sites and connotations of inferiority. In order to provide for adequate sites, responsible State and local governments must take the initiative in altering zoning restrictions and in educating their residents to the need for new low-cost housing, for federal subsidies in themselves will not change suburban attitudes towards low-cost housing. Central cities do not have space for 6 million units; a renewal program seeking to rebuild the slums within the space of 10 years would find too many displaced residents to be rehoused within the city boundaries. Spillover into suburban areas appears inevitable yet the 1968 Act does not make provision for coping with the problems which this will cause. The Act might include programs for publicizing the benefits to be derived from a low-cost industrialized housing system in order to foster a greater demand for the housing and also encourage a wider distribution of the housing among the communities within a metropolitan region. Certain direct benefits such as increased public services or tax benefits might accompany the housing in order to encourage its acceptance in middle income neighborhoods. The use of eminent domain or the formation of special districts to enclose building sites

⁷²The importance of the relationship between site location, housing image, and social behavior is not clearly documented but a case can be made to illustrate the detrimental effects of poor housing and that better locations and a better image for lower income housing will improve the attitudes and the behavior of the residents. The Marksdale III development in Roxbury, for example, built under the 221(d)3 program yet entirely rent supplemented, is occupied by some of the lowest income residents in the area. The housing, however, was built to standards considerably above other 221(d)3 projects and is visually the most attractive housing in the area. Initial surveys by the BRA probing tenant reaction reveal an overwhelming enthusiastic response, suggesting transformations in the attitude and behavior of the residents. New low-cost housing systems must make efforts to experiment with these parameters in the hope of proving that such changes can be induced.

may prove necessary if voluntary cooperation is not forthcoming. New towns or new communities might also be created, expressly to provide new sites for lower income housing.⁷³

Size of Building Sites

To combat the unfavorable image and the many social problems associated with the large site, high density lower income housing projects of the past, low-cost industrialized housing should avoid repeating a similar pattern. Smaller building sites, one to two acres in size, and lower densities, between 20 to 25 units per acre, will make the new housing less conspicuous in the community and also easier to maintain. Since there are probably more small sites suitable for lower income housing than there are large sites, this will allow more choice in acquiring sites in better locations. A larger number of smaller sites means too that they will be spread more evenly throughout a metropolitan region thereby affording the residents a greater locational choice. Communities may be more easily persuaded to accept one or two small developments than a single large one and, since the new housing will create less of a ghetto effect, there will be greater opportunity to promote economic and racial integration. In addition, the small site strategy is more flexible in responding to local demands affecting the staging of the development.

To be sure, there are also reasons against the use of small sites for lower income housing. Local opposition can become as great to a small project as to a large one and the difficulty of selecting and acquiring numerous sites, each with their own particular problems to be solved, can become a monumental task. The greater variety of code requirements to deal with, the greater

⁷³ Refer to the preliminary work on the development of the Boston Harbor as a lower income community.

number of construction sites to organize and the greater number of conditions to satisfy will make the process less efficient and probably add to the unit costs. But this inefficiency will permit greater participation by neighborhood residents and future occupants who would be left out of a more highly centralized and more expensive project. What is called for is a middle-range solution which can combine the economic advantages of large scale construction and the social advantages of small scale control. One such program is suggested in Boston's announced plans to construct 1000 Techcrete units for lower income residents on scattered sites throughout the city.⁷⁴ By building the units over a relatively short time, the building components can be mass produced and the construction operation can be directed from a centralized control center. Citizen participation in the planning and construction of the local projects, in this instance, may not detract significantly from the economies of industrialized production.

The 1968 Act does not offer any encouragement for public officials and private developers to adopt the small-site strategy, or some other middle ground which would avoid the shortcomings of the large project strategy. Small grants made to local resident groups and to developers to subsidize the added costs of citizen participation and the additional legal or development costs might produce a more desired result. Central cities, in attempting to absorb their share of the new low-cost housing units within the time schedule outlined in the Act, will need a positive program of site acquisition, geared to the volume of industrialized housing production, necessary to insure the continuous flow of units to the market. Perhaps more importantly however, the cities will

⁷⁴See Boston Globe, 10 March 1968, p B-41.

need to develop political strategies which will insure that the results of the Housing Act will eventually contribute to solutions to the social problems of lower income residents who require much more than new housing to satisfy their needs.

III. Resident Participation in Housing Production

The conscious extension of any mass housing program into the problems of employment, job skills and income, so closely associated with lower income families, may contribute to solutions to these social problems. By encouraging lower income residents to participate in and become involved in the process of their housing production, they may not only take more pride in their new housing but may also be brought more fully into the mainstream of the American community once they have acquired new skills and larger incomes as a result of the program.

Given the magnitude of the 1968 Act, it seems that the provision of housing could be coupled with certain OEO efforts and the Model Cities program in order to form a wider base for attacking the causes of poverty. The program projects carried out under model cities attempt to make the most of any job creation potential, particularly the potential to "stimulate new employment in the construction trades."⁷⁵ Employment and job training opportunities in the residential construction trades should have high priority due to the growing shortage of labor in that field.⁷⁶ This training may even be extended to include a self-help housing program which would allow lower income residents to work on their own homes.

⁷⁵ HUD, Improving the Quality of Urban Life, page 14.

⁷⁶ See Note 69, supra.

Achieving some of these goals may prove to be impossible, however, in view of the demand for low-cost construction techniques and economy of resources which are inherent in the lower income housing program. The Federal government has helped to create this problem by placing emphasis upon the low-cost aspect of any housing program.

"The program should spark innovation in the application of new and improved technology and design, and in the development of cost-reduction techniques. The volume of construction activity generated by the program should create a significant market for such innovation, and cities should develop procedures to capitalize on this opportunity.⁷⁷

All too often it appears that citizen participation is sacrificed for the economies of modern technology. While an industrialized process implies greater productivity per worker and a less labor-intensive product, it does not imply that there is no room in the process for low-skilled labor. Indeed, if industrialization will raise the productivity of labor, even unskilled labor may be economically employed if the product and the process have been designed to accommodate these types of jobs. The expanded scale of housing production will demand more labor of all varieties, from training programs to highly skilled craftsmen.

The Mitchell housing system provides an example of an industrialized system which has the attributes necessary for resident participation in its production. On the other hand, Techcrete demands highly trained personnel for its construction.⁷⁸

⁷⁷ Ibid., page 19.

⁷⁸ The lower income housing program in Boston referred to in note 74, supra, will be organized around a "highly skilled team of housing construction experts," for simultaneous sitework throughout the city at no loss of efficiency or wasted efforts. See Boston Globe, 10 March 1968, page B-41.

If the Federal government, in its assistance programs, continues to place increasing emphasis upon the need for a comprehensive approach, involving a great range of participation from lower income residents, then some priority should be assigned to the development of housing systems which fulfill, besides the criteria of low-cost, the criteria for encouraging resident participation in the production of their own housing. Industrialized housing, by mass producing simple inexpensive components capable of installation by unskilled labor, provides us with the most rational approach to a solution.

Internal

IV. The Economics of Industrialized Housing Production and the Existing Housing Industry

The Forces for Change

Within the homebuilding industry and particularly among the larger residential construction firms, there is a growing acceptance of new building products, new production techniques and of a new and more functional image associated with housing.

Many of the largest home producers are now actively encouraging innovative building techniques aimed at expanding the volume of their production.⁷⁹ Much of the motivation for innovation within the traditional industry comes from fear that outside competition will eventually achieve a technological breakthrough in housing production and thereby capture a large portion of the market before the industry can recover.

⁷⁹ Kaufman and Brad, for instance, the nation's largest homebuilder after Levitt and Sons, has been seeking acquisition of a large mobile home manufacturer, an unprecedented combination in the industry. House and Home, April 1968, page 10.

One source of outside competition comes from the mobile home producers whose advances in low-cost technology and high-quality products have combined to capture a growing percentage of the new home market. Mobile home producers are currently directing their efforts toward enlarging their existing markets and expanding upwards into the higher priced markets of conventional housing; one manufacturer has recently engaged architect Paul Rudolph to design high-rise structures for mobile home units which are to be constructed for the urban housing market.⁸⁰ The assembly-line fabrication methods employed by mobile home manufacturers, while capable of a rapid expansion of volume, are not organized for high volume management and control and thus expanded production would require a degree of reorganization and an increase in operating costs. Conventional builders, eyeing the 600,000 low-cost homes a year market outlined in the 1968 Act, are understandably anxious to develop techniques which will be competitive in both cost and speed to the mobile home industry.

Another source of competitive pressure for the lower income markets comes from the large industrial manufacturers, such as General Electric, Ford, TRW and others, who are beginning to respond to the profit potential of industrialized housing. U. S. Steel has developed several steel-framed housing systems and Reynolds is experimenting with the use of aluminum in housing. Although no real low-cost system has emerged from this research, several cost-reduction techniques in mechanical systems have been introduced in heating and plumbing. The question remains open as to who will be the first to put together a workable low-cost system which will meet the volume demands

⁸⁰For a discussion of high-rise mobile home technology, see "Stackup Housing: What are Its Chances," Ibid., page 86.

of the government; the mobile home industry with its vast experience in assembling components from independent producers, the giant industrial firms who have the resources to develop and produce many of the necessary innovational components and assemblies, or the structure and methods slowly evolving within the existing housing industry. By whatever route industrialized housing does come it is safe to assume that the existing homebuilding industry will play a major part, if only because they control the skills and management so essential to the process. The participation of the larger homebuilders in proposing innovational ideas and in following up new developments in the field gives them a continuing advantage in preserving their market position in the face of change. Although industrialization may first be introduced from outside the industry, via the mobile home producers or the industrial corporations, it will reach its full promise of low-cost housing under the skillful management drawn from the homebuilder's wide range of experience with the housing market.

Sources of Conflict

There are, of course, many sectors within the existing construction industry that would be hurt by the application of industrialized technologies to housing production. Organized labor, certain materials producers, individuals unable or unwilling to adapt to innovational change, and many others have sensed the direction in which the industry is moving and are opposing further industrialization of the production process. If the industrialization of housing could be confined to the lower income markets, less opposition would be generated because few, if any, of the established participants in homebuilding are involved in the lower income markets. However, new housing systems and technologies resulting from research and development of low-cost housing for the bottom of the market, if proven successful, are quickly adapted by

competitive producers in other markets. This technological "spin-off" is recognized as a potential threat to the stability of the traditional residential markets and construction practices and therefore even innovations intended only for the lower income housing markets find difficulty in achieving acceptance. By introducing technological innovation on a large scale, relying upon volume production and a high speed of development, local resistance might be overcome due to a lack of time in which to react. The force of the change and the magnitude of its introduction will carry it through by sheer weight of momentum. The large volume of housing proposed in the 1968 Act is ideal for this strategy and the Experimental Housing Research and Development Program, already underway by HUD, would serve to produce new concepts in a relatively short period of time. The federal government, by acting as a catalyst in rapidly getting the housing from the development stages into production, would encourage greater participation within the existing industry because of the assurance of quicker returns on investments. By limiting federal assistance to only lower income housing, and at the same time encouraging a greater production volume for conventional housing, as suggested in the 1968 Act, the government could push industrialized housing to a considerable extent without raising too many conflicts. Government can also reduce conflicts with organized labor by insuring that the scope of a development program was limited to lower income housing and that labor would share in the financial benefits of increased housing output.

Volume of Production

The number of industrialized housing units which could be produced in any metropolitan region, as well as their rate of production, cannot be quantified without specific data. Because economies of scale production generally begin

to be realized above 1000 to 2000 units a year,⁸¹ it is expected that this might be a minimum production goal in any given region. The level of production need not be large enough to entirely meet the demands of the lower income housing market but should be large enough to supplement those needs to a considerable extent and serve to test the industrialized hypothesis in actual market competition. If the system proves competitive, production can always be expanded.

If we were to assume, for example, that a given metropolitan region might be capable of absorbing 2000 new industrially produced housing units each year over a ten year period and that the average price of the units was \$8000, then the gross sales would come to \$16 million annually. If this price included a 6% profit margin for the producer, he could expect to make almost \$1 million a year for a ten year period. In a 10% investment market, the producer would be willing to invest about \$6 million to capture these profits.⁸² When related to the proposed housing program, these 2000 new units would be only a small percentage of a total urban market. In 1969 alone the President called for 210,000 new units for lower income families.⁸³ If the 25 largest urban areas were each to absorb 2000 industrialized units, this would be less than one-fourth the volume of needed housing. Therefore, investors in the

⁸¹This figure is based upon European experience and may not be entirely valid for systems employing radically different design approaches. See Journal of Housing, September 1966.

⁸²This is based upon a relative simple calculation using the annuity formula $a_n = [1 - (1 + r)^{-n}] / r$ which shows that the purchase price of an annuity which yielded \$1 million a year for ten years would need to be \$6 million if it were to equal a 10% return on a fixed investment of the same size for the same period. In practice, tax and depreciation considerations would change these figures.

⁸³See Address to Congress, *Ibid.* These dwelling units are to be distributed among lower income homeownership, 100,000; public housing, 75,000; and

industrialized process need not fear that they would be trying for too large a share of the market or investing in a production method which would outproduce the demand.

Organization of Production

The \$6 million in proposed capitalization would not go into the formation of a highly centralized and efficient production process unless a great deal of assurance, probably of the type found in government contracts, were given to the investors. Even then considerations of time would force the use of many subcontractors as suppliers of various sub-systems. It appears that an industrialized housing system will develop as a cooperative effort among diverse suppliers of materials and management because no one producer will have the resources to supply all the components of a system.

This industry structure would not evolve into a single production process but rather into many highly specialized processes, each supplying different component parts to one or more fabricators. In a competitive market this arrangement would insure price competition for component hardware and a continuing search for further innovative ideas. Once the housing system grows beyond the development state and widens its scope, several manufacturers may supply similar components thus offering the consumer a greater choice.

The flexibility which this type of industrialized housing system offers comes at the price of some efficiency, for a single production and assembly process could lower costs still further. The need for flexibility may well be worth the extra cost, especially since the final choice may be either a flexible system or no system at all. It therefore appears that if industrialization is

rent supplemented units, 35,000. Another 90,000 units are to be built for the moderate income market under the 221(d)3 program which may also be considered a potential market for industrialized housing.

adopted by the existing construction industry as a means of fulfilling the quotas established in the 1968 Act, it will be done by one or more producers in metropolitan areas, combining rapid fabrication techniques with the use of industrially produced components supplied by a series of sub-contractors. Once the system proves itself, it may be expanded and institutionalized as a permanent facet of the homebuilding industry.

V. The Relationship of Industrialized Housing to Building Codes and Housing Standards

Code Requirements

The call for a larger volume of residential construction, particularly for housing to satisfy the lower income markets, is also a call for the development of new techniques of production and innovational materials and assemblies which will bring the cost of the new housing down. Without such changes the new housing will not be produced quickly enough to meet the demands of the program and what is produced may well be so expensive as to exhaust the federal subsidies on only a fraction of the needed production. In this search for economies in both time and money, producers and designers have often pointed at the need for building codes and housing standards which are adaptable to new technological developments and to new concepts of residential form and use.⁸⁴ The majority of the existing building regulations are far too inflexible to permit the necessary innovative changes in homebuilding which will lower production costs and speed up the construction cycle.

No significant changes in the present system appear to be coming in spite of the recognized need. Even the development of a uniform building code will

⁸⁴See Commission report on Building Codes, Ibid.

do little to solve the problems of low-cost housing design since the code could not, in its present proposed formulations, be flexible enough to meet the real performance needs of the designers.⁸⁵ What is often called for instead is the institutionalization at the federal level of an inexpensive performance testing and approval method that would encourage the development of new products rather than freeze building technology at any present level. Opposition to this concept is often vehement, as could be expected, from suppliers of traditional building materials who are doing quite well under the present, well-defined system.

Since new legislation in this area does not appear to immediately forthcoming and since there could be no assurance that even if changes were made they would be addressed to every possibility in the field of low-cost housing research, the present process must continue to be used, which, in general, depends upon the development of new technologies which can be shown to be superior in use to existing alternatives. Application for variances and waivers for the use of these particular materials or designs must then be approved. Because local codes vary considerably and local appeals boards, closely tied to the political situation, vary in their emphasis and their attitudes towards proposed changes, the process of technology development by appeal is extremely inefficient.

Developers and designers are forced to seek the mini-economics which are found in particular circumstances surrounding a housing project, such as site conditions and political issues, to reduce costs in the hope of using the new techniques in one or two project locations. Under these conditions it is

⁸⁵The National Building Code recommended by the influential National Board of Fire Underwriters is not unlike a compilation of the extreme provisions of every existing code in the U. S.; see also Building Research Advisory Board, Economic and Other Implications of Performance Building Codes.

extremely difficult to develop low-cost housing solutions which are applicable on the wide scale suitable to industrialized production.

Long-Term vs Short-Term Costs

Another factor which is rarely considered in the development of lower income housing for limited local markets is that low initial costs may not be a reliable indicator of the true benefit of a proposed housing system. Lower operating or maintenance costs, for example, may justify a higher initial cost as may greater social benefits in the form of increased privacy, better use of housing or a closer identification of the resident with the image of the new housing. However, no data exists to show that long-term social costs may actually be reduced by innovational designs.⁸⁶ Long-term physical costs can be lowered if higher quality assemblies requiring less maintenance are included in construction. Experimental work with mechanical systems, for instance, has shown that 5% of the rent produced by conventional dwelling units goes to amortize the cost of the heating system whereas 12% - 17% goes toward direct fuel costs. More efficient systems, integrating waste disposal and vastly improved levels of comfort may be built for about the same total monthly heating outlay and might reduce long-term maintenance costs considerably. Yet until such a system is actually developed and marketed, it will be difficult for code officials to endorse its use. Federal encouragement of the development of more economical mechanical systems is an administrative and political decision which depends upon the choice between low-cost construction and lower initial subsidies or higher initial costs with the chance of lowering the long-term subsidy rate.

⁸⁶ Refer to description of the Marksdale III development, supra, note 72.

Research and Development

The 1968 Act proposes that \$20 million will be spent for research and development in urban technology. Investigation of housing technologies should be the first goal of this expenditure, for private enterprise cannot be expected to risk too much capital on the research and development of systems which may or may not be accepted by local housing officials. Because the cost of housing research is so high and the immediate benefits are social rather than financial, the federal government should sponsor much of the development of new housing systems. For similar reasons the government underwrites the majority of the research and development which goes on in the field of aeronautics. The scale of a progressive research and development program in low-cost housing technology would be too large to be amortized through the price of the housing, especially since the housing is intended for the lower income market. Therefore it seems essential that the federal government, acting in the national interest, become directly involved in providing research funds. Although less explicit in its purpose, the eventual aim of the Experimental Housing Research and Development Program current underway by HUD will be to provide much of this funding. The program is seeking a prime contractor, similar to aerospace procedure, to undertake the initial phases of research and development of low-cost housing systems for use in Model Cities. Mitchell and Koch are among those offices submitting proposals.

Standards

In developing new housing systems based upon innovative technology and special standards, and directed toward the lower income markets, designers must be careful not to depend too much on the belief that federal assistance will help to pay for the advanced designs. For one thing, the necessary appropriations may not be passed by Congress and for another, it is difficult to

believe that the general public would consent to subsidizing large quantities of low-cost housing for lower income families if that housing is actually far better than anything they themselves might be able to obtain on the market. For the moment it may be wiser to strike some median in reference to existing housing standards and low initial costs however promising the new mechanical technologies seem to be. It may be many years and many dollars before such technologies become widely available, even at moderate costs.

A more pragmatic approach to the design of low-cost housing would seem to concentrate upon obtaining better performances from basic materials and assemblies. Simple housing systems, composed of a few basic components, will be less expensive to develop and less expensive to build than the more complicated "total environment" systems. A basic system could prove to be extremely flexible if it were designed so that in the future, as innovative housing components were developed and costs reduced, new elements could be included, either replacing older components or added to the basic frame to upgrade the housing. The initial simple housing might even be built to standards below some of the present housing standards if such a design would bring costs down even further. Residents could then bring their housing up to standard by doing much of the finishing work themselves. Housing which would lend itself to this additive process would give residents the ability to adapt their housing to accommodate their changing demands. In this sense, the basic housing system would be analogous to an electrical socket; just as light bulbs may be exchanged for better quality and differing requirements so might the component parts of the house be changed. Not only will this strategy allow for many varying degrees of quality and cost in the construction stage of lower income housing but it will also allow the residents the opportunity to fulfill their own housing ambitions by gradually building up to them. A housing program based

upon this approach would be able to rely upon support from model cities programs and the social efforts of many community organizations thus involving the residents to a large extent in the process of housing themselves and in the community around them.

VI. The Restructuring of the Lower Income Housing Market

Financing

The production of large quantities of new low-cost housing needs a ready market; the development of financing arrangements suited to the lower income housing consumer is essential in balancing demand and supply. The continuous volume of industrialized housing which would reach the market must be assured of a corresponding continuous demand, a demand backed by purchasing power in both the homeownership market and the rental housing market. One key to this demand is, of course, low cost. The other key is found in the availability of financing at reasonable terms.

The federal government is in a position to exercise control over the availability of credit to lower income families by insuring the mortgage loans and by underwriting the interest rate on the loans. Federal assistance in subsidizing the price of the housing will depend upon the production costs; the industrialization of housing production will lower unit costs, hopefully to that point at which federal assistance will not be required. Once low production costs are reached, the private sector would supply the housing, being able to rely upon the government to insure its marketability.

CONCLUSION

In analyzing the role of industrialized housing in meeting the needs of the lower income market, this paper has revealed a paradox, seemingly inherent in any massive attempt to supply large volumes of low-cost housing to the

market. The paradox arises from the conflict between the development of a modern housing technology, a technology concerned with the efficiency of housing and housing production, and the development of a comprehensive housing program, a program based not upon efficiency of production but upon longer range social objectives which endeavor to eliminate the causes of poverty by structuring the process of housing production to suit the economic and political needs of the lower income population.

This conflict is illustrated by the necessity, on one hand, of creating a low-cost housing technology characterized by a rapid industrialization of the production process, massive amounts of investment capital, a high degree of centralized control and a factory finished housing product, and, on the other hand, of creating a low-cost housing system capable of market responsiveness and flexibility in satisfying a wide range of individual choice as well as resident participation in the production process and the utilization of large quantities of local labor. It is evident that we face a dilemma in trying to meet these requirements, a dilemma that can only be resolved by seeking some form of compromise solution.

Our efforts in finding methods to supply housing to the lower income markets are best directed toward developing low-cost systems which are susceptible to an entire range of fabrication and installation strategies. This option provides for housing to be nearly completed at a factory location and shipped to a construction site or to be shipped as components for local installation. There must also be flexibility in determining the standards to which the housing will be built. The combination of alternatives available in this approach will accomplish two things. First, it will allow the development of a true low-cost system, composed of factory fabrication and a lowering of housing standards. Government can then subsidize the process, providing the resident

participation, and the product, providing for higher standards, to the extent to which the social benefits balance the added costs. This subsidy would be free to vary from place to place and over time according to available resources and public support without affecting the basic supply of lower income housing.

Secondly, this approach will encourage the consumer to become involved in the supply of his housing, both by permitting self-help labor in which the resident is rewarded according to his efforts and in permitting the resident to continue to add to and upgrade the components and standards of his housing in keeping with his financial position and his aspirations.

While a compromise solution does not maximize either the economics of low-cost technology or the resident orientation of the housing, it does serve to optimize these goals and at the same time satisfy the necessity for political choice upon which our governmental process is founded.

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