10 Houses from factories

While we were designing the Habitat interiors I flew down to Toronto to see the Frigidaire assembly line. Since Frigidaire were going to build the Habitat kitchens they wanted me to see the way they should be assembled so this could be taken into account in the design.

It was enlightening. Here was a relatively complex product, a refrigerator, and yet it was assembled simply with few steps. The installing of a particular piece of insulation piping or wiring was timed to the second. Just compare that with a building site! Imagine an automobile assembly line where each step along the line is undertaken by a different company with its own financial interest and separate labor union! I'm convinced that no one is going to be able to mass-produce a house until the entire process is under a single corporate structure, and probably a single union too. Yet factory-made mass-produced housing is the magic word being whispered as the key to salvation.

Present practice is impossible. The client asks an architect to design something specifically for him. In making drawings the architect will specify various components out of catalogues. He is nearly always restricted to elements that are already manufactured. Then the contractor, who has usually had nothing to do with the design process, examines the drawings and makes his bid. Industry supplies raw materials and components and has little contact with the contractor. The various building material manufacturers make their components totally independently of each other. They do not develop a product with an overall view of the complex it goes into. It is an absurd industry, inefficient in comparison with any other area of manufacturing. The design process is done over and over again; the architect has to invent the wheel every time. The contractor, on the other hand, cannot put his own experience into the design process; he gets a set of drawings as a *fait accompli*.

From the time I started working on my thesis, I felt that the whole construction process had to be put into the factory, with all that implies. I studied what was

considered in Europe to be industrialized housing. All their systems in 1959 and 1960 were based on panel construction. The walls, floors, and ceilings of a house were manufactured in a factory. The rest of the building was more or less conventionally finished. This seemed a limited system, since even if you could perform a miracle and produce the shell at no cost at all, all you were doing was cutting the construction cost by twenty-five per cent because seventy-five per cent of the house isn't in the shell.

I concluded, any system that didn't permit you to take seventy-five per cent into the factory was automatically obsolete. I also felt that the limits on these systems forced the architect to produce a vertically stacked cellular beehive of an apartment building. All the components met at corners, and corners are always the weakest point in the structure. Only in the U.S.S.R. was there further experimentation: instead of prefabricating panels, they were prefabricating whole rooms.

So I came to the conclusion, as others have, that in order to take that seventy-five per cent into the factory, you had to deal not with panels but with volumes of space. You had to prefabricate cells of space in the factory, and put your mechanical services, plumbing, bathrooms, whatever else there was, into them in an assembly line procedure. You would then assemble the modules on site and, if connections were simple, you would have a ninety-five-per-cent-factory-produced building. This was the first very important implication of making houses in a factory.

It seems to me that dissection into space cells is going to be the single most important change in the building process in the next twenty or thirty years. It will be necessary to rethink much of the building that makes the city in terms of space cells.

Industrializing building is, however, much more than prefabrication; essentially it is a reorganization of relationships. In the automobile industry, design and construction, research, marketing, and servicing are an integrated process within a single operational structure. The group of people who design the car also design (at the same time) the machinery that makes the car. The quantities involved are such that the company can afford to build machinery to make the particular product. The design of a window, the design of the gaskets for the window, the design of the steel door the window goes into, are all done simultaneously, so they are really designing particular components for a very specific context, in a sense, a closed system. Then, since the automobile company is involved with servicing and marketing too, the designers must also consider operational economy. The large automobile companies can afford to spend millions of dollars – maybe ten thousand per cent of the sale price of the individual product – designing a car that will sell for a few thousand dollars. (Pre-manufacturing costs for particular models have been quoted at anything from seventy to two hundred million dollars.) Conversely the architect's fee is six per cent of the sale price, even though a building is so much more complex than a car.

One of the most critical reasons for reorganizing the industry is to create a capability for research.

Other industries have the ability, once they have decided to manufacture a product, to build prototypes, and test and improve them before they go on the assembly line. The British and French aircraft companies spent two billion dollars on development of the Concorde supersonic transport over a period of many years before manufacturing it. The U.S. expects to spend five billion dollars on its SST. But, if you suggested spending that kind of money building and testing prototype communities (you could build one prototype community in every state and every province on this continent for five billion dollars) people would think you were "unrealistic."

The design cost of Habitat, two million dollars, is building research. In a way the whole cost of design *and* construction, twenty million dollars, should be considered research. Just as the car manufacturers hand-make a test model so Habitat was a hand-made prototype of what eventually could go on a mechanized assembly line. Habitat was more hand-made than even a conventional building. We were following a process of trial and error, trying things out and changing them in the building. The contractor of Habitat estimated that whereas the efficiency of a car assembly line is eighty per cent in terms of the workers' productive time versus idle time, and the efficiency on the average construction job is thirty to forty per cent, on Habitat it was ten per cent.

I do not believe that careful pre-planning would have prevented that amount of wasted time. Most of the time we were learning lessons, not making mistakes. We were learning things that could not have been predicted without physically doing them, for real, in full size. We were stretching the existing state of the building art far beyond its accepted capabilities. For these lessons the Canadian taxpayers paid twenty million dollars.

Building Habitat highlighted the problems of industrializing the construction industry. Construction is one of the few industries that developed before the rise of modern technology. The automobile and aircraft industries developed their own organizational structures as they evolved with that technology.

In a sense, building Habitat was like trying to have an assembly line without the organizational structure of mass-production industry – we proved it couldn't be done. We were successful only in fragments. For example, forty years ago Buckminster Fuller pointed out that a bathroom was made up of five hundred different bits and pieces of pipe and tile and hardware, assembled by a number of people over a period of three to four days, yet the whole bathroom done in one single molding of one material, in five per cent of the time, could eliminate most of the labor and be a superior product without joints. Habitat's bathrooms were a belated realization of Fuller's statement.

It is dangerous to underestimate the difficulties of introducing mass-production, closed-system techniques into housing. A house is much more complex than an aircraft. An aircraft can be clearly defined in terms of physical performance. Passenger comfort is a minor consideration compared with the plane's needed ability to fly at certain speeds for certain costs and to land and take off on available runways. A house is a physical problem, plus a complex social problem, plus a complex psychological problem. A house has to be publicly accepted. It has to have what a real estate man would call "marketability." This basically means it has to satisfy certain requirements not physically definable. These requirements are also dynamic, and therefore less predictable. You could design a complete housing system and find that no one wanted to live in it. Therefore, there is great risk in investing two or three hundred million dollars in a housing system at present; which suggests that the risks should be shared by the tax payer, as they are in space and other research.

Another consideration is that aircraft or cars or appliances or typewriters are relatively compact. The price per cubic foot is relatively high. That means that you can manufacture typewriters in one place in the United States and ship them throughout the world without shipping costs becoming an appreciable portion of the total cost. Housing is much cheaper per cubic foot. A house which has a volume of ten thousand cubic feet may cost twenty thousand dollars, or two dollars a cubic foot. A car with a volume of five hundred cubic feet may cost three thousand dollars, or six dollars a cubic foot.

To take the extremes, there is maybe ten thousand to one hundred thousand times more value to the material per cubic foot in a satellite or a computer than there is in a car; and there is less per cubic foot in the construction of a street or a dam than in housing. Since shipping air is extremely expensive, the shipping costs become a much more critical factor in housing.

You probably could not produce a total housing product in a single location in the United States or Canada and distribute it throughout the continent because shipping costs would be too high. On the other hand, I should think you could manufacture eighty per cent of the house (in terms of cost) in centralized plants on a continental basis – bathrooms, kitchens, electrical systems, heating and cooling systems, everything but the shell – and distribute nationally, just as the car people make their ball bearings in Puerto Rico and all their engines in Detroit. You could manufacture the shells in, say, five locations on the continent and under today's market conditions distribute them within a radius of a thousand miles if you were using relatively light materials, maybe five hundred miles using heavier ones.

These two substantial differences between housing and most other industries explain why private enterprise up to now has not taken the business risk of tooling up for industrialized housing, and illustrate one of the chief problems they will face once they do.

If we apply factory efficiencies to the construction industry, the financial relationship between owner, designer, manufacturer, and contractor must also change. It has to be integrated, made into a single entity. I see no way in which meaningful technical advances can be made unless total integration takes place. You can't deal with thirty different labor unions on a single assembly line, yet that's what we were trying to do in Habitat. The implications are clear: The obvious, even if not the safest, North American solution is for the great corporations, which are already involved in making everything from space ships to toasters, to start making buildings.

If we could achieve this integration, the architect, who up to now has acted as an ivory-towered prima donna making sketches that the contractor will hopefully transform into a building, would become part of a much greater entity. Architects today are certainly resisting any such change. But I'm afraid they are going to be gradually pushed out of the picture. Today, architects in North America design only twenty per cent of all buildings. If they persist in their attitude this percentage will dwindle until only the odd museum and concert hall will be architect-designed. A new profession of industrial building designers will be created by the great corporations.

One thing that frightens most of us architects is the difficulty of preserving identity and authority in the new team. But I don't think we have any choice. This is what differentiates Buckminster Fuller from the architectural establishment of today: Half a century ago Fuller made the link between environment, technology, and industrialization. He stated in clear terms that if we use technology we will be able to provide more for more people using less material. Since this is what we are after, then we ought to use technology to industrialize the methods by which we build our environment. In contrast, Philip Johnson expressing a common view, could say to me in 1967: "I don't give a damn about technology, I'm interested in space." But when he says that, it seems to me, he's also saying that his interest in the environment is in creating certain isolated buildings of as good a quality as he can, but not in making that solution available to everybody. The difference in attitude is one of conscience or politics.

Technology today means mass production, the assembly line, large-scale organization, corporate structure – whether it's in Russia or the United States. It means automation. It means integrated production. In the field of environment, it also means a tremendous threat to human identity and aspirations. Not only architects, but the public too, are terrified of it.

People recognize that our technology basically means doing things in great numbers, which means repetition, which implies the kind of organization that operates on centralized decisions. Nothing more powerfully symbolizes the conflict between the individual and a centralized, numerically-oriented process than the concern with environment. The fear is that the environment will become stereotyped, repetitive, monotonous, overwhelming – a place where the

individual will feel that he has lost his identity or, even more serious, has lost control. People make the link between mass production and monotony, even further discouraging the industrialist from going into mass-produced housing.

In fact, I think the public is right to be frightened of industrialization and all that comes with it. Russia is an example of what can happen when industrialization takes place. Building has been put into the factory, and because there is a lack of understanding or concern for the environmental problems that are caused by repetition, the Russians are creating a deadly monotonous Kafkaesque soulless environment.

Suppose housing were industrialized overnight, and a great new corporation called General Housing Corporation started making houses, with design departments to slather form over the utilitarian chassis – the way they make cars now. How would an ad for houses read in 1982, say in *Life* magazine?

Introducing the new Ranchera	Featuring, for 1982, touch-wrist lighting (you touch your wrist and the lights go on) the new aerolite finish, gold inside and outside hermetically sealed to filter poisonous smoke in the air (you can now remove your gas mask when entering the home) requires no daylight whatsoever – all the walls glow
A new feature	dial-view – select your own view! project it on the walls! Infra-blue automatic cooking, a new kitchen by Fisher.
Special bonus	With each house comes a special bonus of a one-year supply of pre-cooked food for the whole family, six menu selections to choose from.

Or, at the other extreme, we could read in the Washington *Post* in 1982:

Notice TW 6715, Department of Housing and Urban Development

Department of Housing announces that all heads of families born between January 1, 1952 and January 1, 1962 within the income range of $8,450 to $10,740 are now eligible to receive Dwelling Types H, J, or K which are available in zones B1, B2, and C. Applicants must fill in six copies of Form Number HUP 36.968: DC 16/54. The Department also announces that families of category XP14 who are living in Unit Types S, U, and V which were distributed in 1974 may now apply for installation of new washing-drying machines. Applications . . .

That is equally frightening. We already have examples of both sorts of announcement so we can't afford to laugh at them too much. I'm sure you could open up some government gazette in Eastern Europe and find a similar notice; and if we look at TV or magazine advertising in North America today and project those ads into housing, my examples do not exaggerate.

The real issues of the environment as we see them today would no longer be issues. We would not bother trying to organize a city plan that allowed every house to have daylight, we would avoid the issue by creating houses that need none. We wouldn't bother with pollution, we would avoid the issue by creating a hermetically sealed environment. Technology is process and is only the means to an end; it is no guarantee of anything.

If Habitat went on for five miles it would become intolerable, because unless other scales or orders of organization were introduced to give a hierarchy we would lose our sense of location and identity, our sense of orientation, which is the most essential part of any environment. What frightened me about the modern parts of Moscow was the lack of varying rhythm, the fact that you have a series of identical buildings repeating indefinitely in a neutral landscape. You never know where you are. You always seem to be in the same place. You have to rely on numbers and signs to find your way.

Without the introduction of a larger scale of organization Habitat would be no different from Moscow. This hierarchy is created by the interweaving of open and built-up space, by the transportation systems, the varying mixture of land uses. Rhythm is the essential ingredient of a sense of location. If we removed the black keys from the piano, the pianist wouldn't know where to put his hands. Architecture today tends to ignore rhythm, or rather has a 11111 rhythm. Curtain walls, suburbs, modular partitions, much of contemporary architecture is 1 1 1 1 1, a repetitive beat giving no sense of location. In suburbs, we try to create identification by superficial changes to make up for the monotony, whereas in the Greek village they didn't have to paint every house a different color, people recognized their own houses because difference was the result of complex forms.

The challenge of today is to understand the problems our technology introduces in the environment – what Aldo van Eyck calls the problems of the architecture of numbers, and what R. M. Schindler was talking about when he said that in architecture one plus one is not two but three. Only an understanding of the issue can reduce the threat. And there is no use rejecting new technology in building; we have no choice, any more than we had a choice in industrializing agriculture. The only choice there, was between famine or plenty: the choice here is between a decent shelter or no shelter. Are we going to have an environment fit for human beings or mass dehumanization of environment leading to a regression of our species?

Habitat tries to show that it is possible to have an environment that is not monotonous, one that has the possibility of identity and of variety, choice and spatial richness, and yet at the same time the use of repetitive mass-produced systems. For me that is where Habitat has been most successful. The fact that the actual components in Habitat were hand-made is irrelevant in the face of the demonstration that a few repetitive components could be assembled to form a variety of houses and community spaces, the kind of environment that people normally associate with the non-industrialized, handcrafted, vernacular village.

People visiting Habitat were reminded of a Mediterranean village. That association was not rooted in formalism; it is generic in nature. The typical Aegean hill villages, the Arab hill towns, or the Indian pueblos are true building systems. They consist of a vocabulary of repetitive components – for example, the Arab village with its cubical room, dome, vault, and court. These components are manipulated by the individual who builds his own house. The houses are grouped along alleys and streets in harmony with the site. Habitat is in the tradition of spontaneous self-made environments, the beginnings of a contemporary vernacular.

Beyond Habitat

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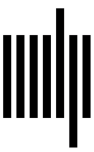

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