20 Puerto Rico: Breakthrough

Fred Epstein and Haim Eliachar were two others who visited Habitat during Expo 67, but I had not met them then. Epstein spent two whole days in the construction exhibit, studying in detail the plans and sketches. He is chairman of the board and Eliachar was then president of Development International Corporation and its subsidiary, Development Corporation of Puerto Rico, a builder-developer company that each year puts up about a thousand units of conventional housing in the public and private sectors in Puerto Rico and the continental U.S.A. They had also built projects through the AID program in Peru and Mexico, among other places.

It is not exactly an everyday happening when a developer putting up conventional housing in the public and private sector comes to an architect who is doing, certainly from the developer's point of view, extremely experimental work, and commissions him to develop a building system. Some background on Epstein and Development Corporation is therefore relevant.

Epstein, a relaxed, friendly New Yorker who graduated as an aeronautical engineer (he flies his own plane), started as a builder of single family houses on Long Island. In 1957 he moved to Puerto Rico and within a few years became one of the most successful and largest developer-builders on the island. He built houses, public housing units, apartment buildings. Eliachar, who was then his partner, also had considerable building background, including prefabricated wood structures. Epstein had done very well and at the time we met was becoming very conscious of the more subtle set of values that must confront a builder on this continent. He had a genuine and strong desire to do something good, and the security of one who had done well and could afford it.

There was a mixture of personal and business considerations motivating him. On one hand he liked Habitat, was really excited about it. He has told me that when he first saw it he became determined to do the same thing on a successful commercial basis, to prove that it could be done in the context of

business. With his keen builder's eye he immediately saw the critical technical difficulties of Habitat and realized that in Puerto Rico he would not be confronted with most of them. As he recalled later, Puerto Rico was obviously the right place: concrete technology was advanced; concrete construction for housing was accepted; the climate eliminated most of the problems of insulation, heating, and protection of mechanical systems. If the system was to go, it would be best to start there.

Epstein also has a total view of the business he is in, something you discover as you get to know him. This total view suggested to him that industrialized building was the coming thing, that modular space cells were something he was reading about in all the trade journals, and that his company ought to explore its potentials. At the beginning of our association Epstein was negotiating an expansion of his company by including some prominent Wall Street bankers as partners; they, too, had responded to the idea of the company's involvement in modular housing and had encouraged investment in it.

It was just after the closing of Expo that I received a call from Haim Eliachar. He and Epstein were interested in Habitat, he said, and they felt they could build it in Puerto Rico successfully. Would I like to come down there and discuss it? At that time I was getting at least a couple of calls like that a week and wasn't taking them very seriously. My test was to say, "Are you prepared to cover all my expenses?" Eliachar said, "Of course we will." That eased enough of my scepticism for me to accept the invitation. I met him in New York two days later and we flew down to Puerto Rico. Epstein had arranged for a number of meetings with Puerto Rico government officials: the head of CRUV, the public housing authority; the head of Fomento Cooperativo, the Commonwealth government co-operative agency which sets up co-operatives for housing or industry; and FHA officials.

The chief administrator of Fomento told Epstein that they would consider having Development Corporation build a Habitat in Puerto Rico, which they would buy on a turn-key basis and make into a co-operative, providing the costs were within the prevailing limits of the 221 (d) (3) housing program (a U.S. federal program of low-interest loans for moderate-income housing). This closely related Habitat Puerto Rico to my efforts in Washington, which were also for the 221 (d) (3) housing program. Fomento offered to make a site available and agreed that if for any reason Fomento caused the project to be abandoned, they would cover the cost of design and feasibility studies up to a hundred thousand dollars. Development Corporation signed a contract with Fomento to proceed with design and feasibility studies and I, in turn, signed a contract with Development Corporation. I called Ed Rice and asked him to join me in Puerto Rico to assess the problem and discuss the production facilities with Development Corporation's management.

At Habitat in Montreal, the plant was on the site. At Habitat in Washington, it would have been very close to it. But it couldn't be close in Puerto Rico. In fact,

Development Corporation envisaged shipping modules to all parts of Puerto Rico and by barge to the Virgin Islands and, eventually, to islands farther away. So it became essential to develop a module that could be shipped on the highways and by barge, which meant that it had to be restricted to twelve feet in width; you couldn't ship the Montreal module, which was seventeen feet wide.

This constraint and the requirement of meeting the 221 (d) (3) cost limitations posed a tough problem. As soon as you reduce the width of the unit you discover that a stair running from one floor to the next one above can't make it in one run unless the boxes are always set parallel to each other. Even then, if you had one box on top of another and two rooms in the top one, you would need space for a stair run and a corridor side by side, so that the space needed for circulation in the house would still be enormous. Also, two-storey houses didn't make much sense in a tropical climate and yet a single-storey house required extensive corridor space and made it very difficult to achieve privacy between, say, sleeping areas and living areas.

These considerations led me to strive for a split-level module. I jogged the module half its height at the center line, with an incline that corresponds to the angle of the stair, producing a sort of elongated honey-comb effect. The smallest house was one unit, a number of units in combination could make a one, one-and-a-half, two, or two-and-a-half level house. It was even more versatile than Habitat. The angle of the incline and stair was repeated at the end faces of the module, so that there was a projection in the shape of a sideways V. This projection became a window with its top half solidly louvred against the sun and the bottom half of glass which, because it was inclined inwards, was shaded so that one could look out even at high noon without the sun penetrating the house. Storage units, kitchen, bathroom, and even some built-in furnishings fit well into these V-shaped spaces, and even though the volume contained was similar to that of a rectangular room five feet shorter, the feeling of the space was much greater because the room extended five feet farther at eye level, which is the level critical to perception. The overall efficiency of the space was at least equal to the same space in a box with vertical walls, and the circulation was better. Compared with the full stair run and extensive corridors of Habitat Montreal, there was just the half stair run on the incline itself and the landings; no corridors whatsoever.

Many of these design developments were generated by visits to both traditional and newly-constructed Puerto Rican communities. Most public housing projects had windows made with solid aluminum louvre jalousies and because of the very severe heat and sun penetration, the louvres were shut for the entire day. Since the people were unable to open the louvres for fear of overheating the house, they were living in virtual darkness.

In San Juan I visited old Spanish houses with their central courts open to the sky, around which were all the rooms. So, when the cluster was designed, rather

than form exposed roof gardens as in Habitat Montreal, we developed a plan in which the garden was a court with dwellings cantilevered overhead to shade it.

By far the most important conceptual development of the Puerto Rico project was the great reduction in the number of pieces that make up the system. In Montreal the modular boxed units formed approximately half of the total number of precast pieces; in addition, elevator cores, street sections, access stairs, and other pieces had to be manufactured. A substantial percentage of the Habitat costs was in these additional pieces. Dramatic savings could be achieved if, in some way, these units could be reduced in number. It was from this that we evolved the idea that the module, by virtue of its shape, could accommodate some of the functions that had been provided for by the additional pieces in Habitat. If the shape of the roof of the module made it possible for it to act as a stair, one could eliminate the access stairs. If the roofs of some of the modules could form a pedestrian street, one could eliminate separate street sections. The module that was eventually designed formed houses, created the internal circulation, created the system of passages, exterior stairs, and pedestrian streets on its exterior surfaces, and practically eliminated the need for any additional pieces.

We also made use of the hilly site and were able to plan at relatively high densities, without the use of elevators, a structure that was in fact five or six storeys high. We thus had an overall gross density of forty units per acre (including the park), without the use of mechanical conveyance.

Not everything went smoothly. The feasibility study had shown that the costs were within the FHA limitations, in other words the project was feasible. The hill site we had chosen in the center of San Juan was made available by the Navy to the Redevelopment Land Agency of Puerto Rico. As soon as the project was publicized pressure from the residents around the site started to build up. They didn't want any construction going on around them, particularly not a moderate income project. Then, we ran into difficulties with the local FHA office, which for some reason – perhaps as a kind of backlash from the Fort Lincoln project – became very hedgy and expressed doubts about many aspects of the project. But here we were within the budget. We were generally within the code. There was nothing that could be questioned. We had a reasonable answer for everything.

As always with projects of this magnitude, the maze of authorities and the communications between, gave the frustrating feeling of trying to shake hands with an octopus. A letter approving the project was issued by the Washington office of FHA, only to be ignored by the local office, who claimed that since the project was not in any way experimental, it was within their own jurisdiction. Negotiations between the various Commonwealth government authorities sponsoring the project and owning the land and the planning board were difficult to co-ordinate. Epstein and his staff found out that breaking new ground in this business was certainly different from building conventional housing. In one year Development Corporation had spent over two hundred

thousand dollars on the development of the system. I think a less determined person would have exhausted both energy and patience and abandoned the project.

To the hedging we encountered, Epstein's response was: "I'll go as high as I have to. I'm not going to take 'No' for an answer, particularly when it's not substantiated. If you have any objections you are going to put them down on paper and you are going to have to back them up."

Nor was my own profession any kinder. As soon as I had started working on the project I checked the procedures for performing architectural services in Puerto Rico. I was first told that as this was a government project, local licensing was not required; nevertheless it was advisable. Two separate bodies had jurisdiction over licensing: the Commonwealth Government board and the *collegio* of the architects and engineers. I contacted the president of the *collegio* who received me very nicely and organized a luncheon at which I made a presentation of the concept of Habitat to the *collegio's* board of directors. There was enthusiastic response at the meeting and the president stated that for special projects of an experimental nature, a temporary license could be issued to foreigners. This friendly beginning deteriorated once the project was nearing reality. A license was denied by the board and my attempt to make a joint venture with local firms, a standard practice under such circumstances, were, to put it mildly, discouraged by the *collegio*. At one point I was asked to sign a waiver of my rights to the design and its authorship, and was told that my firm's name could not appear in any way on the drawings. What made me sad about these events was not so much the administrative difficulties that had to be overcome, but finding national boundaries in an area where professional co-operation and exchange of experiences are so essential.

Eventually things started falling into place. It was subtly suggested that the site ought to be changed, and once we had done that and chosen a smaller hill further east in the city, the approvals started coming. First FHA sent a letter declaring the project feasible. Eventually the planning board also approved. The new site was much less visible, which seemed to make many people more comfortable. Perhaps they were right. This was the first run of an experimental building system. Notwithstanding all the difficulties, many individuals in the public agencies were enthusiastic about the project from the outset and, once communications had been established with the FHA officials and their doubts relieved, we also had general co-operation from them. But to me it proved the fallacy of my hope that "after Habitat it would be easy." Once it departs from accepted practice, a project that confronts the system requires considerable energy to realize and the experience is not transferable from one community to another.

Simultaneously with the beginning of the work on Habitat Puerto Rico, Fred Epstein finalized negotiations leading to a major part of Development International Corporation being purchased by two of the most prominent Wall Street

investment bankers, Wertheim & Company and Unterberg Towbin Co. They, too, proved to be strong believers in modular housing generally and the Habitat system specifically.

In 1969, a year after we began work, Development International Corporation went public through the issue of stock on the New York Stock Exchange, with the Habitat Puerto Rico factory being financed with part of the proceeds.

Because of my involvement with the company as its architect for modular construction and since the company's going public was undertaken in part because of its intentions to specialize in modular construction, I was invited to become a member of the Board of Directors of DIC. The implications of accepting such an appointment were numerous. Certainly everything about the traditional role of the architect would be incompatible with it. In a sense, it was a moment of truth; I had been saying design and construction had to be integrated, and here was a chance. After some weeks of serious reflection I decided to accept.

For almost a full year we struggled uphill like an ant with an overweight burden, slowly obtaining one approval after another, resolving the many administrative problems, and at the same time going ahead with the working drawings. Harouzi Wainshal, DIC's Executive Vice-President – Operations, led the company's efforts in organizing the factory operation, selecting and ordering equipment, and setting up an organization capable of mass production housing. Conrad Engineers, the firm which earlier worked on the Fort Lincoln, the New York, and the San Francisco projects, broke new grounds in an unprecedented structural engineering analysis designed to minimize the material content within the structure, notwithstanding its considerable geometric complexity. As they put it, "We could not have considered it with the tools available to us a year earlier." But with new computer programs they had developed recently, the analysis was possible. There were three trunkloads of computer work sheets to impress the building departments that had to approve the structural design.

At the beginning of April 1970, all had been finalized and the project at last was offered for sale as a co-operative through the organization of Fomento Cooperativo. Two weeks after the first ad appeared in the San Juan papers the project was sold out. In June 1970, the equipment started arriving in the factory, the molds had been ordered, and construction work commenced on the site.

I am constantly confronted in meetings with the comparative costs of traditional construction, ranging from single family houses to high rise apartments. The comparison between one form of housing and another, between the economics of Fort Lincoln at thirty units to the acre, Puerto Rico at forty, and New York at three hundred, made me aware that density had far-reaching implications on all aspects of housing. Density was one variable, with others on the other side of

the equation, namely cost of construction and the quality of the environment. Neither density nor its economic implications could be taken for granted.

It is commonly assumed that the need for higher density in the cities is the by-product of the population explosion. A corollary is that countries with a lot of open space do not really need high urban densities. I think both assumptions are wrong.

Density is not related to population growth, nor to the availability of open space elsewhere. I do not think the density problem of Montreal or Toronto is substantially different from the density problem of, say, Tel Aviv, even though Canada has more open space than Israel. Density is a by-product of the evolution of metropolitan cities, and metropolitan cities are the by-product of fundamental social and economic forces. These forces have created the need for concentration of people and, as a result, high density: more people wanting to be together, to have more amenities and more variety and choice, and business and corporations wanting to be together because they depend on each other for services and pools of skilled people. This concentration, leading to unprecedented growth, has created a kind of new super city. Its size and complexity have made our methods of planning the city two-dimensionally obsolete. Streets, lots, and buildings on them are too restricting, it is like trying to plan a direct-dial telephone system with mechanical means. If we could plan in three dimensions, if we could think in terms of continuous buildings rather than individual buildings, of networks of movement rather than individual transportation facilities, if we could subdivide space instead of land, we could create a better environment notwithstanding the density. But, the implications of density on the building processes are so great that one must first ask whether increasing densities are inevitable.

I had always assumed that the cost of building housing at different densities would be more or less the same: an apartment in a multi-storey structure would cost more or less the same as a house of the equivalent area. To my surprise, a comparative analysis showed that unit for unit, assuming equal amenities, high density cost much more to build than low density housing. The term *equal amenities* must be emphasized, for in assessing housing standards we usually consider only those aspects affecting the interior of the dwelling and not the total environment, a practice that has evolved from extending standards set for single family housing to all other forms of housing. It is generally accepted that the small single family detached house constitutes accepted minimum housing standards on the North American continent. Let us examine what this minimum is.

Our suburban house has a little garden. It has a fair amount of privacy and, being a separate entity, considerable identity. But, as we have proceeded to build higher density developments, it has become more expensive to provide these taken-for-granted amenities of the single family house. When land cost a dollar a square foot, a garden measuring twenty by thirty cost six hundred

dollars. In a multi-storey structure open space costs six or seven dollars a square foot or four thousand dollars for the same garden. Six or ten feet of air separating the wood-stud and brick walls of two adjacent houses is enough to give good sound privacy to a detached house; but it is a major technical problem which costs considerably more to overcome in two dwellings touching each other or on top of each other, as in an apartment. The denser the environment, the more complex and costly it is to achieve these standards.

Many planners have spoken about dispersal as an alternative to density. The most articulate is Jean Gottmann of the University of Pennsylvania, who first used the term *Megalopolis*. He has suggested that the tendency of the city is toward extreme dispersal, which would mean low density. The suggestion is that cities would be evenly dispersed over vast areas, a view that relates closely to Frank Lloyd Wright's Broadacre City concept.

I agree that dispersal is inevitable. Everything that is happening in the field of transportation will lead to greater and greater dispersal. But I believe that the form of dispersal will be much more structured than Gottmann suggests, because of the nature of the transportation systems and because of people's apparent natural preference for concentration. Rather than disperse limitlessly and evenly, we would be dispersing concentrations. It is the difference between an unharvested field of wheat and the dispersed piles of straw bricks left by the combine harvester.

The fact that we are strait-jacketed into a two-dimensional planning pattern and lack the facility to rethink the city in three dimensions, is making the city quite absurd. Pedestrians get in the way of cars, and cars crawl from one red light to the next. Two-dimensional planning results in irrational situations. We put up enormous office buildings and then put up apartment buildings and town houses in their shadow. We want sunlight in a house and don't particularly care if we have sunlight in an office, in fact we may prefer northern light. We build great parking garages in prime space and then build shopping concourses – in which daylight would be a great asset – underground. Because we're dealing with a two-dimensional pattern of individual buildings on the ground, we have to dig to provide services and pedestrian links underground, the least appropriate space for the concentration of human beings.

Suppose we could take the downtown of a city, separate all buildings into cubes, and rearrange them. You could for example, have houses arranged in space where they would have sunlight and a view and they could create membranes – you could say, umbrellas of leaves – below which would lie a continuous public space with shops and recreational facilities protected from the elements. These in turn could serve areas of offices and light industry and below that could be a network of transportation and parking and terminuses. The three-dimensional network would make it possible to walk through the whole complex without ever crossing the path of a car, or drive without ever stopping at a red light. Instead of always having to come down to ground level

to go from one high building to another, one could move horizontally at many levels.

Brasilia, the new capital of Brazil, is a striking example of a new city made obsolete by its two-dimensional structure before it was off the drawing board. While you can drive in that city without ever stopping you absolutely can't walk there. Nor are its urban functions related to the way the people use them; instead there is government in one place, housing in another, major shopping in another. Nor is it possible to improve much on this unless the city is considered from the outset as subdivided space with all its functions integrated and three-dimensionally arranged.

Brasilia is a city divided into separate neighborhoods, and each neighborhood has its little bit of shopping and a little school. But people want variety, they're not willing to limit themselves to that token shopping in the neighborhood, to one butcher or clothing store. Stratifying the whole city into separate neighborhoods connected by highways doesn't work. The same problem occurs in Le Corbusier's great apartment slabs, each of which had a shopping street in its middle level. My feeling was that unless all these shopping streets were linked to each other to become one continuous shopping street in the air, they would never work.

Three-dimensional organization and planning make it possible to achieve complete micro-climates—to respond to the elements in a positive way. Living beside the sea we get breezes because air heats faster over land than it does over water and convection currents are created. In mountain country one kind of vegetation is found on northern slopes and a totally different vegetation on the southern slopes. These phenomena of micro-climate can become part of the design of the city. In a hot climate it's possible to group building elements three-dimensionally so that all houses face north and shade each other, or to group houses in such a way that convection currents of air are created in shaded areas, penetrating the houses and creating breezes. In a cold northern climate it's possible to group houses so that they enclose and shelter public spaces and, packed closely and bubble-like, capture sun and light.

Beyond Habitat

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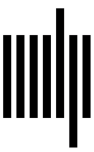

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