

Habitat working drawings were completed in June 1965, when the bids were called.

I began to reduce the office staff. Many of the people who had worked for me were then hired by the general contractor or by the precasting contractor to work on their shop drawings and some of their organizational problems, and in fact climbed very fast to positions of considerable responsibility. Others went back home, and some stayed and are part of the office today. But the office was still a substantial size because the operation of checking shop drawings and co-ordinating them on the building site was formidable. Throughout construction we were still calling for tenders on minor items.

In a normal relationship the architect is between the client and the contractor and he is the on-site authority in interpreting the drawings. Here the client was between us and the contractor. He was the authority on the site. He had his own resident engineers, and his own administrative staff, and he would process the payments. We were consultants in the sense that we gave advice, but we didn't have the authority. Al Meyer was the resident architect on the site representing our office, but the Expo administrator was the man who said what was acceptable and what was not. Often we would reject work that was accepted by Expo, or stop payment for something for which payment had already been released. This made life difficult because, by and large, those involved with the project in Expo's construction division were unsympathetic to us and sympathetic to the contractor.

To make things even more difficult Anglin-Norcross, the general contractor, from the beginning displayed an uncommon lack of imagination, an inability to deal imaginatively with any part of the project that was unconventional. Their representatives, particularly in the early days, were playing a political game of writing letters and using job meetings to document testimony that would be useful in claiming extras later, rather than actually getting on with the work. Our

weekly job meetings became lengthy and tedious discussions about what should or shouldn't go in the minutes.

I almost lived on the site in those months. I was there three-quarters of my time. If one of the workmen was caulking a window emphasizing the wrong line, I would suggest how I thought it should be done, and our consultants did the same. That created a good relationship with the workmen but it was resented by the contractor.

Right at the beginning one particular event set the pattern for our relationship with Expo and the general contractor. Anglin-Norcross had poured the first foundation wall around the parking area. It was an exposed wall supporting the first level of boxes. The specifications were very clear: this was exposed concrete; it had to be of the highest quality. And yet when the wall was poured and stripped, it was just miserable. I looked at it and said it was totally unacceptable and would have to be demolished and replaced. As this was the first wall I felt this was the place to draw the line. That week I was leaving for India for three weeks; before leaving, I asked that it be demolished, and Churchill agreed. But that same week Churchill collapsed in fatigue and was rushed to the hospital, where he stayed for three or four weeks.

After my departure, the construction manager of Expo, who was second in command and acting for Churchill, reversed the decision and said that the wall should stay. That was a major turning point. The contractor knew that he could get away with murder, and those in Expo who were dealing with him on a daily basis would let him get away with it. After that of course, only in a really bad, critical situation could I get Churchill involved and enforce a decision. On day-to-day workmanship it got to the point that because of scheduling and because of Expo's attitude we couldn't reject work, no matter how bad it was. And this was painful because in some cases things were done very badly.

I'll never forget the day when the first box was cast and everybody – Komendant and the engineers and contractors, and many from my office – went down there. It came out pretty well. We stood there for hours while it was being made. Expo decided that it was time for some good PR and arranged a laying-of-the-first-box ceremony.

This was a big event. Up to that time Habitat was constantly under attack in the press, and there seemed to be a general feeling that it would never be built, couldn't be done. The big Dominion Bridge crane had a capacity of a hundred and fifty tons at the base, but only seventy tons at a distance of a hundred and twenty feet from its edge. We didn't know the exact weight of the boxes when we ordered it. This first box to be lifted weighed eighty tons and was one hundred and twenty feet out – too big for the crane at that distance. We suggested getting another, smaller crane, then we would put the two cranes opposite each other and the box in the middle, connect them both to the cross bar on which the box would be placed. This would give each crane the

proportion of the load it could carry, i.e. it would be proportional to the distance from the end of the cross bar to the box.

The contractor insisted that this procedure was absolutely impossible. They delayed the job two weeks arguing that it couldn't be done. Under pressure from Churchill they at last brought in the other crane, put in the cross bar, and lifted the box. The whole thing was done in front of the press in forty-five minutes without one problem. The procedure became so simple that any time the extra crane was required – for about five per cent of the boxes – they just brought it in without question.

I believe it was Commissioner General Dupuy who suggested to Shaw and Churchill that Nina ought to be the one to break a bottle of champagne over the first box. Nina and I were both very moved. It was a bitterly cold and windy day. A group of reporters came down and Nina swung the bottle right against the edge of the box. The stain is still there.

Two months later when the top box was laid, the contractors organized a topping-off ceremony, again in the presence of reporters on a windy day. The box went up with two flags on it – Anglin-Norcross' and Francon's – side-by-side. They stayed there until the end of construction.

They were grand days. There was Habitat, going up! One week you had one box and it had a certain scale, then you had two storeys, then three storeys, then all of a sudden a street was in, and – "My God, I'm walking along the pedestrian street!"

At times too, it seemed the site was swarming with visitors – architects, builders, diplomats – walking all over the building, taking pictures and making notes.

Habitat was not the first attempt to manufacture a house in a factory. The Russians had done considerable work in that direction working with room-size units, in circumstances where the finishes in the house are minimal. But in Habitat we built large units of six hundred square feet, with sophisticated finishes and detailing, meeting high North American standards.

The Habitat boxes are stacked twelve high, each one bearing the accumulated weight of the boxes above. Those at the bottom carry a heavier load than those in the middle, the middle boxes carry more than the top ones. The boxes are not, therefore, completely standardized. Realizing this, people have doubted that Habitat could have been truly mass-produced, no matter how many units were built. But they are wrong. It is easy to standardize four or five types that satisfy closely enough each condition of loading, and then design the mold and prefabricate reinforcing sections to produce variables. In Puerto Rico we are using just eight molds for manufacturing four types of load-bearing boxes, with no sacrifice of standardization from the point of view of production.

The immediate problem we faced in Habitat was that we started the structural design from the top down and the scheduling was such that as a drawing was produced (say a unit on the eighth floor) it immediately had to be rushed to the shop drawing department and then to the plant. At that point the fifth floor might not have been completely designed. Because we lacked time we ended up with much more variation in reinforcing and unit design than would otherwise have been the case, and we did not have the opportunity to review the total building and establish the basic standardized types.

The engineers were worried about weight. We had already ordered the crane for lifting the boxes into place and we needed a safety factor. Taking the roof off would reduce the weight by about fifteen tons. That meant we were working with roofless boxes. The components, bathrooms, kitchens, and so on were then installed under a temporary plastic roof. But as a box went up into place, the temporary lid had to be taken off before the next one was placed over it and even then it was not watertight until the proper roofing and drainage were installed. Invariably it would rain or snow at that point and much of the interior would get damaged, particularly the insulation, kitchens, and partitions.

Having made the mistake of casting the roofs separately, I still feel that there were solutions that we could have used to avoid water damage. For example, we could have used a single sheet of polyethylene sloping to a central drain with a hose connection draining through a window. This sheet would have been left in place throughout construction and finally covered with the ceiling plaster board. That would have cost thirty dollars a unit, but none of us thought of it at the time. In the Washington, D.C. and Puerto Rico projects we decided to pour the unit so that the roof was an integral part of the first casting and then pour the floor separately. That meant a complete new design for the form, resulting in a totally enclosed module.

Another mistake was made in planning the plumbing system. Sometimes the plumbing had to extend from one module to and through another before reaching the vertical distribution shaft. As plumbing must be tested after all the connections have been made we could not test it on the ground. To make matters worse, the plumbers, electricians, and carpenters got in one another's way. Each box should have been self-contained, completed, and tested on the ground. The whole sequence of testing the plumbing became such chaos on the site that at one point the contractor just abandoned the basic concept and installed and tested everything in the air.

This was all happening under considerable pressure. Irreversible decisions were made by the hour. The concrete molds were designed very heavy because the contractor expected to pump the concrete from the bottom up. Halfway through the manufacturing of the molds they changed their minds and decided to pour from the top down. By then the molds had twice as much steel in them as was needed.

At one point we had a fairly serious structural failure. One of the long streets had been post-tensioned. The loading of the units began. Early one morning there was a loud bang and the whole end support sheared. Nothing fell, but the structure was broken. Expo officials immediately emptied the building and surrounded it with cars with red flashing lights. All the workmen were sent home. Komendant arrived from New Jersey. Everybody was pointing fingers at everybody else. The general contractor brought in Morden Yolles, a well-known engineer from Toronto, to advise them. It appeared that a welding plate connection had been inadvertently omitted, but there was also a suggestion that the failure would have occurred whether the plate had been there or not. The project was delayed for two weeks while all parties tried to place the blame where it belonged, obviously on someone else. Then Churchill in his usual lifesaving manner came in and said, "I don't give a damn whose fault it is, I want that job going again." That meant reinforcing the whole end and pouring a new wall against it.

The finish of the precast concrete units produced in the beginning wasn't all one could desire. One Sunday I went down to the site and to my horror saw one wall of one of the boxes painted white. An hour later Churchill appeared for a field inspection accompanied by the vice-president of Anglin-Norcross, who had had the sample painting done to show him. The vice-president suggested that we were so strict with the precasters in our demands for a good concrete finish, and the cost of sandblasting the concrete was so high, that if Churchill would agree that everything should be painted Expo would receive a substantial credit—fifty or a hundred thousand dollars, I seem to remember. I countered to Ed Churchill that it would be the wrong thing to do. Once you paint something you have to keep painting it forever. No paint surface is permanent. It will look good for six months but then it will look much worse than the aged concrete surface which looks better with the years rather than worse. And so the exposed concrete remained.

Well, we learned a lot. The Hilton hotel that was recently built with prefabricated boxes in San Antonio, Texas showed that they had learned to avoid some of our errors. They managed to pre-finish the modules completely. Most of the problems could not have been foreseen the first time around at Habitat.

The spirit on the site was amazing. Feeling among the workmen built up as the job went along. They were working round the clock. They kept reading about the building in newspapers—cartoons, write-ups, criticisms—and they cut them all out and stuck them up in different places on the project. Many of our riggers were Indians from the Caughnawaga reserve near Montreal. At six o'clock one morning the project manager of Anglin-Norcross, Bob Hughes, arrived to hear a fantastic sound coming from one of the boxes. He went to the box and saw all the night-shift dancing a sunrise dance on the subfloor before going home.

While there was a great sense of identity with the project among the workmen, at the management level there was an atmosphere of manoeuvring and

politicking and letter-writing and blame-hanging, each sub-contractor trying to protect his own interest. It was the inevitable result of awarding a lump sum contract for an experimental project. With half a dozen exceptions I don't feel the job received the kind of ingenuity and imagination that had been part of it in the design stage. Those exceptions I would like to name: Reff Plastics, Francon, Frigidaire, Clerk Windows, and Ishii Brothers who did the carpentry. Among these contractor heroes, I would single out Cipriano Da Re, Francon's chief project engineer; he made the building possible by translating the consultants' designs into concrete reality.

We were working to a critical path, a very exact computer-designed schedule.

We had all-day meetings with Colonel Churchill and his staff to discuss means of meeting deadlines. We had great difficulties because, when it became hard to stick to the schedule, the tendency was to do another schedule. Furthermore, the contractors claimed that they had been delayed by lack of information or lack of drawings, and therefore they wanted extras for overtime, for certain molds and jigs, for extra reinforcing, all of which they expected Expo to pay over and above the fixed contract.

At about that time Mitchell Sharp, who was the federal minister in charge of Expo, became the new Canadian Minister of Finance, and Robert Winters took over the Ministry of Trade and Commerce in Sharp's place. When Winters came in I sensed a total change between Expo and the federal government. He started reexamining Expo's finances and singled out Habitat for special attention.

I started hearing rumors soon after his appointment. Habitat was being questioned from first principles. Tony Peters, Expo's project architect for Habitat, called to say there was talk of abandoning the project completely; he had heard of an investigation into the cost of paying the contractors off at that point and dismantling the building. In fact, he had heard a study was being made somewhere to see, if the building were dismantled, whether the modular boxes could be dropped into the river, and whether the river was deep enough to accommodate them all. Obviously if the project were abandoned it would have to be dismantled before the opening of Expo to avoid embarrassment.

Fantastic as this story sounds now, we were quite nervous and concerned at the time. I was told that Winters was very conscious of his candidacy for leadership of the Liberal Party and that his aim was to come through as the taxpayers' savior – and where could you find a better place than Habitat, which was under considerable criticism in the press for its high cost!

In the end they must have decided that it was not practical to abandon the project – it was half-built at that time – and they started looking at other ways of making dramatic cost savings. Eventually the verdict came down: it was government policy to abandon construction of the north cluster, the third of the

three sections that make up the total building. At that point the south and center clusters and the foundation of the northern were completed and we were instructed to see what credits could be negotiated from the contractor.

The situation was too ridiculous for words. The credits we could get from the contractors would obviously be negligible because the costs of the factory, tooling up, and overheads were fixed and would become even more ridiculous when spread over only a hundred and twenty units. Furthermore, many of the north cluster boxes were already cast. But arguing from such facts wouldn't do much good; in Expo, as elsewhere, politics, logic, and economics did not always mix.

I decided that the best way to handle this was to make a big thing of the fact that the building wouldn't be stable structurally unless we built all of it. That was half true, because if we cut the building along the expansion joint that separated the north and central cluster, modifications would be needed to make the structure stable. I met with the structural engineers, and after reviewing the problem, Dr. Komendant and Dr. Monti produced a report showing that the north cluster had to be built in order to balance the structure. This report was happily received by Expo because those concerned with the project felt very much the way we did about the whole issue.

Then came a new threat. It seemed that the minister was determined to swing an ax in some way. He decided that we should not finish the interiors of the north cluster and should negotiate credits with the contractors accordingly. Again this decision had no logic to it whatsoever. The contractor had already bought much of the material and equipment for the houses. We were buying kitchens from Frigidaire that were highly subsidized. If we cancelled the order for forty kitchens we wouldn't get credit for what they were subsidizing. Duct work had been purchased, the windows had been made, and so on and so forth. When you negotiate credits with a contractor for work that has already been awarded you never get full value in the credit. What's more, Expo would lose the rental revenue from forty units for the six months of the exhibition when those rents were considerable.

Once we started negotiating with the contractors we discovered that the most credit to be gotten was approximately half a million dollars, but the cost of completing the work after Expo would be more than twice that. We made a full report, but notwithstanding, we were ordered to change the contract to omit the finishing of the interiors of the north cluster and to accept the very small credit involved.

It was a recklessly illogical decision from the taxpayers' point of view. In 1969 CMHC estimated the cost of completing the north cluster and it was over a million and a quarter dollars.

Then at a formal meeting in the board room at Expo with the minister and other



notables, I was summoned and told that additional funds had been made available to cover the contractors' extras agreed upon by Expo, but no further extras would be tolerated. We just had to get to work and make do with the funds that were available. That was in the fall of 1966, six months before opening day.

As the tension mounted, there was constant pressure to change things in the building. Take out the garden irrigation system! Take out some of the lighting fixtures in the public area! Substitute cheaper materials! At one point a memorandum came from somewhere up there saying that the whole elaborate landscape work, the retaining walls and terraces that extended the building's geometry into the grounds, ought to be omitted and the site ought to be sodded.

Each of these directives was the subject of a major battle, but on the whole we got our way. It took considerable manoeuvring and we always had to find technical reasons why things couldn't be changed, because that was the only reasoning that came across.

After the meeting with the minister the pace at the site became indescribable. We were working three shifts. The contractors became increasingly conscious of the fact that they had to finish the building somehow by April 27th. Even though the north cluster interior finishes were omitted a fantastic amount of work had yet to be done. The settlements with the contractors, several million dollars' worth of extras, were conditional on their finishing the building in time. And I must say that at that point all the contractors really got going.

Robert Shaw talked about leaving the factory in place as an exhibit, to show people how Habitat was built. But Expo management decided the factory should be dismantled completely and the area landscaped. But, Shaw and Churchill still felt that the story of how Habitat was built ought to be told even though no budget for an exhibit was available from Expo. Shaw had been a construction man and was fascinated with the building, and it seemed very important to him to do this. He proposed that the contractors, sub-contractors, and consultants get together and mount an exhibit at their own expense. We decided to leave the crane there and, on condition we leave the name "Dominion Bridge" on it, got that company to agree. Francon agreed to cast three extra boxes showing the cross section of the reinforced concrete, and the window manufacturer donated a few extra windows. The structural and mechanical engineers and the quantity surveyors all contributed cash toward the preparation of photographs and panels, all of which went in four modules in the north cluster which were otherwise unfinished. My office put the whole thing together as our part of the contribution.

During the exhibition thousands of people came to Montreal specifically to see Habitat – delegations of planners, architects, contractors, planning authorities from various cities in the U.S., Canada and Europe. We took the tapes of the



post-mortem meetings and after some editing played them in one of the units so that people could come in and listen to discussions about the structure, and several students answered questions from the thousands of people who visited the exhibit every day.



This is a section of [doi:10.7551/mitpress/1575.001.0001](https://doi.org/10.7551/mitpress/1575.001.0001)

# Beyond Habitat

By: Moshe Safdie

## Citation:

*Beyond Habitat*

By: Moshe Safdie

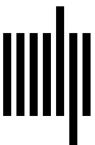
DOI: 10.7551/mitpress/1575.001.0001

ISBN (electronic): 9780262368049

Publisher: The MIT Press

Published: 1970

The open access edition of this book was made possible by generous funding and support from The National Endowment for the Humanities/Andrew W. Mellon Foundation Humanities Open Book Program.



The MIT Press

Copyright © by Moshe Safdie, 1970

Published simultaneously in Canada by Tundra Books of Montreal  
and in the United States of America by The MIT Press, Cambridge, Massachusetts.

First MIT Press paperback edition, January 1973

Second printing, November 1973

ISBN 0 262 19083 4 (hard)

ISBN 0 262 69036 5 (paper)

Library of Congress catalog card number: 76-130455

Printed in Canada

The production of this book took place in Montreal.

Design was by Rolf Harder, Design Collaborative.

Photographs appearing in this book were taken by the following:

Jerry Spearman of Media Extensions, N.Y.C.; The *Montreal Star*–Canada Wide; Keith Oliver; Kero;  
Official Expo photographers; Moshe Safdie.

Figure 25 courtesy of The New Yorker magazine. Open access edition funded by the National Endowment for the Humanities/Andrew W. Mellon Foundation Humanities Open Book Program.

The text of this book is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License: <https://creativecommons.org/licenses/by-nc-nd/4.0/>

Text was computer set in 10/12 Helvetica by Fast Photo Typesetters of Canada and the printout made on a Fototronic Model 1200. Films for the album of photographs were prepared by Klaus Unterberger.

The Enver Azizi cartoon was translated from the Spanish by William Weiss.

The following are quoted with permission from sources stated:

Buckminster Fuller: *Nine Chains to the Moon*, published by the Southern Illinois University Press

Hermann Hesse: *Siddhartha*, translated by Hilda Rosner, © 1951 by New Directions Publishing Corp.

Piet Hein: *Grooks*, published by The MIT Press, Cambridge, Massachusetts

Desmond Morris: *The Naked Ape*, published by Jonathan Cape Ltd., London, England

Lao Tzu: *Te Ching*, published by Penguin Books, Ltd., London, England

D'Arcy Thompson: *On Growth and Form*, published by the Cambridge University Press, London, England