HOUSING DESIGN IN MULTI-STORY SECTIONAL BUILDING SYSTEM

by Jin Kyoon Kim

Bachelor of Science in Engineering
Seoul National University
1968

Submitted in partial fulfillment
of the requirements for the degree of
Master of Architecture

at the
MASSACHUSETTS INSTITUTE OF TECHNOLOGY
June, 1980

Accepted by
Maurice K. Smith
Professor of Architecture
Chairman, Departmental Committee for
Graduate Students

© Jin Kyoon Kim 1980

The Author hereby grants to M.I.T. permission to reproduce and to
distribute publicly copies of this thesis document in whole or in part.

ARCHIVES
MASSACHUSETTS INSTITUTE
OF TECHNOLOGY
MAY 30 1980
HOUSING DESIGN IN
MULTI-STORY SECTIONAL BUILDING SYSTEM
by
Jin Kyoung Kim

Submitted to the Department of Architecture on May 9, 1980,
In partial fulfillment of the requirements for
the degree of Master of Architecture.

ABSTRACT
This study is an exploration toward a possible new method
for design and production whereby industrialized housing
can be made more flexible to changing users' needs.
This study is organized in three parts:

I. Introduction: Social and economic changes over the last two
decades have affected the form of housing in the United States.
The emerging attitude toward housing is more modest, responsive,
and humanly scaled. Studies on users' need are reviewed.
"Framework approaches" are considered viable design methods
for responsive housing.

II. System: Based on the framework approach, an industrialized
building system is introduced. Multi-story sectionals are
the basic space modules of the system. Those are factory
produced prefabricated heavy boxes to be assembled on site by
tilting up, allied with the spanning floor slabs.

III. Design: In the proposed system, multifamily apartment
plans will be designed, comprising various building types.

Thesis Supervisor:
Waclaw Zalewski
Professor of Design of Structures
acknowledgements

I would like to thank Prof. Waclaw Zalewski for his guidance and encouragement with generosity and humour as well as insight in architecture.

My appreciation also to my father-in-law, HanBok Do, for his support to my study at MIT.

Special thanks to Mr. and Mrs. Lee at BanPo.

To my parents for giving me happy memories.

To my little daughter, Arum, for her constant Dad care.
and
to my wife, Yunsoo, for her great devotion to her husband.
I am forever grateful.
content

ABSTRACT ...................... 2

INTRODUCTION .................. 5

SYSTEM ......................... 24

DESIGN ......................... 37

SCOPE ......................... 74
introduction
Up to now the house is built down to the smallest detail and man is pressed into this dwelling - in spirit the same from Scotland to Ghana - and adapt himself as best he may to the life that the architect furnishes him with.

We must prepare the 'habitat' only to the point at which man can take over.

We aim to provide a framework in which man can again be master of his home.

------- ATBAT, Bodiansky, Candillis, Woods-----

The apartment, as the environment of private family life within the urban context, has become stereotype with few exceptions. The marvelous diversity of possible human activity is excluded from consideration for most new multifamily housing, limited to housing essential human activities --cooking and eating, sleeping, relaxing, bathing.-- Framework approach recognizes these restrictions in housing and overcomes the problem by allowing variation within each household.
MULTI-STORY SECTIONALS are the basic space modules of proposed system whereby the framework of multifamily apartments are designed and built. The system allows much flexibilities during the design stage for anticipated space arrangements and throughout the life cycle of building.

In the past, Americans have tended to look upon the problems of providing decent housing as predominantly technical. Much effort has been spent in this century trying to industrialize housing production. These efforts have been characterized by the view of housing industrialization as assembly line process. Buckminster Fuller's 1927 Dymaxion I House is an example of such a product: mass-produced, completely finished, and intended to be sold "fully loaded" with appliances and other mechanical amenities. Same approach was taken in the Lustron House in 1940s. Not one proposed system for Operation Breakthrough(1969) approached the level of consumer choice and flexibility of form that is inherent in the conventional stick-built house.

Today, there begins to understand that housing is a process that a house is something that is born, matures, prospers, and dies!
In North America, the favored form of dwelling is the single family house with its own piece of land. It appears that the tradition has its root back in the early days of the Colonies when British settlers were ingrained with the image of a manor and cottage existence. Government agencies have helped home ownership to become the dominant housing style in American life.

Identifiable units with multiple exposures, cross ventilation, and the potential for some private outdoor space are among major elements easily accommodated by this traditional form at very low densities.

Decades of testing and evaluation has set the list of guidelines predominantly important in family oriented housing. The "program" has been codified in various ways, but essentials can be seen in a list of statements developed by the Institute for Architecture and Urban Studies in New York. Including are:

- **Community:** to organize dwelling and spaces to promote social interaction.
- **Child Supervision:** to provide visual and aural contact as well as easy access between play areas and dwelling units.
Security: to avoid unseen, in active areas.
Maintenance: to minimize undesigned interior public spaces.
Livability: to provide for individual privacy in dwellings, for alternative views, and for cross ventilation.
Responsiveness of Context: to acknowledge and respect existing scale, light, views, etc.

Add to this the potential for displaying the identity of the household and a convenient access to the automobile.

The housing design issues, Low-rise housing, being a closer approximation of the single family house, accommodates the issues better than high-rise.

**Organizing Issues**

1. Sense of Community
2. Child Supervision
3. Security
4. Maintenance
5. Livability
6. Responsiveness to Context
7. Flexibility

Low-rise high density housing

State of the art housing

Cluster dwellings to encourage neighborhood visitation.
Low numbers of units if high-rise spaces.
Visual recognition & interaction.
Ground floor common activities to provide.
Social interaction.

Central core & low-rise spaces.
Maximum outdoor, & social contact
provided.

Maximum outdoor spaces.

Avoids public & private outdoor spaces.

Avoids public & private outdoor spaces.

Provides private outdoor spaces.

Provides accessible & secure storage.

Provides direct individual access.

Provides direct individual access.

Provides direct individual access.

High-rise new concepts.

Offers vertical.

Offers range of alternative living arrangements in high-rise.

Offering range of alternative living arrangements in high-rise.
Although the single family house may best meet the criteria, as the land, material, and energy cost rise, this preferred housing form is now out of reach of most families. A new goal for housing may be to maintain the features and amenities of the single family house while aggregating many more units on a single site for economy's sake. As economic and ecological pressures for denser residential development increase, so does the seriousness of this dilemma. 1) a reduction of private outdoor space to give more community space; 2) a loss of identity for individual units to allow repetition of structure and economy of production; 3) a reduction in ease of access to increase security; 4) a reduction in view and exposure of dwelling to increase privacy and numbers of units; are the sacrifice of personal amenities for economy and community enhancement may entail.

Density may be expressed as people per acre, dwelling units per acre, FAR (Floor area ratio of building to site), people per habitable room, and so on. Though high density is most often associated with teaming slums, some of the densest neighborhood
in the United States are also the most elegant. High density cannot be rigidly equated and numbers alone cannot indicate quality of life. The negative image of high density in the U.S. is associated with long standing antiurban planning mentality. The garden city movement in England and the suburbs in this country were a reaction to the city perceived as dirty, crowded, and crime-ridden. One of the major confusions in the continuing argument over density is the association of high density with high-rise. The reason for building high-rise is to achieve greater density and the logic which says rising costs are defrayed by placing more dwellings upon the land cannot be questioned. However, employment of the high-rise has not resulted in substantial increases in density and land use efficiency. When this building form is used, a great deal of land remains empty to allow the necessary space between the buildings. Herbert McLaughlin (1976) found that low-rise was more efficient than high-rise of more than 10-18 stories. While similar density may be achieved by either high-rise or low-rise, the cost of high-rise was greater.
There has been large increase on the mubers of multifamily housing being built. The number of multifamily housing starts in 1976 was 362,000, but by 1979 it was up to 547,000 units.

In most cases, variety may be assumed to be sacrificed for increased production. Variety can be seen in two ways. First there is the potential for the dwellers to individualize and make distinct their own residences. As densities increase, this becomes more difficult. As units become a single building form, individuality becomes impossible. Variety may also be seen as a range of housing-type alternatives.

Single family units range from one house on an acre to as many as eight houses per acre, each on a 5000 square foot lot. High density, high-rise development may be as great as two to three hundred units per acre. Since the single family house is the most desirable and acceptable housing form it becomes a standard against which any other housing form must be compared.

Over the last two decades, the feasibility or acceptability
of high-rise density housing and the single family house has decreased. A number of different housing forms and ideas have been generated. Characterized by various strategies to maintain amenities of the single family house and meet the needs of particular user group. The accumulation of user group studies is beginning to give a clearer picture of which aspects of the designed housing environment meet with high satisfaction on the single family house must be retained regardless of density. A few number of architects are beginning to incorporate this knowledge into their architectural practice.

**CLUSTER HOUSING**: Retaining more of the imagery and amenities of the traditional house form, The appeal of this form of housing is in the individual access, potential for identity, ground relatedness and generally pastoral setting at densities double or triple (up to 20 to the acre) those of single family house development. Fewer roads and utilities lead to cost saving. The sharing of walls reduces materials and energy consumption.

**URBAN ROW HOUSING**: Many town house developments show internally oriented to create more controlled access, distinguished from
street oriented conventional sitings. Individual parking is often incorporated into the lower levels of the units. (40 to 60 units per acre)

**WALK-UP APARTMENTS:** Even though many units are not resting on the ground, the combinations of emphatic stoops and direct access to the ground through individual stairways does reinforce the sense of separate dwelling. Many families have taken balcony space and created individualized extensions of their homes in much the same way that the suburbanite embellishes through gardening or decorative additions. Most do not have private outdoor space on the ground. They rely on commonly shared stairs and halls for access and most parking is aggregated away from the units. In this form of housing at moderate densities, the organization that has been used frequently to resolve the loss of traditional house amenities is that of interlocking open space to which buildings containing a few dwellings are oriented. In a site plan of interlocking spaces, a variety of activity areas are linked to each other by controlled paths.

**TERRACE HOUSING:** On sites where conventional building forms are
impossible due to difficult terrain, this form of housing was devised. Two strong visual characteristics typify this form. First, the overall form has an aggregated hill town image. This is strong enough to cause residents to identify the whole development as their own individual place. Second, as the mass is stepped back to conform to the hill, each dwelling becomes recognizable and claims an outdoor space immediately adjacent and private on the roof of the lower unit.

ELEVATOR SUPPORTED - LAND-IN-THE-AIR; In conventional double loaded corridor type apartments, the corridor becomes the public space. The functions of surveillance and social buffering are dependent upon doorways which, more often than not, open directly into the major living spaces of each dwelling. Methods for correcting this are the ideas of "land in the air" or the initial justification for pedestrian "street decks".
It appears that the architectural and planning ideas of modern architects have failed wherever the architect disregards the social and aesthetic values of user. In the days when most
architects were designing for wealthy, private clients, the
designer and his patron frequently came from the same social
class, shared similar values, and had little trouble commun-
icating. Furthermore, the client and the eventual user of a
designed environment were one and the same person. The com-
munication of the needs and preference from client/user to
designer was a relatively simple person to person exchange.
With the onset of the Industrial revolution and the emergence
of more complex institutional and corporate environment the
designer-client link became more convoluted.
With the advantages of industrial society modern architecture
has tended to deal with how people should live rather than
how they do live. When traditional social patterns did not
conform to their modern idea of how buildings should be used,
designers ignored them, in the belief that every one in the
world has the same basic social and physical needs regardless
of who the client is.

With the onset of industrialization the architect-client re-
lationship took on a new aspect. In large-scale projects, the
Architecture is going through a kind of minor revolution. Designers are grappling with the problem of the "unknown user," by wrestling with notions of "flexibility," "adaptability," and "responsive environment." During the last two decades increased levels of individual awareness and social consciousness regarding the physical environment are the consequence of a common desire to reevaluate traditional social values. In reaction to the impositions of Modern Architecture the emerging attitude toward housing in these days seem to be more modest, responsive, and humanly scaled.

In 1958, Hunderwasser read his Mould Manifesto in the abbey of Seckau;

1. The architect has no relationships to the building. Even if he is the greatest architectural genius he cannot foresee what kind of person is going to live in it. The so-called human measurement in architecture is a criminal deception. Particularly when this measurement has emerged as an average value from a public opinion.

2. The bricklayer has no relationship to the building. If, for example, he wants to build a wall just a little differently in accordance with his personal ideas, if he has any, he loses his job. And anyhow he really doesn't care because he isn't going to live in the building.

3. The occupant has no relationship to the building.
Because he hasn't built it but has merely moved in. His human needs, his human space are certain to be quite different. And this remains a fact even if the architect and bricklayer try to build exactly according to the instructions of the occupant and employer.

Only when architect, bricklayer and occupant are a unity, i.e. one and the same person, can one speak of architecture.

Historically the places where individuals or groups participated actively in the creation of their environments have a special character. Their uniqueness emanates from the dignity of providing for one's self, of determining one's own living mode.

In 1972, The Shirt-Sleeve Session, held at the Department of Architecture of Massachusetts Institute of Technology, was intended:

Dwellings ought to be fitted to people, not people to dwellings; that building technologies ought to be flexible and changeable capable of fine-grain physical conference to patterns of human use; that people ought to be able to participate much more fully and easily, directly or through machines, in the design, construction, and later modification of their dwellings.

In the past decade there have been an increasing number of projects using flexibility as a mean of personalizing architectural and accommodating different life styles. This principle offers the user the possibility of changing, or making some individual contribution to, his own house. For the purpose of clarity, it needs to define the meanings of terms:

FLEXIBILITY: can be defined as the ability to achieve a change of conditions, without changing the basic system as such;

VARIABILITY: may be defined as the ability to achieve a change of conditions by changing the system.

Thus, FLEXIBILITY refers primarily to adaptation to change, while Variability refers more to change as such.

As the situation stands today, ordinary multifamily housings provide only the reduced dwelling into a few very specific spaces, which in result reducing the diversity of human activity the dwelling can support. Aside from a desired change in locale or place of employment, four types of interrelated change are most likely to require a move if the dwelling is incapable of long-term or life cycle
flexibility. 1) The first major change is household size, occurring by marriages, child birth, etc., which requires spatial needs. 2) An alteration in life style--such as socioeconomic status, aspirations, values and self definition change. People need to imprint their houses with their own self images. 3) Changing equipment is a third consideration affecting residential interiors. --sound equipment, television set, sink washer-dryer, etc.-- 4) Over time a dweller's desired activities may diverge from the sociologists' "norm." --Music listening, piano playing.

In addition to long-term flexibility, the need for alteration of the dwelling occurs in other time frames. Although not necessarily a major moving, lack of potential for change can still cause conflicts and dissatisfaction with living environment. This kind of changes are referred to "short term" flexibility.

RESOLUTIONS: In order to reduce the conflicts which arise from both minimal and highly defined spaces, a number of sol-
utions are possible which permit change and diversity. These methods include perceptual methods for creating privacy, actually increasing or reallocating existing space, reconceptualizing household equipment and reorganizing volume. In addition to these there are planning strategies which have less to do with than the specific physical aspects of the dwelling user in decisions about the dwelling's configuration and ambience. These resolutions are often interrelated. To summarize those resolutions in several categories; 1) Perceptual Resolution; Privacy. 2) Extended Space Resolution: Attempts are made to add spaces to extend the dwelling. In high density, highrise apartments there has been limited experimentation with overbuilding the structural framework to allow for expansion. In row houses, the walls between units may simply be extended to a fixed point of ultimate growth. 3) Space Reallocation. 4) Equipment reconceptualization. 5) Space reconceptualized: In Le Corbusier's development at Pessac, the machine domains which incorporate kitchens and baths will not themselves be elements of change and flexibility. Instead, individual space interpretations were to be attached at the discretion of the user.
One way to include flexibility in housing was through the "open aesthetic", which was formulated by Team Ten at Otterloo, in 1959. It offered the user the possibility to change or add to completed house so that inhabitants could mark their housing with their own individual stamp. Helping to build one's own house, even on the small scale of participating in semi skilled construction work, is an excellent way to begin bringing the house and the way people use it closer together. Obviously the more the client is involved in the basic planning decisions, such as determining room sizes and locations, the better the idea works.
ANALOGIES: There are analogies and images of housing that move beyond narrow sense of industrialization to something richer and more varied. What such analogies try to do is to create a framework for housing that leaves the individual householder with partial or complete responsibility for the arrangement and in some cases the form of his housing. Such a framework aims at meeting the needs not only of the first users of the housing, but of each successive user who might live within the framework. Its aim is not to try to embody human actions and desires, but to accommodate them.

1. The wine bin analogy: Like Le Corbusier's Marseilles block, the block consists of a framework - the wine bin that holds an infill of housing - the wine bottles. Corbusier saw the infill as something of fixed arrangement, but conceptually it could be varied a great deal. It connotes something of fixed shape and size, but containing wine of every variety. Welton-Beckets contemporary Hotel at Disney World is direct application of the wine bin analogy: Its ziggurat framework holds prefabricated steel hotel room modules.
This makes it possible to replace or refurbish whole rooms without disrupting the operation of the rest of the hotel. They also allowed the hotel to be finished rapidly, while minimizing the number of workers who had to be brought to and maintained at the site. But, like the Marseilles block, each of the modules is basically the same. Archigram group's Plug-in City Project and Kurokawa's Capsule Hotel in Tokyo's Ginza District are both variations on the wine bin theme.

The problem of wine bin analogy and its variation is that they depend on some outside force to remove and replace the housing modules, and they picture the module themselves as things of fixed dimension and arrangement. Although flexibility is provided, it is limited, provided to the framework and not to the housing.

Brolin sees some problem in that kind of mega-structures and notes:

Van Nostrand Reinhold Co.
N.Y. 1976, p. 84.

...the complications of moving large apartment-sized object through dense urban areas, it seems that mega-structures would only be flexible if they were not used to capacity,
and therefore were uneconomical. With a profitable 3, or 5, percent vacancy rate a mega-structure becomes relatively inflexible: You cannot expand if your neighbor will not contract.

2. **The bookcase analogy**: This tries to redress such a problem. The Townland (one of the competitors in the Breakthrough Program) System is based on the same separation of structure and infill that characterizes the wine bin analogy and its examples, but goes a step beyond in providing the kind of ambiguous space that associated with a bookshelf - a space that can hold not only books, but lamps, aquariums, bric-a-brac and a host of other things. One of the presentation drawings showed the frame structure filled with a variety of housing types - multi family multi-story and detached single family housing, each somewhat different from the next, at the same time variety of other functions could be inserted in the framework, - playground, schools, stores, offices and community facilities.

3. **The play pen analogy**: Both the wine bin analogy and the bookcase analogy are evolutions of the 19th century industrial loft. Loft buildings can be thought as an example of separation of framework and infill, but they also can be considered as
separating the building envelope and interior space. What they provide is a sheltered interior space that can be adapted to housing and other uses. Another analogy is derived from such a framework of housing. Martienssen chose the term play pen because she thinks;

The play pen provides little more than a defined (and thus limited) place where the child can assemble his own desired equipment and provide for his own small industries, whether those be with paints, bricks, counters, or any other articles contributary to his business,— and the important quality is flexibility, adaptability, and unobtrusive behavior of container surfaces and limiting walls, a lack of encroachment either in actual substance or in visual instances, a reticent in fact and lack of aggressive demand.

She further notes that the external and internal expressions of the container can hardly be of matter of importance, so:

it is the things contained that are of importance, and the person or persons manipulating those things, who may well desire enlargement of the space available as those things take shape or are dismantled.

One cannot simply apply analogies blindly, or think them up in isolation. Each has to grow out of a consideration of the community - its technology, its resources its desires.
4. The umbrella analogy: Buckminster Fuller is responsible for pushing separation of envelope and space enclosed its logical conclusion, proposing that an immense dome be built over part of Manhattan, thus creating an umbrella between New York and the environment. It can easily imagined that the regulated internal climate of the dome could result in a more tropical architecture, one less dependent on bulk and mechanical equipment than its outer counterpart.

It can be pointed to some examples of this kind of ideas, though not in such scale, in the building that provides only a sheltered area for their owners and tenants: large shopping malls typically provide only raw space and utility hookups, placing the burden of development on the individual tenant, who is free to plan the space within a clearly stated set of rules.
alora dole del castello
ale Dopie una per lo Chastellano
l'altra per i provisionati
Among those analogies the "play-pen" concept was adopted in formulating the idea of new system that makes industrialized housing possible to be more responsive to users' needs.

Although "self-help" is the most perfect way to produce dwellings in terms of user participation, there are four areas of construction which are uncommonly difficult to undertake without special skill: 1) structural/envelope system; 2) water/waste system; 3) power/energy system; and 4) foundation/footing system.

From a three-dimensional point of view, buildings designed with planning grid have divisibilities into two kinds of structural volumetric module; the one including "fixed core," such as bathroom or elevator shaft; the other includes sheltering envelope, such as exterior wall or windows.
MULTI-STORY SECTIONAL BUILDING SYSTEM is a sort of specialized case of three dimensional building system. This is basically composed of load-bearing vertical boxes, which are envelope units and service core units, combined with floor and roof panels to create an integral structure. The modules are monolithically cast, box-like concrete units of same size.

The modules can be combined in a variety of configurations, producing a wide range of building forms from low-rise walk up townhouse to high-rise. The combinations possible for extremely flexible floor plans and form designs.

The modules are produced and finished in the production facility. So there can be a range of finishes available, both for exterior faces and interior surfaces. But in terms of flexibility for users' participation it would be reasonable to leave the interior as constructed.

The basic form of sectionals is a vertically long, narrow volumetric module complete in three sides except
one side which is open. The modules contain all necessary electrical, plumbing, and heating-ventilating services, which are installed during the precasting process. The boxes incorporate all the various openings required, such as door and window frames. Kitchens and bathroom, separate units, complete with fixtures and accessories, installed in the factory.

Those sectionals come in four floor heights, and can be stacked one upon the other to produce high-rise building up to 16 storeys. The size of sectionals is generally limited by the maximum size permitted for highway transportation.

**SLABS:** The floor panels can be large, roomsized slabs or precast hollow-core planks. In view of the system's objectives, that is to provide flexibility to the plan configuration, hollow core planks are considered appropriate components. Some of the available hollow-core planks in the market is well provided with the characteristics needed in this particular building method. Because the plank is machine extruded on beds up
to 600 feet in length, and can be cut to desired lengths its applicability for this system is eminent. The planks can span up to 48 feet without intermediate support.
DESIGN METHOD: The housing scheme which starts from an additive system invariably ends in formalism. It has been found, in the planning of housing units, that the most effective way to proceed is to start with those elements which can first be determined and defined (entry, kitchen, bath, etc.) and to cluster the rooms around these services. This concept by dissociation is general practice today. First the core is determined, then the cluster is formed. This is true for one-family houses as well as for blocks of flats, and as a planning process usually results in good and efficient design.

In The Place of Houses, Moore categorizes domestic spaces into machine domain" and "our domain," a separation similar to Louis Kahn's "served and servant spaces." The "machine domain" can either be condensed appendage to the plan or a compact island within it, leaving the remainder of the dwelling a flexible activity area.

Rietveld's "Kern Huizen" (apple core) design. 1929
In terms of the directionality of the system, multi-story sectional system is three-dimensional. By manipulating basic modules hundreds of dwelling plans can be acquired. Versatility of form configuration would be considered a great advantage of this system.

AMBICUOUS ZONE occupants will design and build as they wish.
Foundations are finished.

Multi-story sectionals are transported and erected by tilt-up method.

Boxes are jointed.

Slabs are lowered and positioned.
Floor plan of a low-rise walk-up apartment: One stairwell serves two units.
DOUBLE ASPECT THREE BED ROOM UNIT: LOW-RISE WALK UP APARTMENTS.
View from the inside of bedroom toward the balcony. (A3)

Interior perspective of A3 living dining room, looking toward balcony/kitchen.
Two bedroom unit in low-rise walk up apartment.

Alternative plans.
Double aspect corner unit (three bed room) in high-rise apartment.
This floor plan shows an elevator supported high-rise tower building.
Interior perspective of a living room in a tower apartment."(A7)
Two bed room unit in the tower apartment. (double aspect)
Efficiency units in a corridor type apartment.
Two bedroom unit plan for corridor type apartment.
Three bedroom unit plan for double loaded corridor type building.
One bed room unit for corridor type apartment building. Double loaded configuration.
One bedroom unit plans for double loaded corridor apartments.
Floor plan showing double loaded corridor type apartment.
BUILDING SECTION

[Diagram of building section showing slabs and sections labeled as 'SLAB', 'ENVIRONMENT BOX', and 'BATHROOM BOX'.]
SECTIONALS

ENVELOPE MODULE

KITCHEN MODULE

BATHROOM MODULE

PLAN OF BOXES scale: $\frac{1}{4}''=1'-0''$
Sectional Elevation "B"
- Scale: 1/8" = 1'-0"

Section "A"

Plan of an Envelope Box
- Scale: 3/8" = 1'-0"

Details

Concrete 4"
Air space 1 1/2"
Rigid insulation 1"
Steel stud 2"
Gypsum board 1 1/2"

Floor: hollow core concrete plank
HIGH-RISE APARTMENT COMPOSED OF TRIANGULAR PRISM MODULES.
DIVISIBILITY
- Section and an elevation of a box
  Scale: 1/8" = 1'-0"

- Isometric view

- Plan of a box
  Scale: 1/8" = 1'-0"
STANDARD JOINT: Two types of joint were developed. (see following page)
This drawing shows how lateral connections are made by dry joints. Nuts to be welded after the unit is aligned, and then concrete is filled.
**JOINT DETAIL BETWEEN THE BOX AND SLABS**

Scale: 3/4" = 1'-0"

- Suspended ceiling
- Closed cell insulation
- Vapor barrier
- Dry wall screwed to metal Z clips

- 1" dia. h.s.f.g. bolt
- Hardened steel washer

**JOINT DETAIL BETWEEN THE BOX AND FOUNDATION**

- 2" dia. tube
- 1" dia dowel
- Foundation
About the future development of industrialized building

Carlo Testa has an opinion that more far-reaching may be developments in the demountability and transportability of the building itself, and even of complete town. He writes that the real necessity for this requirement of "flexibility in time" has not been proved yet, but the very mobility of the society strongly indicates a growing interest in that feature. He also foresees that;

Testa, C. The Industrialization of Building, Van Nostrand Reinhold, 1972, p. 180

The requirement for "flexibility in time" will modify the present essence of a building (a static structure) and transform it into a dynamic structure. Requirements of this kind are already in existence for schools, public buildings, offices and hospitals, but in order to become meaningful these requirements will have to be extended to the complete "town system".

Taking the broadest possible view of ecologists' theory the future may find out the necessity of requirement (that Testa hasn't seen) more urgent and realistic.

R. Meier mentions on the future form of housing:

Meier, R. "FUTURES FOR HOUSING", from THE FORM OF HOUSING, Van Nostrand Reinhold, 1977 p. 270

Despite strong conservative forces in the institutions responsible for the provision of housing in North America, the need to cope with global shortages, massive catastrophes and harsh environments should stimulate diversity in form. --- The necessary economies in the use of resources are best achieved through clustering of dwellings to economize on vehicular use. ---
best achieves through clustering of dwellings to economize on vehicular use.---

It has been forecasted that more turbulent environment will be formed by the conditions in climatic change of the Earth, and that a new Ice Age is due in our era. However, this kind of extremes is certain to stimulate huge migration, followed by the construction of habitat in new locales.

The present situation in the international political environment is so terrifying it paralyzes all rational considerations. Mis-handling of nuclear energy is another possible cause of the huge scale migrations. Will there not be possible solutions to bring their houses to a new place to avoid the refugee camp?

In terms of "flexibility in time" the Multi-Story Sectionals, with its high degree of demountability, can provide a useful idea for future housing. For instance, one possible solution is making the surface of the envelope into a sun collecting device, etc. Space grid structure is applicable to make the modules lighter. Potentials will remain to be developed.
IS DIS A SYSTEM?