KINETICISM IN HOUSING

by

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KINETICISM
IN
HOUSING

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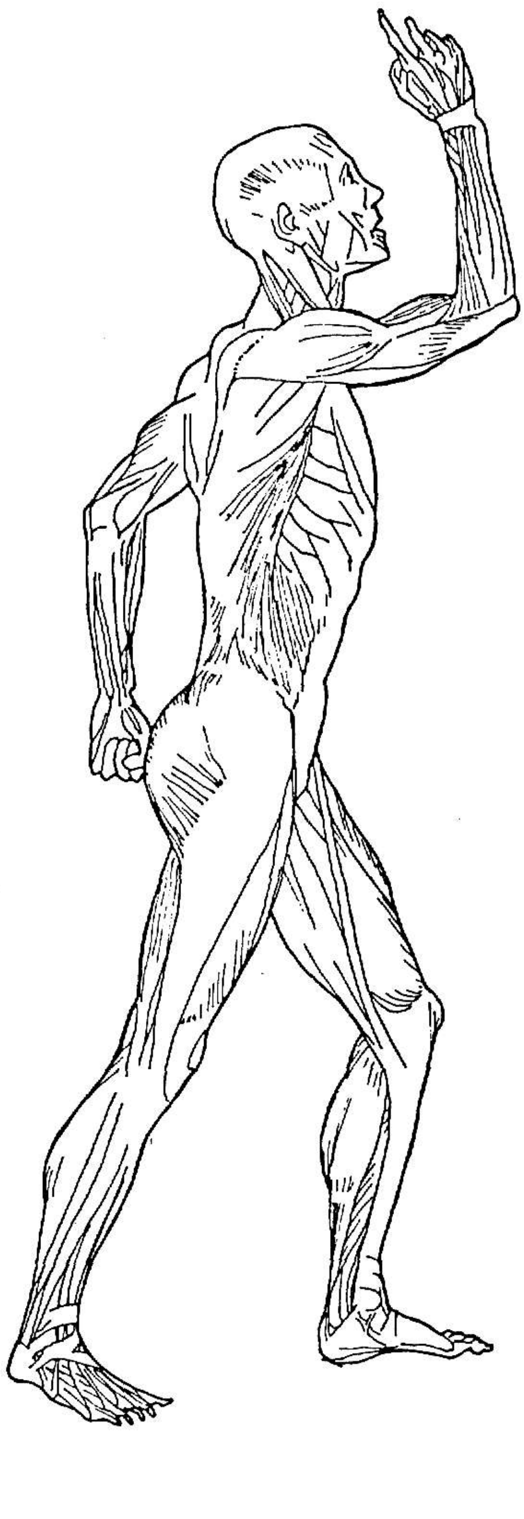
INTRODUCTION

STATEMENT OF THE PROBLEM



Man, along with all living things, is part of a continuous changing cycle. Charles Darwin has suggested that the problem of survival always depends upon the capability of an object to adapt in a changing environment.[1]

Traditionally architecture has been perceived as a permanent structure. For centuries, architects have been searching for modes and materials that would make a building ever-lasting. Most recently, recycle of buildings for different useage became practical simply because many buildings were originaly designed with the assumption that they would last for-ever.

Living in a fast changing age when culture is changing and intermixing faster than it has ever changed before, man is facing a lot of problems which is beyond the accommodation of existing facilities in the field of architectur K. Lonberg-Holm in his article "Time Zoning as a preventive of Blighted areas," stated,

> Most industrial products are today manufactured for useful life spans much shorter and costing less than

> those which only recently were considered essential and economical. But immovable human shelters and cities are manufactured for a physical life far beyond their socially useful life on the original site, in spite of the obvious impossibility for any 'planner' to predict technological progress and socio-economic changes and to define future needs. The procedure imposes heavy liabilities on future users and creates expensive obstructions to growth.[2]

Man and his family are now in a constant state of flux which is truly kinetic in nature. So the matter of a house which is the problem of providing a place of a family's living has to be kinetic in nature as well.

The word kinetic means something which is produced by motion. Kinetic architecture therefore is architecture which is subject to motion or constant change. Change is very much related to challenge of pressure and response. In William Zuk's words, architecture can be described as a three-dimensional form responsive to a set of pressure,[3] existing as a series of interacting elements which are not isolated from one another. A change in any one element of pressure, therefore, would effect the outlook of the whole system.

We might repeat here that as man's family is in constant flux and change, housing constantly faces pressure of change within its form. The matter of a house as the basic place to live is indeed particularly kinetic in nature.

THIS BOOK CONTAINS NUMEROUS PAGES WITH DIAGRAMS THAT ARE CROOKED COMPARED TO THE REST OF THE INFORMATION ON THE PAGE.

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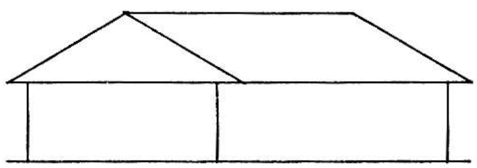
REVIEW OF THE ISSUE

20th century modular architecture is widely adapted for the use of mass-produced housing especially for kinetic architecture.

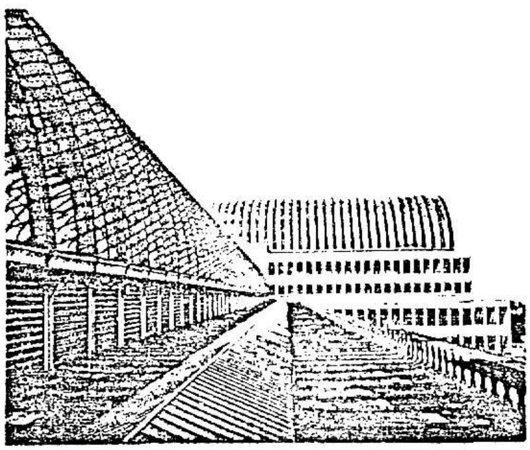


Yet well past mid 20th century, though appliances and some utilities have undergone considerable change, the basic structure of American house has essentially unchanged for over 100 years.[4]

During the immediate past, many construction programs such as Urban renewal and Model cities have failed due to many reasons, mainly administrative, conceptional, and finance inadequacies. In particular many government and publicly assisted housing could not be built simply because of constant construction cost rise.

Housing thus has always proved to be unprofitable. So the commitment of buisness capital is usually unwarranted for new private housing, except for luxury units.[5] For this reason few experiments has been done in developing the present housing systems. As most of the buildings were made for the well to do people, housing became more costly because it often ended up with costly ornamentation, as if it was a luxury handcrafted sculpture. Low cost, prefabricated housing system never got proper attention in American housing market.

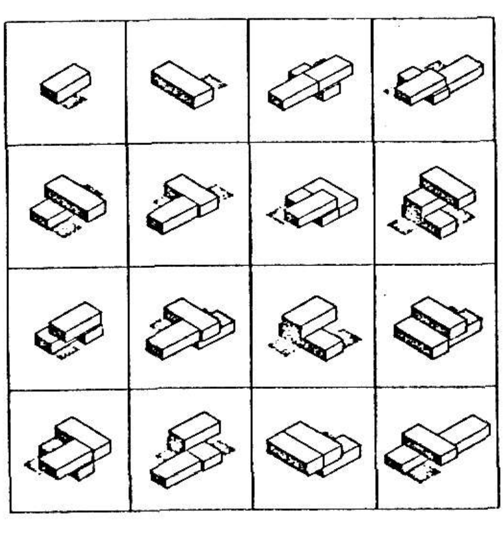
Men have walked on the moon. Yet, housing on earth is still built with the craftmanship institutionalized by the medieval guilds.



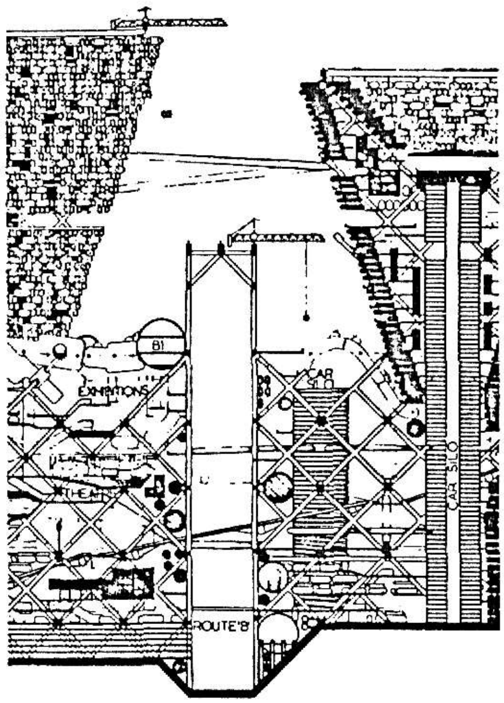
Joseph Paxton : Crystal palace

The first major kinetic building, The Crystal Palace, an exhibition hall covering 20 acres was built in England in 1851. It was erected with prefabricated iron, glass, and wood elements in six months time. Mostly after the pattern of the Crystal Palace, the prefabricated housing types, patents, techniques, that has been used between 1860 and 1890 remains unchanged in this century.[6]

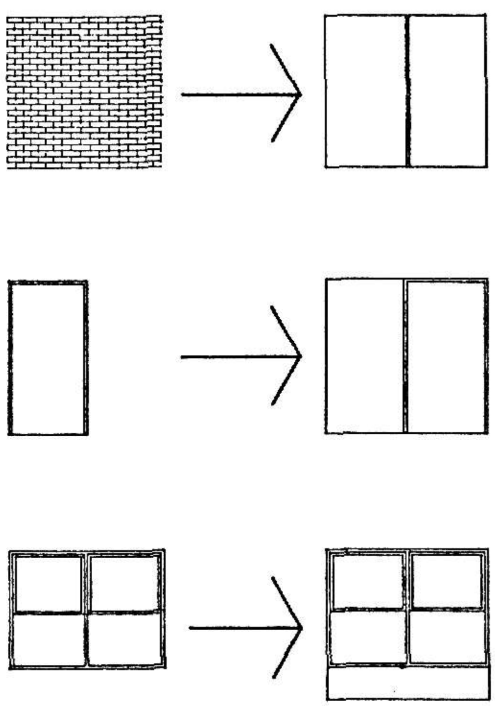
Moshe Safdie: Basic structure Habitat, Expo '67



In 20th century, many architects, engineers, industrial designers, and manufacturers, inspired by the specific demand for mobile homes, have began to think abstractly of dwelling modules as 'Boxes' or 'Building block', where each units could be produced in the factory and then transported over highways. Moshe Safdie's Habitat at Expo '67 is one example of the flexibility of a box system.



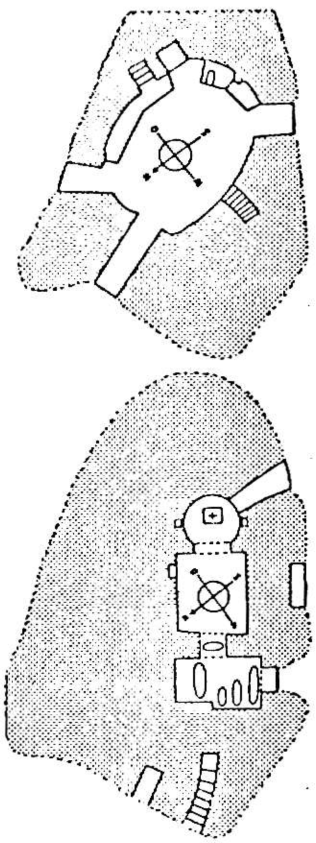
Plug-in City: Archigram



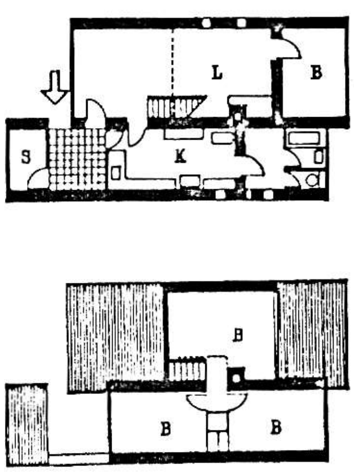
The Plug-in City of Archigram group of England and the Clip-on architecture of the Metabolist group of Japan are other examples. All these can be generalized as a general system where modular approach constitutes the basic element of kinetic architecture. Based upon the basic facility of existing building techniques or systems, the method employed herein involves many elements which follow some type of system or another, and are designed in varied way in order to suit specifically predetermined situations in terms of dimensions and needs.

Brick is considered a very flexible modular building material, but its modular size is so small that it requires quite a long time to build just a simple wall. In terms of efficiency, factory made wall panels, doors, and windows are the other element in our existing modular building systems that furnish good accomodation. Elements such as a door has become more or less a modular element with standard measurements first of all good for a door itself. Window space however can be replaced with plain wall panels or panels that attaches with windows. Once a system approach is introduced for most if not all building forms by standardiging building elements or components, the opportunity to accommodate the needs of change, growth, and renewal without painful and wasteful removal or remodeling of existing element is totally secured.

PURPOSE OF THE STUDY



Goreme Cones
Fifth century A.D.



James Stirling : Priject 1955

From the very begining until this day of man's civilization, although man's habit have been changing frequently and often radically, but his basic architectural requirement — the form of living and sleeping areas etc. that he needs, have remained rather consistantly similar except, due to technological advancement, the size of the areas and the domestic utensils attached to them have changed by necessity.

Basically man is an adaptive animal. Many of us still manage to live in a house which were built say, a century ago, regardless of the fact that their requirements and needs have substantially changed since then.

Changing the overall function of a house is not always feasible because of present rising cost of labor and material. Lack of flexibility precluded in the design itself makes changes or extentions a rather difficult task.

It is the purpose of this report to review or study a few conceptual types of kineticism and their characteristics in relation to their structural integrety as well as to their compatibility with the environment.

NOTES:

1. William Zuk and Roger H. Clark, Kinetic Architecture, (New York: Van Nostrand Reinhold Co.,1970), p.4.

2. K. Lonberg-Holm, "Time Zoning as a preventive of Blighted areas," Record and Guide, (June 24,1933).

3. Zuk and Roger, op. cit., p.5.

4. Center for Housing and Environmental Studies, Cornell University : Ithaca, The New Building Block, 1968, p.15.

5. Peter Wolf, The Future of the City,(New York : Watson-Guptill Publications, 1974), p. 97.

6. Ibid., p.97.

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KINETIC HOUSING CONCEPT

SCOPE OF THE PROJECT

Architecture is changing very rapidly. In Peter Cook's words, the architecture of the past used a static language; the architecture of the immediate past has had to invent a language to absorb dynamic and change; it is reasonable to predict that the architecture of the future might totally embody this dynamic quality.[1]

This study covers different types of kineticism which are presently being used or which have shown possibilities for future application. A physical design expressive of the best possible kineticism from the report on different types of kineticism would illustrate the coordinated function of these types. However, one must understand that this proposal was not intended to be a thorough and accurate design for a housing project. It would require an elaborate design process in order to design a housing complex which is very complicated in nature in terms of a detailed analysis of social, physical, environmental, and economical factors. This project primarily aims at the description and application of the kinetic possibilities in the field of general housing.

CONTRIBUTION OF KINETICISM TO HOUSING

As a solution to present day's insufficient flexibility in man's parts-to-whole arrangements between or among independent units of large scale housing complex, the application of the technique of kineticism in housing can fullfil these general objectives:[2]

1. To develop a modular system for the design of houses whose components could be adopted or changed to compensate for the fast changing society.
2. To find a solution in housing where people can have the individual freedom of choise in the design of a house from a great variety made possible by different combination of housing components, of construction materials, and of different types of units in terms of size, function, and hopefully appearance.
3. To propose a kineticism in housing where technology can be used as an obliging means and not as a dectating pre-requisite.
4. To offer an architecture under people's control in which the individual client can become a part of the process of design by choise.

5. To develop a modular housing system whose different parts of a unit, i.e., wall, door, window, partitions, etc., can be changed very easily like different parts of a car.
6. To develop systems whose number of housing units could grow vertically instead of horizontally, where different portion of each floor can be used as one interior "plot" for one unit, housing or apartment rather.
7. To develop housing systems whose variety and quality would be concieved as a " Consumer product".
8. To find a solution where cost would be reduced by employing mass production method. Also there should be continuous upgrading of housing quality in line with technological progress.
9. To find housing systems that would permit easy replacement of obsolete components.

PARTICULARS OF KINETICISM IN HOUSING

The particulars of kinetic housing could be outlined as follows :[3]

PLANNING

* A system should allow varied combinations of units or components in the plan.
* There should be sufficient flexibility to adapt to changing family needs.
* A modular housing system should be able to adapt to any topography and site.
* The units of a housing system should be able to adapt to varied situations in terms of scope ranging from a single-family housing units or multi-family housing set-up to the extensive involvement in a cluster of housing complex development.

SPACE CHARACTERISTICS.

* The housing system should allow a consumer's choice in the selection of dwelling types and architectural components built within or around different physical surroundings.
* They should have sufficient flexibility to allow for the transition from indoor to outdoor spaces.

* A modular housing system should permit the possible outdoor extension of housing units to adapt to seasonal, climatic and environmental changes.

MARKETING-FINANCING

* It is highly desirable that common spaces and facilities should be considered as shared property.
* Dwelling and equipment component of each housing unit to be considered as personal property.
* The kinetic housing system should be conceived as a "Consumer product". The clint should be able to select housing components from a catalogue classifying standard types and optional parts.

PRODUCTION

* All parts of a building system should be extensively factory-produced in order to minimize on-site labor cost, which is much more expensive because of lack of precise control of labor.
* There should be a provision for periodical, independent replacement of

components according to the criteria of relative obsolescence.

* Land, structure, and mechanical systems, should be subject to normal code regulation.
* Quality of modules should conform with industrialized housing performance standards set-forth by designers.
* All components of the system should be designed to facilitate transportation convenience and regulation.

NOTES :

1. Peter Cook, Architecture: Action and Plan, (New York: Reinhold publishing Corporation, 1967), p. 41.

2. William Zuk and Roger H. Clark, Kinetic Architecture, (New York: Van Nostrand Reinhold co., 1970), p.155.

3. Fabio N. Fabiano and Miichel A. Panzini "Leasure Habitat," Domus 509, (April 1972), p. 15

3
TYPES OF KINETIC ARCHITECTURE

KINETIC ARCHITECTURE

Kinetic architecture can be broadly divided into two different catagories.[1]

1. Closed system kineticism
2. Open system kineticism

1. CLOSED SYSTEM KINETICISM

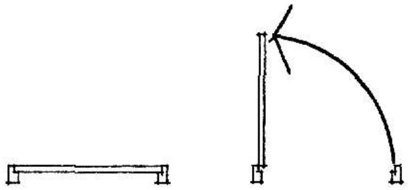
This method emphasizes the rationality of economy which furnishes only limited interchangeability of parts. It may offer some variety in the planning stage, but once the layout is agreed upon, the prefabricated pieces are interlocked into a closed unit. This is called "CLOSED SYSTEM" because the system accepts only parts predesigned to fit into the pattern designed specially for this system. Most of these projects are not very flexible. They are, however, generally very efficient.

Closed system kineticism can be further devided into two basic catagories.

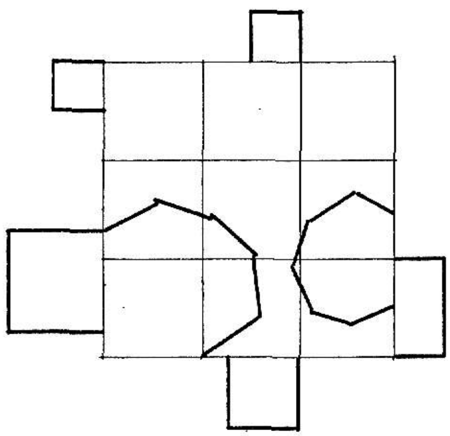
a. Kinetic components,[2]

b. Reversible architecture.[3]

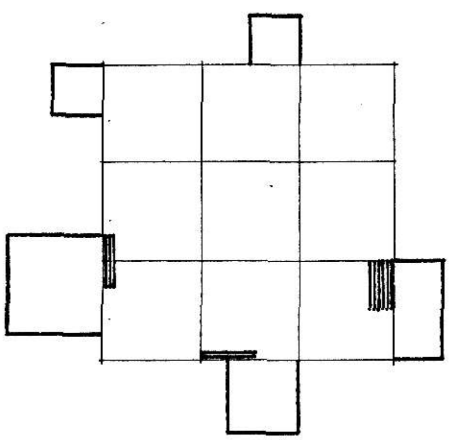
KINETIC COMPONENTS



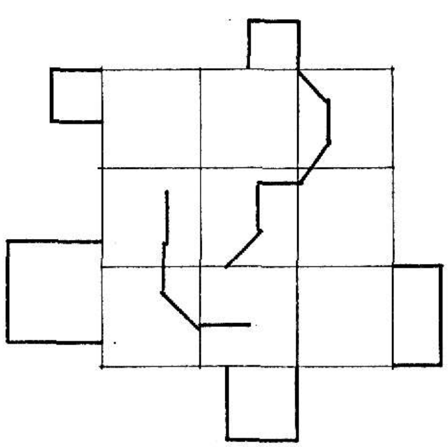
Doors, windows, elevators, and folding partitions which contemporary urbanized man experiences almost every day and are routinely accepted as part of todays' architecture, are some of the kinetic components.

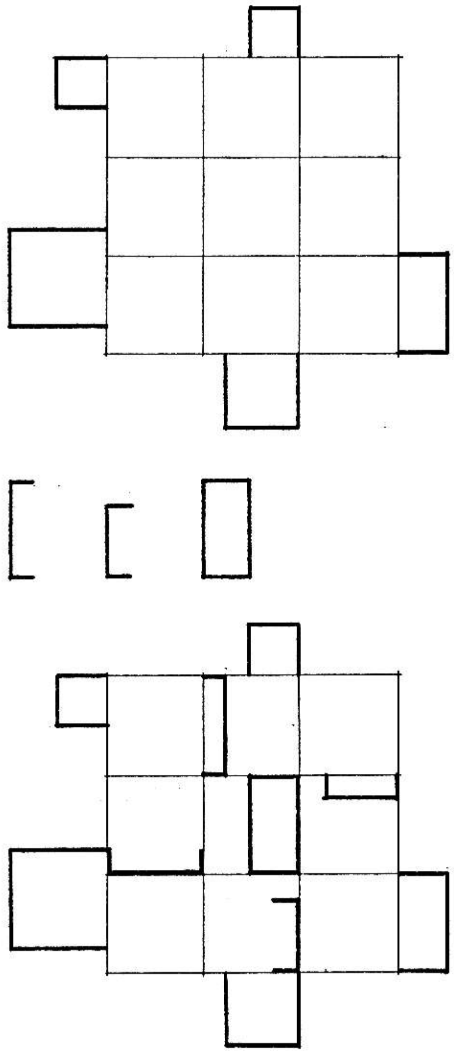


The principle of the sliding door or small folding partition has been finding great application in office buildings and schools where rooms are subject to frequent changes. These folding partitions has to be nonload-bearing so that it can be freely located within a comparatively long span structure covering the entire floor.



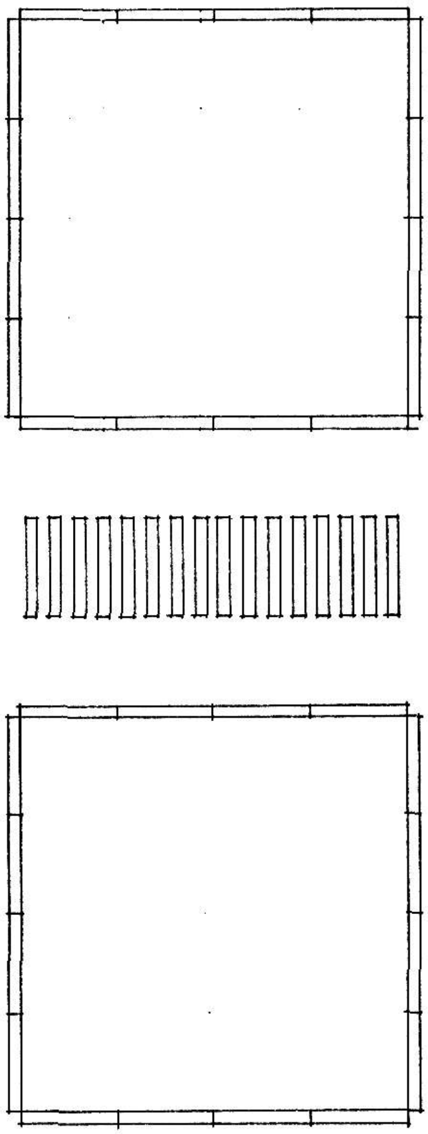
For kinetic housing these partitions could be used to change certain space into different rooms as needed by a client.





Movable wall panels could be replaced by three-dimensional units, i.e., closet, toilet etc., where each unit could be self standing.

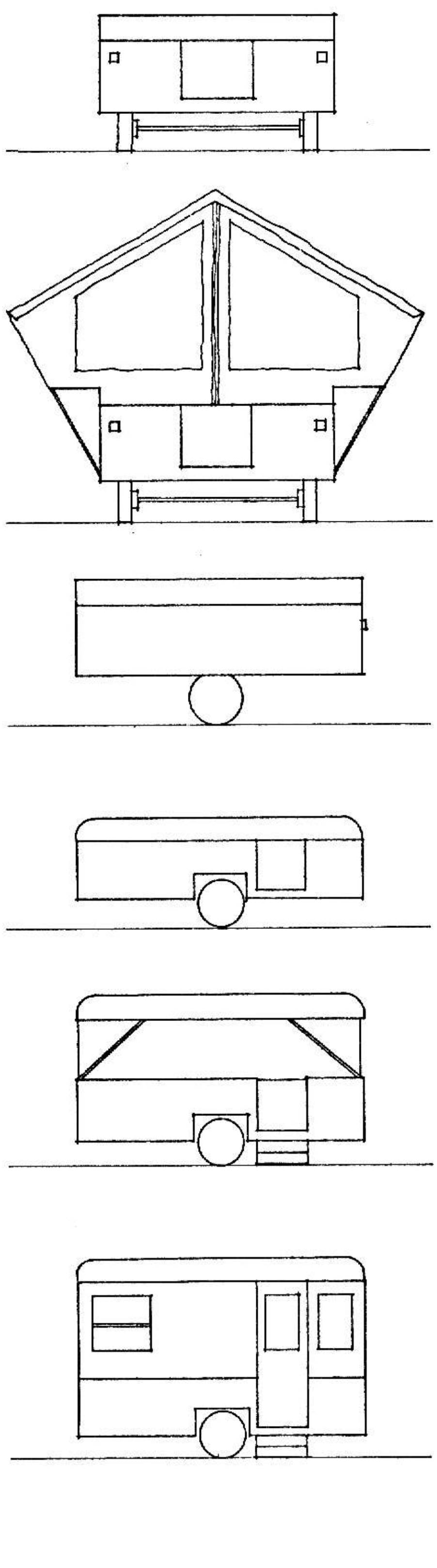
REVERSIBLE ARCHITECTURE



Reversible architecture is, in essence, a form of architecture that can be dismantled non-destructively or better even, collapsed in a manner to give more open space when it is needed.

Such a structural system, therefore would permit a building component or a building as a whole to be dismantled and then to be reerected at another location without making any major change to the building.

With urban population growth, being a matter of reality the life process of change in a city is a necessity and the location of many structures should be able to change accordingly. For it is only when housing densities, and the corallary systems has reached that point of maturity that high-ways, etc., appartments, and shops might be forced to abandon their continuity of growth.

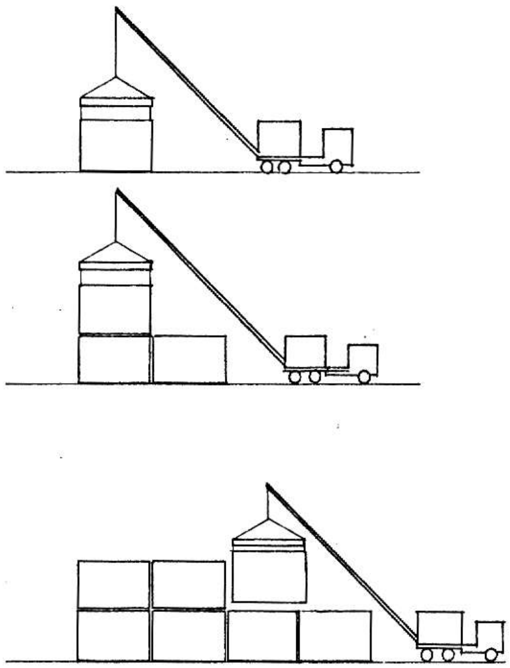


SMALL SCALE STRUCTURES

The Camper-trailer is one of the popular small scale reversible structures that encouraged ingenious forms of collapsible shelters themselves and the furnitures and accessories that go with them. The reason for collapsibility, of course is to avoid hauling air resistence and to permit compactness of space when traveling.

Low trailers can be expanded to a four-man tents by the turn of a crank and they can be dismantled in the same way without any loss of any material.

A hard walled camper-trailer is a good example of reversibility. Erection of a completely hard walled camper-trailer can be fully automatic at the press of a button. Reversedly, it could also be collapsed by just pressing a button.

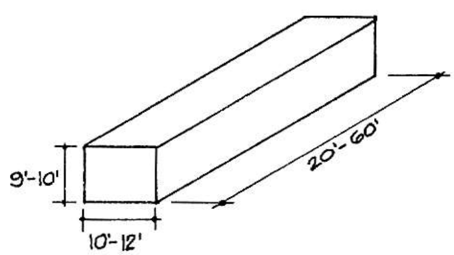


LARGE SCALE STRUCTURES

As technology develops the concept of reversibility could be utilized to sectionally and systematically dismantle a structure of any size.

Large scale reversible structures are becoming more prevalent — particularly in housing. Small scale construction modules like brick, are gradually being replaced by a larger functional module —'The Room'.

Paul Rudolph has described this as the "New Building Block".



Due to present constraints of road widths and the capacity of lifting equipments, the module size is limited to 10 to 12 feet width, 9 to 10 feet height, and 20 to 60 feet in length, which is quite appropriate to a living unit or module.

Some of these units are erected and stacked as bare structures to be completed in situ. Others are factory complete with utilities, built-in cabinats, and even carpets.

Some are made of standard reinforced concrete (with or without prestressing);

Some, of light-weight concrete (with or without prestressing);

Some, of steel frame with wood, metal, or gypsum panel infills;

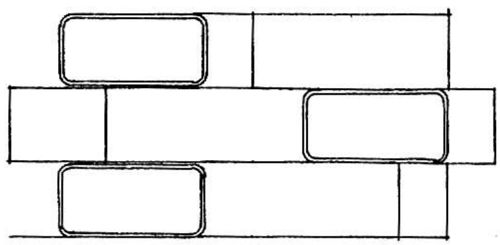
Some, of wood frame with sheathing or panel infills;

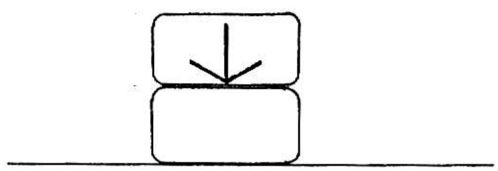
And some, of reinforced plastic, such as fiberglass-laminated.

For ease of manufacturing, shipping, and stacking, most of these units are prismatic, box shaped elements.

Upto two or three levels these units rest on top of one another connected by normal mechanical connections, such as bolts or welds. The manner of connecting these units must be such that they can be easily and nondestructively disconnected.

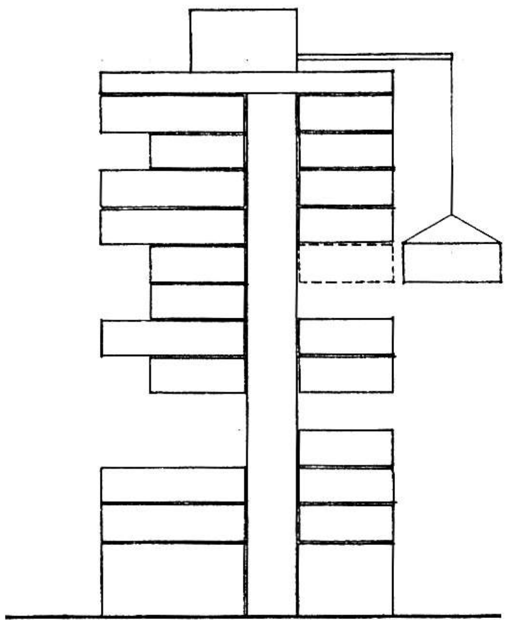
There are two fundamental approaches to building multistory units with modules:





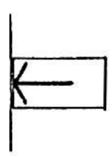
1. DEPENDENT STRUCTURES:

This is done by stacking one unit directly on top of the other. It is called "Dependent Structure" since the lower modules can not be removed without first removing those on top. The bottom units support the units above. This means that theoretically the bottom modules must be stronger than those on top. In order to achieve an efficient material economy, each additional layer of the units should be designed to carry less weight. An extreme case would require so many modules of different structural design that potential economy of mass production would be unduly minimized.[4] At any rate one must look for simplicity of structure where by no other supporting structure is required. This sort of stacking has limited flexibility in Planning, since one module cannot be removed without first moving those which it supports. Of course one whole building could be unstacked, moved, and re-assembled.



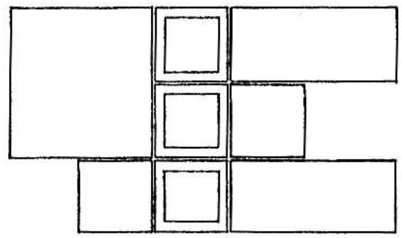
2. INDEPENDENT STRUCTURES:

The second approach is to incorporate a separate structural frame or Megastructure which supports each module independently of all other modules and can also supply utilities and circulation to and intervening modules. This could be done in both skeletal-frames and suspension systems. Since the structural frame supports the weight of each module independently, every module can be structurally identical favoring mass production. Potentially this type of structure may be used for much greater heights. In the independent system, any module theoritically could be replaced without affecting other modules.[5]

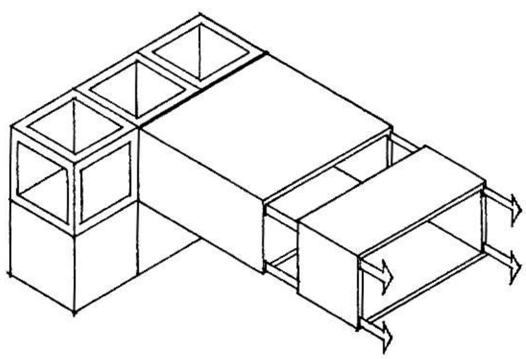


A suspension system requires a support tower or towers and a large support girder from the support.

In independent structure cost of a structural frame might look higher for the lower floors. In respect to the dependent structure, the cost is neutralized in the case of high-rise structure.

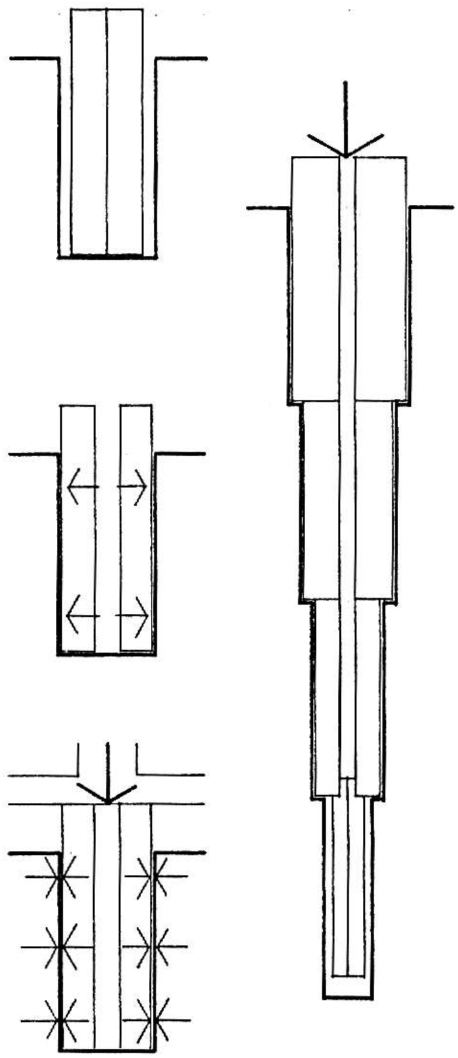


Worthy of our mention is a research project done at the University of Virginia school of Architecture by Paul Edmeades, Lennart Walloff, and Glen Tipton, under a grant from the American Iron and Steel Institute. This project has been directed tewards the maximum utilization of reversibility.



The basic concept of the project is to have independent spatial modules clustered as a vertical core structure. Planwise, the configuration of the core works most effectively as a cruciform shape, providing for large amounts of free surface for attachment of the modules, as well as providing good structural stability for the tower.

It is visualized that the modules (up to about 50 feet in size) would be of stressed skin construction and attach directly to the core surface in a variety of possible patterns. All units would be directly accessible from the outside of the tower for changing or removing these modules, separately or sequentially.



Foundations also could be made reversible: Deeper footings, necessitated by poor surface soils or heavier loads, could be constructed with expensive hollow piles or tubes. Sections of split tubes would be inserted into prebored holes in the soil and then expended by mechanical linkages or pressure cells to bear tightly against the sides of the hole. Larger diameter tubes would be used near the surface. As boring proceeds downwords, a smaller diameter hole would be cut, slipped in through the hollow tube at the top would be another split tube; that would then be expended diametrically to wedge against the soil and lock into shear keys with the upper tube.

The diagram shows the concept of reversible pile foundations as might be used in the A.I.S.I. project or another reversible structure.

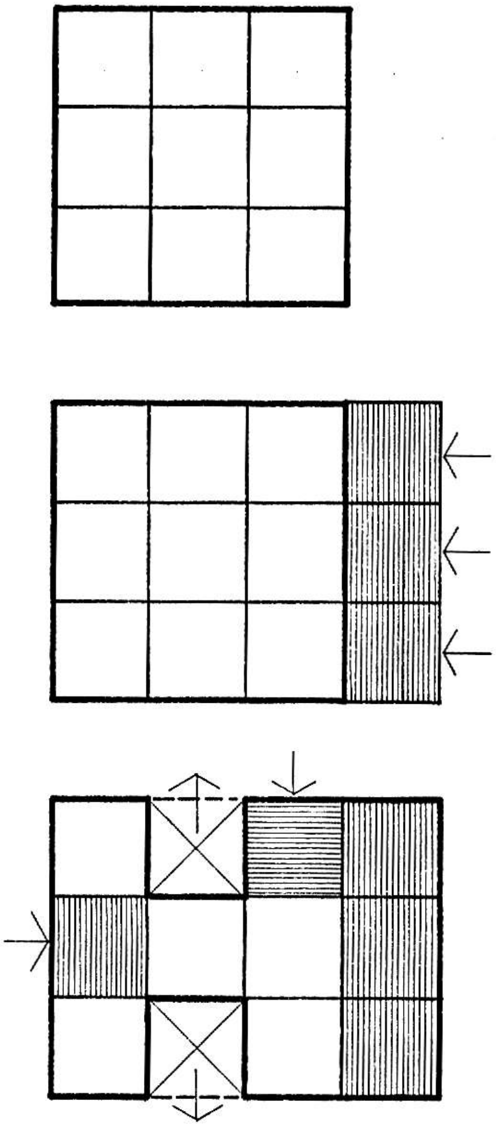
2. OPEN SYSTEM KINETICISM

It uses seperate prefabricated elements, each selected because of its capacity to serve a specific function, and combines them to provide flexibility in adapting to varying site conditions, functional requirements, and the change incured by time.[6]

Open system kineticism can be devided into three basic catagories :

1. Incremental architecture [7]
2. Deformable architecture [8]
3. Mobile architecture [9]

INCREMENTAL ARCHITECTURE



Incremental architecture is defined by William Zuk as, "— the kinetic system, that may be opened to accept new, outside elements which may not have existed at the time of original form inception".[10]

Because of this reason, incremental architecture can respond to a wider range of pressure changes than is possible in any form of kinetic architecture.

In incremental architecture the basic system of kineticism is done by,

1. Addition
2. Subtraction
3. Substitution

With all these types of kineticism nearly all sorts of unlimited types of kineticism can be applied in a building.

In incremental architecture, the design process can not be based upon a fixed predetermined set of criteria, which describes what the optimal solution of a building must be. Rather, design would have to be based upon the range of potential, encounterable pressures.

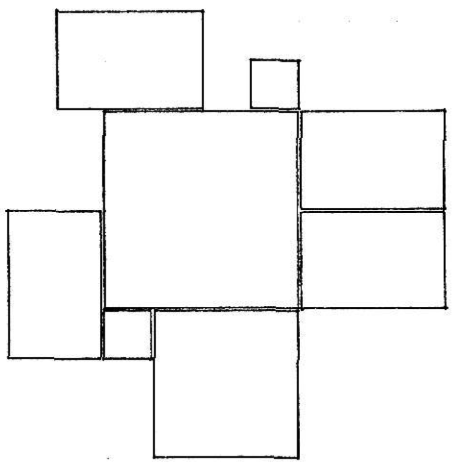
Incremental architecture have to follow industrialized mass production techniques, where standardization is the basic prerequisite to a mass-produced component system. Modularity is the main element for standardization.

Addition, subtraction, and substitution are the major elements of incremental architecture where in each case, joints are the critical factor, which creats problems of structural integrity, weatherproofing and aesthetics. Standardization would make wider range of options and choices. Moreover it would permit replacement or repair of worn-out parts.

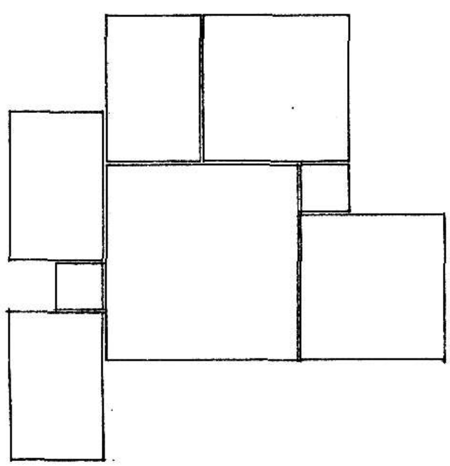
Construction of a building should recognize the change inside the building due to pressures which William Zuk describes as: 'Permanence in kinetic architecture can not be the result of static form, but can only be expanded by the effort of form to stay in balance with the set of pressure.[11]

The construction method employed in todays buildings make a family so static and fixed in place that changing something of the building would mean demolition of the whole structure.

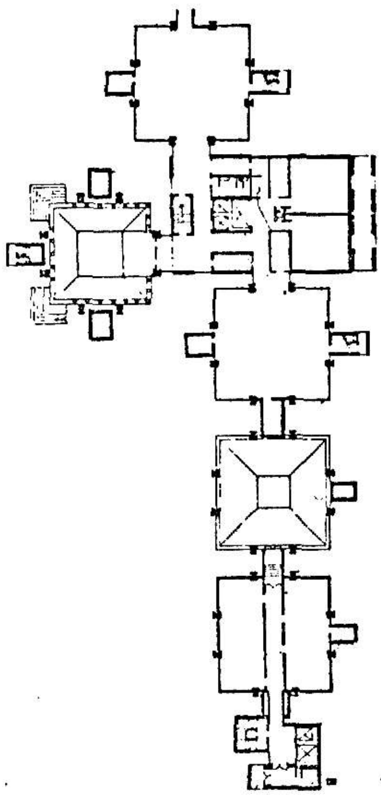
Undoubtedly this type of change is expensive and it makes any kind of change impossible. A building which would allow for substitution in its structure would also have the capability of receiving addition.



Separation of various functional systems within a building are one of the major important factors in incremental architecture. It's set-up is such that one part or one function can be changed without disturbing any other function. In William Zuk's description"--the problem becomes one of identifying the probable patterns of change and recognizing the varying rates of obsolescense of the parts".[12] This might suggest, for example, that structure should be separated from special enclosure and mechanical spaces should be separated from non-mechanical or use spaces. At least, it does imply that any part within the whole should be separated in order to facilitate removal, renewal, or replacement.

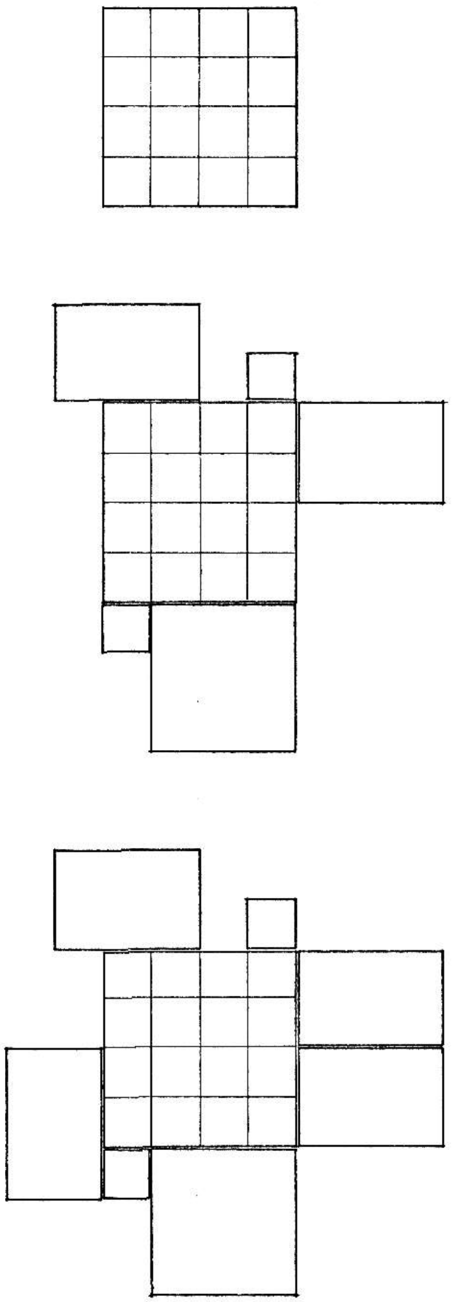


Louis Kahn's concept of served and servant spaces is a realization of the separation between equipment space and use space. His Richard's Laboratories at the University of



Pennsylvania and Salk Institute of Biological studies at San Diego, California are early examples of the separation of primary spaces from service spaces.

Louis I. Kahn
Richards Medical Research Bldg.

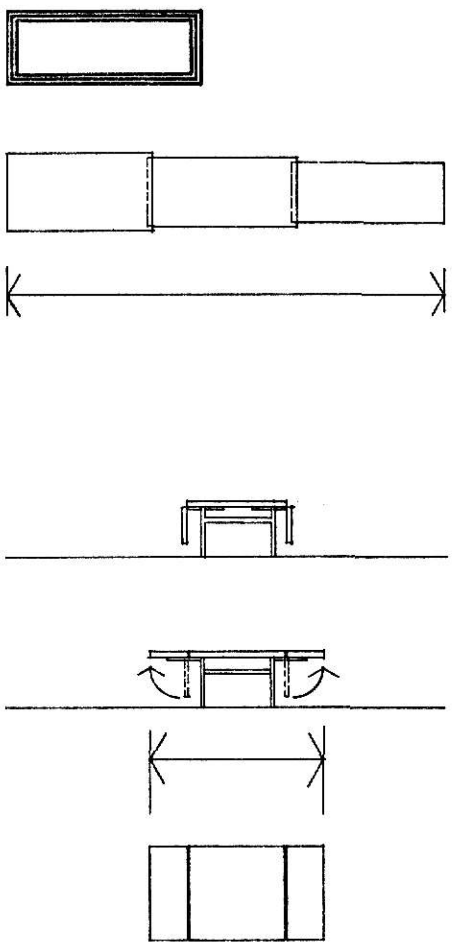


1. ADDITIVE

It is one of the three types of incremental architecture which is best described by William Zuk as, "--- additive incremental architecture deals with growth — extension from the original form at the same site. In organic form, growth and form are inseparably associated. It is justifiable, in some aspects, to think of form as the direct resultant and consequence of growth."[13] The rate of growth in nature is affected by many outside pressures and may be described as a reaction of the living organism to its environment or to certain stimuli. To fully describe growth it must be understood that growth involves concepts of magnitude and direction related to the dimension of time. The amount, the direction, and the rate, or frequency, of growth are essential considerations of additive incremental architecture.

There are two distinct models for achieving additive qualities in architecture:

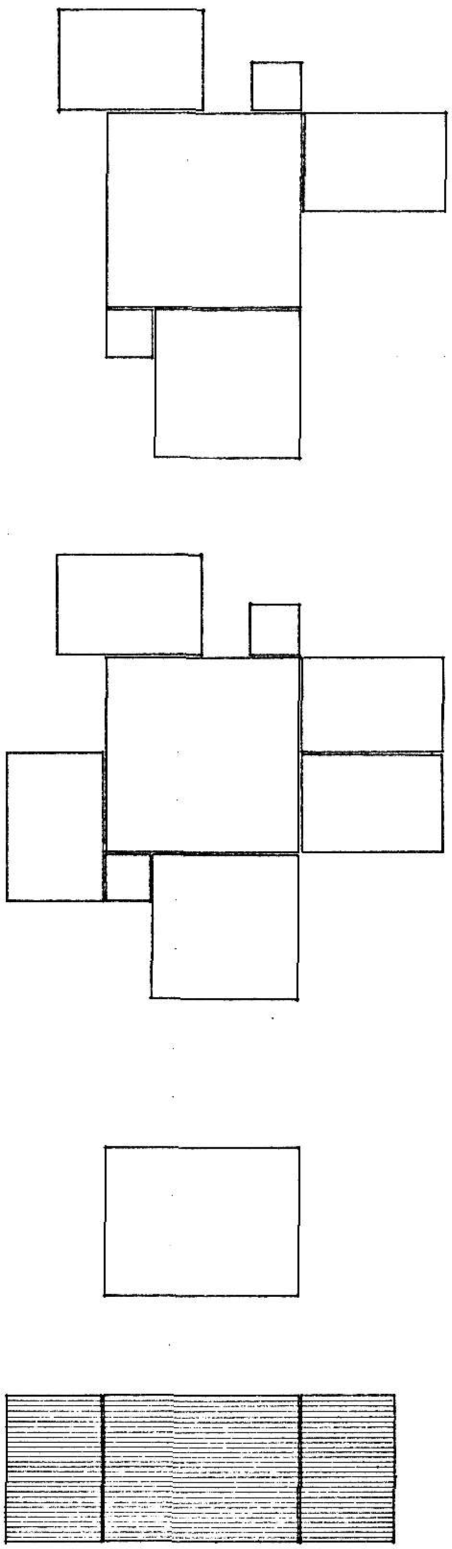
1. Self contained in the original form
2. The result of *adding parts*.



1. SELF CONTAINED IN THE ORIGINAL FORM

This model is less flexible between the two. As the flexibility of a form is limited within the original design, growth is limited between two extreme limits.

The direction of growth particularly for such a model should be thought out at the time of original design decisions. Generally it contains built-in movable units which slide over each other in order to diversify definition of space. The only disadvantage of such a self contained additive system is the possible duplicity between the basic form that is needed and pre-provided elements such as walls, panels and overhang roof, that also occur when the total unit is not fully extended. It however makes it possible for us to handle the flexibility of a large unit rather easily. It is not an ideal solution for the future growth but it's readiness truly makes sense in accommodating immediate change.



2. RESULT OF ADDING PARTS

The second method of achieving growth in additive incremental architecture is through the addition of new parts. Since this technique implies that growth would occur in the form of adding parts not included and therefore not pre-limited in the initial form, it offers maximum flexibility.

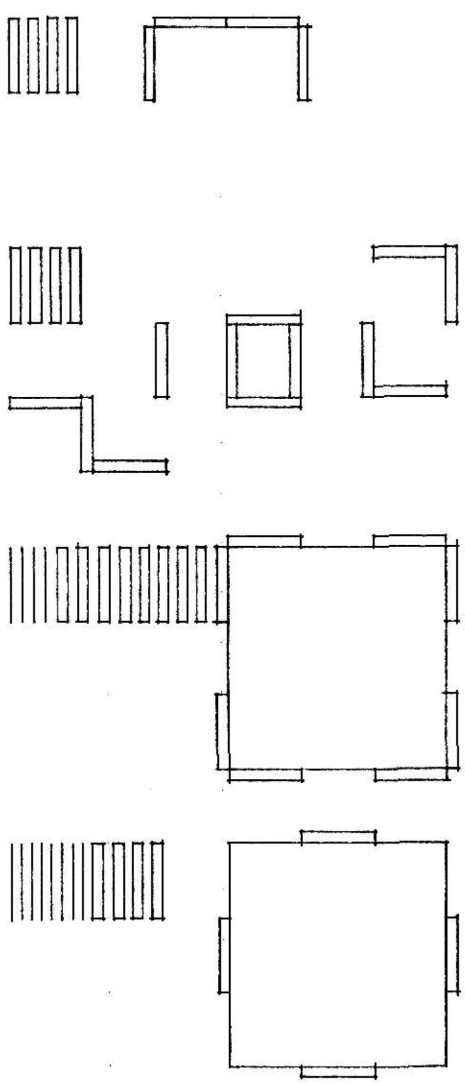
The amount, the direction, and the basic movement of growth in this type of incremental architecture is not exactly predictable. The new addition may include new hardware, new equipment, and new amenities at various levels of organijation to new functional spaces that is physically needed or simply to additional visual space. Such additional spaces may be either subservient to an existing setup or they may actually become new primary spaces themselves.

This method is used for increasing the space or adding new spaces to an original form. Presumably it is more efficient in response to cases where the growth takes place after the originally conceived form is physically actualized.

There are two basic kinds of new parts in additive architecture,

1. Two-dimensional panels
2. Three-dimensional modules

<u>1. Two-dimensional panels</u>

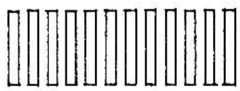


The two-dimensional parts, or panels, may be combined to make three-dimensional space enclosure.

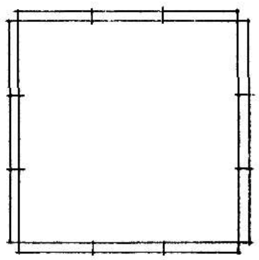
Two-dimensional parts offer more flexibility since endless types of space-defining forms could be arranged by placing these panels in variety of positions.

Moreover, by change of material of the panel, further flexibility could be accomplished. Variations in the panels may involve character that is solid or transparent, fixed or opera-ble, rough or fine in texture and subdued or brightenup in colour, etc.

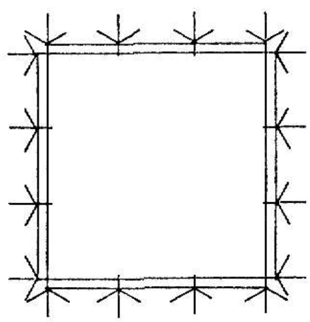
Successive increment of growth is largely related to size of the panels. Smallness of panel size strongly suggests high inherent flexibility.



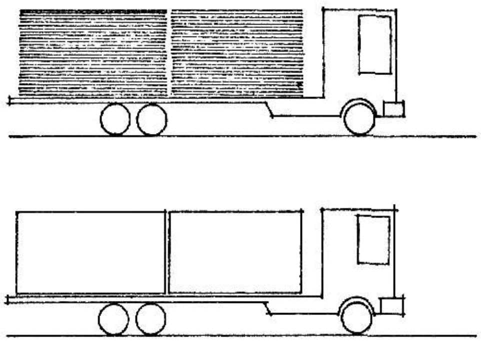
There are, automatically, more parts to handle and more joints to make in this type of additive architecture.



Weathersealing problems for the joints is the particular technical problem that often goes with the problem of structural integration of the panels if the panel themselves are also structural by design.

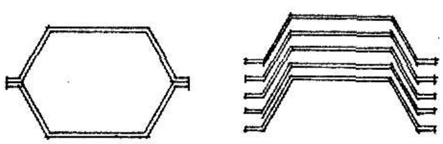


Separation of general structural system from the panel system whose sole function is to enclose space, would permit greater flexibility in terms of variation of location and types of panels.

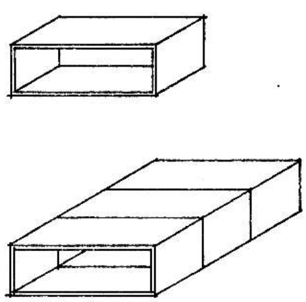


2. Three-dimensional modules

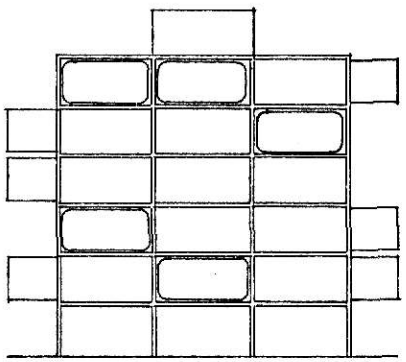
By necessity, the three-dimensional space modules that are self-contented are bulkier than the two-dimensional panels in extension within the limitation of handling and transportation feasibility and restriction. Bulkier additive modular space, however, can be created by integration of prefabricated intermating forms whose size is not beyond the limitation of handling and transportation feasibility and restriction.



Though the three-dimensional space modules offer less flexibility than the two-dimensional panels within its range of form potential, it neverthless has some significant advantages. First of all the module is a self-contented unit by itself. It therefore takes less time to make one complete additive space.



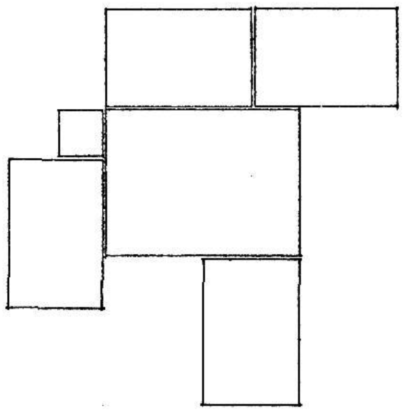
While it is more difficult to transport a large three-dimensional space module, at the same time, it neverthless eliminates much of on-site uncertain and costly labor by finishing the unit economically in the factory strictly under managerial control. This is specially true when the space module is a more self-sufficient unit.

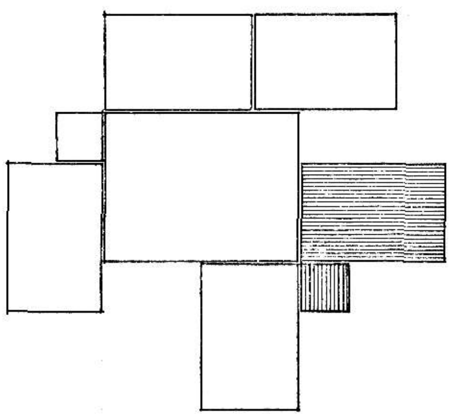


Three-dimensional space modules are also structurally sound by itself.

In a multi-story complex the units could be stacked one after another, after the fashion of stacking hollow building blocks. The number of stacking, however, is limited sincs the standard strength of a module, when placed at the bottom to take the accumulated load, is limited. An independent structural system is required if the extraordinary height or changeability of stacking is called for. At any rate, structural innovations in terms of light-weight, fireproof, and economical material are most appropriate for construction of additive space module. The application of such new techniques would be unlimitedly increased. One should consider it a real blessing for us to be able to foresee or even to practice the extensive use of this additive incremental concept that would certainly facilitate the growth of any kind, any amount, and along any direction from an original set-up.

Incremental additive architecture most significantly may accomplish more than just adding more space to an already existing function.





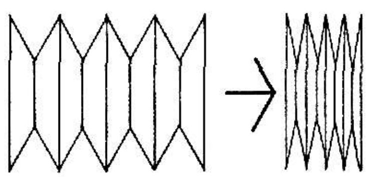
It may also increase or diversify the facility's functional capability by adding new types of space for new uses. Such new spaces may have qualities distinctively different from any of the original spaces.[14] A guest bed room,for instance, may be added next to a living room. A bathroom may be added next to a bed room. This type of horizontal growth in additive architecture, however, may be subject to restriction brought about by outside influences in urban and high-density areas. In that case, there is no choice but to grow along the vertical dimension where units could be separately added level after level.

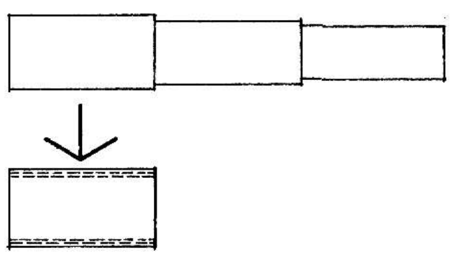
The pattern of vertical growth in a broader sense is much more complex in design since coordination for human movement, i.e., elevators and stairs etc., for electrical and mechanical connection and for structural stability, would have to be considered at the time of the original form conception. In this case the system may become rather costly. Generally, a combination of horizontal and vertical growth is quite feasible.

2. SUBTRACTIVE

Subtractive architecture is the reverse process of additive incremental architecture. All the systems that has been discussed in additive architecture could be applied in subtractive architecture.

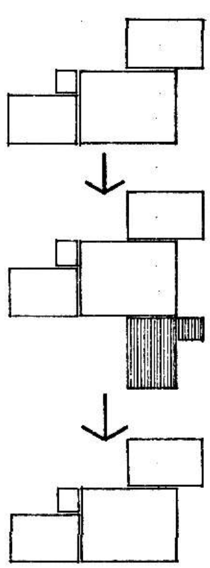
Like additive architecture it can be devided into two catagories:





1. Self contained collapsible. Basically it deals with reverse *telescopic* motion of parts.
2. Physical subtraction of parts.

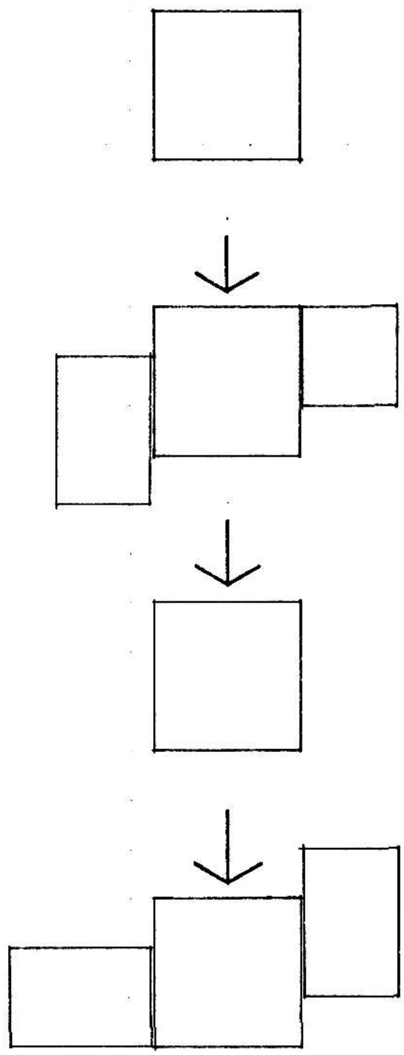
   In dealing with subtracting parts from an architectural form, the most important consideration in incremental subtractive architecture is the method of fastening.

   In order to dismantle an object the technique for and ease of separation and removal of the parts is essential to the success of the process.[15]

   This type of incremental architecture deals with the subtraction of some space or some element which has previously been added to the original form. A room which was previously added after the birth of a child, for instance, may be subtracted when he or she

3. SUBSTITUTIVE



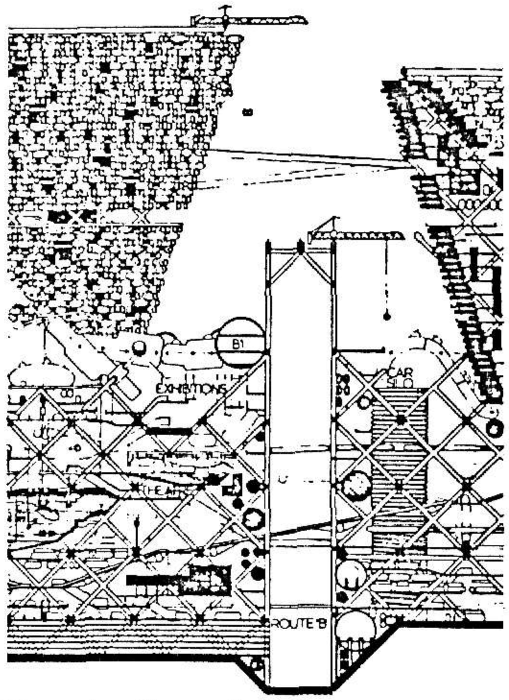
Substitutive architecture is the third types of incremental architecture, which defined by William Zuk as :

> ....if incremental additions may be made to a form, and if later these additions may be removed, then it is possible to add something else in the area vacated by the subtractive action. This implies a third type of incremental architecture — substitutive — which entails flexibility and adaptability to change in the set of pressures through interchangebility of parts.[16]

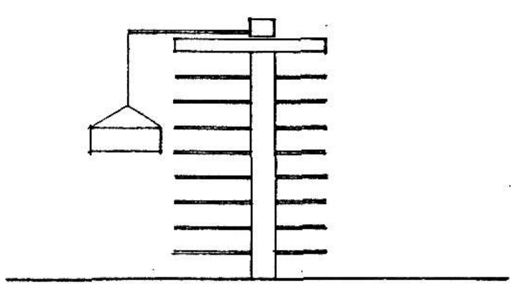
In this type of kineticism all parts of any unit may be changed, but the change of parts does not simply mean the total elimination of the replaced parts from a system.

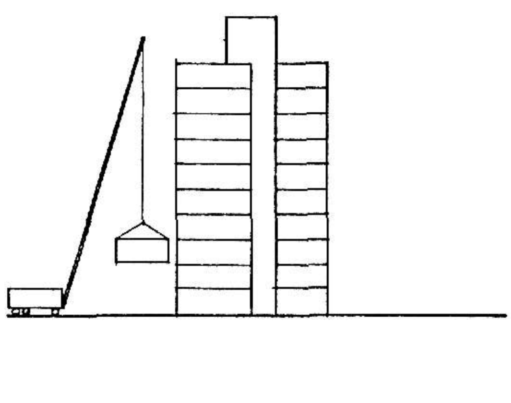
Instead, such replaced parts from building could be used in another building either separately as mere parts or together as complementary components made useful in a different situation.

Since combination of components could be reused in different configurations, the recycled use of replaced components from a substitutive project to an additive project could reciprocate economy between them rather effectively.



Plug-in City: Archigram





The best example of substitutive incremental architecture is the Plug-in City by the Archigram group of England and Clip-on City by the Metabolists of Japan.

In urban areas every building or structure should have a place to place the hardware which would be used for the substitutive process that would take place every once in a while.

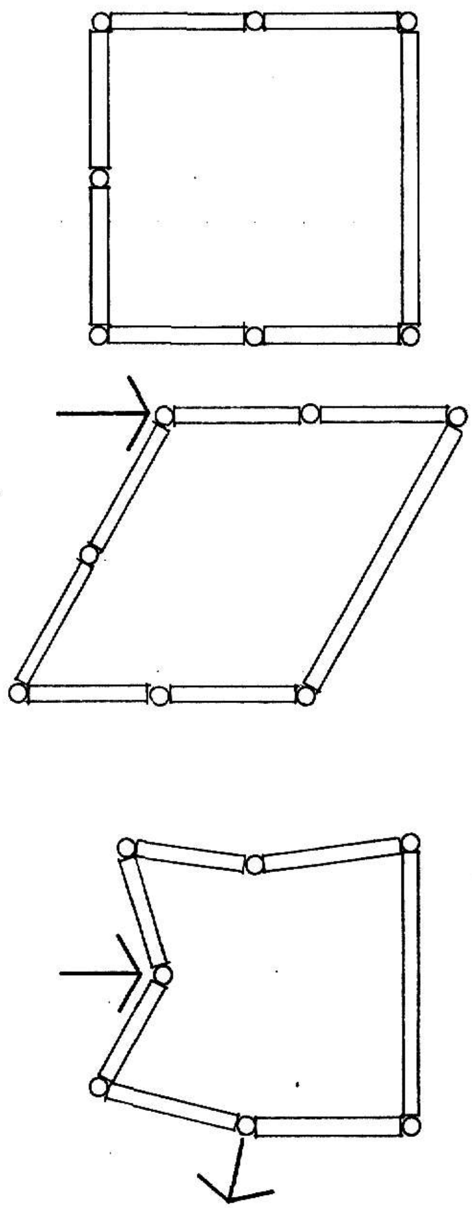
Hardware like crane, for instance, could be mounted permanently on top of a building. Mobile ground cranes might perform the substitutive process more adaptively but it takes too much ground space for the process.

All this would mean that in additive incremental architecture the componential elements could be either two-dimensionally or three-dimensionally substitutive. Overall, these elements could be added in assortment of combinations, interchanged whenever they need to, and in time replaced by new and improved components.

Together, in short, additive and substitutive incremental architectures would allow the form to evolve due to the pressure of change, and allow technological progress and new design developments to emerge.

Happily, it thus fulfill the constant mission of fighting against deterioration and allowing for continuous upgrading of any building.

DEFORMABLE ARCHITECTURE



Deformable kinetic architecture is defined by William Zuk as; "it refers to an architecture which has the potential to allow for change which fundamentally affects the whole form." [17] Unlike the other incremental kinetic architecture, its change does not require an assembly of pieces or the interchange of parts, the form as a whole by itself is deformable.

All the parts of the basic deformable form are contiguous and remain so throught any change. Deformable architecture thus is most applicable to space which is singular in nature where the problem of interior partitions and subdivisions, which must respond to deformation of an over all form, do not exist. Describing the possibility of kineticism William Zuk stated;

> In deformable architecture the action is limited to functional changes and change by itself. It does not respond to deterioration of material, unless the whole structure is changed or some elements could be changed by parts if it is designed previously to do so. Since the deformation is limited, the form can only respond to certain functional changes limited within the initial envelope.[18]

There are two types of deformable architecture which only differ in the timing of kinetic action :

1. Initial deformable architecture
2. Future deformable architecture

1. INITIAL DEFORMABLE ARCHITECTURE

In this type, deformability takes place prior to the use of a space and the structure is not usuable unless the deforming action has taken place. Obviously it is easy to handle this kind of architectural components prior to errection and for this reason also easier to transport a such a would be large structure by truck or rail.

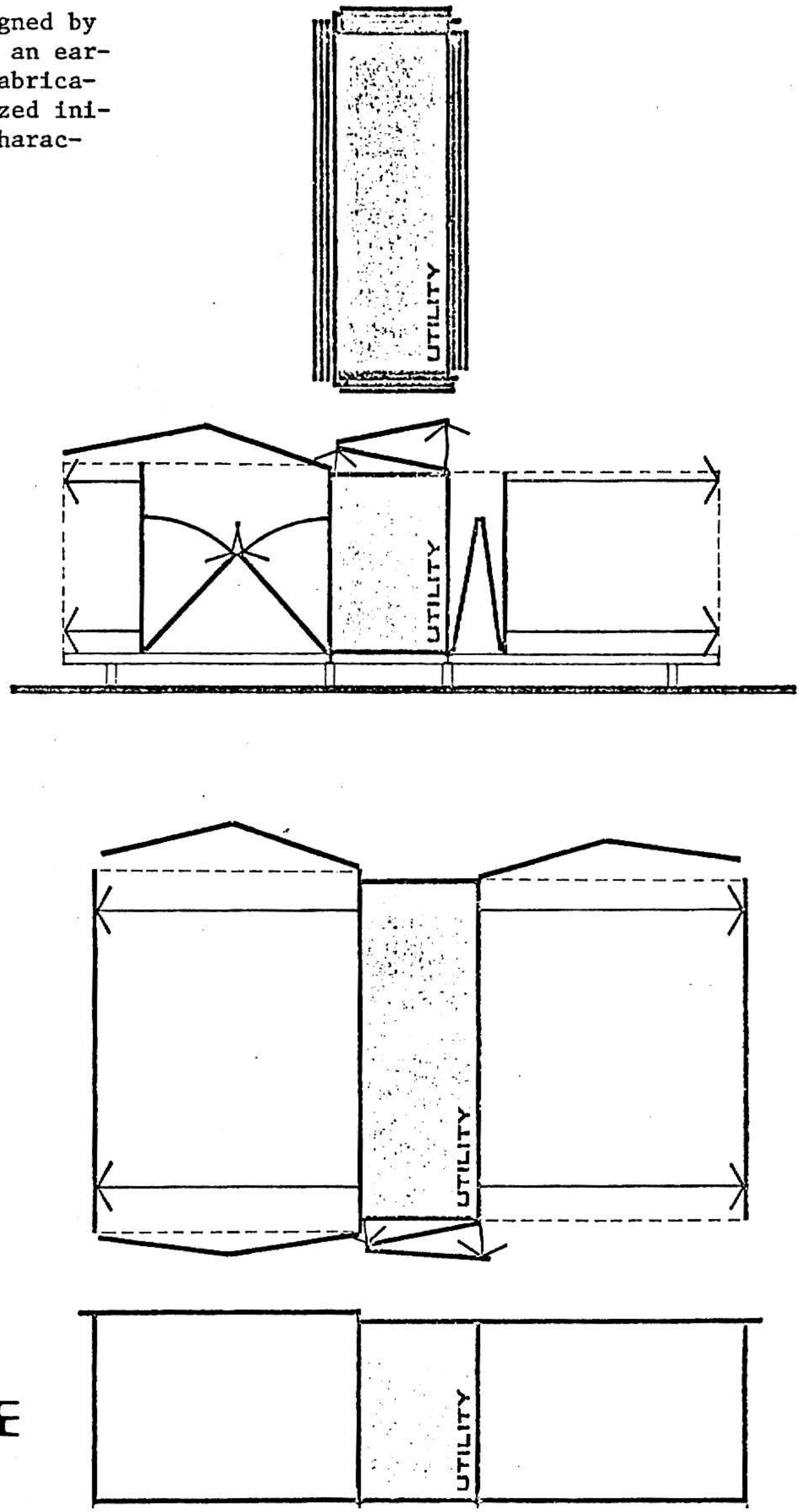
There are basically two types of folding systems which are applicable to deformable architecture,

1. Folding capability made possible by hardware,
2. Inherent within the material.

1. FOLDING CAPABILITY MADE POSSIBLE BY HARDWARE

Some hardware such as hinges or pivots can be used to connect two rigid parts where folding action is supposed to occur.

The Acorn House designed by Carl Koch in 1948 is an early example of a prefabricated house that utilized initial deformability characteristics.



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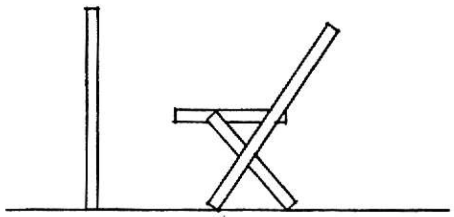
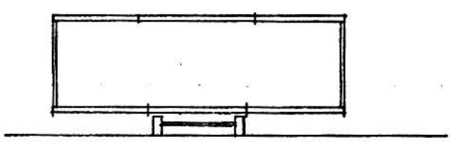
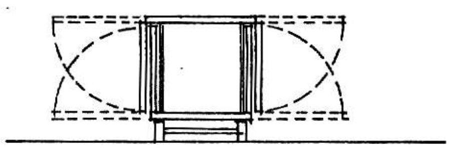
ACORN HOUSE BY



A folding chair is the best example of deformability by folding made possible by hardware. Paul Rudolph's project for housing in Charlottesville, Virginia, is a good example of deformable architecture itself made possible by the use of hardware.



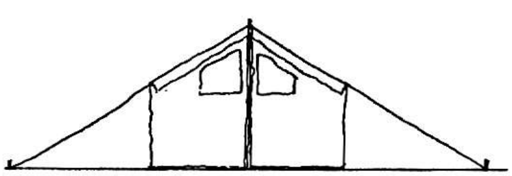


Through the folding of rigid parts, it is possible to have a protective covering around a specific element with other elements that are less effected by weather, such as the underside of a floor.

With the folding of parts it is possible to maximize transportation convenience by folding a big element into a small compact package.

2. INHERENT WITHIN THE MATERIAL

In this case the deformability takes place after the architecture has been used, or more specifically, after the initial form has been established. In this case, the folding capabilities are inherent in the flexibility of the material used. The material used usually are not structurally independent by themselves and outside supplementary resistance or counteracting tensioning or both would complete the functional balance of a deformable material.



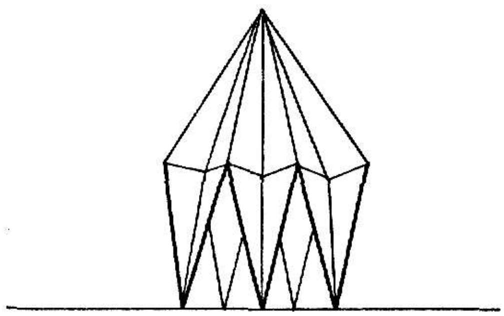
Its advantages:

* It occupy relatively least of space.
* Generally the foldable material is also lighter in weight than rigid elements and metal hinges which may well require the same amount of space needed for the rigid components.
* By far the foldable material system could be more easily transported than rigid materials.

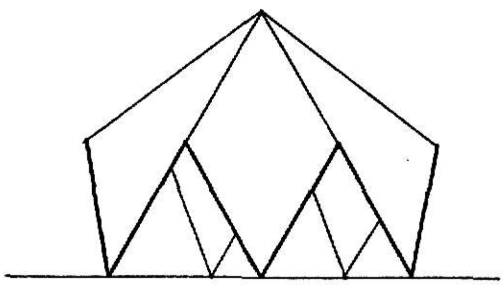
Disadvantages:

* The principal concern is the problem of how to make the flexible material at least strong enough if not rigid.
* The life span of a flexible material is usually short.
* It takes some technical sophistication to secure the solving of insulation and waterproofing problems.

2. FUTURE DEFORMABLE ARCHITECTURE



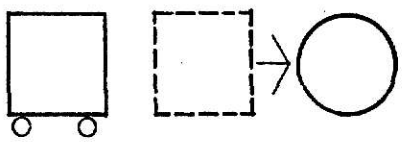
The second type of deformable architecture is concerned with the ability of the form to kinetically respond to future changes in the original set of pressures. The deformation in this case takes place after the initial form has been established.



In the future, the in-place kinetic relationship of pneumatic and elastic deformability related to a material is more important than a material's characteristic itself because the construction system as a whole is much more difficult to replace than just dealing with the foldable material alone. In future deformable architecture, as one part of the system moves the whole form would change, because all the parts must remain contiguous and synchronized throughout the movement.

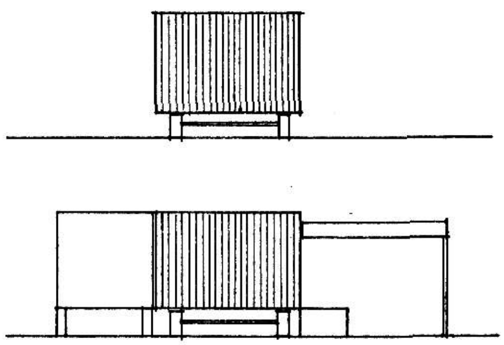
Basically much of future deformability is the result of unbalanced shoving, unbalanced twisting, pushing or pulling which perhaps could only be corrected through periodical "tuning" or structural readjustment.

MOBILE ARCHITECTURE



Mobile architecture refers to a class of kineticism in which the building moves as a total unit.[19]

Trailer-type vehicle and some mobile home which travel on the highway are probably the typical mode of mobile architecture. But the trend of architectural planning seems to be treating a mobile home as fixed as a typical home in an ordinary community and installing non-mobile additions like extra rooms, carports, porches, and storage space to it with out consideration of mobility at all.



Perhaps solely as a result of finance consideration, mobile home has changed traditional concepts of family housing and has developed into a major force in the area of housing in United States. Over 40 percent of all single-family homes sold in 1969 were mobile homes.[20] More than 5½ million persons in the U.S. live in mobile homes. In response to such a great demand about 300,000 units are being produced per year. Monetarily, mobile homes represent better than 80 percent of all homes that currently sell for under $ 15,000.

Mobile home gives a psychological feeling of mobility to the owner, because it can be moved whenever one wants to, although 60 percent of mobile home dwellers never change site.

A mobile home is legally considered a vehicle although functionally it is a dwelling. It is, most exceptionally, virtually immune to the same set of rules of financing, zoning code, taxation, and labor restrictions that apply to conventional housing. Since the legal definition of real property is based on a structure that is permanently fixed to the land, property that is so affixed is classified as personal property. The basic mobile home unit has wheels and can be moved; hence, it does not fit into the legal classification of real property.[21]

A mobile home can last for a maximum of 20 years. As a mobile home is moved by existing transportation system, its dimension is limited to maximum of 12 feet wide by 60 feet long, which from highway restriction permit maximum width to accommodate lanes and maximum lengths to facilitate turning. The mobile home by the industry's own definition, is a dwelling unit that been prefabricated and designed to be towed

NOTES:

1. Michael F. Ross, "Architechnics," Architecture Plus, (May-June, 1974), p. 89.
2. William Zuk and Roger H. Clark, Kinetic Architecture, (New York: Van Nostrand Reinhold Company, 1970), p. 61.
3. Ibid., p. 74.
4. Center for Housing and Environmental Studies, Cornell University : Ithaca, The New Building Block, 1968, p. 47
5. Center for Housing and Environmental Studies, op. cit., pp. 47-48.
6. Ross, op. cit., p.89.
7. Zuk and Clark, op. cit., p. 83.
8. Ibid., p. 98.
9. Ibid., p. 110.
10. Ibid., p. 83.
11. Ibid., p. 84.
12. Ibid., p. 86.
13. Ibid., p. 86.
14. Ibid., p. 90.
15. Ibid., p. 90.
16. Ibid., p. 92.
17. Ibid., p. 98.
18. Ibid., p. 99.
19. Ibid., p. 110.
20. Earl W. Morris and Margaret E. Woods, Housing Crisis and Response, (New York: Cornell University, Ithaca, 1971), p. 3.

20.Margaret J. Drury, Mobile Homes,(New York: Praeger Publishers,Inc., 1972), p. 122.

21.Zuk and Clark, op. cit., p.112.

4

APPLICATION OF KINETICISM IN HOUSING

SYSTEM APPROACH TO KINETICISM

A living unit should not be considered as houses in kinetic architecture. Instead it should be considered as a systematic combination of factory-assembled modules. Referring to system Morris stated:

> The 'system building' and other terms that refers to building systematically are meant to describe the building process as a set of interrelationships: building material to final product, component to modular coordination, house to site, and so on.[1]

In other words a system building should relate to all elements which must function together to achieve certain goals. Coordination of parts and the parts scheduling are the two important concepts that can guide to build systematically.

A system approach to housing depends on so many things starting from their construction to their financing. A housing system would include at least these elements :[2]

1. Research, definition, and design, including considerations of all aspects of the housing determinants.
2. Production (including labor, marketing, etc.)
3. Maintenance, including keeping the product up to date, recycling data, and reclaiming materials.

4. Management, including financing and administration.
5. Land, community.
6. Housing product, including shell, core, site improvements (excavation, utility connections, pavement.)

Any change in one of these areas would have repercussons in others.

Separation of functions is the most important aspect of system building.

CONTROL AND MAINTENANCE

Since the buildings can potentially move from one location to another, city to city, city to county, and state to state, new building codes and zoning laws, would have to be needed. Building codes, of course, would have to be adjusted to permit new technological materials. A new forms of planning and building agencies would have to be established by local and regional authorities. They would be responsible to set technical criteria, formulating public policy, regulate the movement of structure.[3]

Module and component system is one solution from keeping the housing from deteriorating or becoming obsolute. Because module and components could be changed due to technological advancement and family needs.

'The New Building Block' describes the useful approach of keeping the modules and components from becoming obsolute :

> Each component or module might be considered as a discrete entity, assigned a different useful life-span, and manufactured to specifications consistent with that desired life. A housing system could result that would make it convenient to

replace components without replacing the entire building and allow the unit to function efficiently at all times. Rapidly improving elements could be replaced frequently while permanent components would be kept for the full duration of the site. For example: an appliance component, since appliances constantly and rapidly improve, might have a short life, perhaps 5 to 10 years. A general space might be expected to last 20 to 25 years, while foundations might be designed for 50 years. In a high-density arrangement, a megastructure might last 100 years while modules could be replaced every 15 years or so.

Housing in which new products can be installed as they come on the market can be kept up to date and even improved components could be effectively designed for simple replacement. The building could maintain its value throughout its life, since parts that have become obsolete because of changes in style or technology, could be easily replaced. [4]

FINANCING AND OWNERSHIP OF KINETIC HOUSING

Kinetic housing should consists of two types of functions, individual units made of components and modules and megastructure made of structural framework to support the individual units.

Dwelling units manufactured in discrete package, can be bought, financed, and sold in parts. The portion of the dwelling that is to be initially occupied need to be assembled. As more space or rooms are needed, additions could be made by adding more components or even a new unit. Young couple, who need and can afford only minimum space when they start building a home can purchase more space as the family grows or as their financial condition improves. Additional amenities such as an entertainment panel which contains television and streo equipments certainly could be readily added into the dwelling units. Similarly other kinds of amenity items could be added to the kitchen or in any other room. Such units or item would be deliberately designed to fit in or ready to be cliped-on or slid-in.

Each component would be sold with manufactures maintenance guarantee performance. Complete dwelling unit with or without optional items could be rented or bought from housing suppliers.[5]

The extent of individuality of each dwelling modules would depend upon the finance and patterns of ownership that vary with the income level and individual taste of the buyer. Physical dimensions of the components and modules would have to be identical but would be made of different materials of different costs. Regardless of all these, the demand of costlier things is growing as stated by William Zuk :

> ... More expensive materials, higher maintenance, and special control equipment, may indeed increase the costs above fixed types of architecture. However, society has come to expect higher costs for things that do more and are more useful. The modern automobile with its many laborsaving features and luxuries is a far distant cousin from the first model T Ford. It costs a dozen times more and yet it is eagerly accepted. The movement of society is toward a higher standard of living, even though it costs more.[6]

As kinetic architecture permits easy change-overs, the wornout parts of components of the units could be changed or the whole unit could be changed to keep the units up to date. Building modules could be changed like car, which would keep the economy of production line going through continuous production and sale.

Megastructure framework for urban high density housing could be considered as the extensions of the infrastructure system of a city like street. Here instead of extending horizontally, plots would be aligned to expand vertically, with common vertical mains of piping and wiring systems built in at the very begining.
Vertical spaces on each floor supported by the megastructure framework would be rented to different people depending on their specific needs within the context of sharing condomonium form of ownership. Corporations therefore not only should built, but also should service and maintain the utility cores of such megastructures whose overall ownership is shared by private owners of the modules. Amount of ownership of space would depend upon the income level of the residents. Wealthier people or group might own one whole structure, while less well-to-do families might occupy one space

within a structure which would be government-owned and maintained.

Mortgage for sections would be more easily obtained, thus less money would be involved and the cost would be within the reach of common people.[7]

THE HOUSING SYSTEM AS A COMBINATION OF MODULES AND COMPONENTS

Without focusing on only one element of the housing system, the housing element were to be conceived as a combination of discrete parts, each able to be manufactured independently and integrated at will.

Substitutive character should be considered as the major factor for the kinetic housing system, where building should be broken down into different subsystems. For example, a bathroom might be considered as a separate item, so might a storage space, or the wall and window panels. In this last case, smaller wall panels might be assembled to make a long wall. Each modular wall panels could be of different types, i.e., plane wall panels, wall panels with windows or wall panels with doors etc. The addition of all these wall panels could be based on individual choise or physical requirements of the site.

Another way of subsystematize the housing product would be to divide the entire dwelling unit into a few large sections regardless of function, or it could be combination of large multifunction sections of dwelling units referred to as modules and smaller, particularized units or smaller wall or window panels referred to as components. A complete dwelling unit could be assembled from one, two, or several modules, or it could be a combination of modules and components, or it could consist of components only. Parts large or small so combined would furnish great variety of building types and floor plans.[8]

Same modules could be used to build both single family one unit dwelling to multi-storied high-density dwellings. In multi-storied high-density arrangements, a structural framework to support independent units would be built with modular beam and coloum components, along with the mechanical and electrical ducts and stair or elevators, prior to the installation of dwelling units. The dwelling units would be pluged-in or built-in-place after the megastructure is completed. Units could be built or pluged-into any floor any time, because structural integration of each unit at each floor and each bay is structurally independent.

Traditionally, site work has been separated from the shell work. In kinetic housing, site along with the megastructure framework could be of separate ownership and maintened by companies, or local government who would rent out the bay-space to private owner of the modules. In response to the realistic needs of a mobile society, this arrangement is necessary because the vertical structural framework integrated along with the site could remain with the foundation permanently, while the dwelling units or modules could move with the owner to any new locality when he needs to.

In February 1962, 'House and Home' made this projection :

> Movable houses will be built all of a piece or possibly in two or three sections and then trucked from the plant, ready to hook up utilities at the site.
> If you don't like where your house is tomorrow, you can just lift it bodily off the foundation posts, put in on a big trailer, and haul it away to a new site you like better. Or if you like your location, but your house no longer fits your needs, you won't have to waste good money trying to change it. You can sell it to somebody else, let him move it away, and put a new house that you like on your lot. This will be the biggest change in housing since man came out of the cave. It will free housing from the death-grip of land — The death grip,

> that makes millions of homes obsolete at their site long before they are obsolete in any other way. It will change the whole economics of real estate investment. It will give new meaning to urban renewal in suburbs where so many little post-war houses have turned or will turn into slums.[9]

ZONING

From the viewpoint of position of property, kinetic architecture can be subdivided into three groups:[10]

1. Buildings on fixed sites,
2. Reversible sites (meaning that sites can be easily vacated)
3. Moving sites (meaning that the structure is in an almost continuous state of motion).

For the first case the kineticism would be limited mostly within the building itself where the building can horizontally and vertically be subdivided into housing spaces depending on the existing zoning restrictions.

For the second case where the site would be used for different types of kinetic architecture or building, the size of the building on the particular site would be subjected to the existing zoning regulations. In that case a placement of a building with bigger dimension could not take place in a site with smaller dimension or a placement of a highrise structure could not take place in an area with lower height allowance.

For the third case, the new location of a site of adequate size would be subjected to the existing zoning restrictions.

In kinetic architecture zoning would have to include direct consideration of the mobility, changeability, and time relationships of buildings at large.
In addition to consideration of the existing static condition of buildings, zoning laws and construction regulation should atleast be compromised in some cases with the new kinetic concept of the building industry.

LOCATION AND SIZE

All dwelling units we have covered so far could be built anywhere in the United States. The key of their adaptability is the size of a housing unit which should be considered as an independent unit to fill in any slot of a high-density multi-storied housing complex. In the case of an independent system the building would stand by itself without any outside structural support except special arrangement against extreme soil conditions. Even in the case of a multi-storied housing complex each unit would be independently supported by structural frames (megastructures).

SITE CONSIDERATIONS

The dwelling components would be combined to direct the specific layout of the structure and the foundation needed. In hilly areas combination of different types of foundations would have to make while the rest of the megastructure would be the same as a structure on flat land above the foundation level.

NOTES:

1. Earl W. Morris and Margaret E. Woods, Housing Crisis and Response, (New York: Cornell University, Ithaca, 1971), p.45.

2. Center for Housing and Environmental Studies, Cornell University: Ithaca, The New Building Block, 1968, p.17.

3. William Zuk and Roger H. Clark, Kinetic Architecture, (New York: Van Nostrand Reinhold Co., 1970), pp. 152-53.

4. Center for Housing and Environmental Studies, op. cit., p. 19.

5. Ibid., pp.20-21.

6. Zuk and Clark, op. cit., p. 153.

7. Center for Housing and Environmental Studies, op. cit., pp. 20-21.

8. Ibid., pp. 17-18.

9. House and Home, February 1962.

10. Zuk and Clark, op. cit., p. 149.

CONCLUDING REMARKS

CONCLUDING REMARKS — SELECTIVE AND COMPOSITE APPLICATION OF KNOWN KINETIC PRINCIPLES

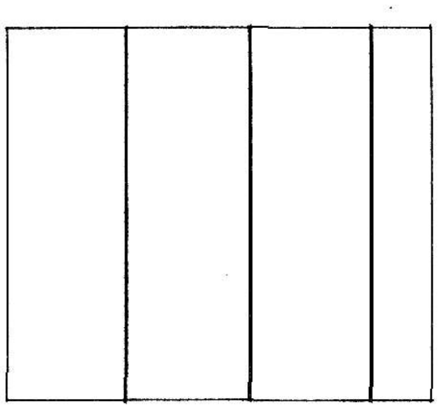
The specific type of composite kineticism proposed in this project is a unique concept applicable to either a housing complex or simply an independent housing unit. It is formulated to deal with some of the inefficiencies and problems presently identifiable in our housing industry. It is a response to the present day housing crisis which happens to involve particular problems such as rising building costs, premature obsolescence due to speedy inventions, lack of spatial flexibility for future growth and change which denies proper additions and substitution etc.

The kinetic housing system proposed herein aims at an efficient, flexible, and substitutive quality which could be used in a variety of ways ranging between the creation of an independent unit to the adventure of a high-rise megastructure.

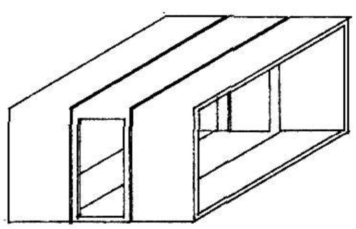
One might add that change is very much related to human nature. For this reason alone, spatial flexibility should be given the prime consideration. In order to fully utilize factory produced modular units which are supposed to be both efficient and economical,units for addition or substitution are modularly standardized so that different types of units from different companies could be used to fit in a standard site, location, plot, or grid.

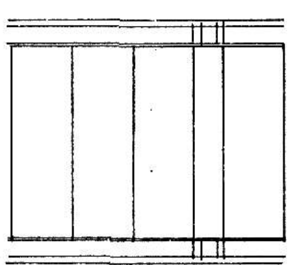
The general review portion as well as the suggested application method reflected in this study should be considered as a conceptualization of only the technicality of kineticism in housing. Hopefully it could be used as a guideline for future and more detailed studies in this subject whose other environmental and human factors are subject to even more elaborate and lengthy discussion. What can be said here is : Besides kineticism in terms of spatial flexibility by itself, the technique of addition and substitution are needed and industrialization of such is inevitable. It is obvious that to compensate for the lack of humanism in manufactured elements, natural elements that goes with the landscaping of a housing site, which is not intended in any way as the concern of this study, is however particularly important in overall practice.

The known techniques of kineticism employed in the composite application in such an exemplary design attached herein includes :

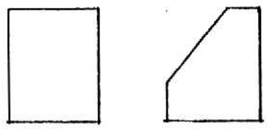


1. Modularity : Using 5 feet module that makes 5 X 15 feet panels which is a multiple of 5'.
2. Addition and Substraction : Panels or complete room units could be added to or substracted from the system.
3. Substitution : Substitution working with the same modular "space panels" could be easily accomplished.
4. Flexibility in placing the "space panel" in all direction is made possible by a 15' X 15' bay system which consists three 5' X 15' "space panels" all of which having total open ing in the direction where they are integrated with one another on both sides while only the central "space panel" of the integrated three could have end opening in the other direction when it is needed.





5. To secure the flexibility of placing the "space panels" in both directions, a special half "space panel" (2½' X 15') is basically needed to cover the space occupied by structural columns.



6. An overhang "space panel" is a special feature that may secure as handy addition to a housing unit which gives much of formal expression to a structure.

APPENDIX

A REVIEW OF FIVE CASE STUDIES IN KINETIC ARCHITECTURE

David Green's Living-pod is the best example of incremental architecture. His concept of the Living-pod is: 'a house' is perhaps a skin for many to live within, but one that is mobile.[1] Basically the Living-pod is a two-story fiber-glass mobile home with retractable legs (or wheels) in which the servicing tubes are separated from the shell consisting of two major components : a living pod and attached machines.[2]

The pod is a two-story mobile home stands on twelve support nodes (6 in tension, 6 in compression). There are four apertures (25 per cent surface) or windows and 1 access aperture or door, all with vacum fixing seals.
The attached machines consists of : 4 automatic self levelling compression legs; two transparent sectionalized sliding aperture seal with ramp and hydraulics; two wash capsules with electrostatic disposal, air entry, and total automatic body cleaning equipment; two rotating silos for non-disposable clothing, sundry dispensers and silos for disposable toilet and clothing object etc; and one vertical body

hoist; climate machinery for temperate zone (with connections to inflating sleep mats and warm section of inflating floor); non-static food dispenser with self-cook modifications; non-static media, teach and work machine with instant transparent cocoon ring; inflating screen to sleep mats.[3]

Most adaptively, the capsul can be hung within a "plug-in" urban structure or can be placed anywhere in the open landscape.

ILLEGIBLE DOCUMENT

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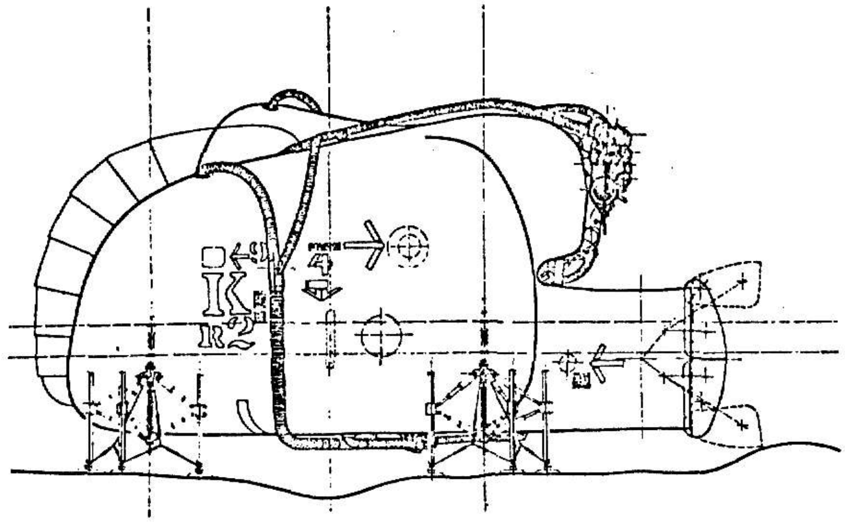
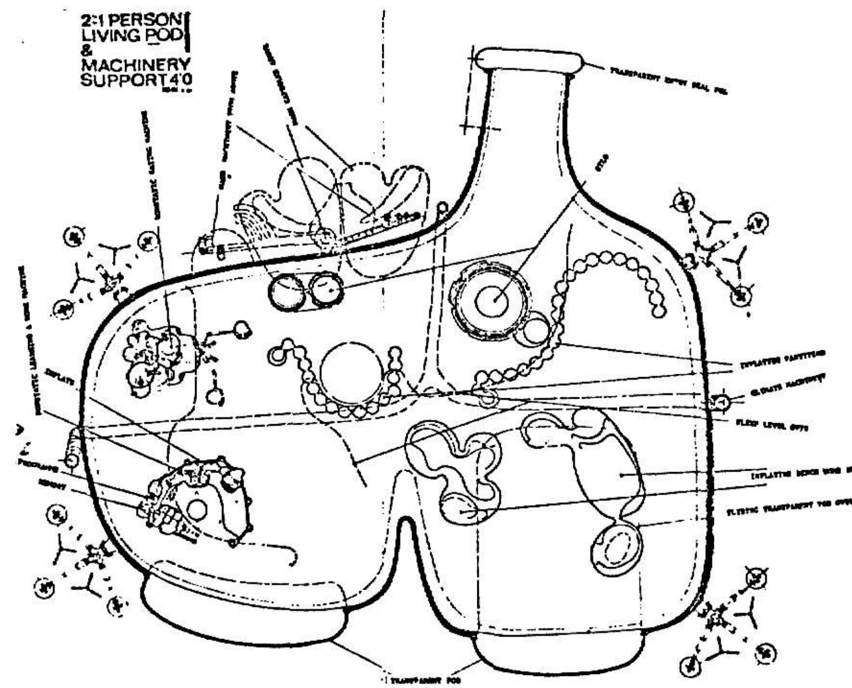
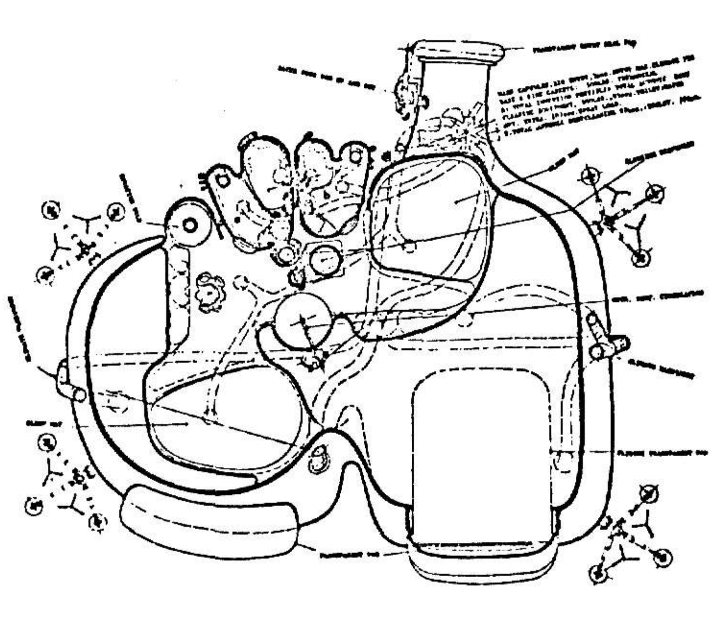






2
LIVING POD
BY
DAVID GREENE

The "Plug-in" city concept by Archigram is a complete urban complex that explores many aspects of incremental architecture, which Peter Cook describes :

> It is 'herioc' apparently an alternative to the known city form, containing 'futurist' but recognizable hierarchies and elements. Craggy but directional. Mechanistic but scalesble. It was based upon a drawn plan, which placed a structural grid on a square plan at 45 degrees to a monorail route that was to connect existing cities. Alongside ran a giant routeway for hovercraft (the ultimate in mobile buildings), the notion being that some major functions of the several linked parts could travel between them. The essential physical operations are stressed: the craneways and the bad weather ballons, and the lift overruns are deliberately exaggerated. But overriding all this was the deliberate 'varietousness' of each major building outcrop : whatever else it was to be, this city was not going to be a deadly piece of built mathematics.[4]

The "Plug-in" city came from the aspect of problem-defining which calls for the necessity, predicting far into the future. In this fast growing society, with needs changing continuously at an ever-increasing rate, in the present technological age, a building, a street, or a city is likely to become obsolescent from a users' point of view, long before it becomes physically obsolescent. In "Plug-in" city all units are planned for obsolescence, in which each component could be given a predicted "useful life", after which it could be economically written off as obsolete and ready for replacement.[5]

Typical permanence rating of the components would be :

Bathroom, kitchen, living room floor: 3-years obsolescence;

Living rooms, bedrooms: 5-8 years obsolescence;

Location of house unit: 15 years duration;

Immediate-use sales space in shop: 6 months

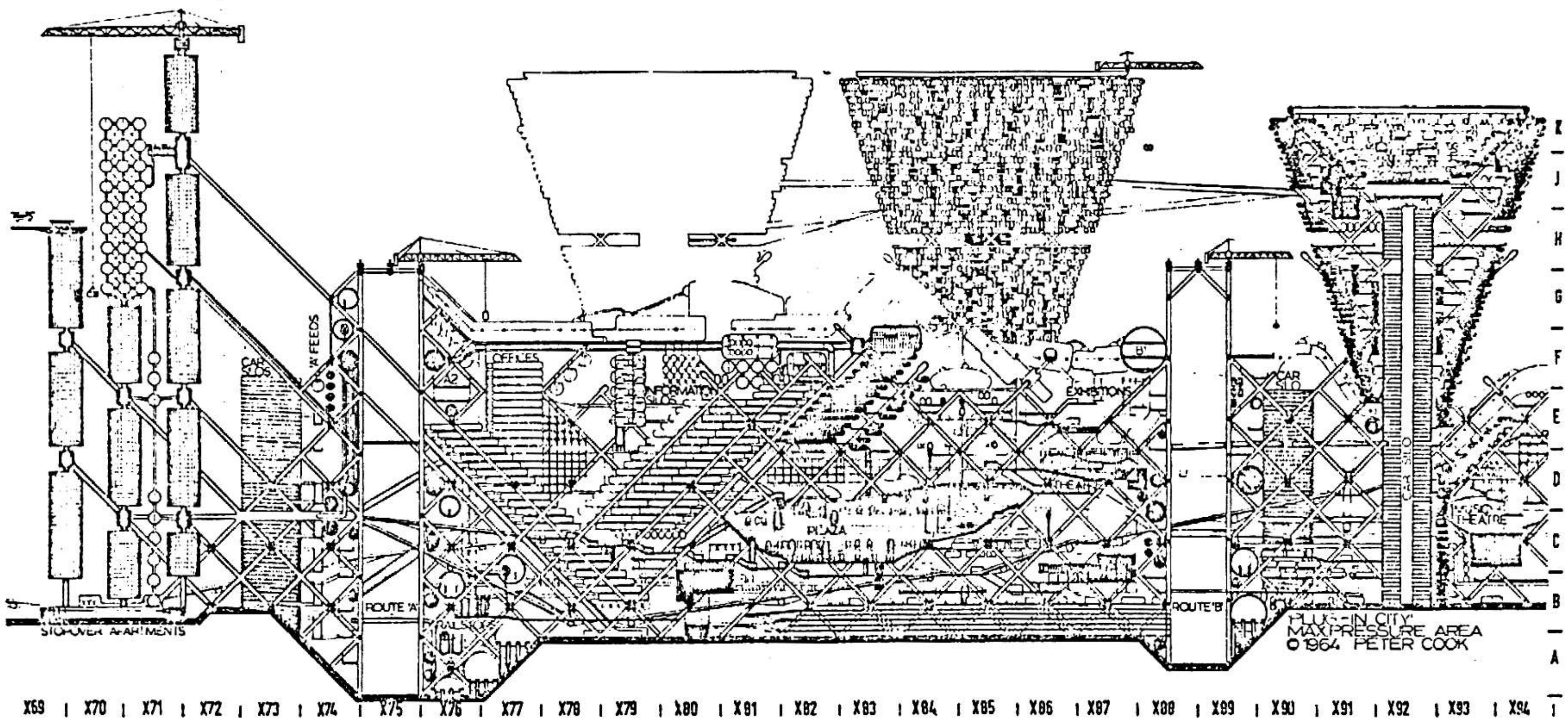
Shopping location: 3-6 years;

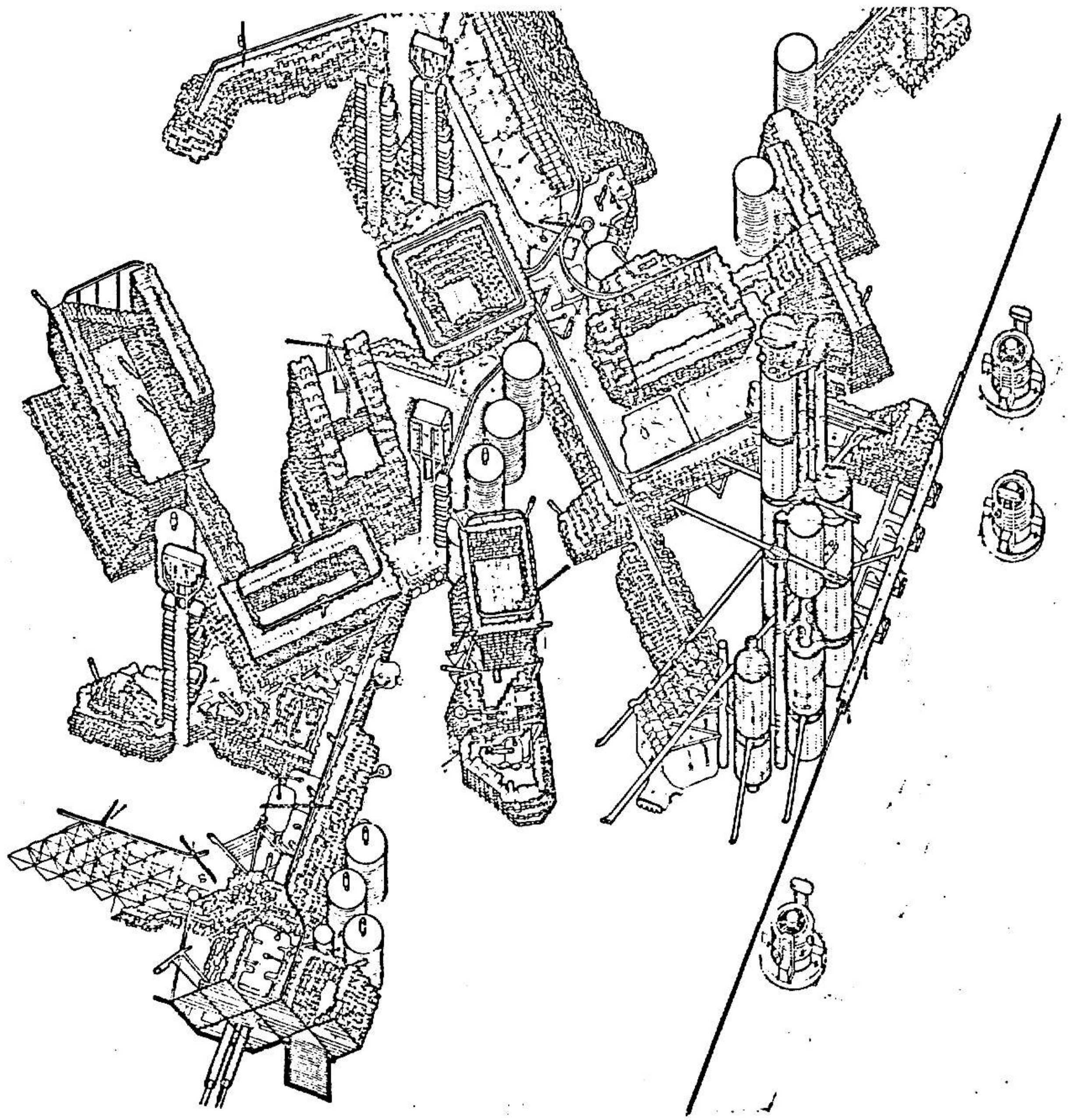
Workplaces, computers, etc: 4 years;

Car silos and roads: 20 years;

Main megastructure: 40 years;[6]

3
PLUG-IN CITY : ARCHIGRAM





4

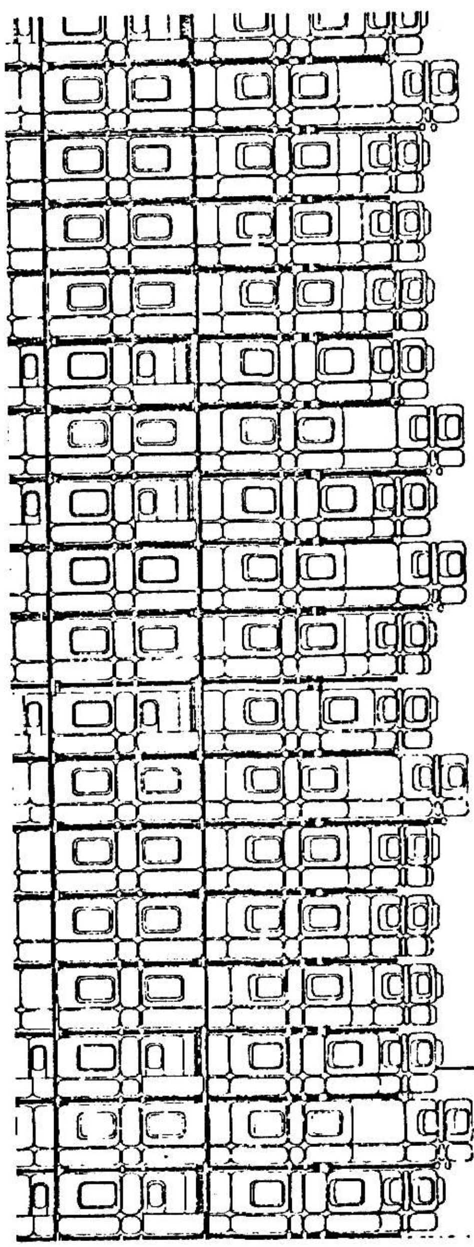
PLUG-IN CITY, MEDIUM PRESSURE AREA.

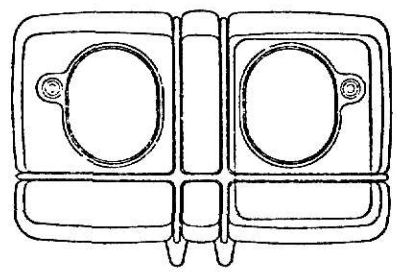
Warren Chalk's Capsule home project utilizes substitutive capsule dwelling as a set of components : whilst snugiy and efficiently locked together, stacked around an access core, forming a circular tower, which were capable of total interchangeability. Continuous exchange would be taking place, with constantly changing and evolving parts.[7]

A crane would be used to reorganize the tower by replacing larger elements while the smaller elements would be manoeuvred from within. As a result the units would have substitutive character, which could be capable of being opened-out or clipped-in. The variations in the elevation are created by varying sizes in the apartments.

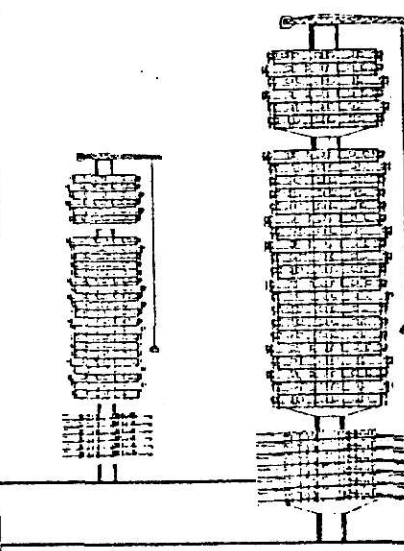
The capsule consists of a series of very sophisticated and highly designed elements locked together within a 'box' which is itself highly tailord. All parts of the capsule would be factory built.[8]

The Capsule was designed with the sophistication of a space capsule. All parts could be changed to be updated as technology moved forward, and as the dweller changed his needs. A typical capsule home would have:
1) service duct, 2) bathroom, 3) pneumatic lift, 4) clip-on appliance wall, 5) pull-out screen, 60 wide service door, 7) services connections, and 8) storage units.[9]





Typical Plug-In Unit

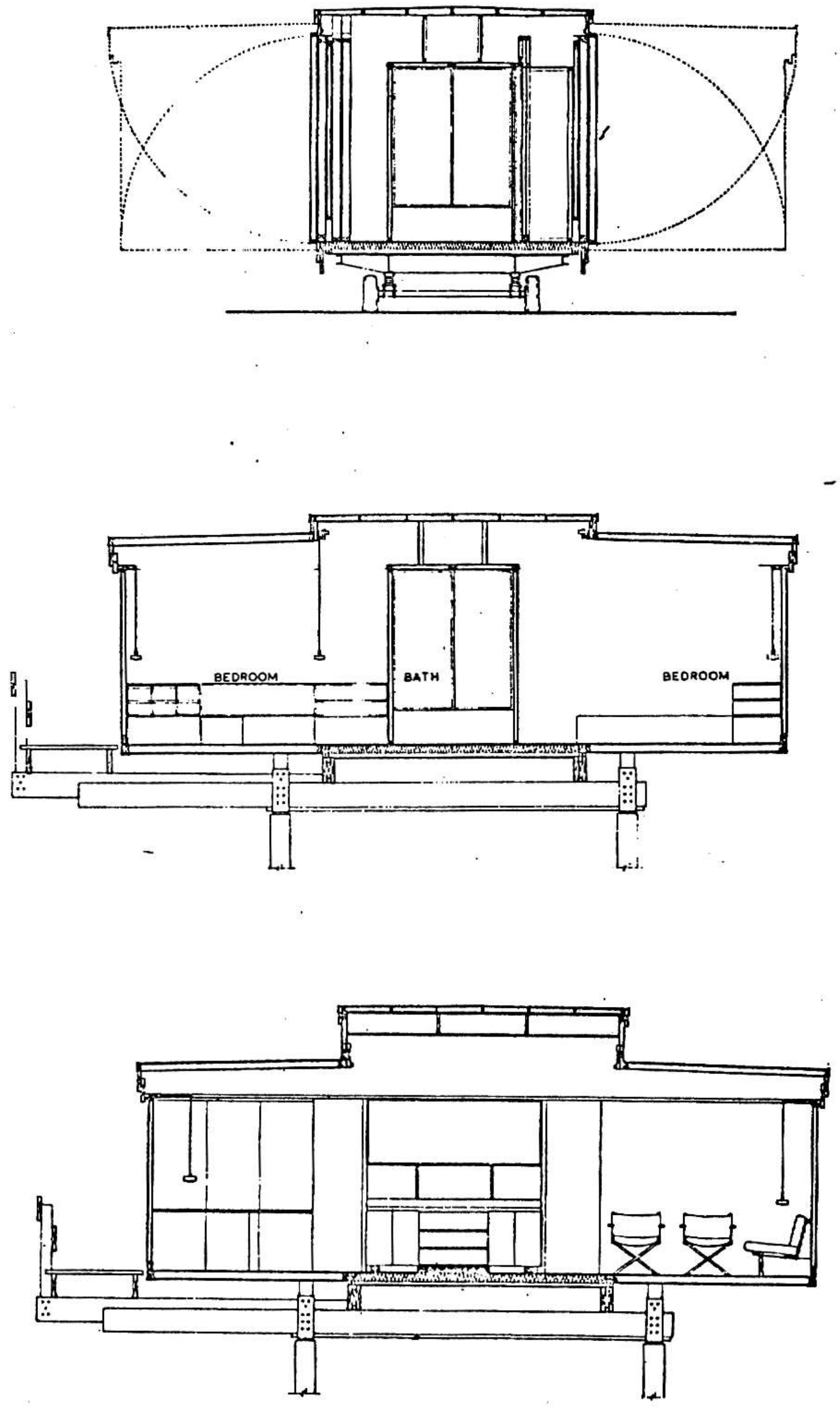


5

THE CAPSULE : WARREN CHALK

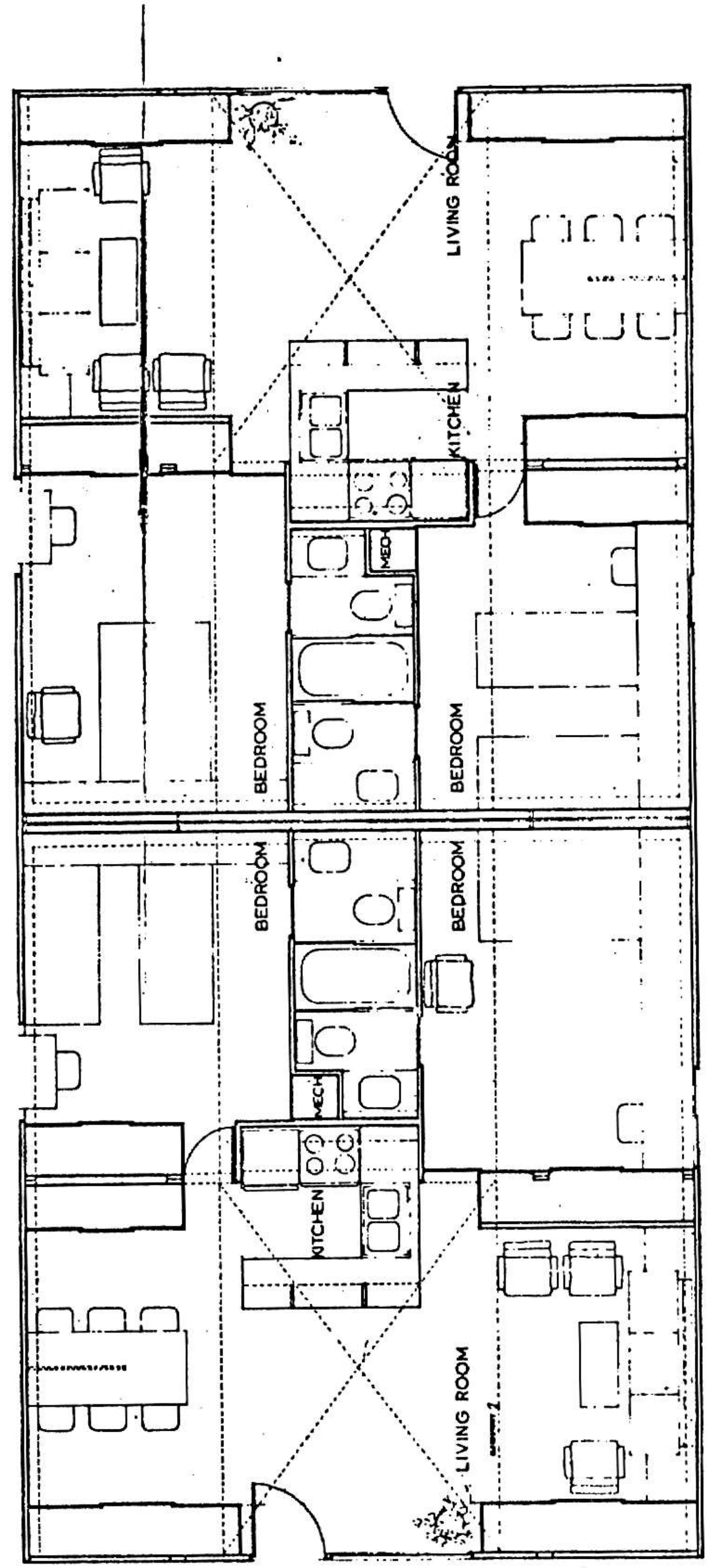
Paul Rudolph's Charlottesville student housing at Charlottesville, Virginia, is one of the best example of deformable architecture. His units, as a basis a 12-foot wide box, is tightly organized around a kitchen-bathroom utility core, with panels hinged at the roof and floor that fold out to increase the width to 28 feet, 8 feet on each lateral direction. Each unit contains two back to back two-bed room apartments, 30 feet long, making the total, two-apartment unit length 60 feet, and bringing the total transported package size to 12 feet by 60 feet, the maximum dimensions for highway transport.

All the utilities are laid underground. The platforms are set up and utilities run up through transit pipes. The units were set on the platform by light-weight crane, where they were unfolded.[10]



6

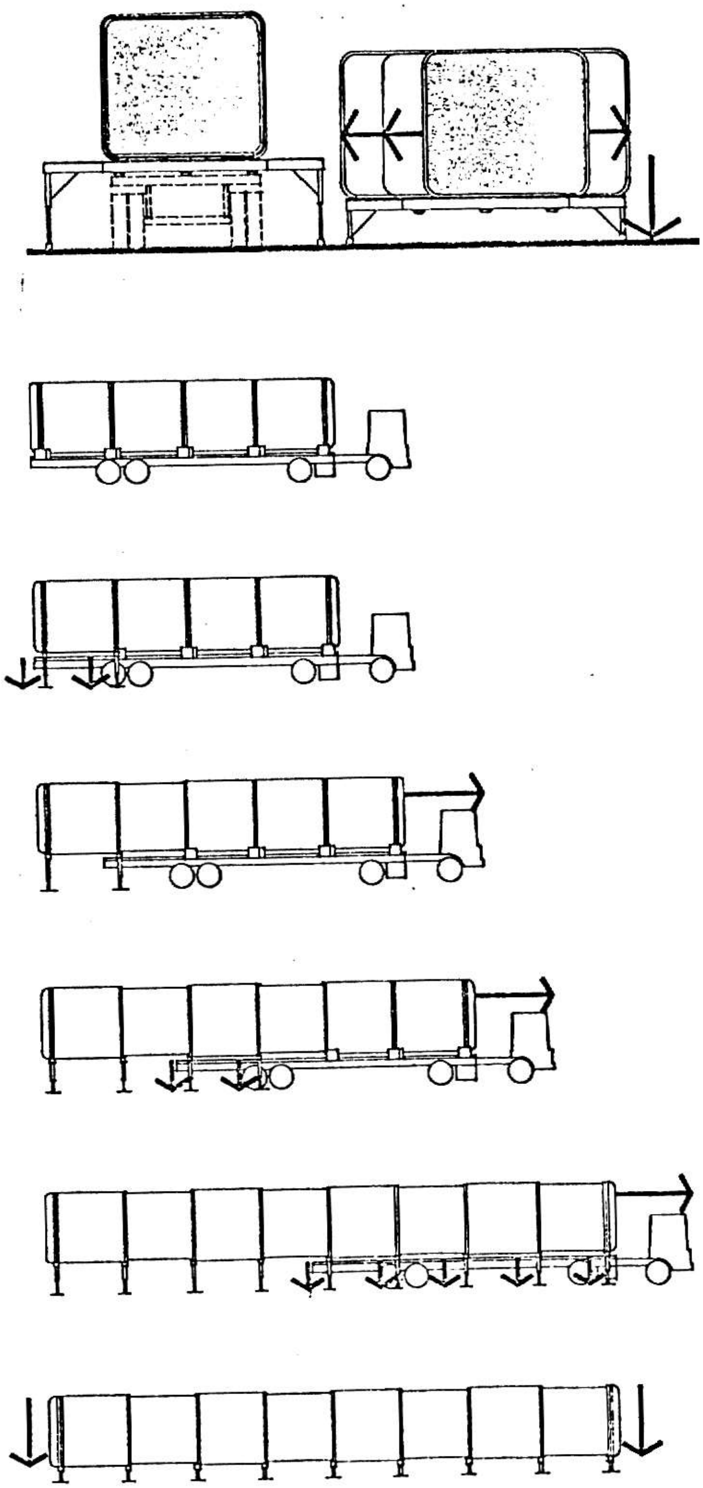
STUDENT HOUSING : PAUL RUDOLPH



7

STUDENT HOUSING : PAUL RUDOLPH

John Vredevoogd's proposal for a mobile home is based upon a series of eight foot sections. A minimum of 4 sections would make one unit. It could go up to eight sections. The sections have been designed, so they telescope with one fitting inside another. In this way eight-sectioned home (64 feet long) would form a package only 34 feet long. In his design the house is extended as it is being unloaded from a truck. After the truck is removed all eight units are lowered. The sections then could be offset from one another along transverse girders, creating a staggered plan. Each segment is structurally considered a continuous tube which includes walls, floor, and roof.[11]



8

MOBILE HOME: JOHN VREDEVOOGD

NOTES:

1. Royston Landau, New Direction in British Architecture, (London: Studio Vista Limited, 1968), p. 100.

2. Peter Cook, Archigram, (New York: Praeger Publishers, 1973), p. 52.

3. Ibid., p. 52.

4. Ibid., p. 36.

5. Landau, op. cit., p. 69.

6. Cook, op. cit., p. 39

7. Landau, op. cit., pp. 90-92.

8. Cook, op. cit., pp. 44-45.

9. Ibid., pp 44-45.

10. Center for Housing and Environmental Studies, Cornell University : Ithaca, The New Building Block, 1968, pp. 99-101.

11. William Zuk and Roger H. Clark, Kinetic Architecture, (New York: Van Nostrand Reinhold Company, 1970), p. 112.

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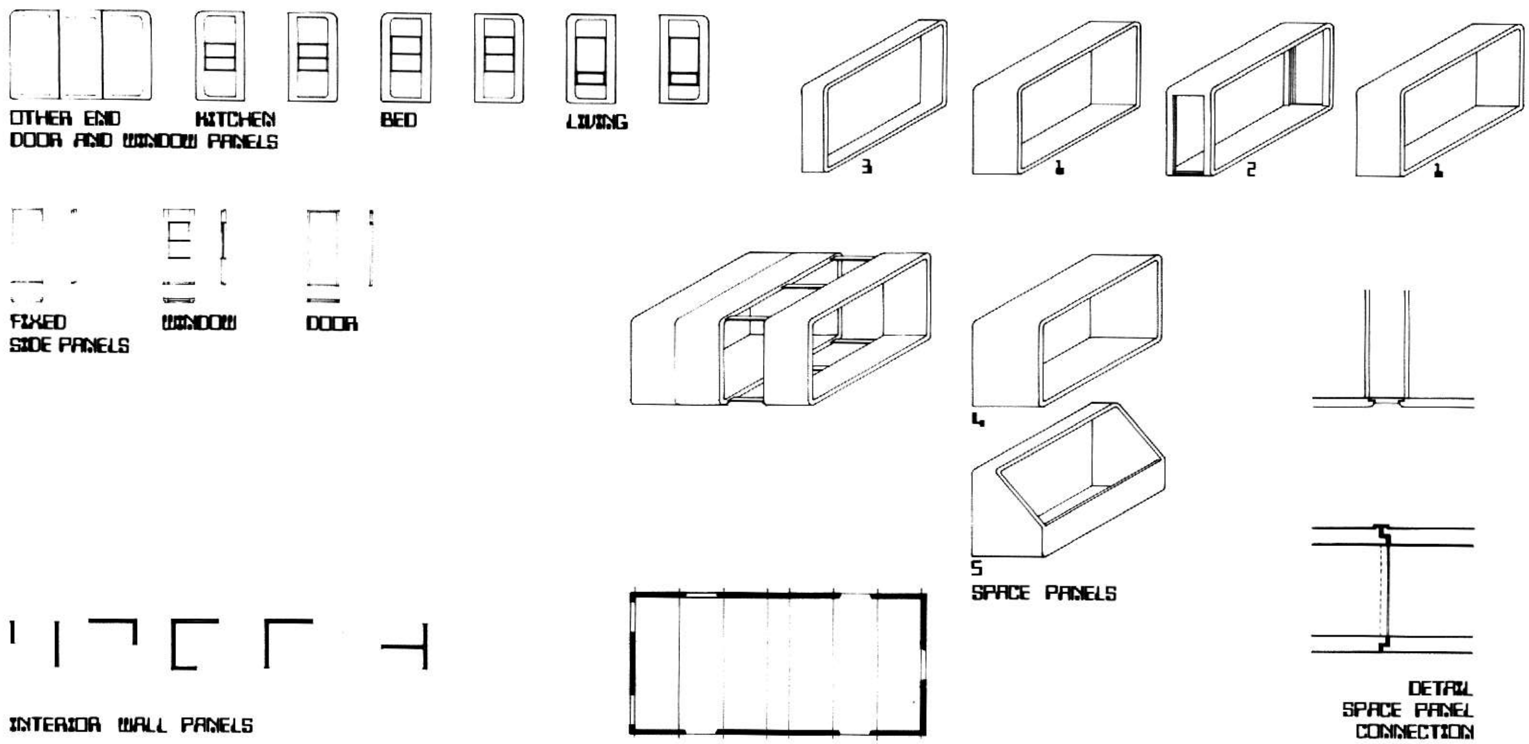
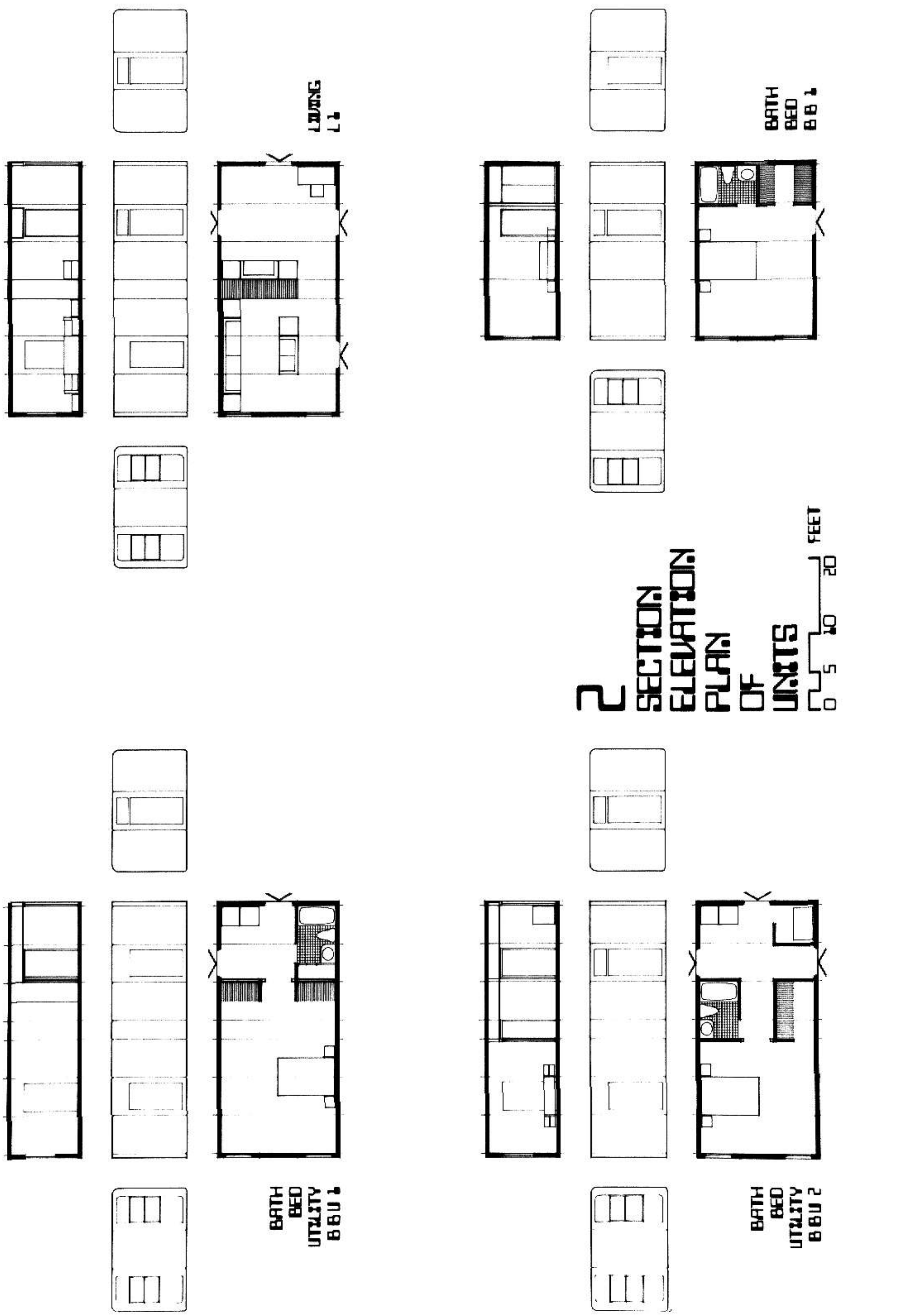


1 SYSTEM PANELS

ILLUSTRATIVE DESIGN OF A KINETIC HOUSING SYSTEM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BATH
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B B 1
2
SECTION
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PLAN
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BATH
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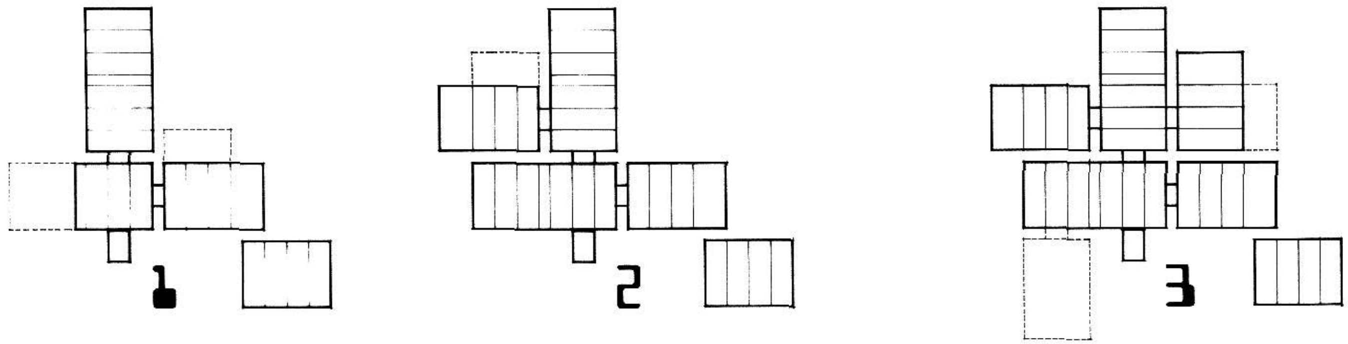
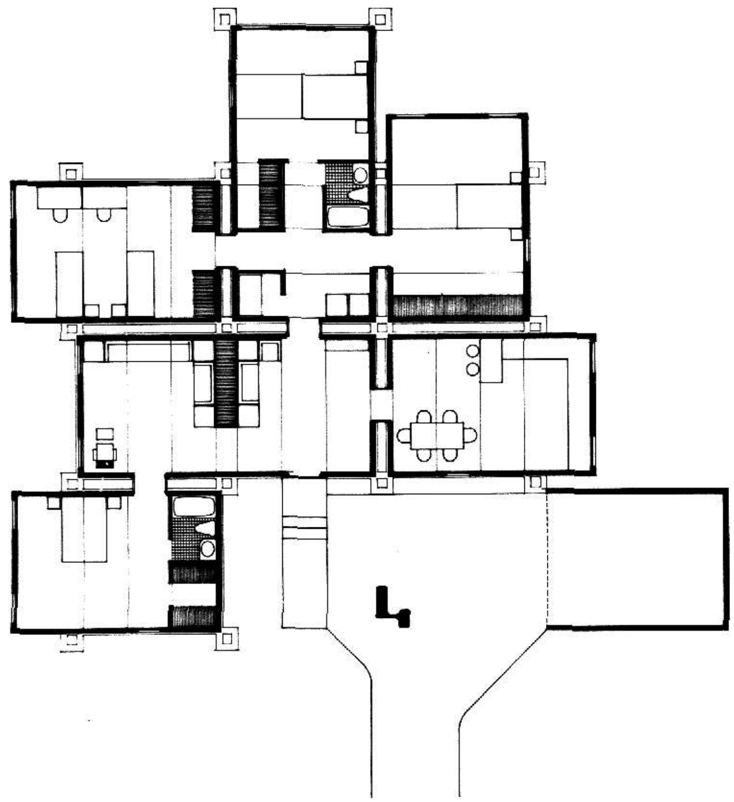
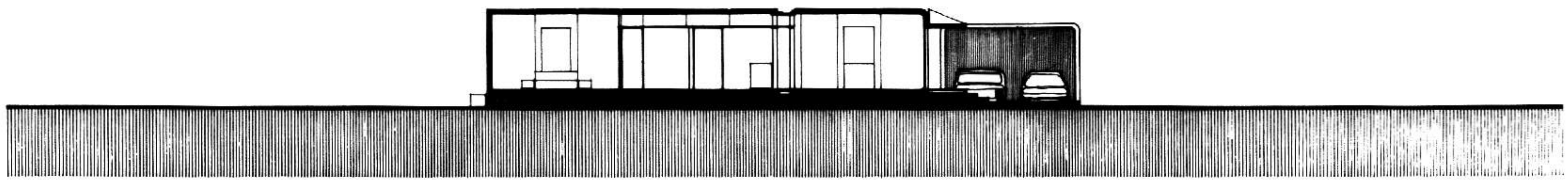




4
PLAN:
FOUR
STEPS
OF
ADDITION
IN
A
HOUSE
FEET 0 5 10 20



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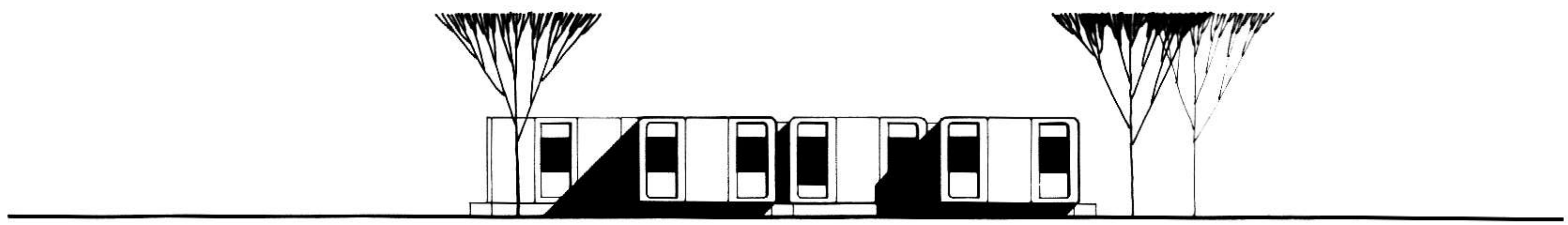
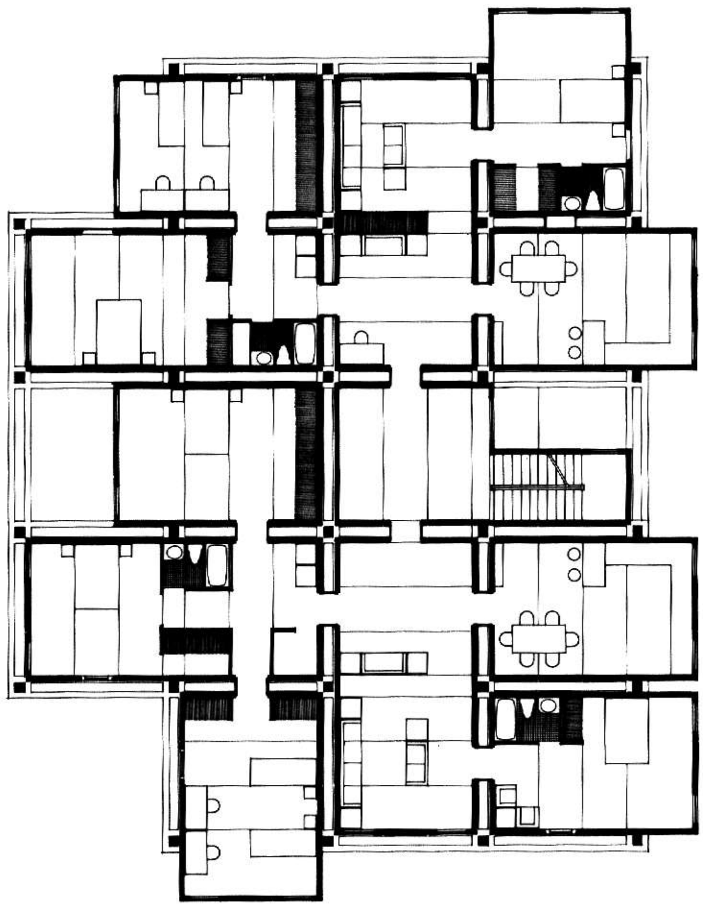


ELEVATION

5 STEP 4 : A HOUSE

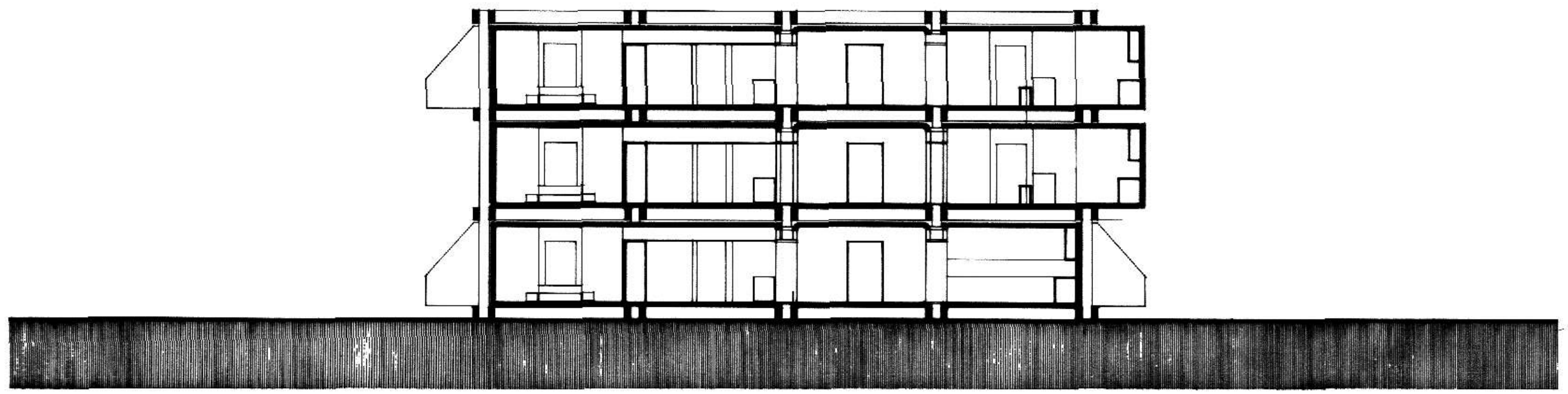
0 5 10 20 FEET



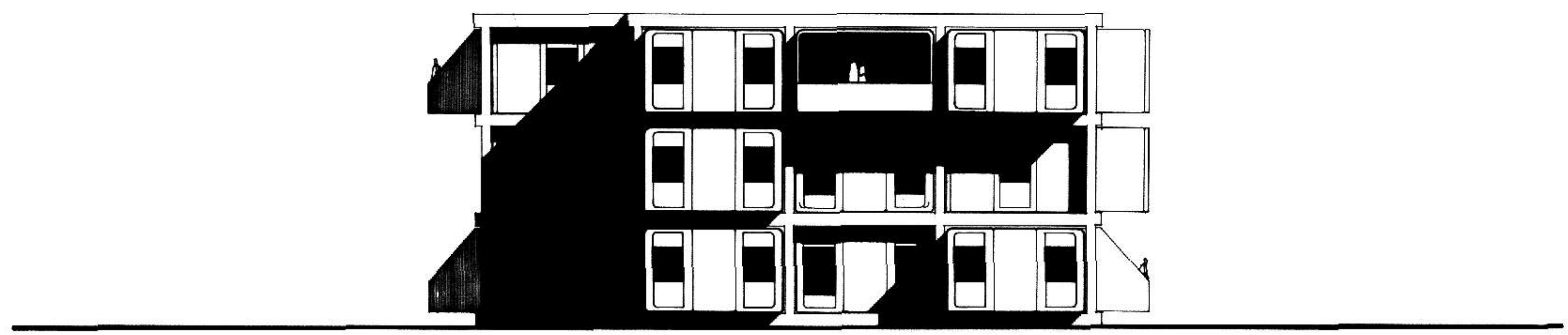
FLOOR PLAN

6 MULTI-STORIED HOUSING

0 5 10 20 FEET



SECTION



ELEVATION

7 MULTI-STORIED HOSING

0 5 10 20 FEET

KINETICISM IN HOUSING

by

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AN ABSTRACT OF A MASTER'S THESIS

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ABSTRACT

Architecture in general is the art and science of building. It reflects the culture which is directly related to the architecture of a society. Architecture, in short, should be responsive to the essential characteristic of our society — change.

Most of the past buildings became obsolete functionally long before they became obsolete physically mainly because architecture had not been adequate for dealing with the speed, the scale, and the nature of change. Only changeability going along with social change which would keep a building long lasting.

The factors that could make a building obsolete are many. They are : social change; life of building material; extraordinary demand; and invention of new machineries etc. Idealistically an architect is expected to design a system by which the housing units could be readily changed Some parts of a building could be separately replaced as they become functionally obsolete. The unit involved could be made bigger or smaller in size and in terms of the number of rooms. Under any circumstances, such a housing

system should also be capable of adopting and adapting new inovations of house-hold machineries.

There are three main objectives in this study. The first is to register the need for kinetic architecture and kinetic housing in general. The second is to identify different types of kineticism that has been used in some well-known buildings or projects as a whole. The third is to propose and suggest an approach to the design of a kinetic housing system, namely selective and composite application of known techniques, that would help to control obsolescence of housing units which could grow with the growth of a family and family needs.