To grow a house : an introduction to the core-house concept

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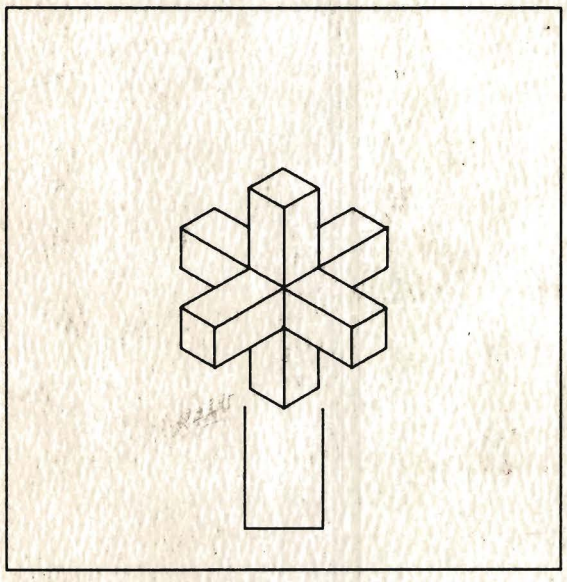

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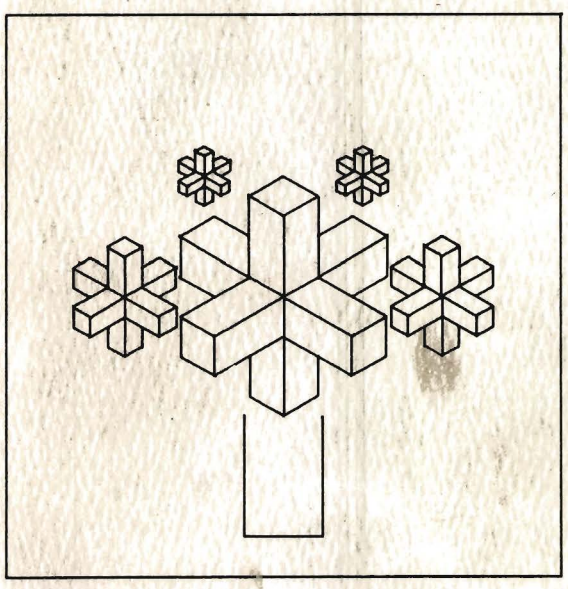

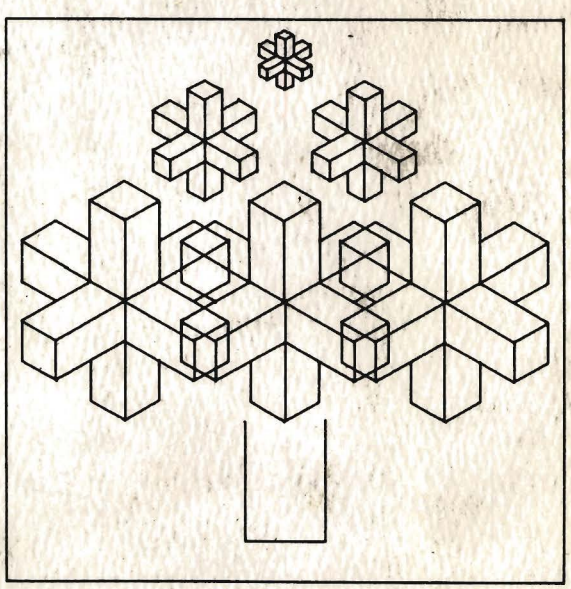

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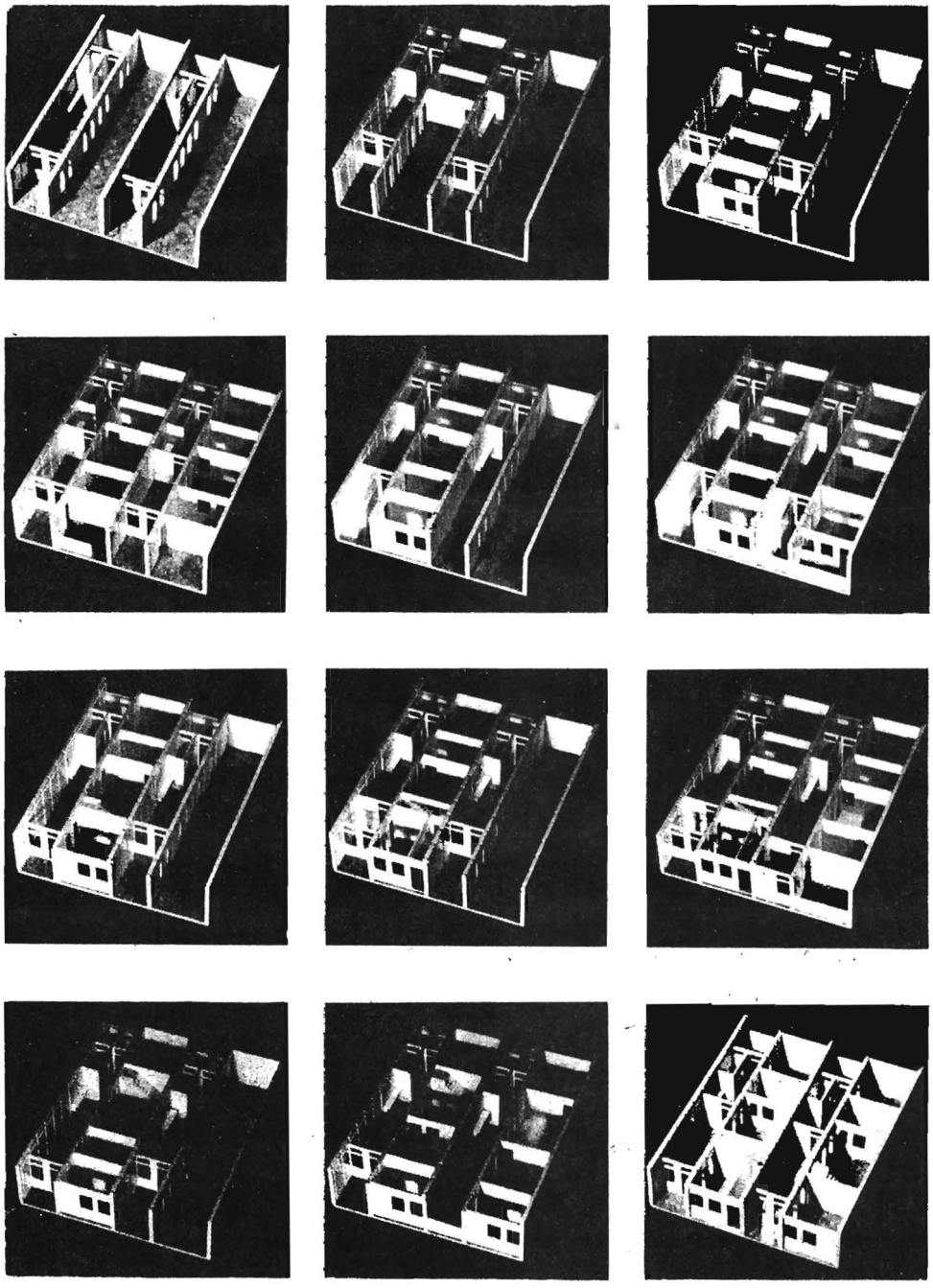

to grow a house

TO GROW A HOUSE

An Introduction to the Core-House Concept

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This pilot research into the theoretical problems associated with the design of growing houses was carried out in the Department of Architecture, Building and Planning of the Technical University, Eindhoven, Netherlands. It is the result of a collaboration between a principle researcher and a supervisory team; this same group experimented with some of these ideas within the frame work of the design studio with a small group of students. It was originally planned, and still is hoped, that this subject would be considered in a colloquium bringing together world-wide experience and opinions on the phenomenon of staged building.

These activities were made possible by the generous provision of a Philips stipendium. The T.H. and this Department have provided services and support in a most efficient and kindly manner; the ambiance created by colleagues and the physical environment has been stimulating and wonderfully conductive to scholarly activity.

This work builds on a distinguished and distinctive body of research which has been developed in Eindhoven since the mid-Sixties. Currently this research into environmental structure and processes is continued in G.O.M. (the Design Methods Group) of the Faculty and at S.A.R. (Stichting Architecten Research). I have benefited more than this work can show from my association with these two groups. Professor Thijs Bax and my other colleagues and friends of G.O.M. have made valuable contributions as has John Carp, the Director of S.A.R.

John Habraken, who is always a part of all of my work, provided me with material; the title is derived from his thoughts about "an architecture to grow houses in", and the cover photograph is from his work with Buwalda on the EMAD project for Egypt.

My association with the four students of the team has been important for the work. We have carried on a year-long dialogue about the problems of designing growing houses. Some conclusions not included in this report are to be published in a forthcoming issue of Open House International. The students are also responsible for all of the graphic work.

Marianne Janneman, secretary of the G.O.M. group, took on the typing of this work in addition to her other work, and I am most thankful.

To all of the people with whom I have worked this year I wish to express my deep gratitude and that of my family for the warmth and kindness with which we have been received.

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1. INTRODUCTION

1.1 Preface

The core-house concept, the idea of a house growing over time, is a phenomenon natural to the process of dwelling. Transformation in the physical environment is as characteristic in artificial systems such as settlements as it is in the natural, and the growth and change of parts or wholes of environmental systems is today a subject of both theoretical interst and practical importance. Freedom to grow and modify at the scale of the house has for centuries been an attribute associated with living in a house.

The house predesigned for growth or staged construction has become a subject of increasing interest during the past two decades. This interest in growing houses as a type problem is perhaps related to the more general goal of creating a process-responsive form of physical environment. A goal, by the way, which has been kept alive by a few pioneers who postulated a revolutionary image of architecture as dynamic and responsive to the changing requirement of its users. The particular territory in which these ideas of housing design have flourished has been that of the developing countries in which, causes such as rapid urbanization of populations, limited resources, and the need for minimal shelter which could be upgraded have made the idea of the partial provision of housing services - core housing or sites and services - a reasonable approach. The concept of core housing has in such situations frequently been associated with other attributes such as self-help in completion of construction and even industrialization.

The major thrust of work in this subject has been developmental. There has up until the last few years been little or no theoretical work on the core-house as a type problem in architecture. In recent years under the influence of the relationship between the Netherlands Bouwcentrum International Education (BIE) program and the housing research organization, Stichting Architecten Research (SAR), several interesting theoretical studies have been published along with a growing body of design proposals for core house projects throughout Asia and Latin America[1)].

There has been some indication from other research, including research in Israel[2)], that the core house concept may have some applicability in developed societies as a means of provision of the right to build even in situations of multi-family, public housing which normally provides the restrictive format of the "apartment".

This present research has been envisaged as a pilot study of core housing as an architectural problem. Its main goals are to define a conceptual structure for this problem and to attempt to provide a mapping of the aspects concerned in a form which might be universally applicable. The problem of universality is great considering the diversity of socio-economic, cultural and technological factors, which exist in different geographic applications of the core-house concept. This complexity notwithstanding, this work attempts to provide, first of all, a theoretical base from which other work can develope. Part of this base includes a state of the art survey of examples and literature.

A second major goal has been to attempt to develope a methodological approach to the design of growing houses. Much work has been done at the SAR, BIE and MIT Dept. of Architecture towards this end, and the present work continues this tradition of application of SAR methods to the study of core houses. More explicitly, zoning is used here as a tool for generating a typology of core-houses. These types are then analysed and compared for their potential for growth. In establishing criteria for this comparison, emphasis has been placed on what might be called, urban core-house design - and less-emphasis upon the normative conditions of third-world situations. Nonetheless, effort has been made to keep the work as general as is reasonable within the scope of this subject.

Finally, this research has been carried out simultaneous with student work in the design studio which has developed some of these ideas in a national housing competition in the Netherlands. The focus of work in the competition has been upon the study of the potential of the core-house approach in low-rise, high-density multi-family dwelling forms. This project work is illustrated in an appendix to the report.

1.2 To Grow A House: An Introduction to the Core House Concept.

Basically, the core house concept treats the programmatic and physical elements of the dwelling as subdivisible into separate components which can be provided in various combinations in an initial stage of provision - the "first-build". This first-build is to be added to over time, often by the dweller himself, in order to achieve a completed dwelling. The range of programmatic variation extends from sites and services to the typical core-house involving spatial and utilities facilities which can be increased in size, improved, or added to over time. Considering the physical elements in successive stages of completion of the dwelling is another way of conceiving of the core-house concept as a flexible mechanism for responding to various housing situations. So the first characteristic of the core-house concept is that it is an approach to staged building in which the combination of program and physical elements can be varied according to the particular ad hoc conditions of the problem.

The present study attempts to consider the core-house approach as a type problem, that is, without reference to the normative factors of specific situations. Analysis of the core house proceeds to the point at which normative aspects must be considered; these are then classified and analysed for the way in which they influence the problem of the design of core housing or the architect's role in this process, these being the questions underlying the present study.

Following are certain of the components which contribute to a rationale of the core-house approach.

a) Transformation

Permanence and Change in the Built Environment

Transformation is an intrinsic aspect of built environment, its purposes and its meaning. Architecture must develope institutions, values, methods and techniques which accept change as the natural state of environment.

Building for Time

Thus building for time, and recognising processes which occur over time, is the mandate of architecture; dealing with the complexity of the unpredictible is a characteristic of today's architecture.

Housing as Dynamic Process

Housing programs derive from the dynamic processes of the lives of their users. The cycle of family life; the myriad of socio-economic changes in any life-time, the rate of technological and cultural change affecting the meaning and useage of the dwelling; all are parts of the process definition of housing.

Housing as a Vehicle of Social Change

In addition to functional accommodation, housing fulfills for the individual and for society, a myriad of socio-cultural functions including symbolic or urban values. It further may provide a vehicle whereby broader social processes of change e.g. work-home-relationships, may be enhanced.

Housing as Diversity

Housing is a durable good with a long life. During the use life-time from a physical point of view, both users and their needs and desires may change many times. Thus housing design must accomodate such diversity.

The Durability of the Housing Stock

Given the physical durability of housing, its ability to withstand obsolescence depends upon its adaptability to change. Examples of such changes derive from the family cycle, changing ownership, etc.

The Adaptability of Housing

In planning housing for building in stages, reversibility of the process may be taken into consideration, with excess built space being transferable in ownership. Such options render the total housing stock more responsive to change.

b) The Form of Housing and the Rights of the Dweller

Mass Housing and the Limits of Change

Modern urban mass housing projects have generally tended in the past to be standardized and unresponsive to the diversity of needs of users. Such housing strictly limits the dweller's ability to modify his environment.

The Influence of the User

Housing in all socio-economic contexts must provide the user with the greatest possible margin of influence. Both architecture and institutions must be developed which are responsive to user participation. The core-house concept, being a time-related model, preserves a degree of influence in proportion to the part of the process which is deferred to the "second-build".

The Attributes of Houses

At what point do certain housing forms lose the freedom to act which is associated with the idea of a house. Is there a distinction in this respect between what in Western society is known as the house and what is known as the apartment.

Freedom to act

What are the rights which are associated with the house. The right to build, to grow, to personalize, to modify are such rights. The symbolization and materialization of the dwelling process through modifications is a characteristic phenomenon in the house.

Institutional Flexibility

The core-house concept can be applied in a variety of socio-economic and cultural situations. Given that the rate of completion is in the hands of the user, it is a mechanism which provides flexibility of choice both to institutions and to individuals.

Housing as Capital

The core-house can function as a source for investment and growth of capital.

The Degree of User Control

The core-house approach formalizes a physical realm of user control. It increases substantively the realm of participation over and above that of interior modifications, often associated with apartments.

To Grow a House

Growth is in the nature of families and the accommodation of growth and change of family composition and character is possible in core-housing. Core-houses grow as needs occur and means permit. They have an organic relationship with the life processes they serve. Thus it is appropriate to consider houses grown rather than built.

c. The Architect and the Housing Process

Designing Freedom

The responsibility of the architect is to provide a framework for growth and change, an evolving architecture. This requires a new vision of architecture as dynamic and in a constant state of change. Such an image contradicts the centuries old conception of architecture as formally composed and static.

Responsibilities

The design of core-housing must reflect the split allegiance of the architect: for the user he must create a framework for life processes; to society, the designer is responsible for materialization of values at the level of the group, the neighbourhood, the city.

d. Costs

First Costs

First costs for provision of housing services are reduced by reducing the amount of finished housing which is provided.

The Cost of Futures

The amount of construction cost saving is not strictly proportional to reduced area. Certain basic costs such as utilities connections may be made in the first build. Secondly, designing and providing for unpredictable growth may necessitate a certain degree of "over-provision" or redundancy e.g. of utilities. This payment for flexibility qualifies the simple arithmetic calculation of not built = cost savings.

Social Costs

Direct costs are not the only types of costs which a society should associate with housing. Dynamic housing which can be enlarged and improved over time may have the effect of reducing mobility and stabilizing community.

e. The Interaction of Scales

Boundaries

Core-houses function purposefully with respect to their own scale; at higher levels - the neighbourhood, the city, they are not necessarily purposeful. Moreover outward growth may have

a negative effect on collective image. This work will introduce the concept of boundary as the physical element or place which constitutes a realm of interface between public and private values.

Low Rise - High Density

The process of easy and technically non-specialized growth at sporadic intervals is related to proximity to ground. Urban mass housing usually implies density and buildings of certain minimum height. The core-house concept in low and dense housing groups has difficulty in boundary conditions as physical proximity becomes greater.

Domains and Territories

Boundaries become a framework for the definition of spatial domains and their rights of use (territorial rights).

f. Low and Dense Growing Supports

Core-Housing as Growing Supports

The SAR design method as developed by Habraken and the SAR provides concepts and tools which may be useful in the design of core-housing. The SAR's method of spatial zoning may provide a means to predesign potential growth without prescriptive planning.

Extroverted and Introverted Supports

The core-house concept further enlarges the realm of user control to an area of potential growth outside of the core while maintaining the potential for user control within the core.

The Framework of Supports and Tissues

The spatial framework of supports and tissues provides a basis for defining roles, responsibilities and rights in staged building. Zones are the manifestation of future possibilities upon which can be made the agreements and covenents which may be necessary between neighbours.

Hard and Soft Housing

The concept of an institutional start and an individual completion of the dwelling - the hard and the soft housing - offers an approach to mass housing through staged provision. This study proposes to consider the core-house concept in multi-family, low and dense situations, and to employ the methodological tools of SAR in the process.

g. Intentions

The motives for the extension of the dwelling are part of a more general category of purpose devoted to increasing the degree of choice and control which the dweller has in the housing process. Other phenomena involved are user participation, self-help and personalization. Often those phenomena are grouped under the rubric, participation, and frequently occur together. In order to evaluate the response of the physical environment to these various motives, it is important to be clear about which you are studying. In the present work, extensibility is considered independent of other characteristics.

1.3 Forms of Transformation

What should underlie any systematic study of the core-house is a more general theoretical study of the phenomena of change in architectural systems, growth being one major class of the phenomena of architectural change. Such work does exist in various sources, and it may be of interest to briefly note some of this research.

From the point of view of a theoretical treatise on the relationship between form and change in the built environment, John Habraken's new book Transformations of the Site is such a general theory. The work makes important contributions to our ability to observe and understand the processes of change in the built environment, a prerequisite body of knowledge to designing for change. Transformations of the Site treats of the important relationship between spatial orders and spatial rights, the concept of territory, as an integral factor in all processes of change in man-made environment; it also introduces theoretical consideration of "territories" and "boundaries". Both of these are concepts of fundamental importance in the core-house, in which territory and boundary must be defined in such a way that rights are maintained without being deterministic upon unpredictable change, one class of problem in designing for the future. In addition, Habraken provides certain basic operating definitions, on the forms of transformation,

"call the form of transformation caused by the addition of elements: Growth".

Regarding an implied order of spaces and rights which may exist in the design of a growing house, certain other definitions, such as that of "system" provide a very useful theoretical base,

"A system is a structure and variants. The variants are the visible part of the system. The structure is the invisible part".

A second important class of theoretical study into the relationship between architectural form and processes of transformation are the researches of Peter Cowan and John Weeks [3]. Cowan's work derives from empirical studies of growth, change and aging in various building types such as hospitals; Week's work is complementary in the sense that he generalizes about the implications of the process of change upon the problem of designing for diversity and change. The formal constituents of adaptive change or the relationship between form and transformation have been studied by various researchers. In addition to the literature of cybernetics on adaptive processes, Alexander has written on adaptive design in various of his works[4].

Finally, an extremely interesting historical and typological study of additive growth as a form of transformation in the urban environment has been done by Perez de Arce in "Urban Transformations and the Architecture of Additions". Perez de Arce defines the following characteristics of "additive transformation",

"Additive transformation is only one of the possible mechanisms of growth and change, but is presents some characteristics which are important for the quality of the town.
First, by being a gradual and organized incorporation of parts into an existing core, it implies the use of a pre-existing structure, and by doing so it extends the likelihood of this being in use for a prolonged period.
Second, by being based on the retention of what already exists, additive transformation allows for a form of development characterized by its low cost in both social and material terms.....

Third, because it is a sedimentary process, additive transformation ensures a sense of continuity in the construction of the town, and a sense of "place" in both historical and spatial terms....."

Perez de Arce proposes the use of transformation through additions as a means to modify or transform the character of existing urban patterns[5].

Each of the works above shares the recognition that growth and change are characteristic processes in architectural and urban systems and that the built environment must be conceived of as in a state of transformation, rather than as something static and composed.

1.4. On Form and Growth

Growth in nature is generally interpreted as an increase of size. Before proceeding to study the growing house, it may be valuable to consider the relationship between form and growth in order to understand some of the morphological principles of the biological phenomenon called growth; as well as the potential application of certain of these principles to the problem of growth in artificial systems.

The phenomenon which we visually observe as increase of size is, in fact, a variety of biological phenomena which we may consider principles of growth. Each of these principles existing in nature may generate a morphological sub-class depending upon the particular geometry of the biological system.

Bifurcation - the first principle is that of splitting, a basic form of growth in cellular multiplication. The process involves enlarging in size to a point in which the cell subdivides.
Fusion - this is another basic process in which size is increased by the joining of two entities. In the case of bifurcation, growth takes place while the morphology of the basic unit is maintained; fusion is the complementary process whereby newly

multiplied entities combine to form a, potentially, morphologically different entity.

Annular Growth - from the latin annulus, or ring. We observe an increase of size due to growth by the addition of circumferential rings, as in the annular rings of a tree trunk section. We should note that we are above the scale of basic, biological principles of growth, and are now considering morphological principles of growth.

Linear Bifurcative Growth - another morphological principle is that of linear growth in which successive elements are added in a linear rather than concentric fashion.

A morphological variation on annular and linear bifurcative growth is that of the chambered nautilus in which additive growth occurs in a spiral fashion, each of the successive chambers being larger in size than the preceding.

Wrapping - Both processes, that of the tree rings and the chambered nautilus are examples of wrapping or layered growth, in which a core becomes wrapped by successive layers in a concentric or spiral fashion. This was recognized as a principle of growth by Le Corbusier who applied it in the design of the museum[6]).

Branching

Bifurcation means branching or forking, and branching as in the growth of trees is a form of hierarchical, bifurcative growth. In the bifurcation of cells equilibrium is maintained in the relative size of cells; in trees there is a hierarchical order of major minor between trunk and branch. Both of these principles of growth are known in architectural systems. A classic example being the addition of discrete, subsidiary volumes to an existing nucleus. The form of additive growth which will be discussed in subsequent sections.

Differentiation

Differentiation is the process of increase or modification of the subdivision without necessarily being accompanied by an increase in size. Strictly speaking, this is not a form of growth, since it generally involves an increase of complexity rather than the increase of size. This is transformation through addition, or additive transformation. It is a significant form of change in artificial systems such as cities.

In summary, we have briefly considered various forms of growth in natural systems as a first step towards thinking systematically about growth in artificial systems, and particularly in the growing house. With respect to the relationship between form and growth -a relationship which we will continue to study throughout this work - we may distinguish at least two variables through which basic biological principles of multiplication are developed into principles of growth. The first of these is the morphological character of the relationship between entities and increments of growth. We have, for example, discussed bifurcative growth as being point (cellular), line (linear) and concentric (annular). The second variable is the mathematical character of that relationship. Growth may be multiplicative, that is, of an equal or incremental relationship to the initial entity; or it may involve an arithmetic or geometric progression. The chambered nautilus is a case of concentric multiplication of progressively larger increments.
We will now consider how some of these principles have occured in architectural and urbanistic systems, before going on to propose a classification of growing houses.

1.5. Concepts of Additive Transformation in Built Environment

In order to study the core-house from a typological point of view, we must introduce the concepts which enable us to distinguish differences in the process of additive growth. Since the principle of staged building is applied in such diverse circumstances, the ability to compare the architectural aspects of various applications requires such a set of concepts which enhances our understanding of the phenomenon.

Morphological Pattern

This term may be applied in connection with growth in various building types. It refers to the morphological type of the pattern of growth -principally as related to the natural patterns which have been previously described. What is considered as constituting a morphological pattern is the relationship in scale between core and increments of growth. Factors such as the timescale (frequency) of additions, or their particular geometry

(form) are not considered. Thus the relative scale and pattern of core to growth increments describes the morphological pattern. This term may be useful in comparing growth in various building types or urban forms and in studying the connection between typology and growth pattern, as de Arce has done.

Resource Strategy

A more specific term may be applied in the context of housing to introduce distinctions between types of core-houses. We can assume that at least one characteristic motif of the core-house concept is the deferring of the use, or consumption of resources in the first stage of provision of housing services. So-called "site and services" provides an extreme example in which the minimum resource list includes land an utilities to the site, with the provision, acquisition or construction of all other aspects of housing to "after occupancy". To understnad this useful concept and its application, we may postulate a matrix in which certain basic strategies can be located. This matrix has as variables a list of elements and their degree of completion.

Physical Components / Staging	Deferred	Started	Partial Completion	Requires Final Work	Completion
Site					
Site services					
Site boundary walls					
Structure					
Roof					
Exterior walls					
Wet cells					
Electricity and plumbing					
Interior components					
Finishes					

This matrix refers to the relationship between the physical components of the housing service and the degree of their completion. Some of the classic scenaries of staged building described by Abrams can be easily plotted in the matrix, e.g. roof-built core-houses. The first-build of the "barrada" scenario described by Turner can also be plotted. Any profile through the matrix may be plotted and analysed.

The matrix list may be modified or extended depending upon its use. For example, if one of the motives of the core-house concept is to increase user-initiative in both design and construction, then the degree of difficulty or quality of skill required in completing the physical component may be one basis for beginning to group these components into categories, e.g. site, supports, infill, technical. The staging categories may be elaborated to include the "what" as well as the "when" completed. This distinction would enable reference to self-help, aided self-help, professional construction, industrialized components and similar factors. Other qualitative aspects of staging such as coordinated, sporadic and sequential additions may also be included.

The resource matrix is an excellent conceptual tool, since it creates a basis for typological distinctions which helps to connect aims and means. The types plotted from the matrix demonstrate the connection between completion and deferment of parts of the building process. What is lacking in such a matrix is the relative scale of the completed and the deferred.

An example of using the matrix for purposes of classification or analysis can be given with a well-known prototype of patio-form core-housing, the Peruvian "barriada house". The barriada house is a "boundary-built" core-house, in which the boundary of the plot is defined physically at an early stage in the development of the core house. The main ingredient of the boundary and small core space maintains a high degree of deferred construction.

We may continue to generate types of strategies using the matrix by emphasizing the aims-means relationship in core-housing. If we first define the aims in specific terms, the matrix offers a tool for selecting generic approaches to the means.

Design Strategy

The resource strategy describes the relationship between physical elements and schedule of execution. The design strategy refers to the particular characteristics of a design approach. The design approach may be distinguished by various factors. The following are significant examples:

Relationship to Ground

Given that the core-house concept involves on-going staged construction during occupancy, questions such as access to building site and minimization of disturbances to neighbors are probably related to proximity to ground. We can distinguish various conditions such as ground-attached proximity to ground or multi-storey.

Direction of Growth

Expansion may be horizontal, vertical or both.

Dwelling type - Building type

Growing row-houses and patio-houses offer examples of the way in which the particular architectural type developes its own generic possibilities for growth. This relationship between building and plan typology and characteristics of growth will be considered in Chapter 3.

Type or Scale of Addition

The form or scale of the additions is another basis for distinctions. We can speak of incremental additions, addition by room-sized modules, etc.

The Technology of Growth

Technology, or the building systems employed, may be distinctive, e.g. addition of prefabricated space modules or non-systems additions.

Normative Factors

So far we have attempted to suggest the possibility for typological distinctions between approaches to the core-house on the basis of morphological patterns of growth, the staging of construction, and the particular type of design. A class of factors which provide a basis for distinctions, if not classification, are normative factors which influence housing programs, the use and meaning of residential space, the nature of the family, the scenario of family dynamics and other non-physical, programmatic aspects.

These factors constitute a class of variables in themselves.
In Chapter 2 we will look at normative factors in an attempt to identify and comment upon the types of factors which may exist in various applications of the concept throughout the world.

1.6. Three Strategies of Staged Building in Housing

Growth can be achieved by various resource and design strategies. These strategies can be differentiated on the basis of the degree to which growth is pre-planned and pre-structured; the degree and type of overprovision provided in the first stage; the type of physical modifications required to accomplish expansion, i.e., is it necessary to add structure, or is all of the structure completed in the first stage; and the manner in which the limits of possible growth are defined, if defined at all. There are three classes of strategy for expansion: growth by Combination, Subdivision or Addition.

a. Combination: This is a strategy which uses rearrangement of partitioning between dwelling units as a means of reciprocally increasing and decreasing the floor area between two units. Space is traded between adjacent dwellings, the increase in one causing a decrease in the floor area of the other. This exchange may take place in plan and/or in section. No structural changes are involved. The enlargement of one dwelling at the cost of another requires a symbiotic relationship of need which is usually rare.

   Growth by Combination: Fusion

   This is growth through the combination of two complete dwelling units to form a large dwelling. This and the following sub-strategies can be accomplished through combinations in plan or combinations of full or half levels in section.

   Growth by Combination: Conjunction-Reduction

   This is the enlarging of one dwelling by borrowing part of the space of an adjacent dwelling. It involves the opening of

partitioning between units, and moves the area of acoustical separation between dwellings from one place to another as area is increased or decreased. Such changes may require modifications to the system of internal partitioning as well as to the common walls.

Growth by Combination: Intercalary Space

Intercalary means space inserted between a regular modulation of partitioning, i.e., structural cross walls. By opening or closing predetermined areas ("soft spots") in the cross walls, this in-between space is added to and subtracted from adjacent apartments. As in the case of Conjunction, the point of acoustical separation between dwellings changes location, but in the case of intercalary space, the possibilities of expansion and contraction are predetermined by the prime space, secondary space modulation of the structural system, or the location of service ducts or both.

- b. Subdivision and Sequential Completion: The addition of useable floor area by finishing space which is provided in the originally completed building volume, but not all of which is used at first. An example is the completion of attic space in houses which have gable roofs. The rationale is to complete the spatial volume in the contractor's first build. The increase of useable floor area is then achieved by various means such as finishing unfinished areas, adding partitions, moving or adding exterior walls. Rabeneck defines it as:

  - ... "the gain of useable floor space without actually increasing the ground area occupied by the house".

  It can be used as a strategy in multi-family dwellings as well as in detached houses. The economic rationale is that withing the total cost of housing including land, interst payments, site development costs, and the provision of general utilities systems, the relative cost of the incremental addition of space is small and worthwhile with respect to the adaptability which it adds to the dwelling.

All of the "front costs" - the indirect costs such as site development - exist for a small dwelling as well as a large one, and the construction of small dwellings may be an illogical national policy. There are various sub-strategies for subdivision which involve the completion of the structure and part, or all, of the exterior enclosure in the first build, finishing part of the spatial volume; and at some later date, expanding into and finishing the remaining area. The degree of completion of the exterior wall is a variable in these sub-strategies and expansion may be an enclosed volume of space or into an unenclosed volume of space.

- Growth by Subdivision: Unused Adjacent Space

The dwelling expands into an adjacent area, either open or enclosed. This may be a terrace which is enclosed, or in the case of a larger scale of growth, a space equal in size to the original finished space. Growth is horizontal. The increment of growth requires frontage and access to service ducts, if separate wet services are required in the addition.

Growth by Subdivision: Unused Floor

The dwelling expands vertically into an unused an unfinished area. All of the structure exists. Exterior wall may or may not have to be moved or added after expansion. Vertical circulation exists. Attic or basement space is an example of this type of growth. This is a strategy suitable for large-scale growth. The location of service ducts is important, since expansion of space on a new floor may necessitate duplication of wet areas as social and/or private spaces are added. Various possibilites exist within this sub-strategy for both full level and half level growth. Expansion on to half levels may provide the possibility of utilizing existing bathrooms which are removed one half level from newly added floor area. Provision for extension of utilities should be made in the first build. Depending upon the arrangement of entrances and wet services, this can be a reversible type of expansion with the extra space rentable when the need for it no longer exists. In such cases the need for separate "zoning" and control of electrical metering and heating should be taken into consideration.

Growth by Subdivision: Multi-Floor Envelope

The dwelling is designed to occupy two or more levels. The total environmental envelope is completed during the first build. The owner occupies a multi-storey volume, and expands his useable floor area by adding new floor structure and stairs, if not provided in the first build. There are two distinct possibilities for architectural applications of this sub-strategy.

Growth by Layers: The envelope comes without subdivision of floors. It may or may not have completed stairs. The user adds floor structure as the need arises for more space. Partitioning, wiring and other subsystems are added as required.

Growth by Infilling Opening in Layers: The dwelling starts as a multi-storey unit. Upper floors have less floor area than lower floors, and this difference is expressed as openings in the floor section. Growth is by infilling of these openings with floor structure and partitioning. For example, a two storey dwelling may have a "double-height" living area. The occupant can increase his useable floor over this double-height space.

Both types of expansion within a multi-floor envelope require considerable overprovision in the first build. Growth by layers lends itself to a small initial build and a relatively large percentage of increase (50-66%) depending upon the number of possible storeys. Infilling opening in layers provides a relatively small percentage of increase. Both involve the addition of structural elements, but in the case of infilling holes in existing layers, this may involve relatively short spans and light-weight structural elements. In the case of the former, it may be difficult to add structure on the interior of an enclosed dwelling unless the wall to wall span is narrow. Growth by layers is problematic especially in the early stages of growth when the envelope is complete, but only the first layer exists. The volume may require heating, though it is unused space. Rooms on the lowest floor require a temporary ceiling, or a ceiling acoustically satisfactory until a floor is built on the next layer. Aesthetic and psychological aspects of this strategy may also be problematical.

c. Addition: This is the third of the strategies of expansion. Growth may be horizontal and/or vertical. In this strategy, the structure is added as growth takes place. Strategies of Combination require no structural modifications, and may or my not require addition of relocation of exterior wall. Strategies of Subdivision require the addition of structural floors, and, again, may or may not require addition of exterior wall. Strategies of Addition require the provision of roof and exterior walls as growth takes place. In some cases, floor is also required. This is a common growth strategy in ground-attached dwellings.

There are five sub-strategies of growth by Addition:

Growth by Addition: Clip-on

This involves the addition of a module of space and external wall at the periphery of the existing dwelling. This strategy utilizes the existing structural system. Clip-on is a strategy of incremental addition, and provides increments of space to an existing spatial subdivision. Requires structural over-provision in the first build. The exterior wall system should be designed for easy replacement. In multi-storey structures, this strategy provides minimum opportunity for self-help construction and sequential completion.

Growth by Addition: Unroofed Terrace

Building on to projections adjacent to the dwelling. In multi-storey buildings these are terraces, or in the case of stepped or terraced houses, the projection of a lower floor. A floor exists, but a roof and walls must be added. In row housing, parallel walls may provide structural support for all future phases of growth. This requires structural over-provision in the first build. In low-rise applications, growth by addition can conceivably be self-help. The exterior wall should be relocatable without destruction. Roof drainage and waterproofing must be designed to accommodate all stages of potential growth.

Growth by Addition: Roofscape

This is the adding area of enclosed space on a rooftop. It is a sub-strategy which can be applied without special building geometries, such as stepped sections. Provides an area of growth for one layer, the top, as compared to stepped sections in which each level grows equally. Walls and roof must be added.

Growth by Addition: Bridging

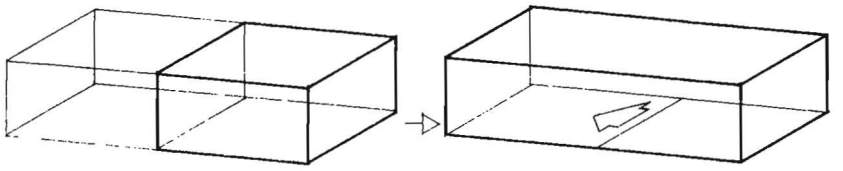
Lateral expansion of dwelling between buildings or building modules of a high-density, low-rise system. Requires the addition of floor, roof and exterior wall. Employs the existing structural system, wholly or in part.

Growth by Addition: Add Beside

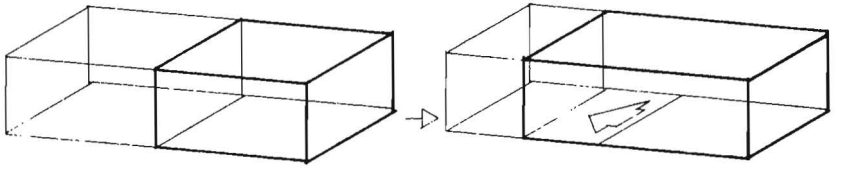
This is a form of growth similar to the annular rings of trees; growth is horizontal and the direction of growth is outward from a core. Growth need not be in all directions, but may be to one side or another, alternating on various floors, in spiral pattern, etc.

The reverse of outward growth, growing inward from a ring-shaped original dwelling, is also theoretically possible. The growth areas need not be on the same level, but may be in a half-level relationship with the original dwelling. This sub-strategy is similar to Clip-On, in that growth is peripheral. In the case of Add Beside, there is less reliance upon the existing structure as the basis of structural support, and larger degrees of expansion are possible depending upon the building type, and space available for growth.

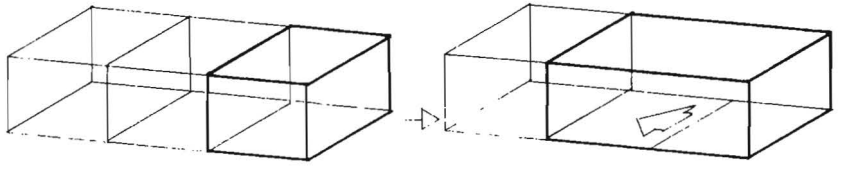
Various combinations of these expansion strategies are also possible. In general, if it is desirable that the expansion or sequential completion of the dwelling be accomplished by the dweller himself, at his own rate, the degree of over-provision and overplanning - what is provided and unused - will be higher in the initial phase than otherwise required. For example, addition of structural floors in an otherwise enclosed dwelling is probably more difficult than the addition or moving of exterior wall which is more complex than the addition of finishes. Minimum demolition and destruction of elements should be necessary in order to accomplish growth. In multi-storey, multi-family dwellings, those strategies which involve structural additions or modifications may be problematical, if self-help is contemplated and if completion is at the rate of the dweller and independent of the rate of growth of his neigbors. In strategies in which there is a need to add structure, and in which the structure must be added for all levels of the building at the same time, growth is often zoned to one side of the dwelling group,



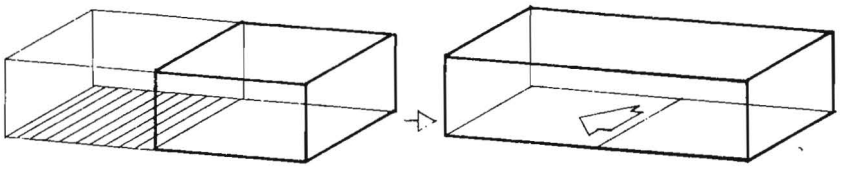
A1 Combination Fusion



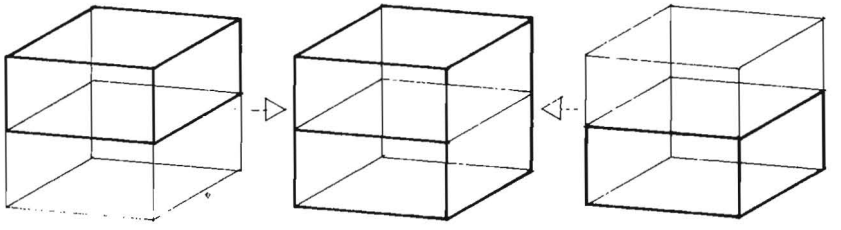
A2 Combination Conjuction-Reduction



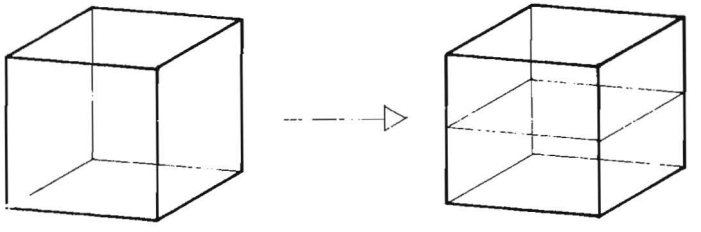
A3 Combination Intercalary Space



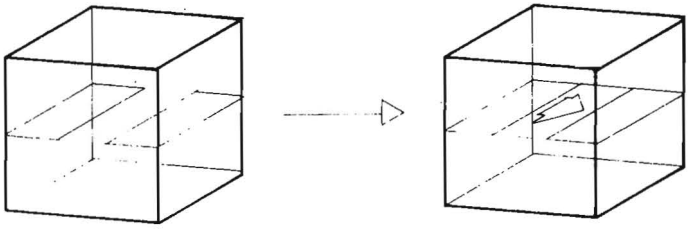
B1 Subdivision Unused Adjacent Space



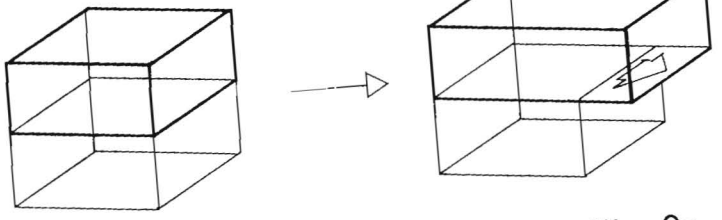
B2 Subdivision Unused Floor



B3 Subdivision Multifloor Envelope

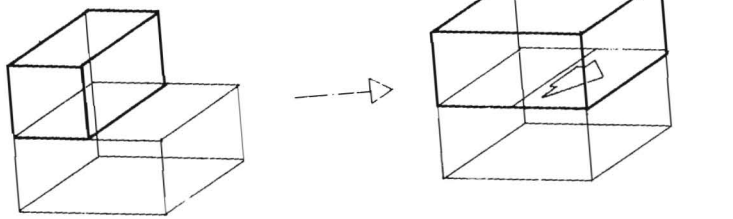


B3' Subdivision Openings in floors



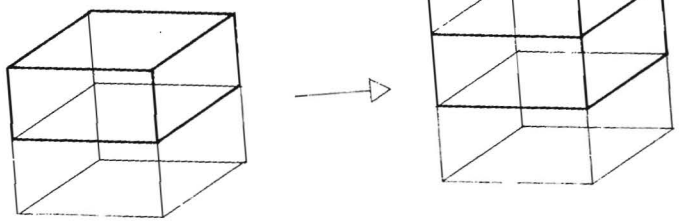
C1 Addition

Clip On



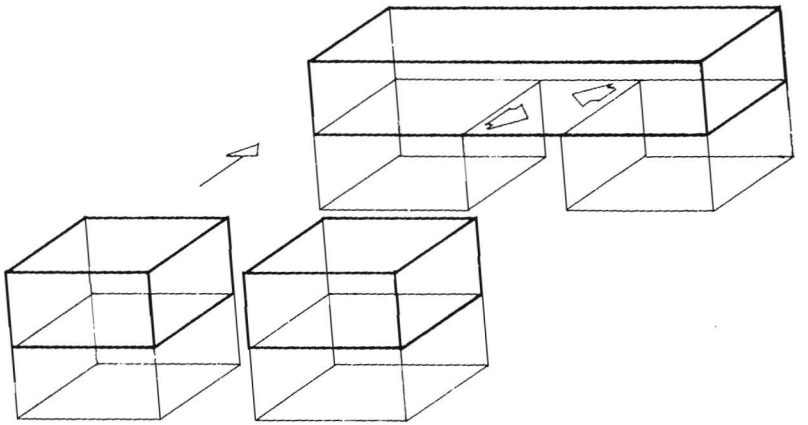
C2 Addition

Unroofed Terrace



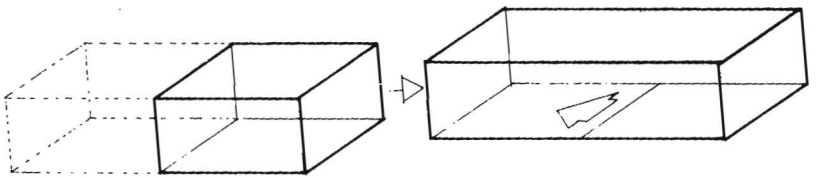
C3 Addition

Roofscape



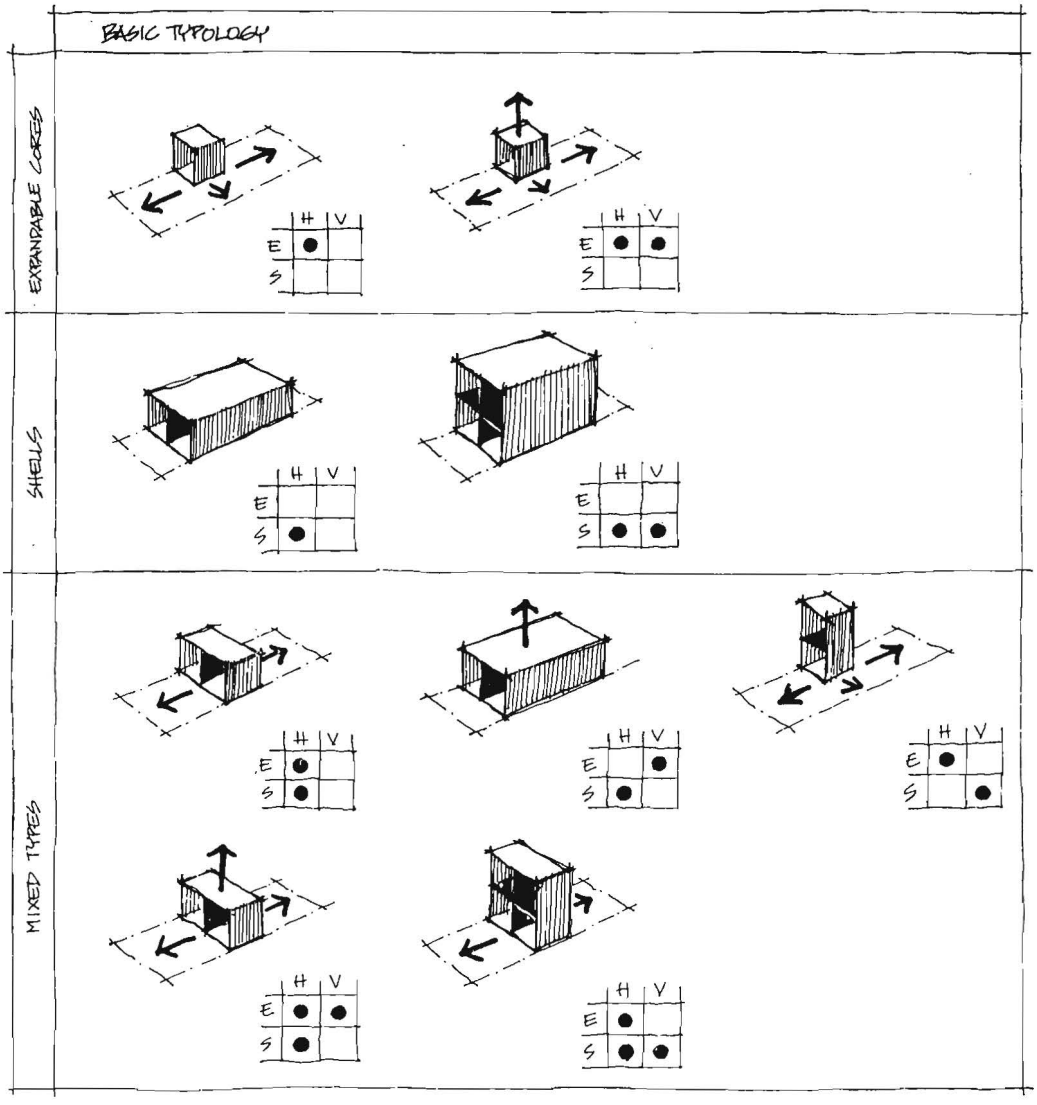
C4 Addition

Bridging

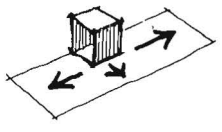


C5 Addition

Add Beside

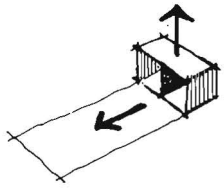


A first and rather primitive attempt would consist of indicating the *growth options (GO)*, in terms of kind and direction(s) of feasible transformations, as offered by a given proposal.



Growth Option = EXTENSION → 3 directions on the horizontal plane

GO = E → 3H



Growth Option = (EXTENSION → 1 direction on the horizontal plane + 1 direction on the vertical plane)
+(SUBDIVISION → on the horizontal plane

GO = (E → H+V) + (S → H)

DI LULLO

in order that groups of dwellings can be extended with a minimum of disturbance. This is a common strategy of growth in row type housing. The problem of disturbance from construction during sequential growth of groups of dwellings at the same time, may necessitate the concentration rather than diffusion of areas of growth within the neighborhood unit. This is especially important if construction equipment is required for expansion.

These strategies are intended for the increase of enclosed space per dwelling, rather than the increase of the absolute numbers of dwellings per specific area. However, growth strategies have definite implications upon density. In strategies in which reversability, i.e., contraction, is possible, the number of discrete dwellings in any agglomeration may vary. For example, a family expands its dwelling as the need for space grows; when the children have grown and left home, the dwelling contracts, and the owners rent the unused space, which in itself may constitute a small dwelling. The option to rent unused space may be a basis for justifying the over-provision which is required of various growth stategies, many of which require overbuilding in the early stages. If this administrative strategy is to be employed, it may impose specific design requirements such as alternate means of access, which are not significant to the growth strategy itself.

1.7. The Core House Concept

The core-house is a special case of staged building in which some portion of the construction of what is potentially the final house is deferred to the future and to the control of the dweller himself. Thus, strictly speaking, in most cases of core housing, we encounter two of the three classes of staged building: subdivision and addition. There is possibly a basic distinction which can be made between these two classes. We may distinguish a point in the resources matrix at which the basic carrying structure, or support, is constructed in the first build and this, more or less, defines the limits of growth. The process of sequential completion is the completion of the building process other than major building structure. By contrast, the process of addition is one in which more

of the building process is deferred and there is generally more freedom with respect to ultimate form. Thus regulation of the limits, or form, of growth is generally more characteristic of subdivision than of addition. But this distinction is meaningful only up to a point. Systems in which the structure has been completed e.g. Hollabrunn (see examples below) may be liberal with respect to the architectural character and degree of personalization possible in the completion; on the other hand, the principle of completion in addition may be regimented, if a building system is involved, e.g. the Gropius extensible prefabricated house (see examples below)

The comparison is useful, however, in understanding the difference between applications in developed or developing countries. In the former, the building type is often such that there is a greater degree of restriction upon size and form of the additions. In developing countries, the first-build tends to be small and represents a relatively small portion of ultimate possible building; the possibilities for future growth being more open-ended.

The following section provides a representative survey of contemporary core-house projects. Given that the motivation of the research was to provide a theoretical introduction to the core-house approach with the view to establishing the principles of design policy, this selection of examples is weighted towards preplanned approaches to the core-house. Furthermore, an effort has been made to add examples of core housing in western urban societies to the larger body of material already available on the core-house approach in developing countries.

Even with such a specifically defined subject it was obvious that certain interesting material would have to be overlooked in the present study, because of the limits of its scope. Before discussing the examples, let us briefly consider certain categories of supplementary material which should be considered in subsequent research on the subject.

The Growth Principle in Indigenous Building

Additive transformation in Third World societies or indigenous building. Example: Beinart's study of the transformation of government provided housing in South Africa is a contemporary example. There is also an extensive literature available on the subject in connection with self-help, and site and services projects, many of which are in Asia, Africa and Latin America. Much material comes from the active participation in such processes by institutions such as the World Bank and A.I.D. John Turner at AHAS in London[7)] is a source for literature on this work both in developed and developing countries.

Historical Study

Historical study of the growth principle in the transformation of house forms in urban societies. In addition to general historical study, there are certain interesting examples from the early part of the century, such as Wagner's publication of the entries of the Wachsendes Haus competition of the early Thirties. Among the 500 entrants were schemes for growing houses by many notable architects including Walter Gropius. A third category of study is represented by Boudon's Lived-in Architecture, in which user initiated personalization and expansion of Le Corbusier's housing at Pessac is described. A recent study of user initiated expansion in public, multifamily housing in Israel has been recently completed by the author in collaboration with the sociologist, Dr. Naomi Carmon.

Systems for Extensible Housing

There are certain building systems, which have been designed to be "user interactive" in the sense that they can be constructed by the individuals themselves, use indigenous materials, etc. Alexander's system for Peruvian houses is such a proposed system. These systems may also involve a certain degree of industrialization or site prefabrication; the Mitchell framing system is an example of an industrialized kit of parts for self-help construction of extensible houses.

The illustrated examples provide a relatively large sample of architectural work on the core-house in the last fifteen years. The examples fall clearly into the category of core-house systems in the sense that most of them bring the core-dwelling and its future

possible extension into some pre-planned relationship. In this respect, there appears to be less difference between the European and examples from developing countries than there is between all of these architect designed examples and an indigenous process, such as that described by Turner in the squatter housing of Lima's "Barriadas". The distinction being the degree of determinism imposed by the core upon the user. The limitations imposed by the core can be numerous including technical, e.g. imposing a building system; spatial, e.g. imposing a modular system; sequential, e.g. imposing schedule or scale at which extensions can be made. The barriada example defines the boundary as the "core". The difficult interface between individual and group is completed early in the process, while the staging, character, and quality are within the user's control.

There is a funter distinction between the European and examples from developing countries. Many of the European examples are designed and described as if they were pre-planned options for growing incrementally by stages. The examples from developing countries are more open-ended in two senses. First of all they are process oriented in their consideration of life-style, family scenarios, context, etc. Secondly, they may consider alterna-tive "routes" of growth of the house rather than prescribing one ideal progression from type A to type B.

Competitions

Two architectural competitions have provided several examples of core housing. The first of these is the Previ Competition for low cost housing in Peru. This was an invited competition between 11 teams including internationally known architects, such as Stirling, van Eyck and Christopher Alexander. Most of the projects involved core housing since this was one of the programmatic considerations: "The dwelling was not to be conceived as fixed unit, but as a structure with a cycle of evolution". A brief family scenario was described. We illustrate the schemes of Stirling, Atelier 5, Josic and Correa. All are patio houses, which grow within a fixed lot; all are single ownership lots; all are linear patio houses, with the exception of Stirling's square scheme with central patio in which the stair location, patio and exterior walls are the fixed elements. The

second competition is the Habitat '76 international competition for low-cost housing in Manila. The first, second and third prizes are examples of the principles of addition and staged completion in core-housing.

BIE/SAR Studies

An exceptional series of studies have been produced as part of the Bouwcentrum International Education program. These studies, done by students of the program, all incorporate SAR methodology in core-housing design. The projects generally deal with Latin American and Asian contexts. They have been published as BIE bulletins, and also in Open House International. We illustrate three representative projects: Chawalit Nitaya's project for Thailand, Win Zaw's for Burma and Stefano Anzellini's for Columbia.

Three other works of this program are of special interest for their theoretical content. Two are by staff members of the BIE program. Edgardo Martinez has written a paper which developes a relationship between the SAR method an philosophy and the core-housing approach. Raul di Lullo in his paper "Evolutionary Housing Design: An Instrumental Contribution", has analysed various models of patio housing for their freedom of growth. Finally, Lupe Williamson, from Colombia has produced an exceptional study which evaluates various models of core-housing using the technique developed in the Caminos - Goethert, Urbanization Primer.

MIT/HARVARD Studies

For various periods during the last fifteen years the MIT-Harvard community has been a focal point for important work towards a more responsive housing environment. Among some of those figures who have been working in Cambridge are John Habraken, John Turner, Horacio Caminos, Ian Terner, Neal Mitchell. Some of their work has involved core-housing.

The EMAD project by Habraken and Buwalda is a growing support project for Egypt which constructs all load-bearing structure and the roof of the core in the first-build. In 1970, Prof. Habraken participated in a seminar, co-sponsored by the Joint Research Team on Housing in Egypt (Cairo University - Mass. Institute of Technology). The subject was "core housing

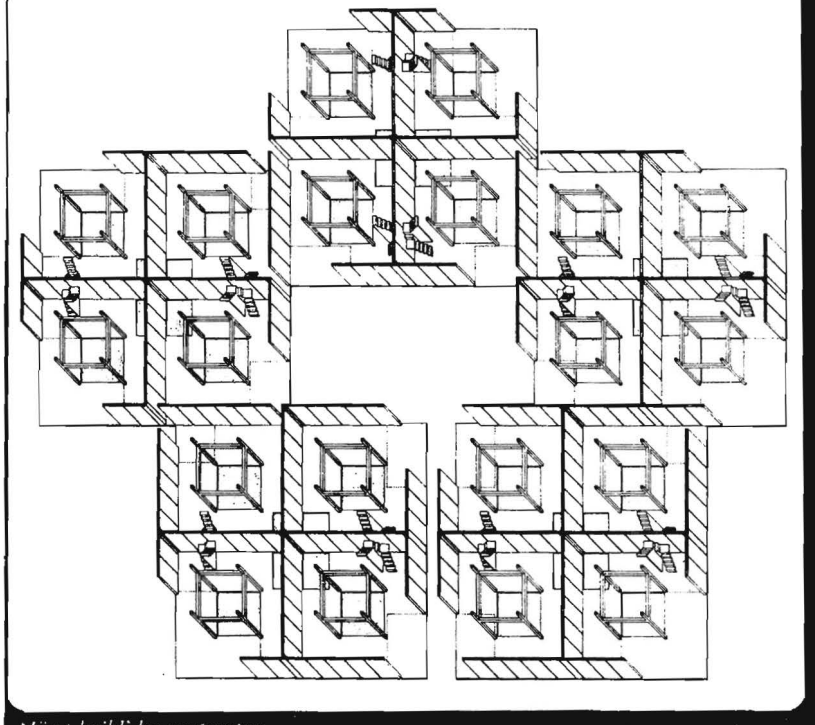
and sites and services projects for low-income groups". Various proposals for core housing were presented. Several are illustrated here.

Finally we have illustrated Neal Mitchell's Framing System, an industrialized system for sef-help housing which can be built in stages by the dweller while living in his home.

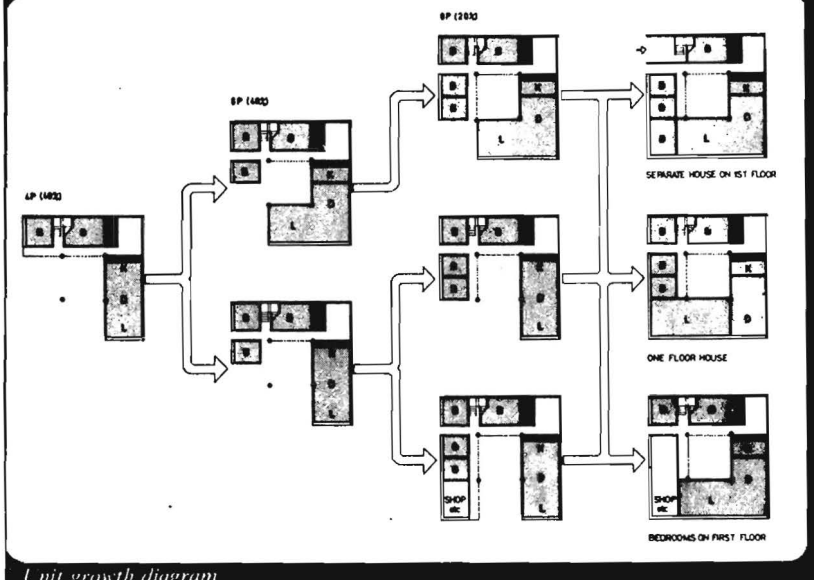
Core-House Approach: Northern Europe

There have been many proposals for core housing in the Netherlands, Germany and Scandinavia. These include projects for one-owner and multi-family sites. Five Dutch projects are illustrated. The Bakema and Hertzberger projecs are for extensible row housing, with extensions on the open ends; The Bakema project has been built. The Haaksma project is an example of two principles of addition and staged completion; space may be added on the exterior and completed on the interior. Two additional projects, by Wauben and Dillen have been completed. The Skjetten project near Oslo is a growing row-house project by Erik Hultberg and Prof. Nils Ole Lund. Eventually this project should contain 1100 core-houses, which should make it the largest core-housing project in Europe. This project is reputed to have an excellent occupant's manual describing ways and techniques of extensions, neighbours rights, etc.

Two additional projects, Hollabrun by Uhl, Voss, Weber, Dirisamer and Kuzmich and experimental housing in Munich by Steidle and by Thut are multifamily projects in which the structure for subsequent growth is built in the first-build. The building form has a linear core of completed dwellings with exposed structure on the exterior to receive the future stages. The Hollabrun project has been developed using the SAR method.

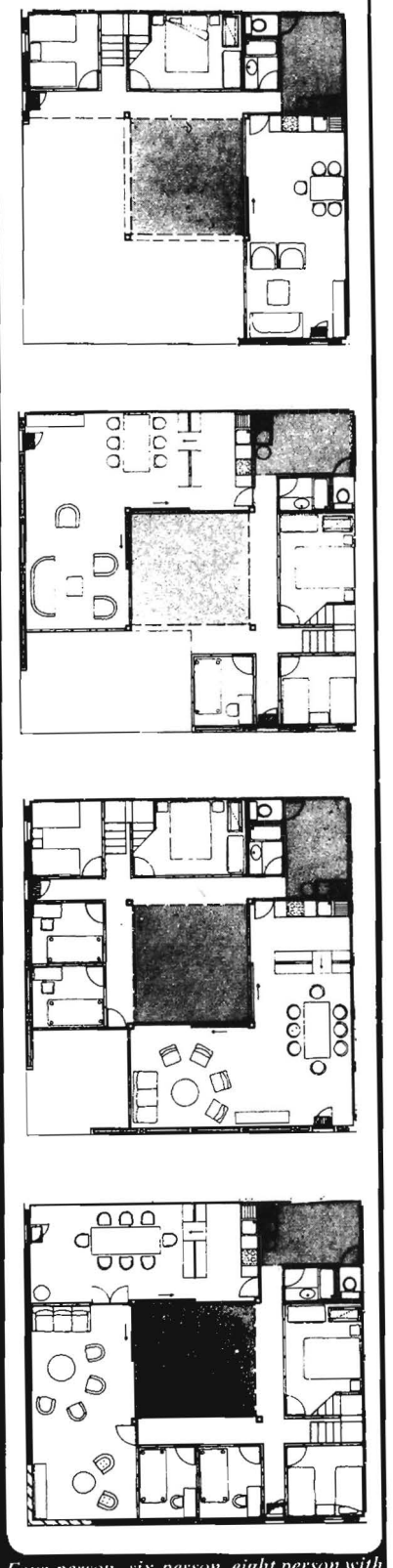


'First build' by contractor



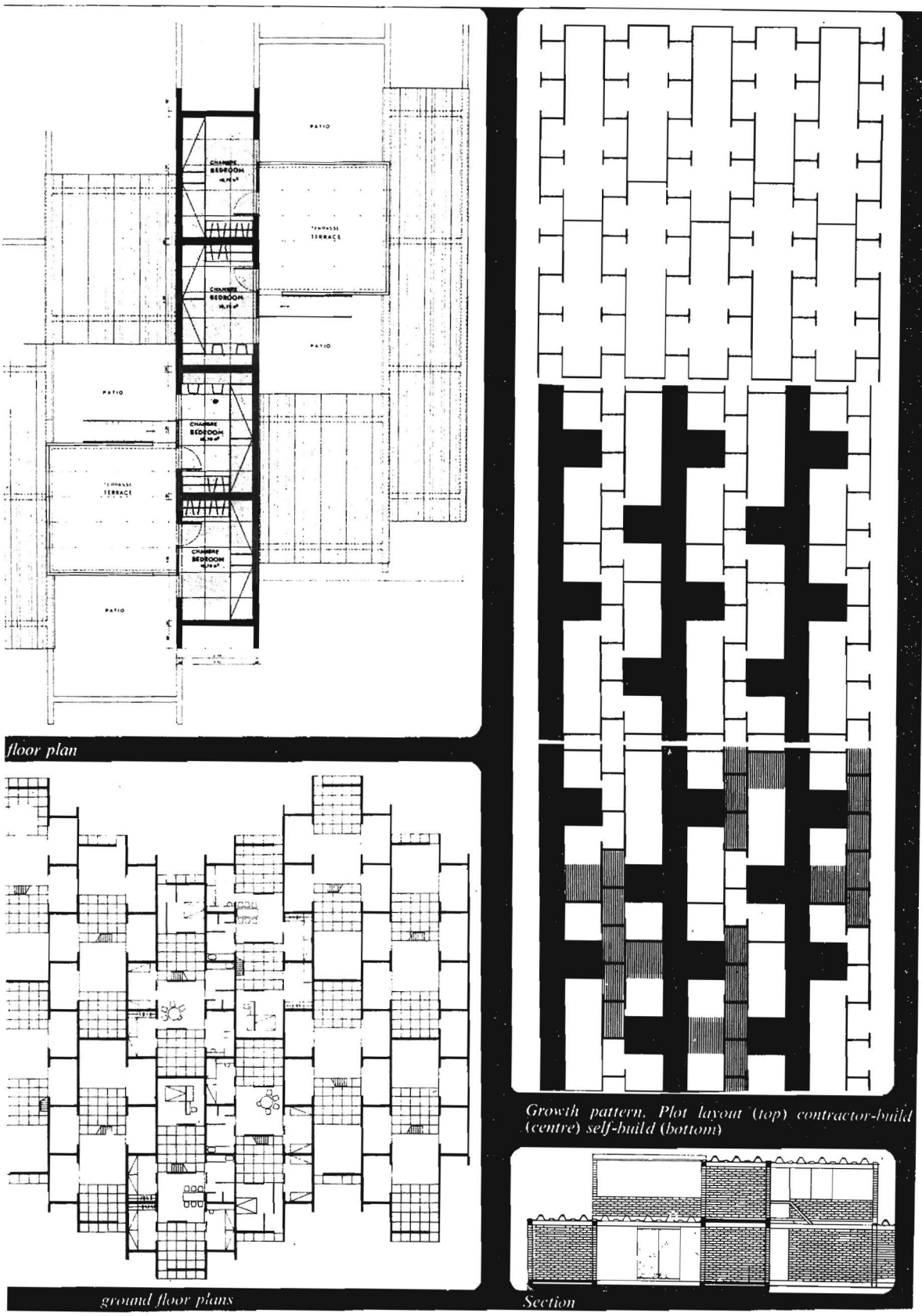
Unit growth diagram

Section

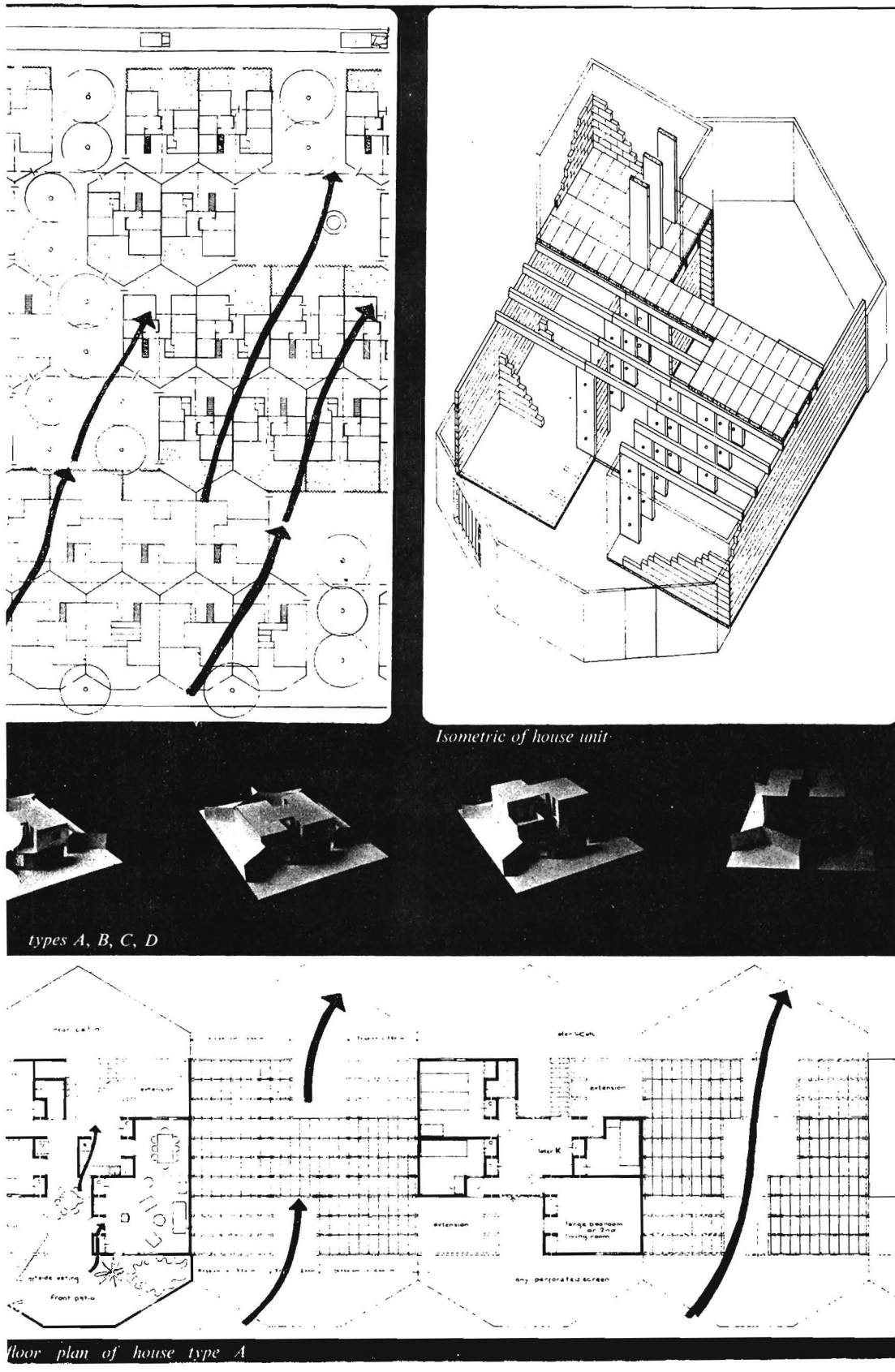


Four person, six person, eight person with open corner and eight person unit with corner completed by householder

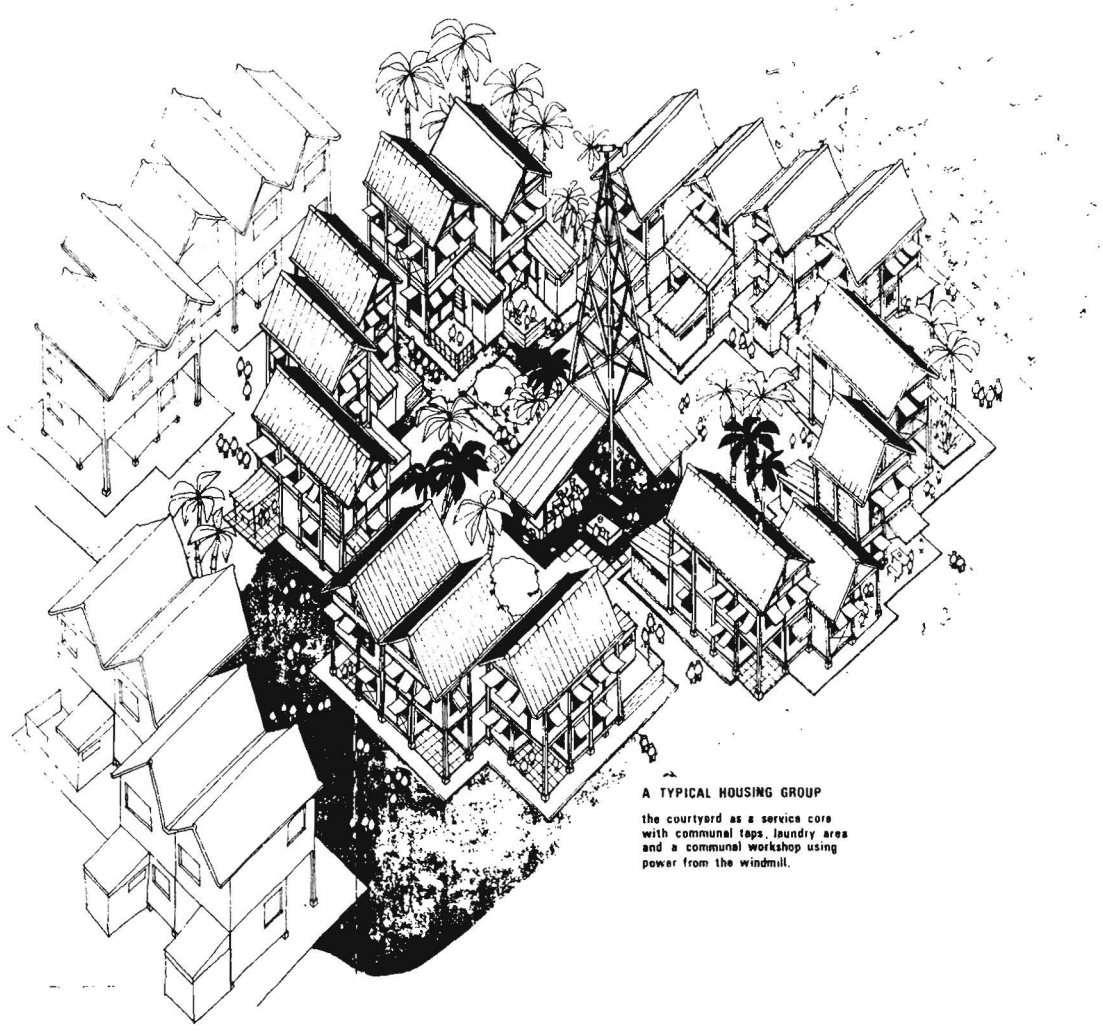
PREVI - STIRLING


PATIO
CHAMBRE BEDROOM
TERRASSE TERRACE
floor plan
Growth pattern. Plot layout (top) contractor-build (centre) self-build (bottom)
ground floor plans
Section

PREVI - JOSIC

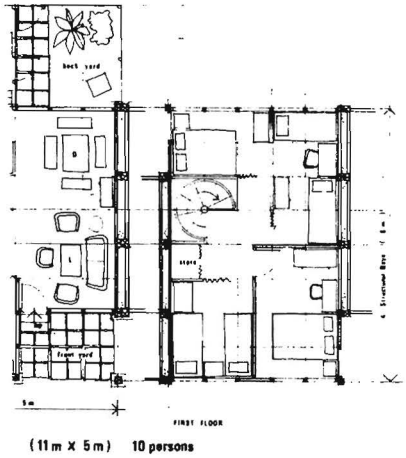


PREVI - VAN EYCK

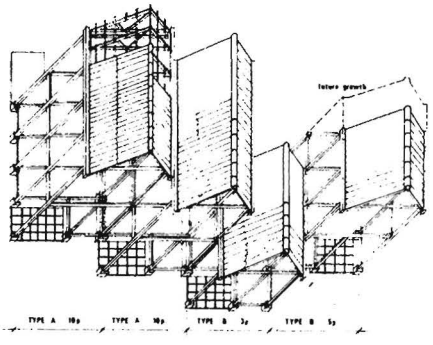


A TYPICAL HOUSING GROUP

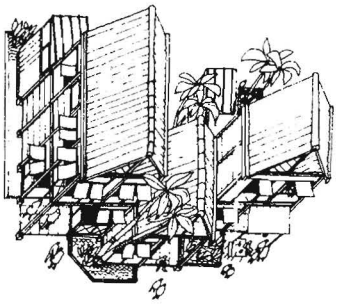
the courtyard as a service core with communal taps, laundry area and a communal workshop using power from the windmill.



(11 m x 5 m) 10 persons

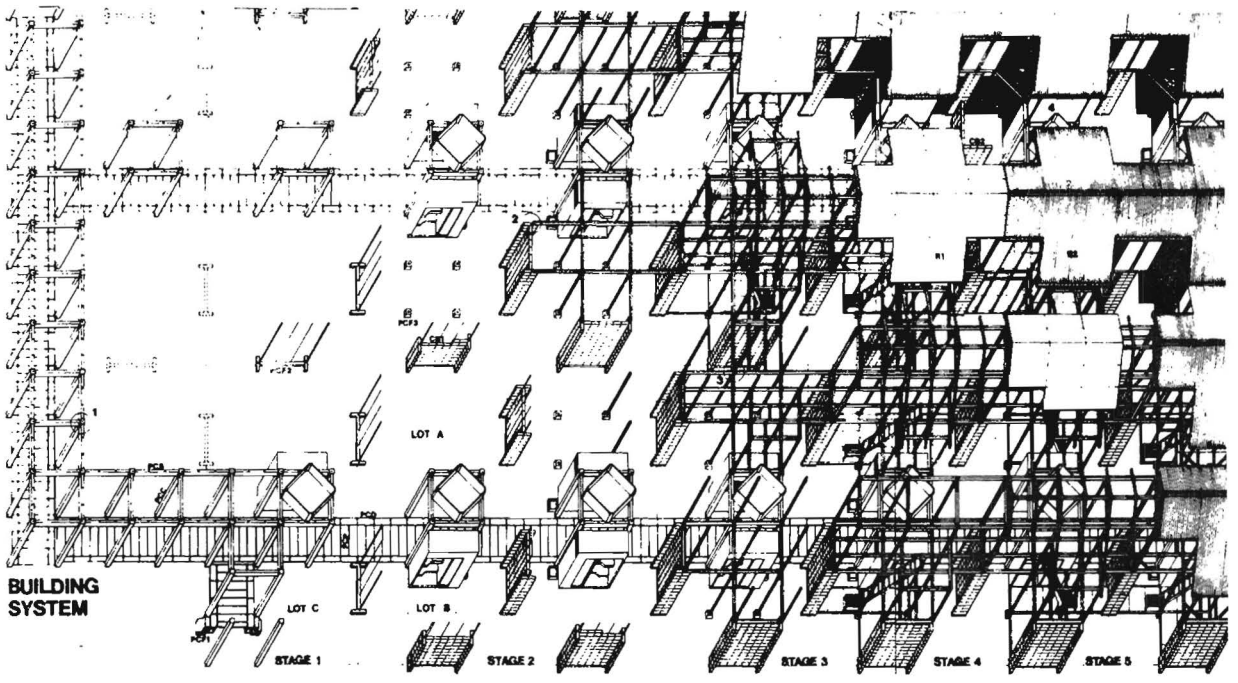


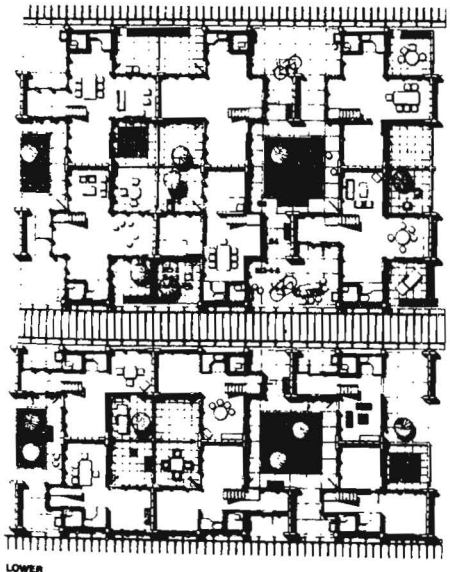
FIRST STAGE BY GOVERNMENT

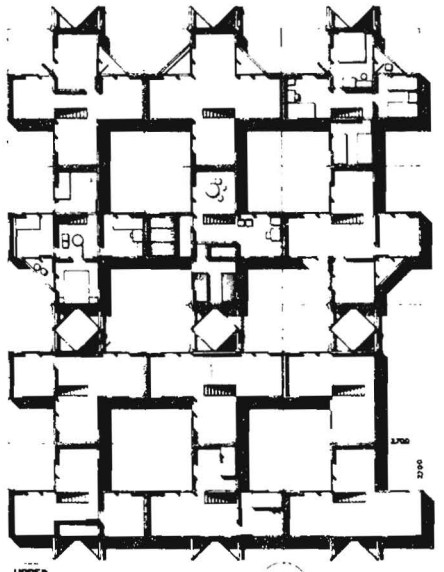


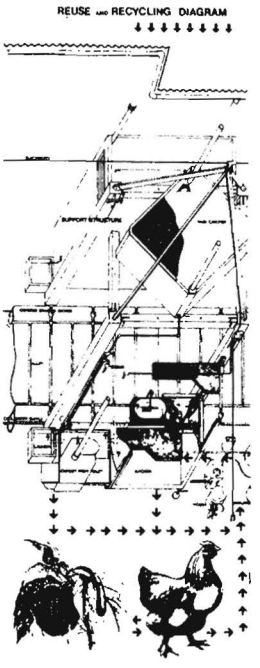
COMPLETED UNITS BY RESIDENTS

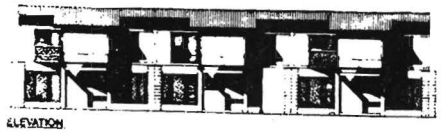
HABITAT MANILA



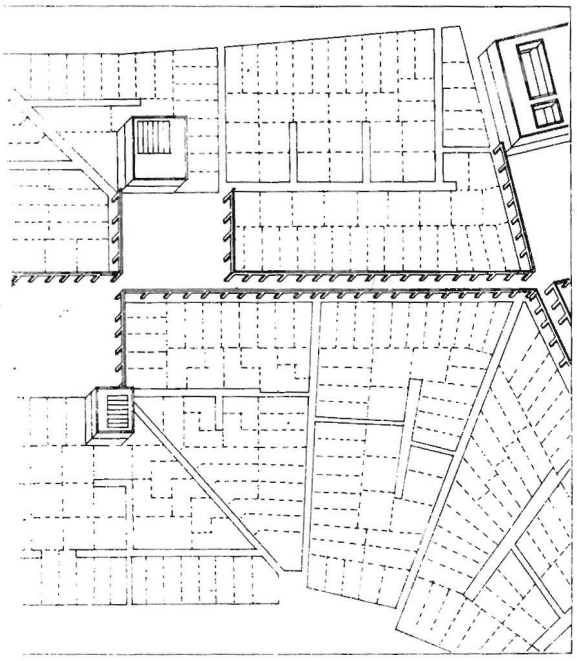




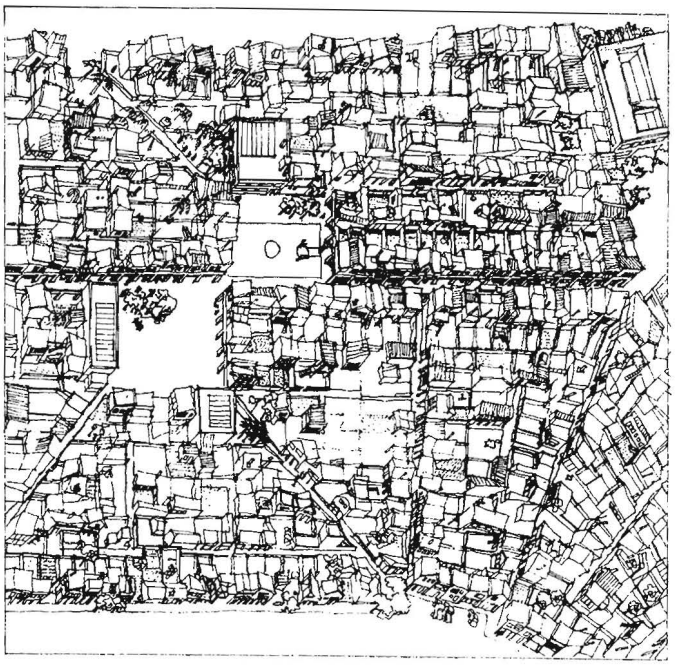




HABITAT MANILA

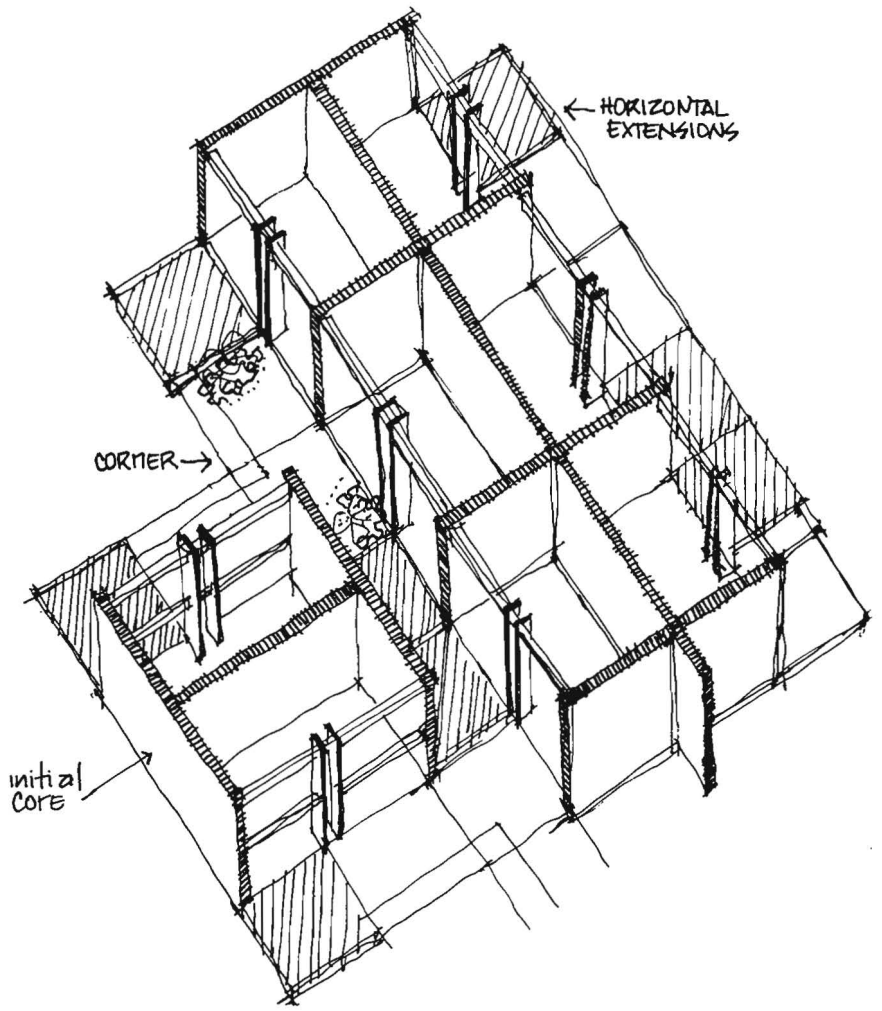


INITIAL CONSTRUCTION

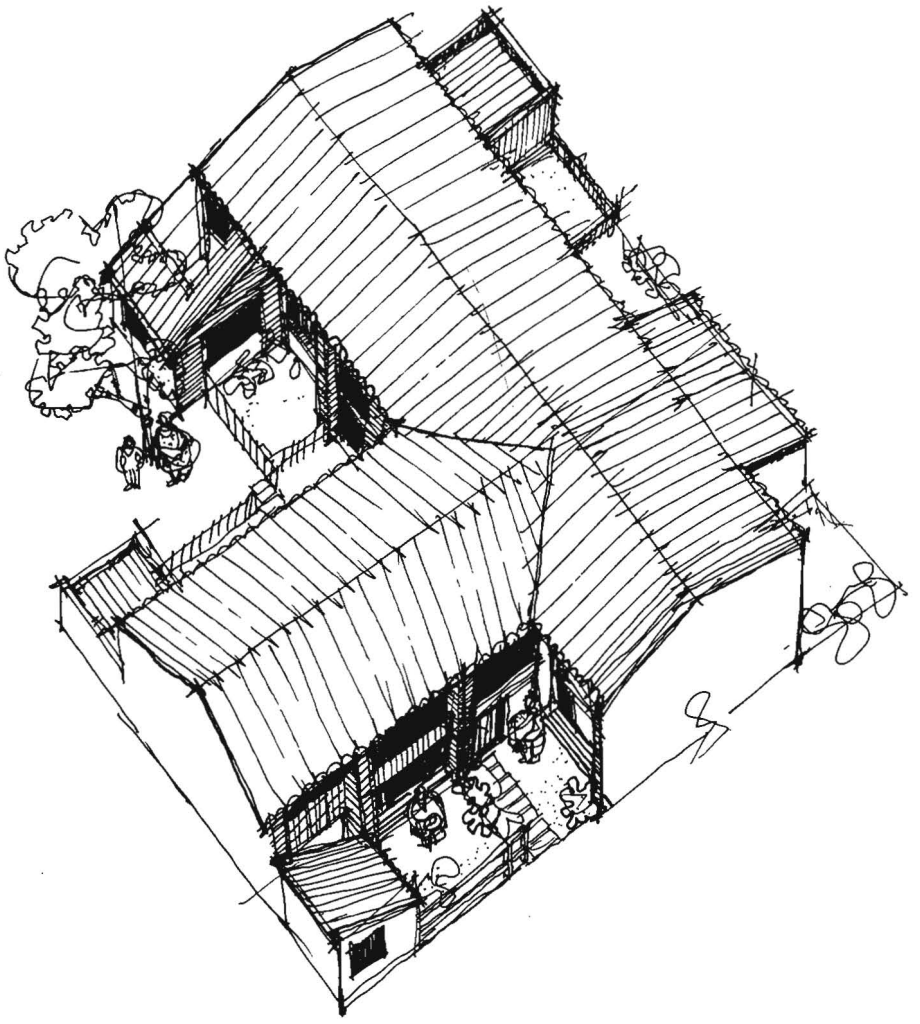


DEVELOPMENT

HABITAT MANILA

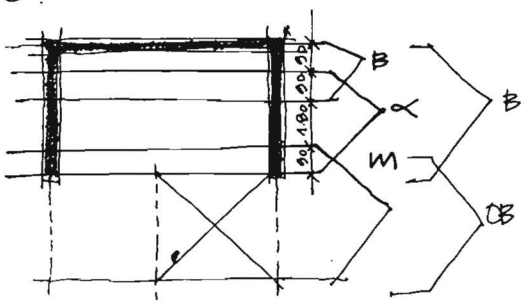


SUPPORT GROUP



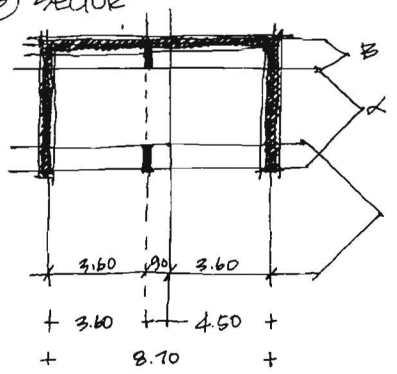
EXAMPLE OF EXTENDED CORE

(A) ZONING



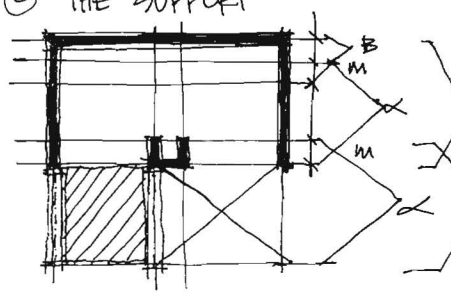
(REFERING TO ZONING analysis PRESENTED IN CHAPTER 4-b)

(B) SECTOR



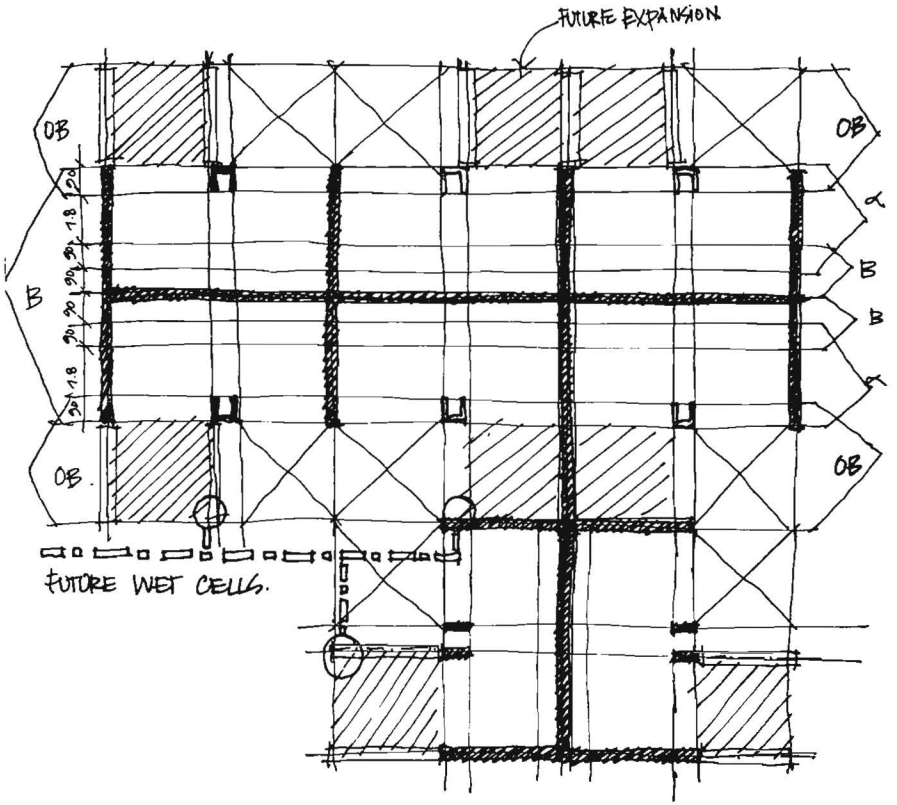
(SECTOR analysis - chapter 4-b)

(C) THE SUPPORT



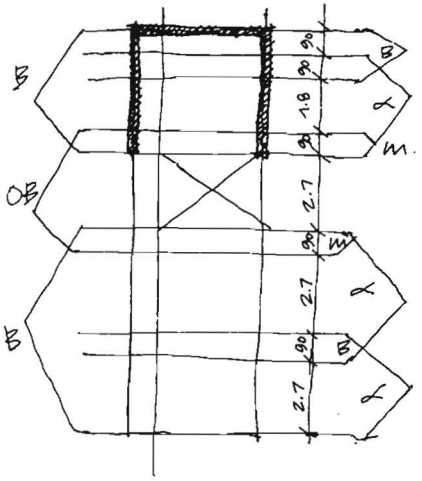
B - CORE HOUSE
AREA → 36.45 m²

OB - future Horizontal Extension - 12.92 m²
total AREA : 49.41 m²
(ON FIRST FLOOR)

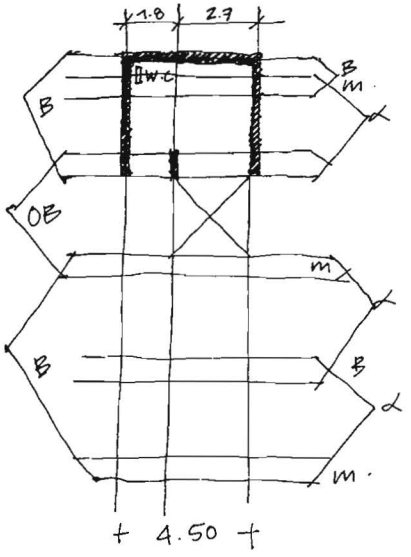


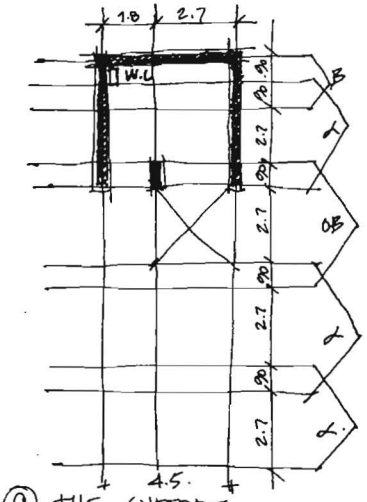
- DETAIL - OF a CORNER OF a SUPPORT GROUP
- MAXIMIZATION OF SHARED WALLS AT initial STAGE
- INFRAESTRUCTURE ON SEMI-PRIVATE LAND

Ⓐ ZONING



Ⓑ SECTOR

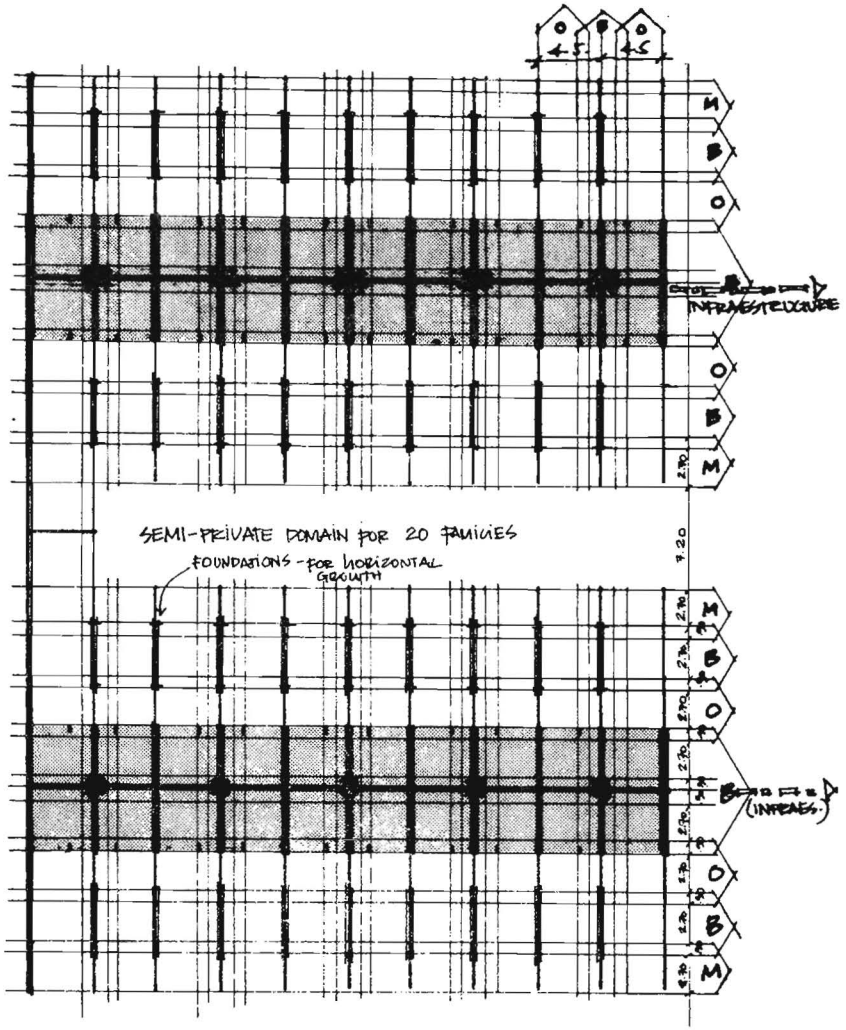




Ⓒ THE SUPPORT

→ CORE HOUSE AREA: 20.25 m² ON FIRST FLOOR (GROUND F.)

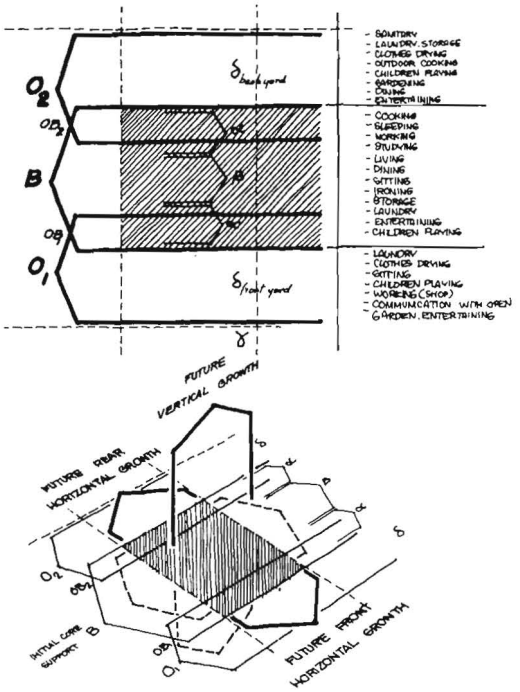
→ area for future horizontal expansion



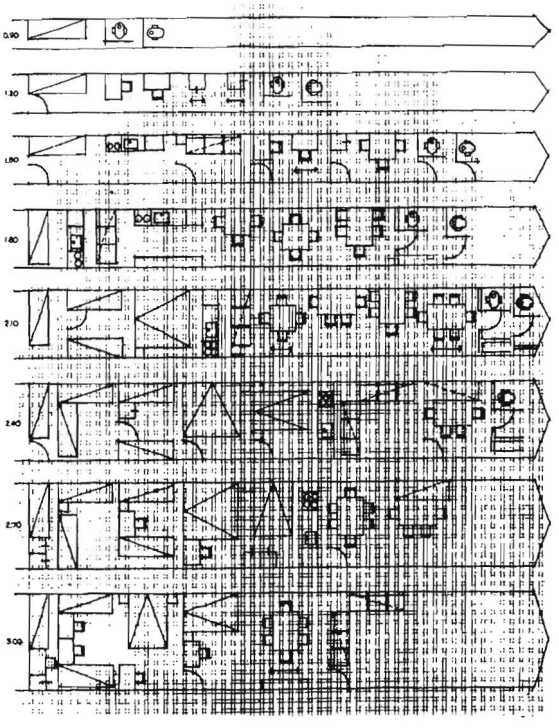
MODEL 1b. → SUPPORT –

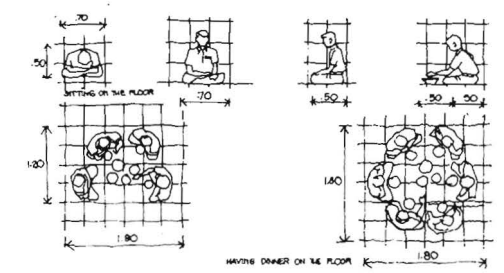
minimum built - initial core 20m²
UNION OF 4 WET-CELLS

BUILDING "SPINE" + INFRAESTRUCTURE "SPINE"

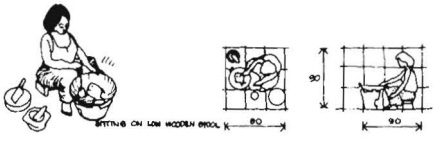


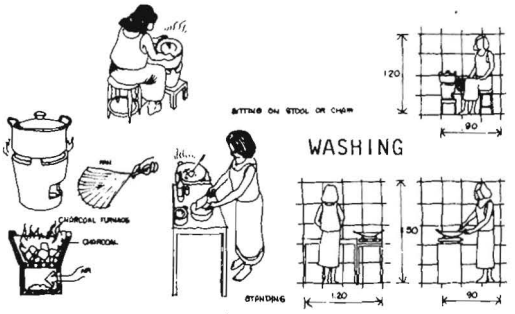
STUDY OF ZONES AND MARGINS



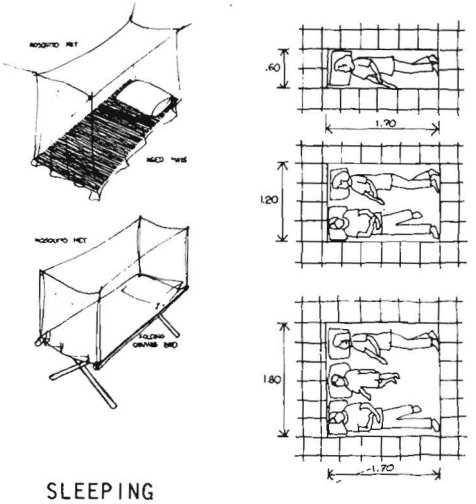


DINING





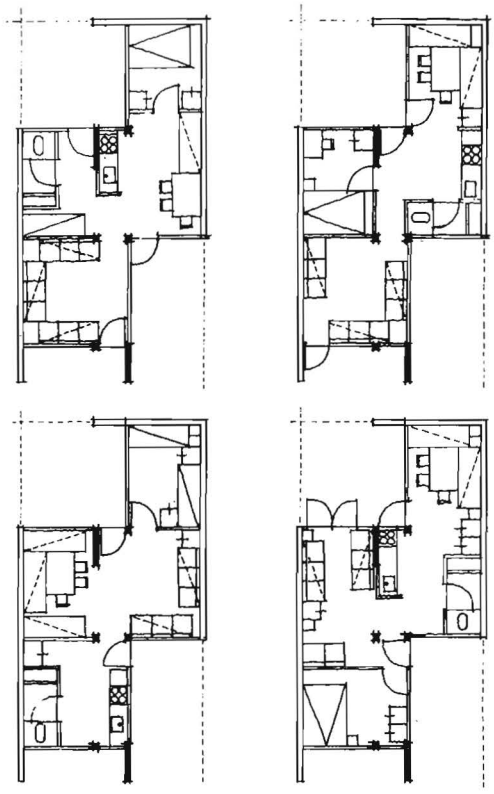
WASHING



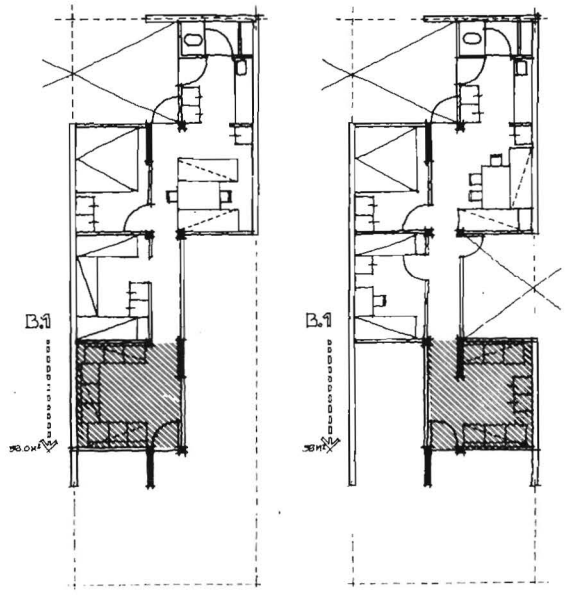
SLEEPING

NITAYA

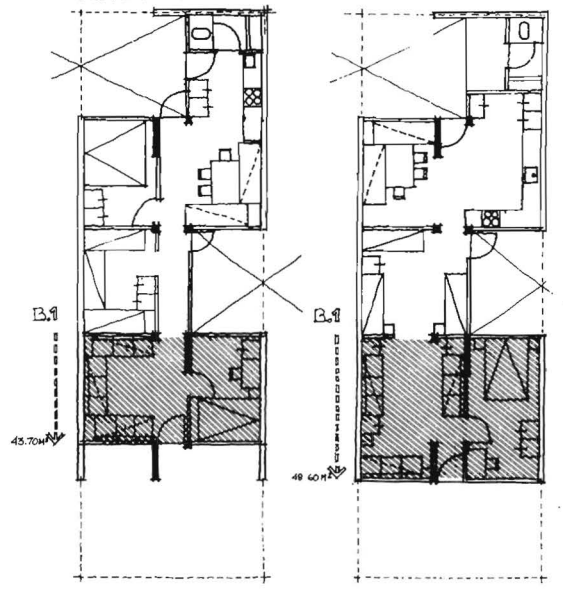
CORE HOUSE TYPE B.1: ALTERNATIVES



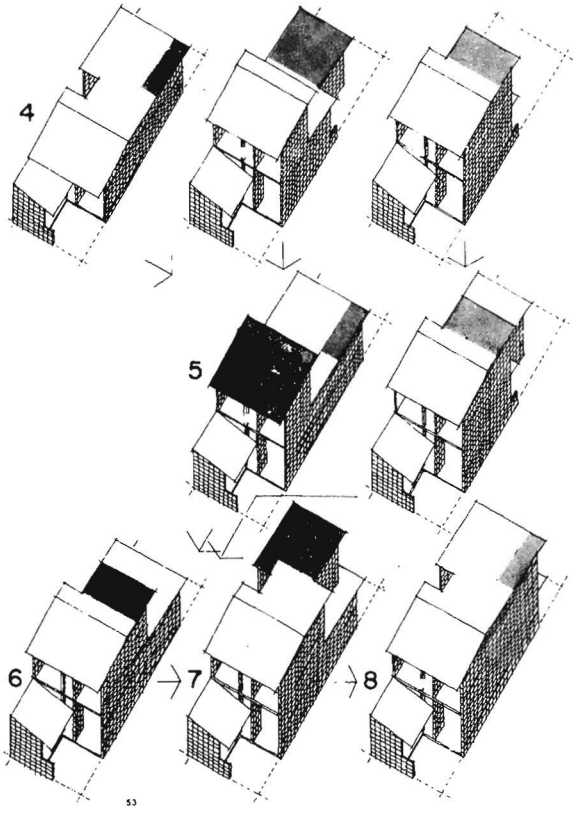
CORE HOUSE TYPE B.1: HORIZONTAL GROWTH



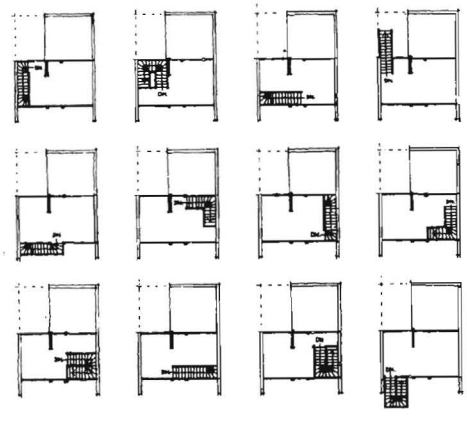
CORE HOUSE TYPE B.1: HORIZONTAL GROWTH ALTERNATIVES



POSSIBILITY OF VERTICAL GROWTH IN SEQUENCE

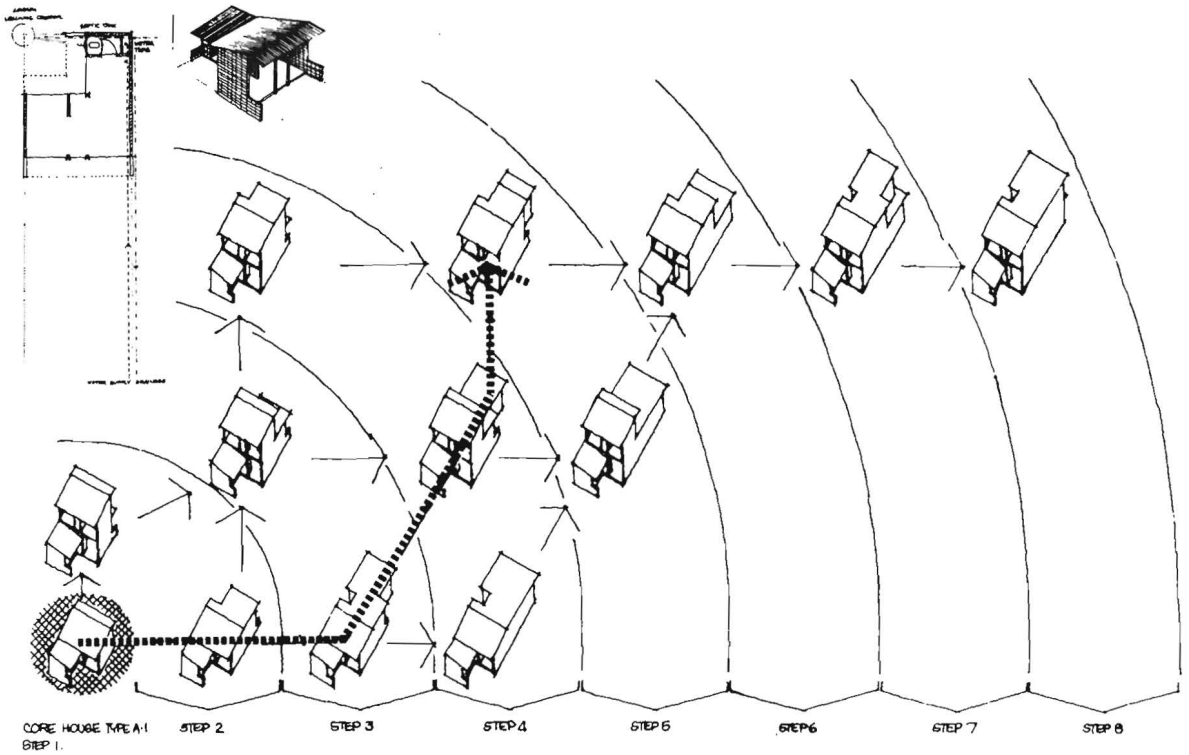


POSSIBLE STAIRCASE AND ITS POSITION



NITAYA

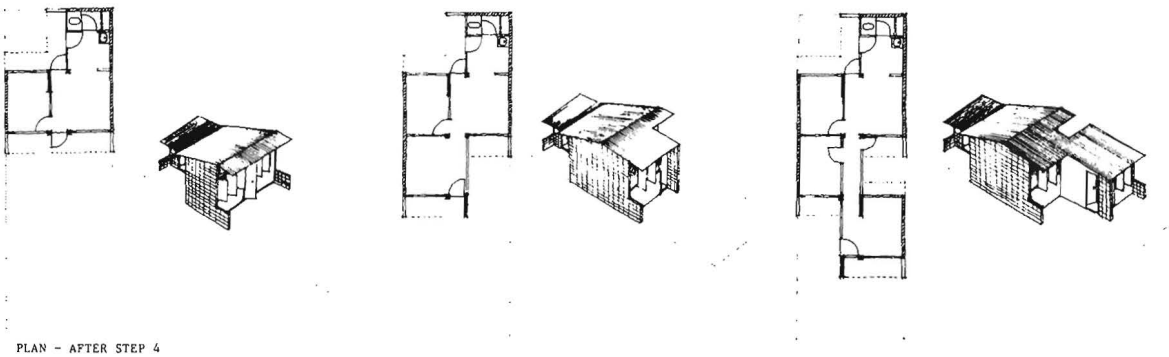
PLAN OF INITIAL CORE HOUSE TYPE A.1 AND PERSPECTIVE



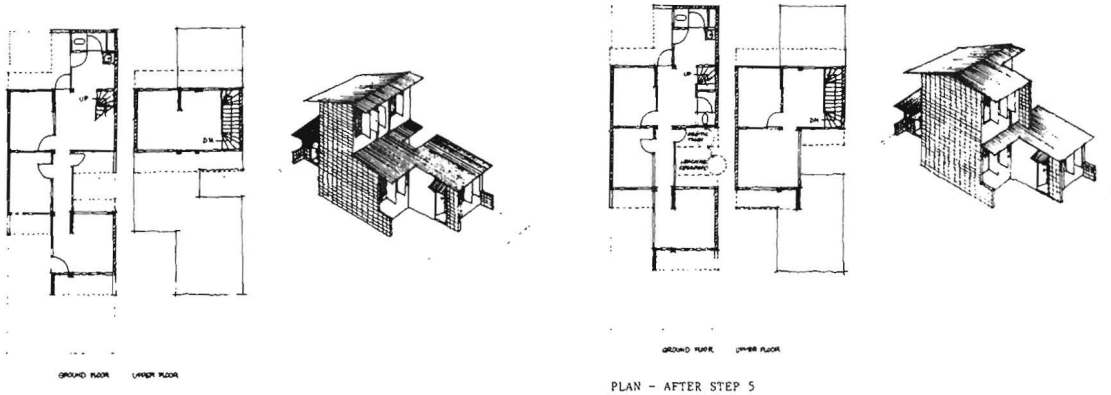
PLAN - AFTER STEP 1 AND PERSPECTIVE

PLAN - AFTER STEP 2

PLAN - AFTER STEP 3

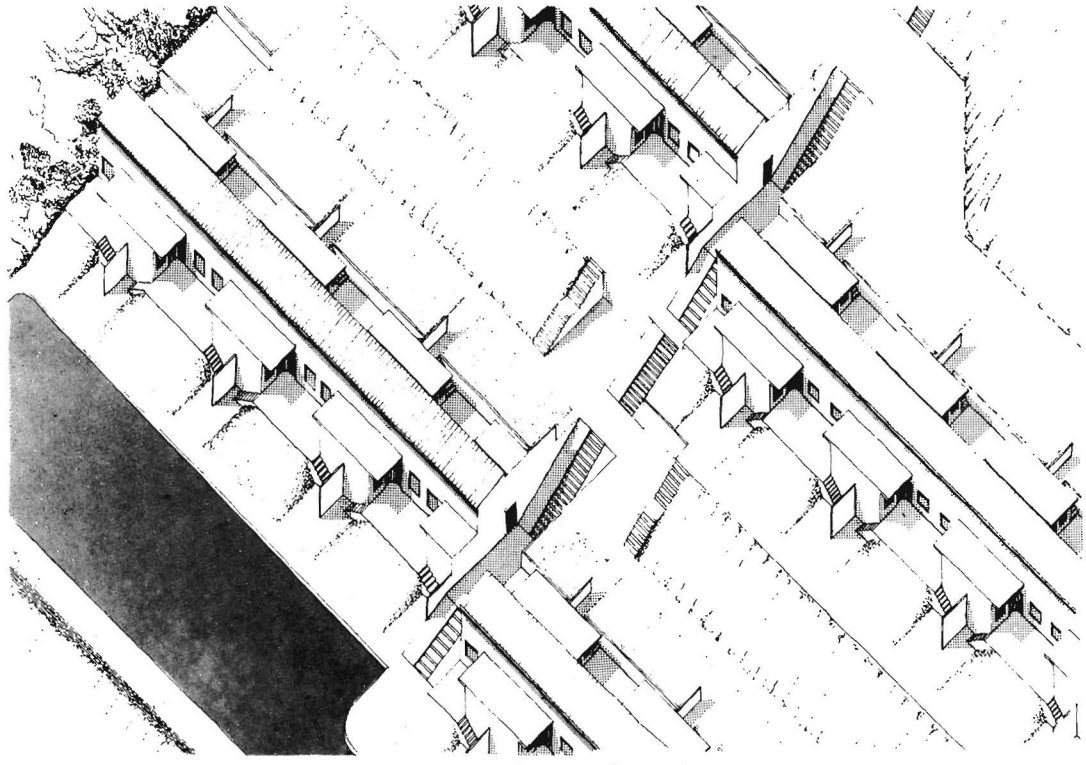


PLAN - AFTER STEP 4



PLAN - AFTER STEP 5

NITAYA



Core-house support structure on steeply sloping site.

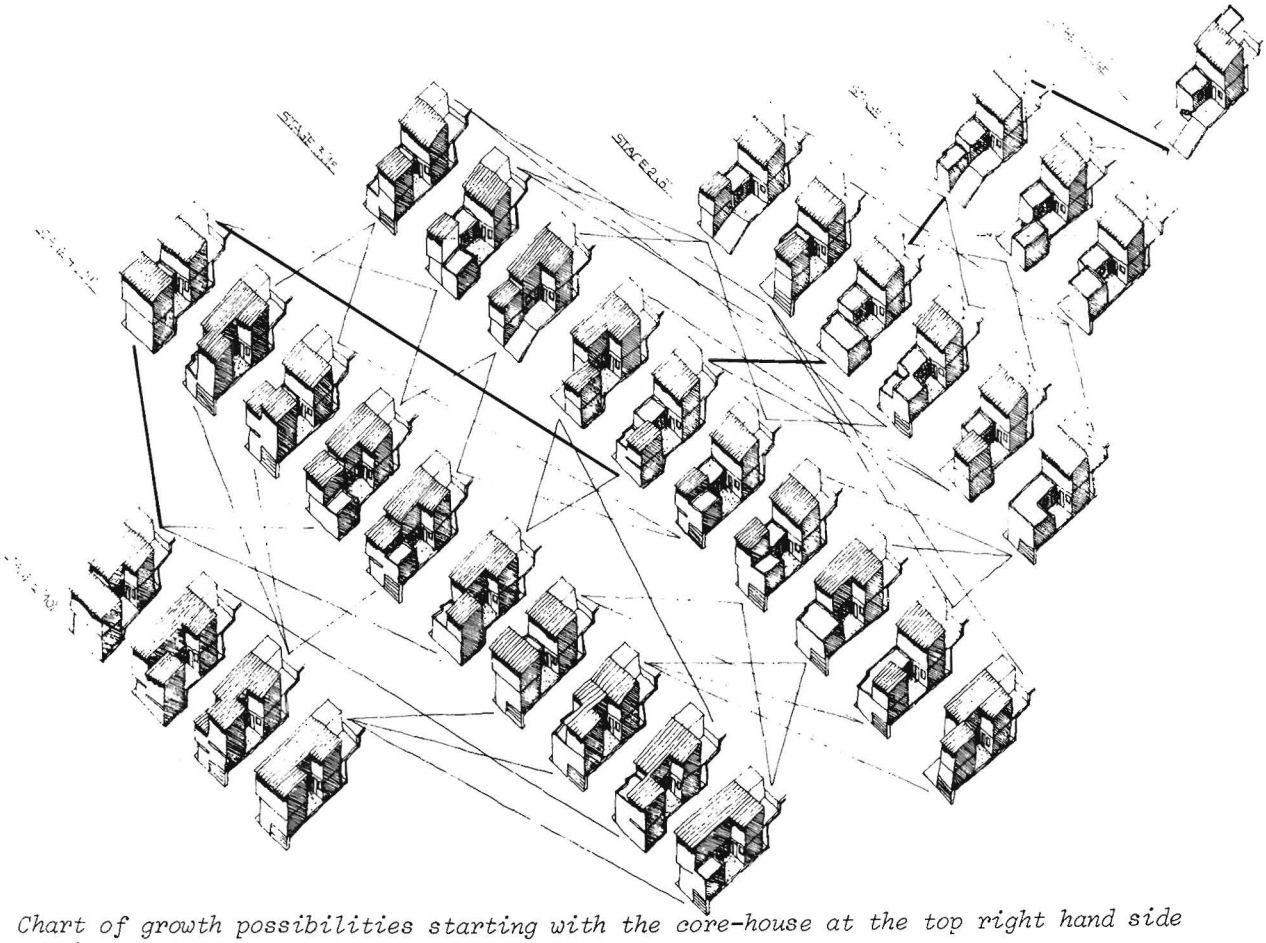
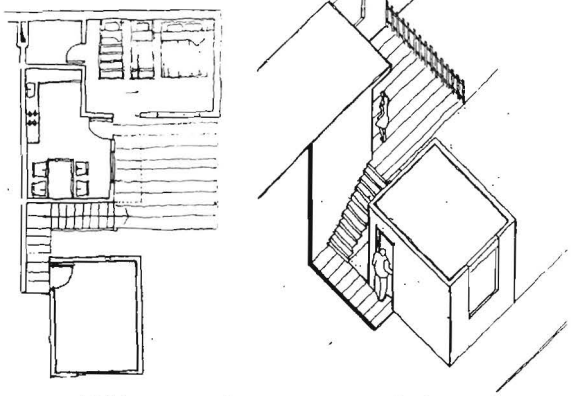


Chart of growth possibilities starting with the core-house at the top right hand side of chart.

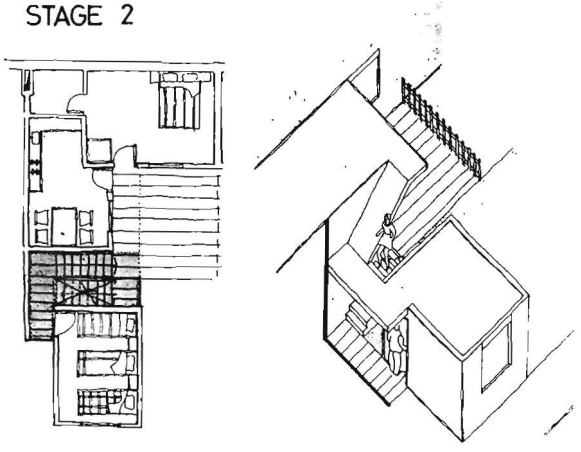
STAGE 1



. *Building on the front an independent room (2.70 x 3.50) in level (0) with flat roof slab.*
. *Paving of entrance (.90 x 2.70) Its limit will establish a guideline for future growth.*

These 2 stages are common for almost every alternative of growth, so, if there is an agreement amongst community members, the construction can be carried out by mutual aid, and, from here on, by family of neighbourhood effort.

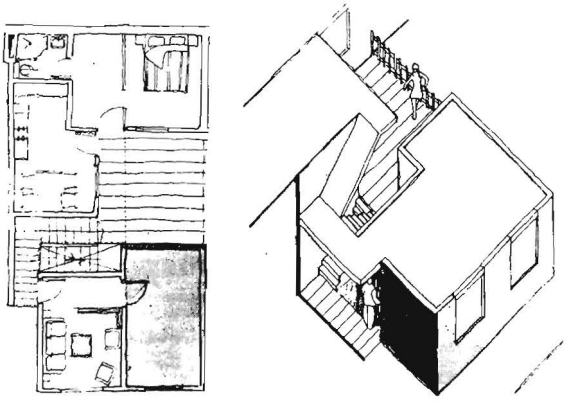
STAGE 2



. *As the staircase is a main issue in the development of the dwelling, two criteria can be used:*

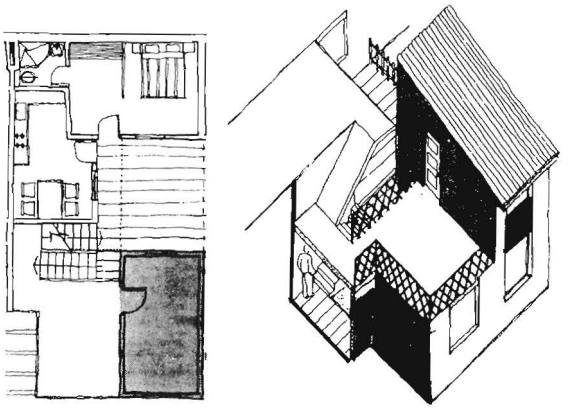
1. *Building the staircase as an independent construction volume to which spaces will be connected later.*
2. *Only the necessary peice of stair required at a given stage is built thus completed at the end of the process only. This implies partially uncovered circulations.*

STAGE 3



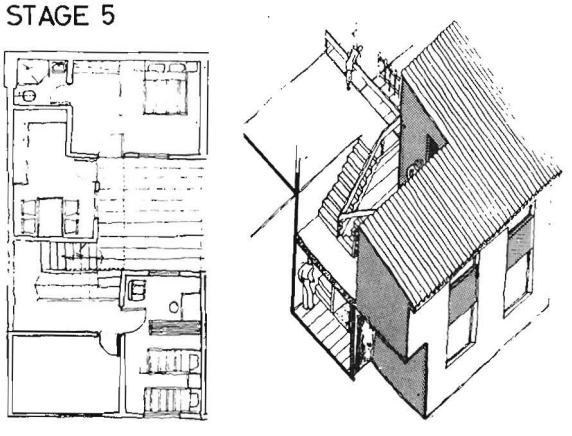
. *New room towards the front of the plot (completion of the front)*

STAGE 4



. *Front entrance can be closed. New room in the second floor.*

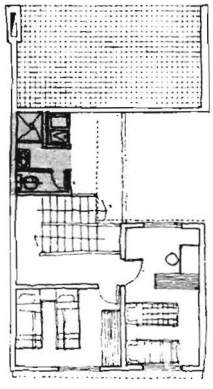
STAGE 5

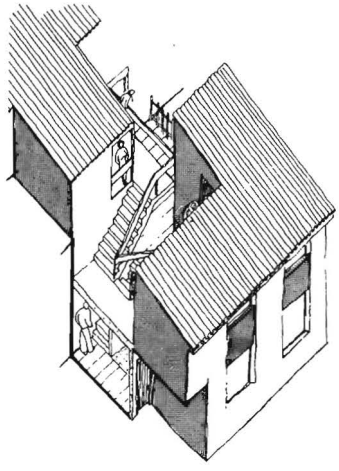


. *Building of the rest of the staircase and the terrace to new room in the front, 2nd floor. Circulation is uncovered.*

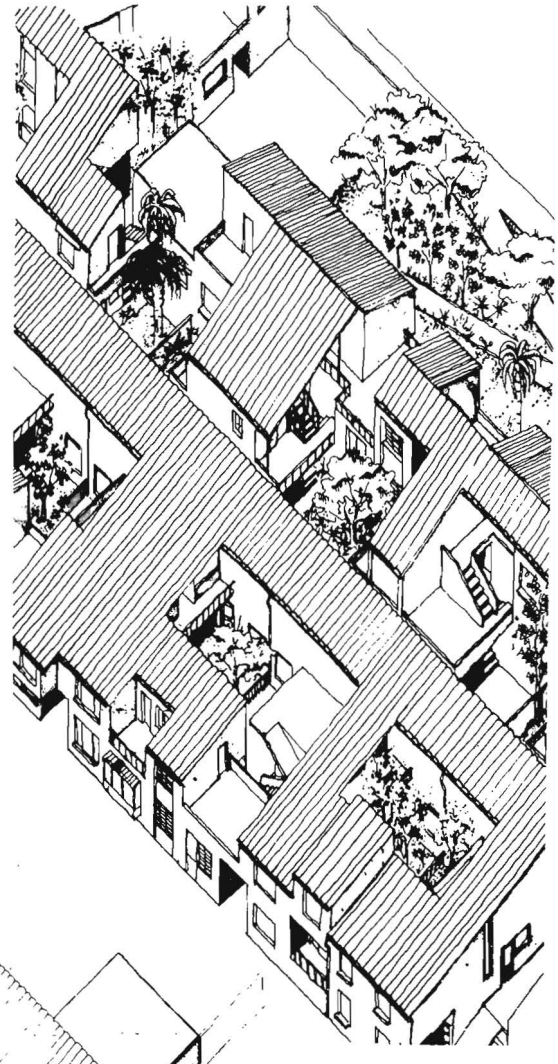
ANZELLINI

STAGE 6

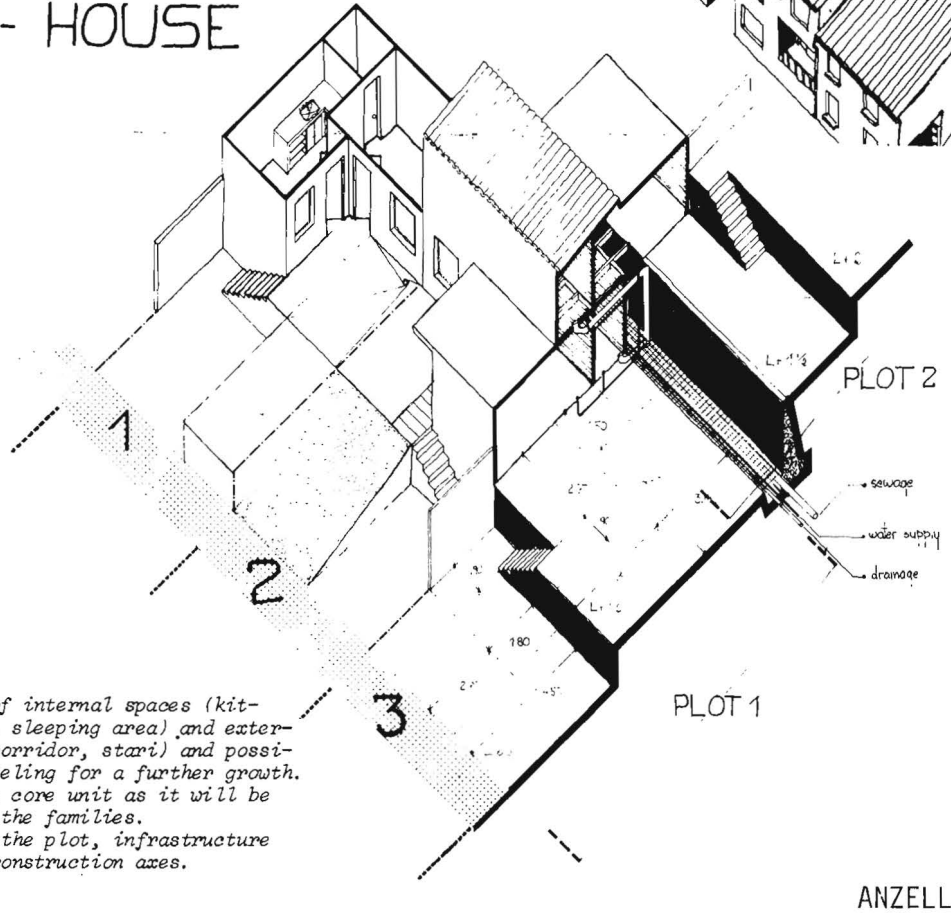




. *Building a new wet cell on top of the kitchen.*

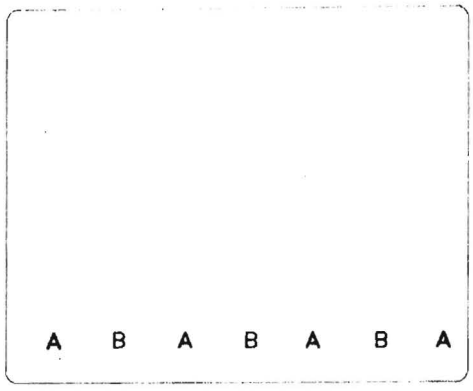


CORE - HOUSE



1. *Axonometric of internal spaces (kitchen, toilet, sleeping area) and external (patio, corridor, stair) and possibility of leveling for a further growth.*
2. *Volume of the core unit as it will be delivered to the families.*
3. *Terracing of the plot, infrastructure tunnel, and construction axes.*

ANZELLINI

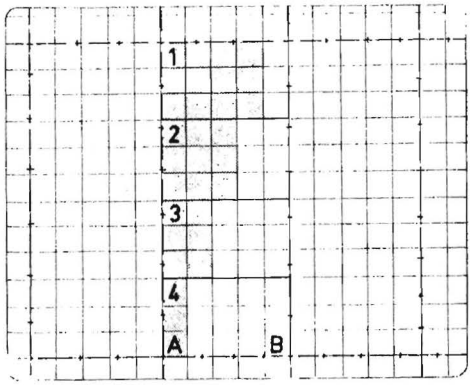


From a survey in Shubra, Cairo the following most common room dimensions and sizes were derived

	dimensions	
bathroom	1 Module	2 Sq.
kitchen	1 Module	2 Sq.
rooms	2-3 Module	6-9 Sq.

areas

Modules (2.88 m^2)
Modules (2.88 m^2)
Modules (8.64 - 12.96 m^2)



The zones should each at least comprise of the following elements:

Zone A:

- entrance
- kitchen
- bathroom
- circulation space

} permanently fixed in use and area

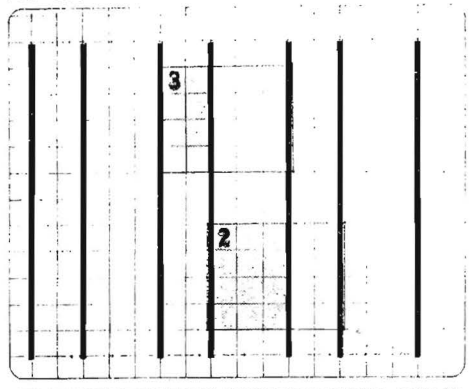
- living/sleeping space — temporary use; use to be extended into zone B progressively.

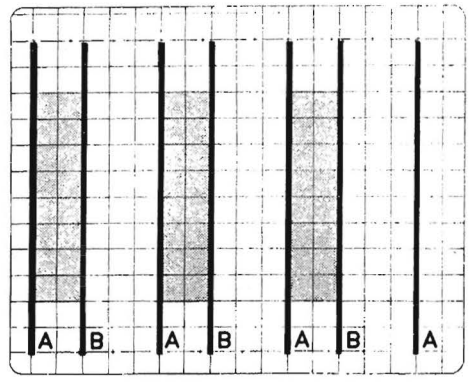
Zone B:

- living room
- bedrooms

Note: the location of other optional elements such as stairs, courts, internal shops/workshops etc. will be discussed separately below.

The above elements in zones A and B can all be accommodated within a width of 2 Modules and 3 Modules respectively, which latter measurements were selected for the zones.



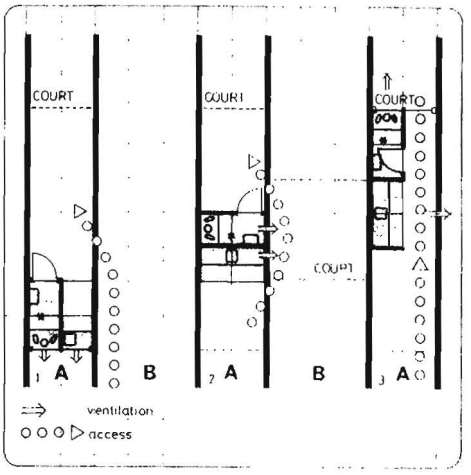


HABRAKEN, BUWALDA

The location of the wet areas in Zone A.

For proper ventilation of bathroom/WC and kitchen, location on an outer wall is mandatory. The adjoining location of kitchen and bathroom is desirable to reduce plumbing work and hence to save costs.
The following alternative locations have been compared (see figure).

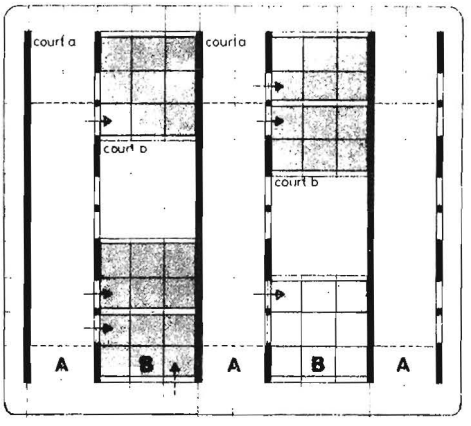
1. no front access to EMAD. Kitchen width unuseful.
2. all circulation through court.
3. permits circulation area in Zone A WC/bathroom in the rear more desirable than near entrance.



The location of rooms and commercial space

Selected room areas 6 - 9 Sq.
Modules (see 4.3)
For ventilation purposes location adjoining street or court is required.

Alternative room lay-out studies determined standard location of openings in wall between Zones A and B (wall AB), permitting a large degree of freedom in the lay-out of Zone B by owner.

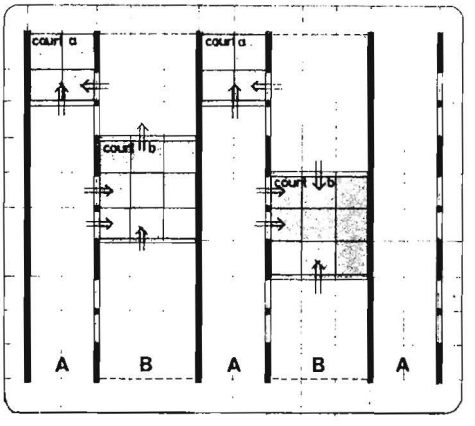


The location of courts in Zone A and B

Three types of courts can be distinguished:
- courts for private domestic use
- courts for the provision of light and ventilation to bathrooms, kitchen and stairs
- courts for the provision of light and ventilation to the rooms (e.g. bedrooms).

For ventilation of kitchens, toilets, baths and stairs, the smallest dimension of the court must not be less than 2.50m and have an area of not less than 7.5m^2. The area of other courts must not be less than (2/5 H)^2, the H being the height of the highest side on it, and its smallest dimension must not be less than 1/4 the height of the highest side on it, under the condition that the area is not less than 10m^2.

(Egyptian building regulations)



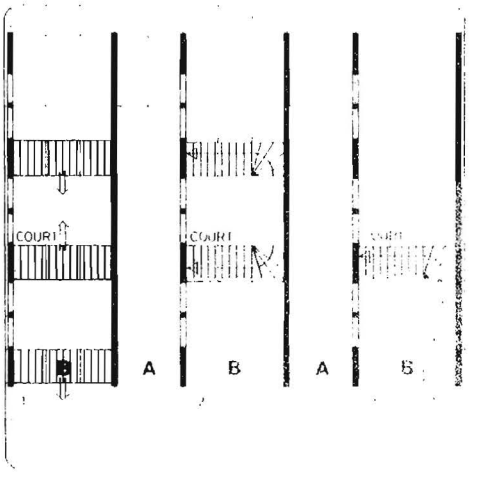
HABRAKEN, BUWALDA

The location of stairs

Since demand for vertical extensions of the house cannot be foreseen, space for a staircase should only be found in Zone B and not in Zone A, unless the plot comprises of two- A-zones, as will be discussed later. For the EMADs a maximum of three floors is envisaged. The following stairs locations have been considered (see figure):

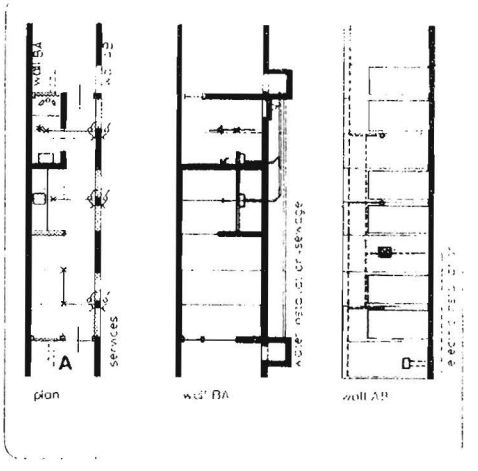
1. Possible locations (stairs in front location not recommended).
2. Practical locations of the internal staircase for a single family unit.
3. Single preferred location of external staircase for a multi-family unit.

The owner has to make a timely decision on whether he wants to develop a single or multi-family building.



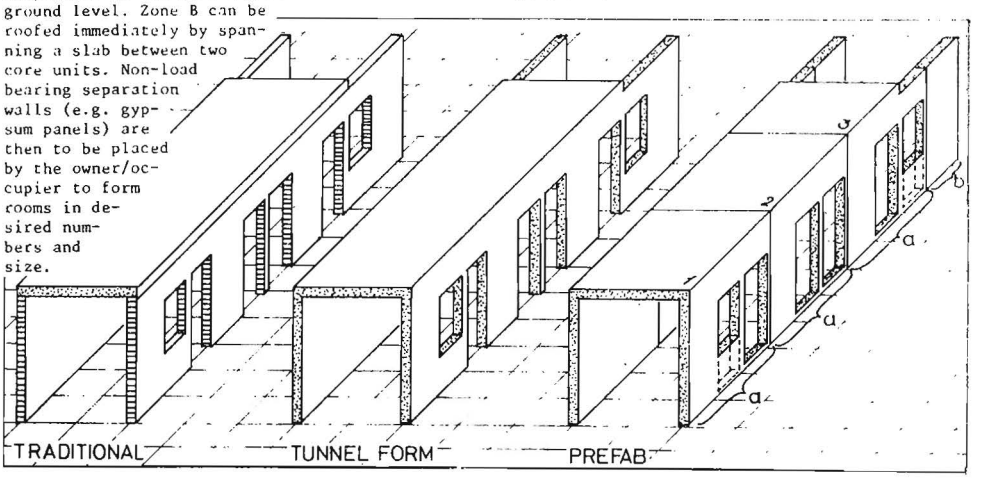
The location of services

Wall BA carries all sanitary provisions such as the water main pipe, shower, sink, taps, etc. The sewer/drain pipe runs alongside this wall in Zone A. Wall AB carries exclusively the electrical system, containing supply cable, meter box, switches, wall outlets and distribution points for ceiling lights. It is advised to lay the drain pipe already in the EMAD for future connection to the sewerage system. This to avoid extra cost later on.



Modes of construction

The EMAD is proposed to provide the basic structure of the initial and future building. For example, no load bearing walls need to be constructed for the completion of the building at ground level. Zone B can be roofed immediately by spanning a slab between two core units. Non-load bearing separation walls (e.g. gypsum panels) are then to be placed by the owner/occupier to form rooms in desired numbers and size.



HABRAKEN, BUWALDA

PROTOTYPES

Using the design criteria presented in section 4, building prototypes can now be developed for different plot sizes. Development of more than one prototype will satisfy varying demand as follows:
- different income levels of future residents
- more choice
- greater flexibility in larger buildings
- more visual variety

The prototypes should evolve from the following variables:
- plot width (6 - 7.20 - 8.40m)
- plot depth (12 - 14.40 - 15.60m)
- alternative combinations of A and B zones
- alternative plot widths
- alternative lay-outs per zone.

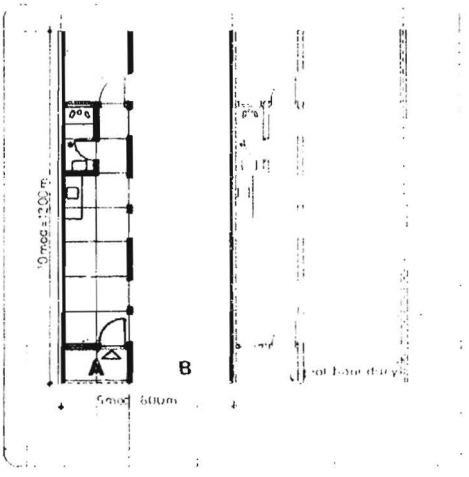
From these variables two prototypes have been developed:
Prototype 1 is based on:
- very low income tenants
- minimum plot size (6 x 12m)
- one single family unit/plot (min. investment)
- inclusion of small (work) shop area
- likely development of 2 storeys (max. 3 permitted)

Prototype 2 is based on:
- low to medium income tenants
- maximum plot size (8.40 x 15.60m)
- multi-family building (rent producing investment)
- inclusion of one or more (work) shops
- likely development of 5 storeys (max. 3 permitted)

EMAD 1 (expanded)
Illustration of a possible lay-out of a two storey dwelling as completed by the owner/occupier.

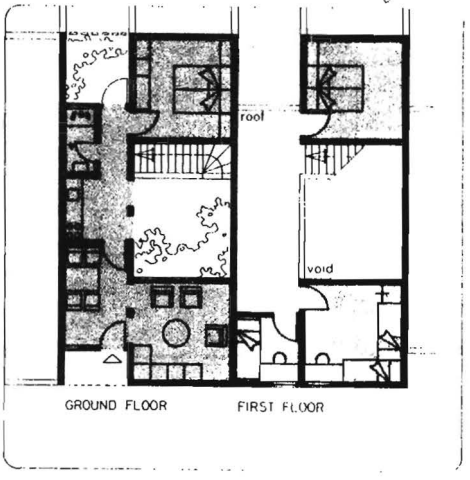
plot area	72.00 m^2
covered floor area	77.76 m^2
plot ratio	1.00 m^2

Siting particulars
- buildings attached on three sides
- rear court to adjoin same court of dwelling behind; a 2.20 m high screen wall to separate courts for privacy
- work (shop) can be established in front room.

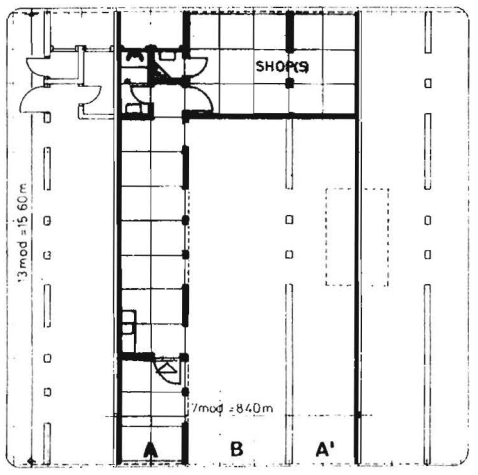


EMAD PROTOTYPE 1

plot size	6.00 x 12.00 m
plot area	72 m^2
covered floor space (gross)	23.04 m^2



HABRAKEN, BUWALDA



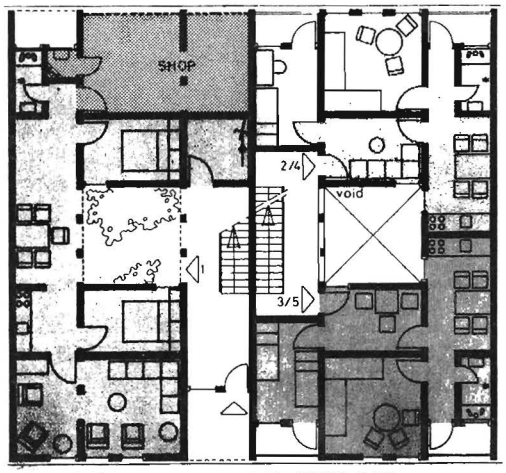
plot area	131.04 m^2
covered floor space (gross)	299.52 m^2
plot ratio	2.3
average size dwelling unit	60 m^2

Siting particulars
- buildings attached sideways
- buildings to have frontage on two sides (through lots) with access to (work) shops from the more important street and access to all dwelling units via a common entrance on the opposite frontage.
- this prototype to be located preferably on the edge of the EMAD area and to front with its (work) shop side onto a collector road, a local road or a major central services area.

EMAD PROTOTYPE 2

plot size	8.40 x 15.60 m
plot area	131.04 m^2
covered floor area (gross)	56.16 m^2

EMAD 2 (expanded)
Illustration of possible lay-out of a multi family building with 5 dwelling units as completed by the owner/occupier.



GROUND FLOOR FIRST/SECOND FLOOR

This arrangement was chosen as the basis for PROTOTYPE 1

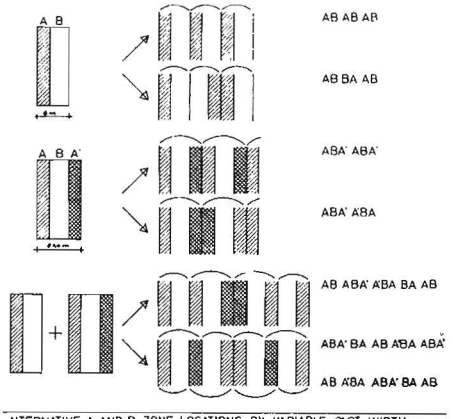
not possible: party wall between two B-zones is structural wall.

conclusion: B-zones need always to be located in between two A-zones.

A'-zone is ideally located for the stairs: last area at ground level to be developed before vertical expansion and does not interfere with layout of A + B zones.

Even more practical arrangement since wet areas and stairs are located back to back across the party walls: PROTOTYPE 2

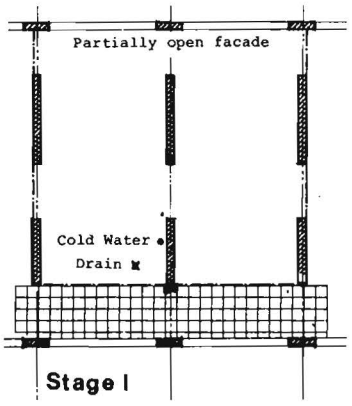
- always wet areas back to back
- one A'-zone always between two units:
- choice of allocation to either unit and option to use one staircase for joint access to upper floors of two adjoining units.



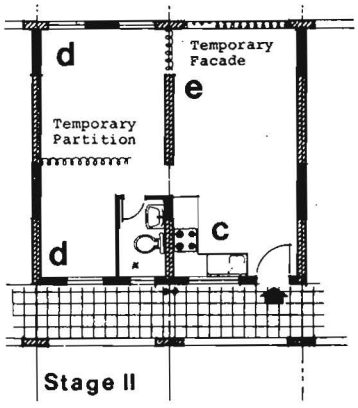
ALTERNATIVE A AND B ZONE LOCATIONS BY VARIABLE PLOT WIDTH

HABRAKEN, BUWALDA

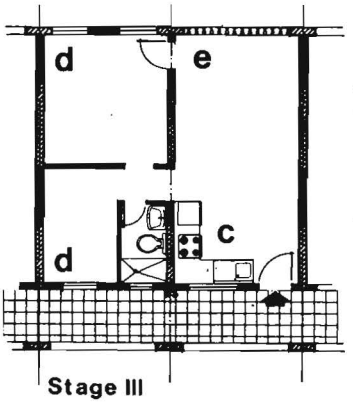
General Example of Staging Process



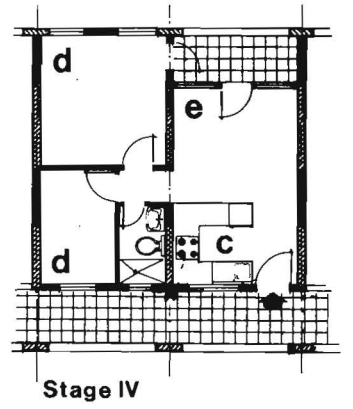
PHASE I
This represents the basic support as a minimum dwelling site to be occupied by user. Depending on income level or economic capacity, it may include more elements than shown here. In this case only a single cold water tap and a floor waste drain are provided.



PHASE II
The user has installed bathroom facilities first, with kitchen facilities second. He has also built front facade, and completed part of rear facade. Temporary partition for sleeping areas act as privacy screens, to be completed later. Living room facade is also temporary.



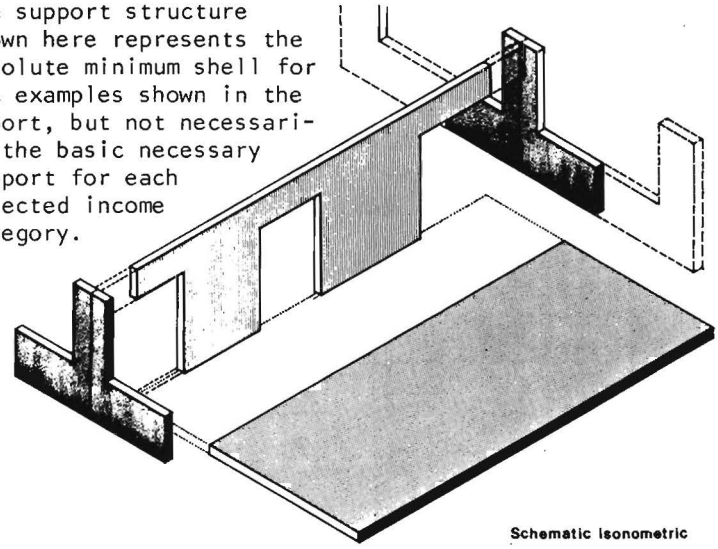
PHASE III
Permanent partition for parent's bedroom with door has been added.
Refrigerator may be priority over rear facade.
Painting and other finishes have been completed in enclosed areas.



PHASE IV
Dwelling is essentially finished.
Rear facade completed. Living room fully finished.
Doors added for all rooms.
Balcony provided for family room and bedroom.

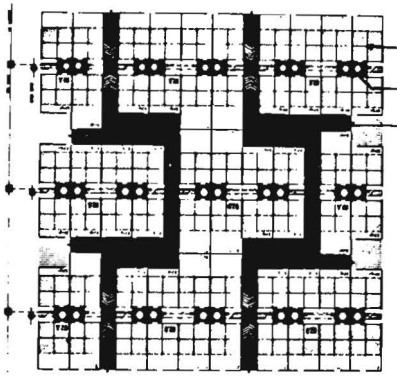
Support Elements
The schematic sketch, shown at right, is provided only as a general indication of the geometric nature of the basic elements of the support.
Choice of specific materials and/or construction technology must be determined on the basis of further engineering and cost studies, and also may vary from project to project. Conversely standardized, prefabricated elements may be selected, depending on availability and ability to provide different spans for modular bays.

The support structure shown here represents the absolute minimum shell for the examples shown in the report, but not necessarily the basic necessary support for each selected income category.

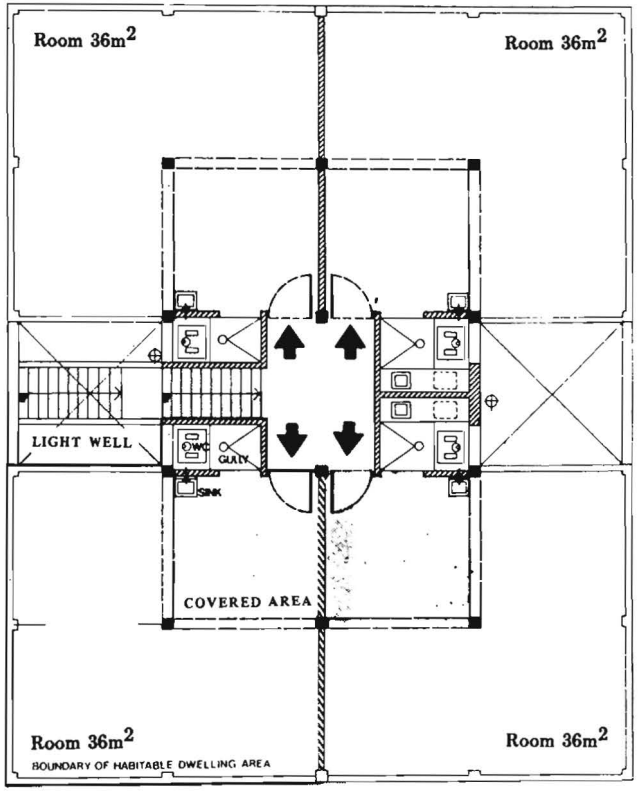


Schematic isonometric

DLUHOSCH, RYBCZYNSKI

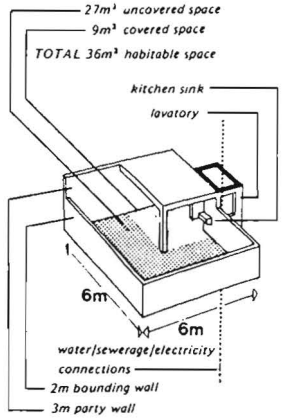


HOUSING CLUSTER
تجمع سكنى



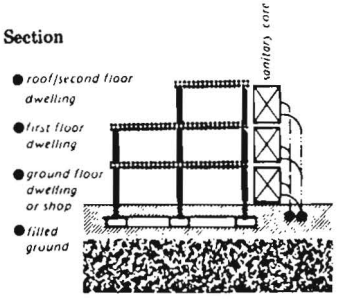
TYPICAL PUBLIC HOUSING BLOCK: TYPE B2(a)
نموذج نمطى لعمارة اسكان حكومى نموذج ب ٢ (أ)

Isometric

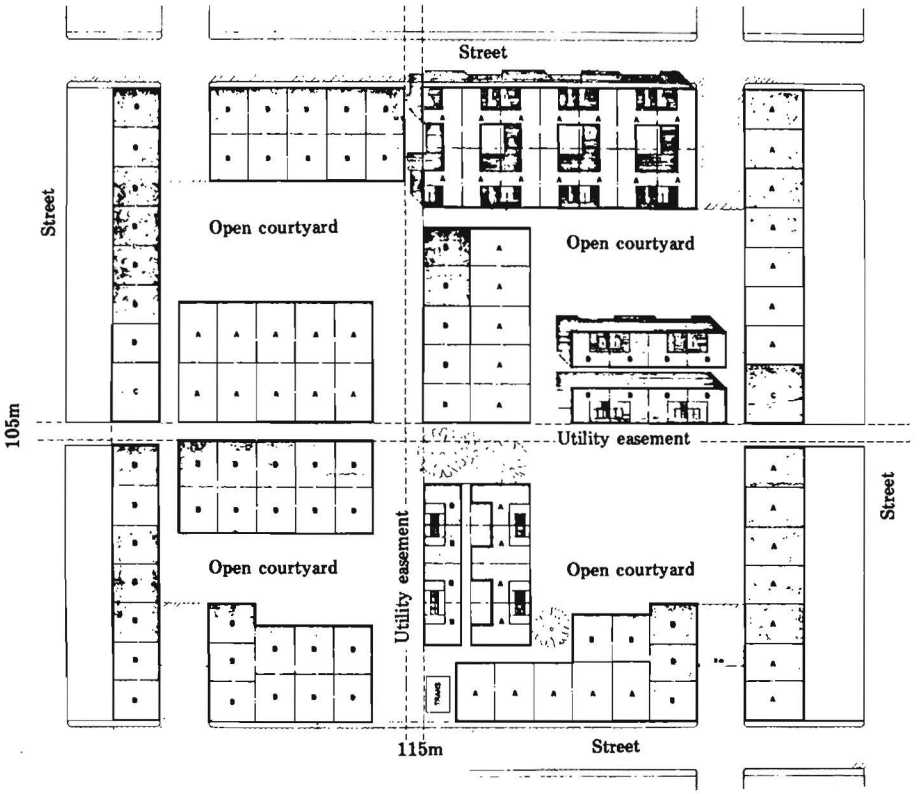


Isometric

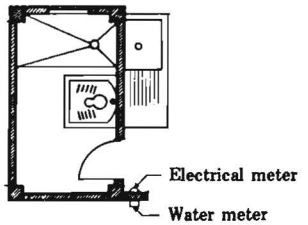
Section



TYPICAL UNITS IN BLOCK
نموذج نمطى للوحدات فى العمارة

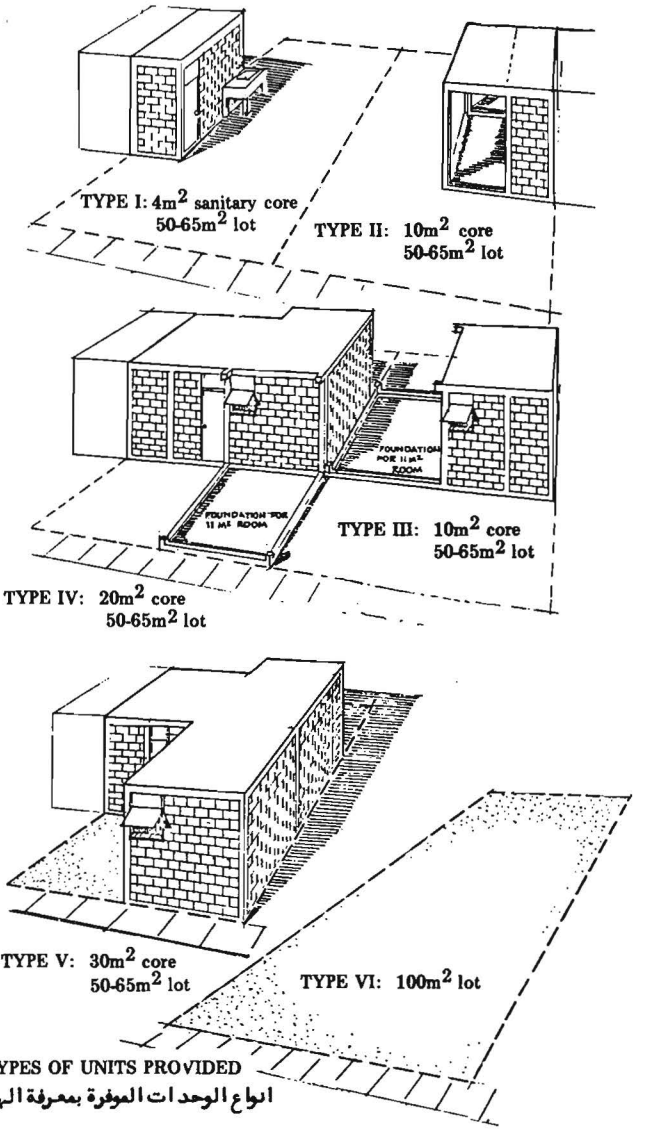


TYPICAL NEIGHBORHOOD BLOCK MODULE نموذج نمطي متكـرر للقطع بالاحيـاء

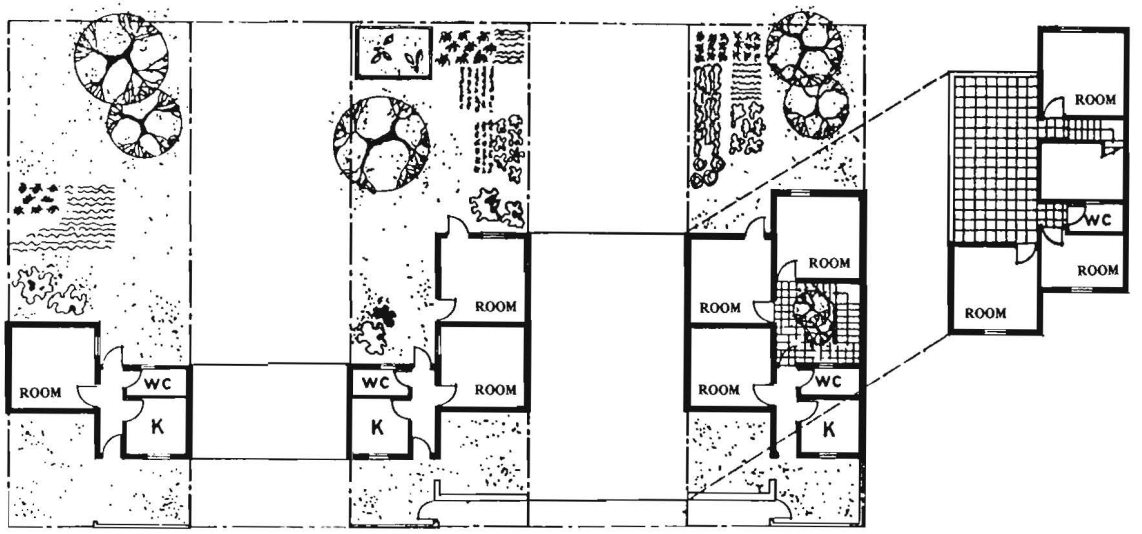


TYPICAL UTILITY CORE
نموذج نمطي لنواة المرافـق

Note: Shown are only preliminary feasibility studies; the designs are under review and will be changed as needed.



TYPES OF UNITS PROVIDED
انواع الوحدات الموفرة بمعرفة الهيئـة



SMALL CORE DWELLING
نـواة لمسكن صغـير

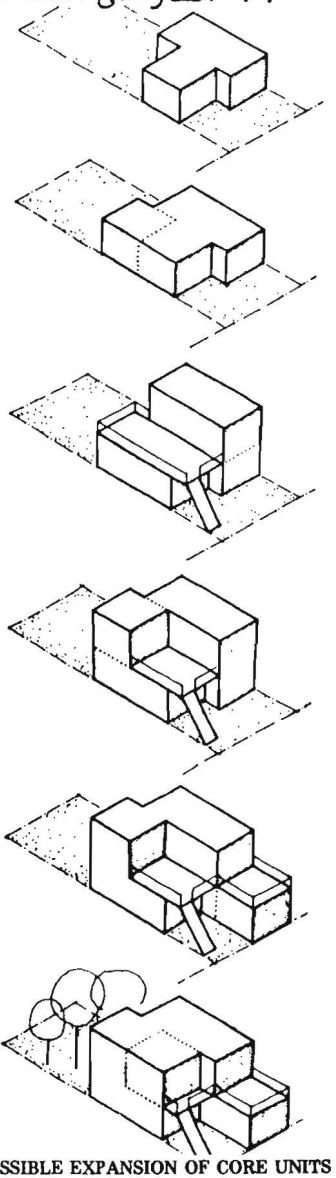
MEDIUM CORE DWELLING
نـواة لمسكن متوسـط

LARGE CORE DWELLING نـواة لمسكن كبيـر

TYPICAL CORE DWELLING
نموذج نـواة المسـكن

	Unit Site Area m²	Dwelling Area m²	Cost Per Sq. Meter	Dwelling Cost
Site and Communal Services	140	--	--	--
Basic Utility Core	140	12	--	LE 625
Core Shelter Unit	140	24	LE 37	910
Core House Unit	140	37	37	1,360
Expanded Core House	140	61	37	1,755

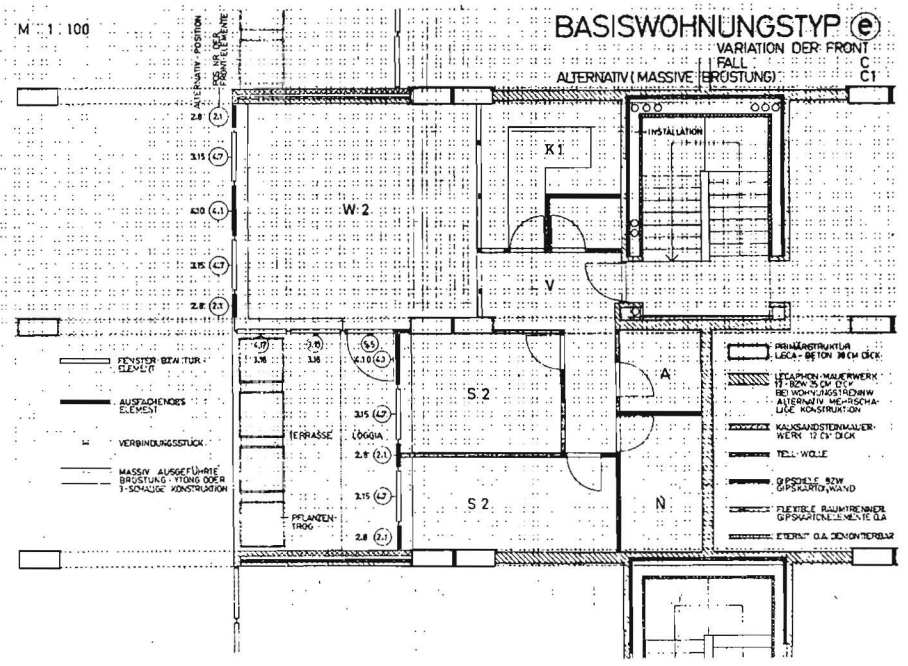
TYPES OFFERED
النماذج الموفرة بمعرفة الهيئـة



POSSIBLE EXPANSION OF CORE UNITS
الامتدادات الممكنـة للنـواة

JOINT RESEARCH TEAM

UHL,ET ALIA HOLLABRUNN



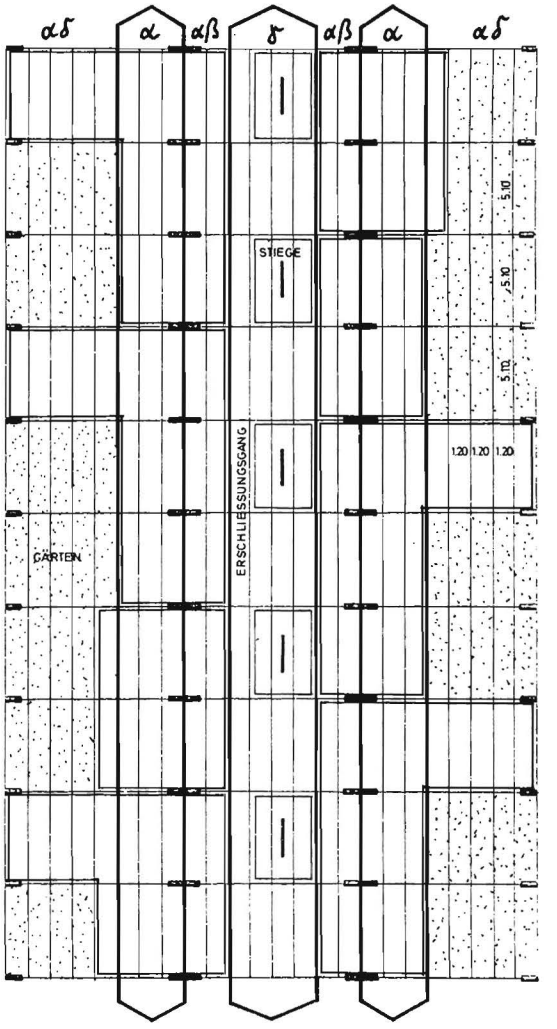
Auf den folgenden Seiten wird die Zonierung eines Baukörpers in Hollabrunn gezeigt.

Legende:

α-Zone	=	Außenzone, darin liegen besondere Aufenthaltsräume (das sind Räume, die zwar eine besondere Bestimmung haben, aber doch Aufenthaltsräume sind, z.B. Kinderzimmer, Küche)
β-Zone	=	Mittelzone, darin liegen Gebrauchsräume (z.B. Naßräume, Kochnischen)
δ-Zone	=	Sonnenzone, darin sind Loggien, Balkone und Terrassen möglich
γ-Zone	=	Erschließungszone, also Stiegenhaus oder Laubengang
$\alpha\beta$-Marge	=	Variationsbreite zwischen benachbarten α- und β-Zonen, hier können sowohl besondere Aufenthaltsräume als auch Gebrauchsräume liegen
$\alpha\delta$-Marge	=	Variationsbreite zwischen α- und δ-Zonen

Zonierung

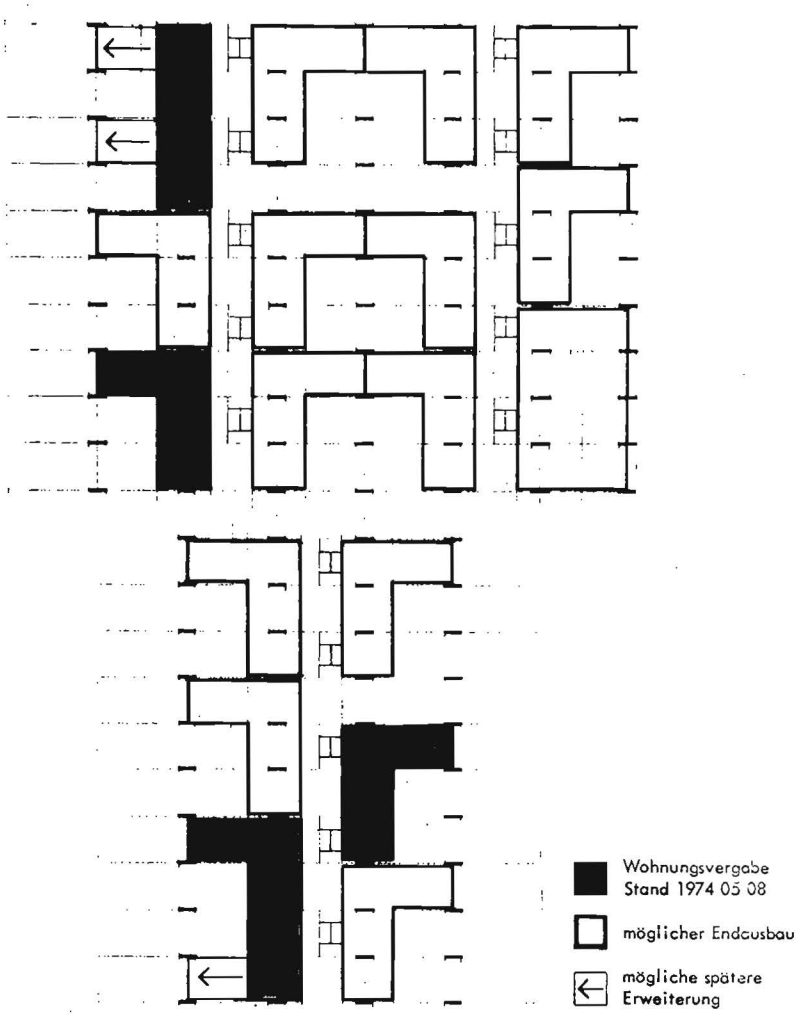
Erdgeschoß, M.: 1:250



UHL, ET ALIA HOLLABRUNN

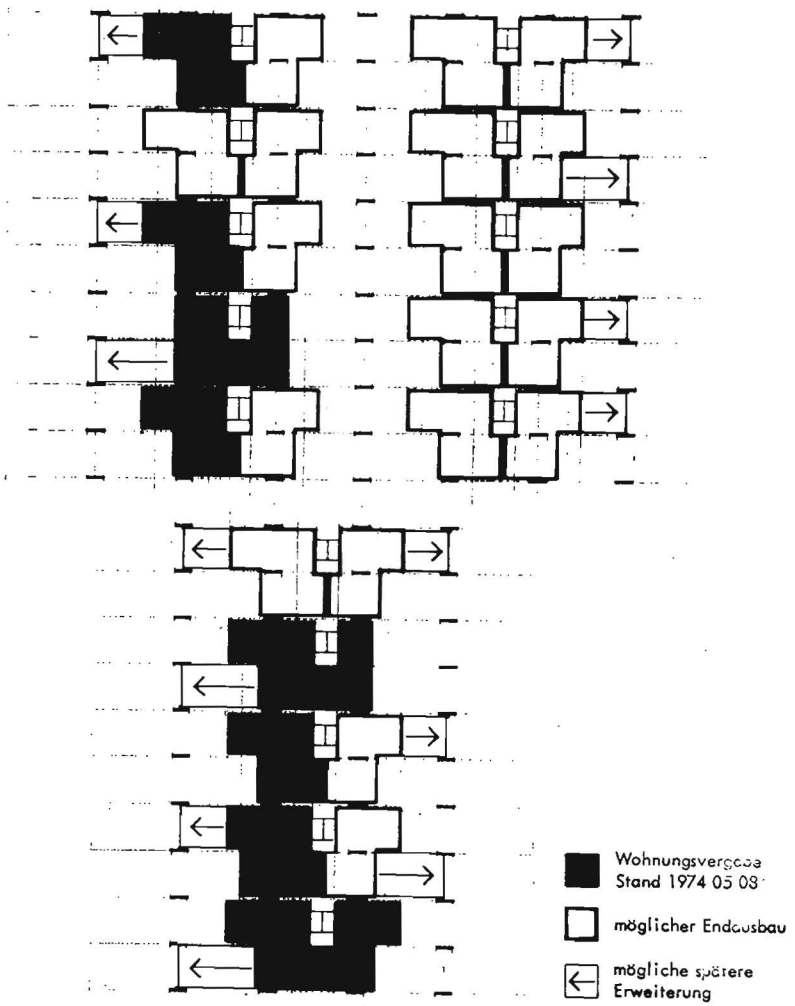
Erdgeschoß M.: 1:500

Annahme 1

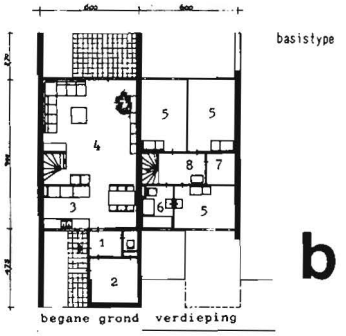


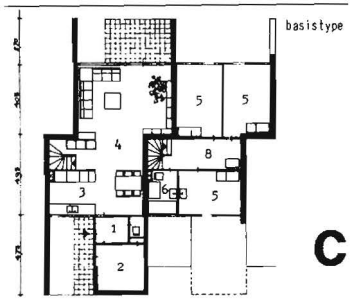
1. Obergeschoß M.: 1:500

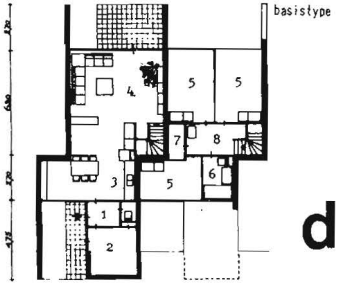
Annahme 1



UHL, ET ALIA HOLLABRUNN

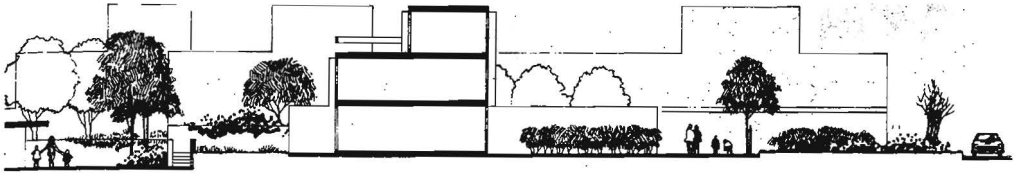


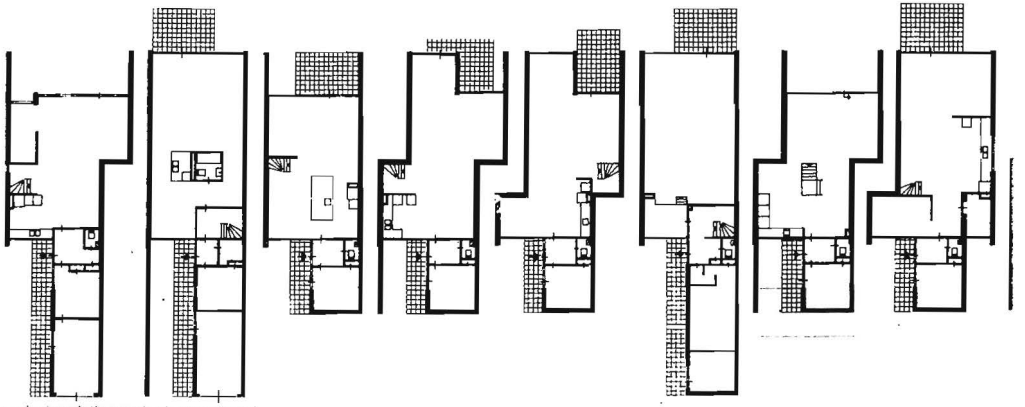




1 entree woning
2 berging
3 keuken + eetruimte
4 wonen
5 slaapkamer
6 wasruimte
7 berging
8 c v ketel

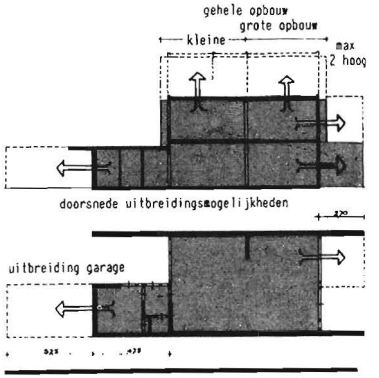
basistypen plattegrond



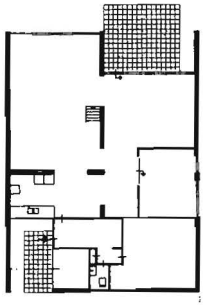


varianten plattegronden begane grond

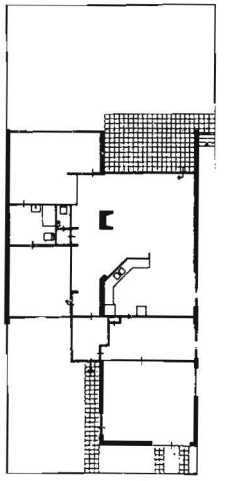
varianten plattegronden eerste verdieping



plattegrond uitbreidingsmogelijkheden

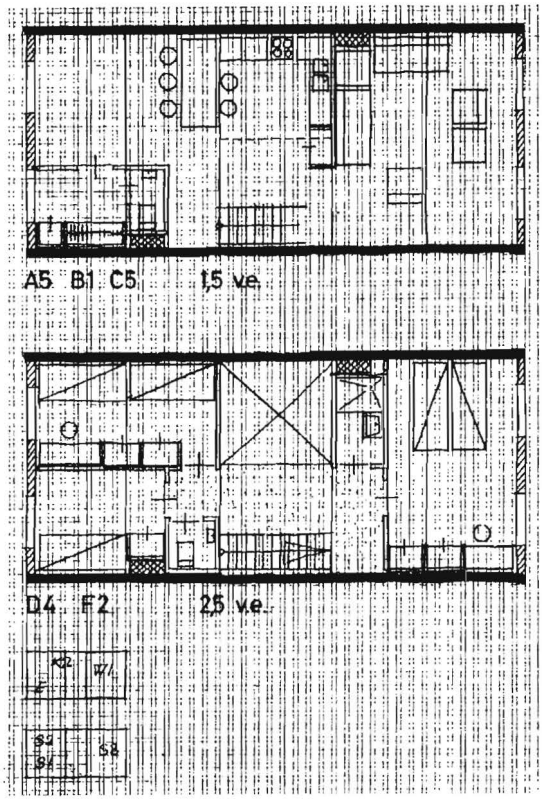


begane grond twee kavels breed

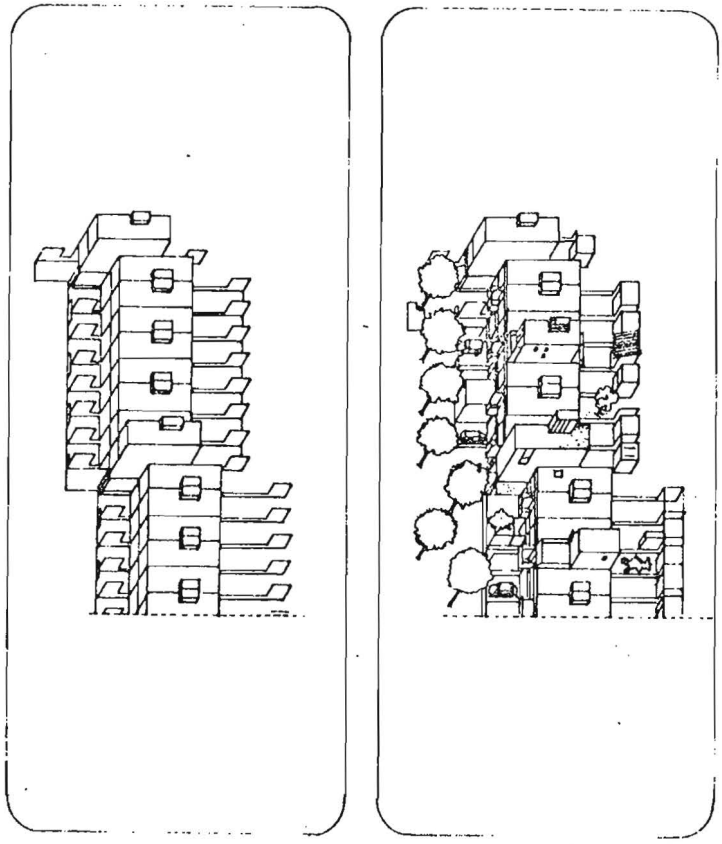


type bungalow op de kop van een rij

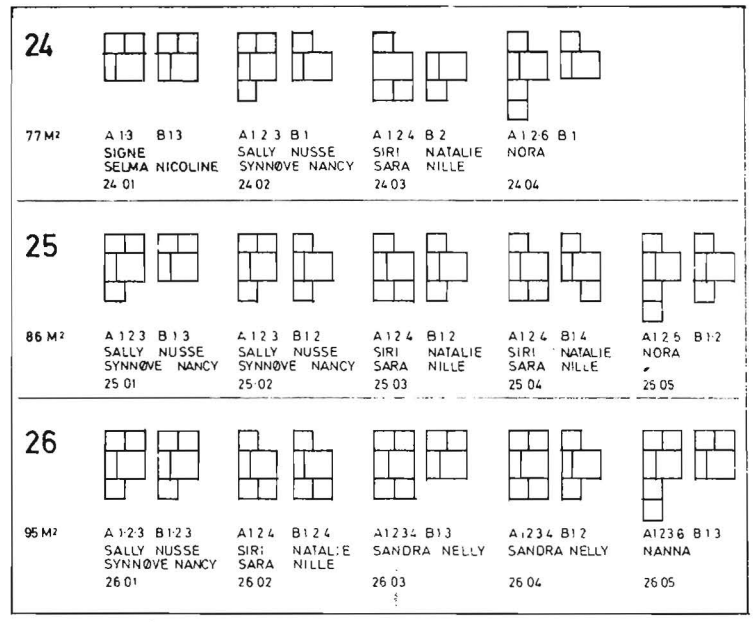
VAN DILLEN



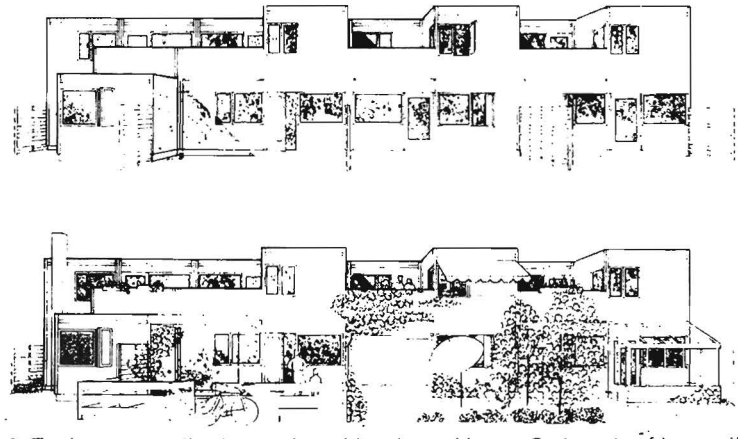
HAAKSMA



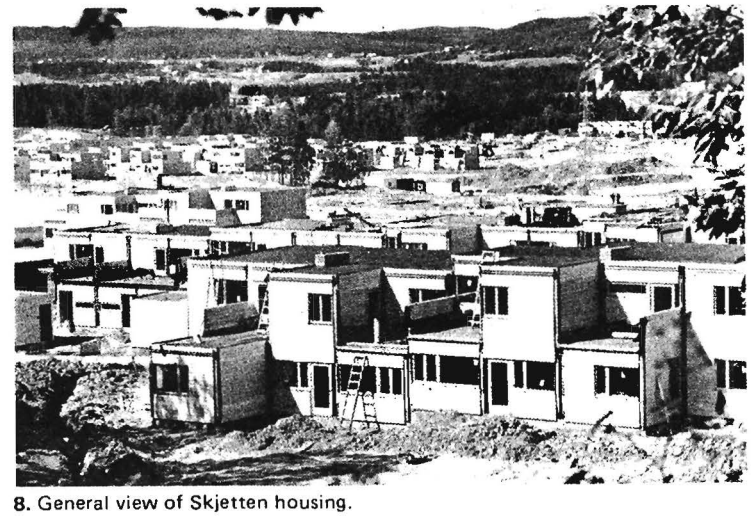
HERTZBERGER



5. Selection of plantype variants.

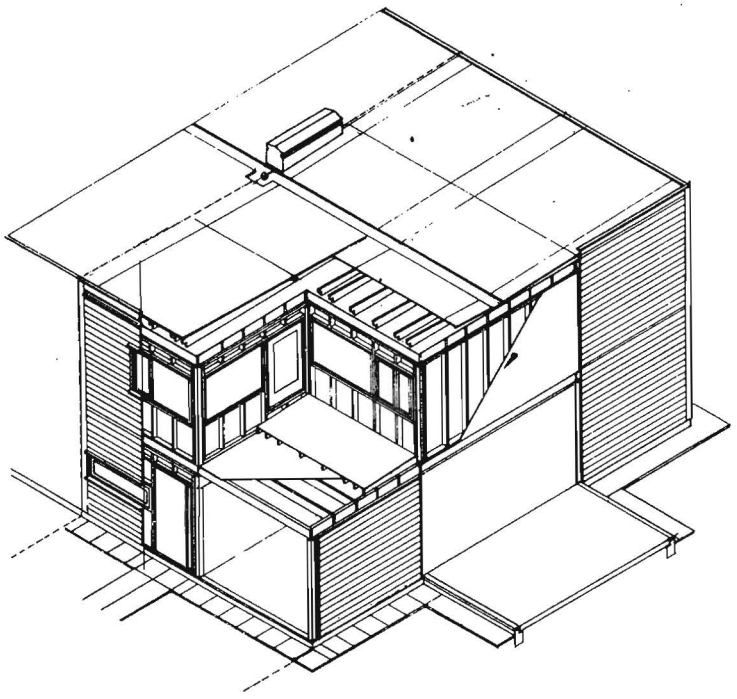


4. Typical personalization envisaged by the architects. Basic style of houses if purposely neutral to emphasize effect of subsequent personalization.

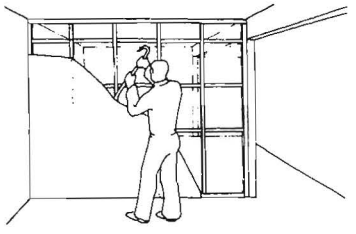


8. General view of Skjetten housing.

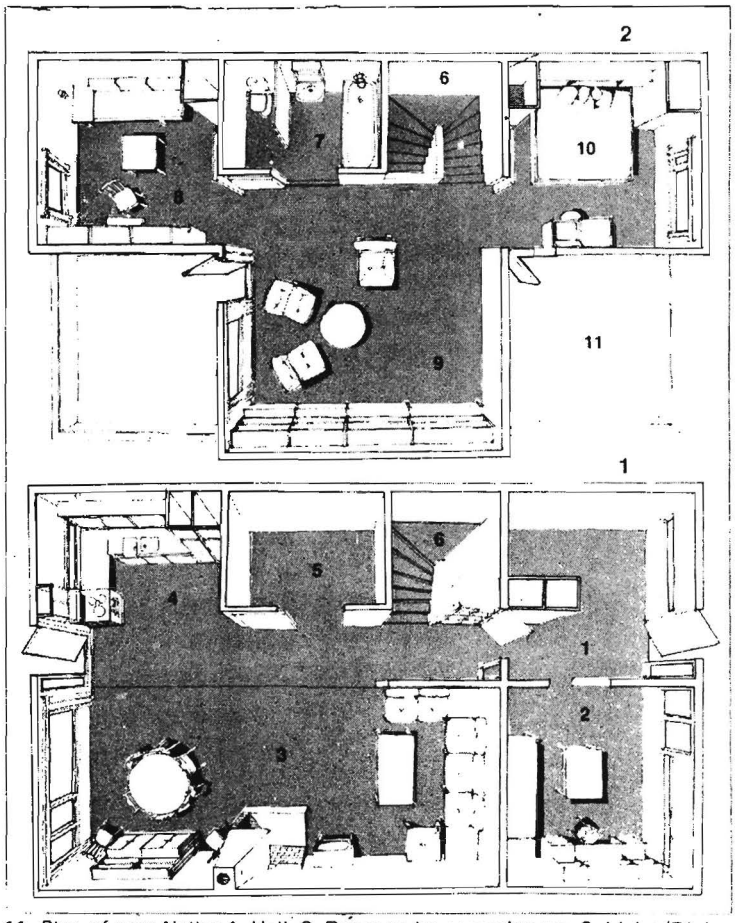
HULTBERG, LUND



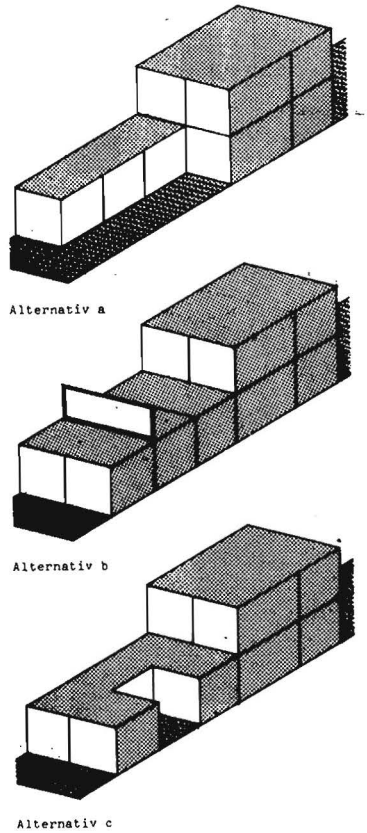
15. Isometric of constructional principles.



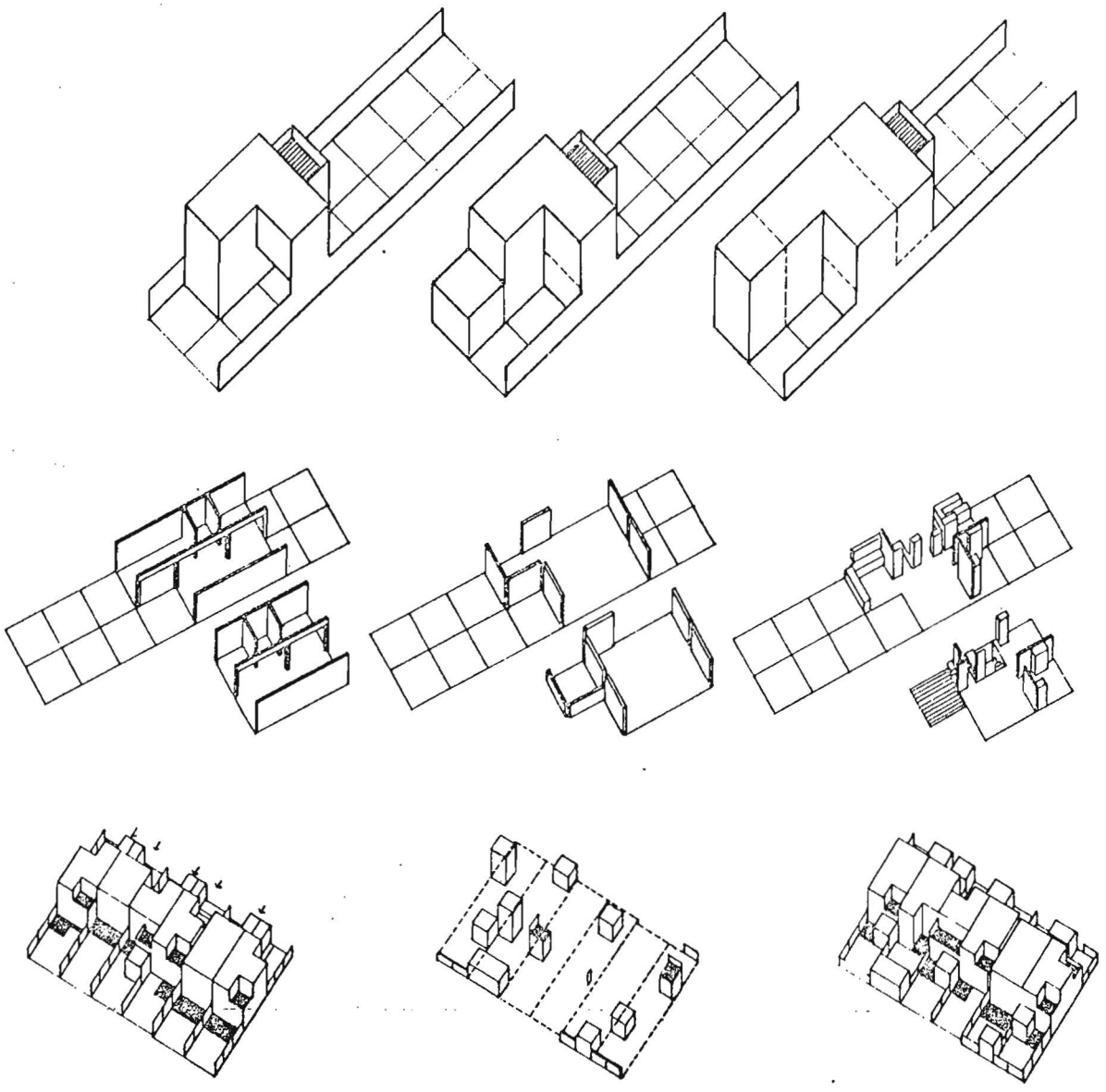
16. Removing a partition



11. Plan of type Nelly: 1. Hall, 2. Room to let or workroom, 3. Living/Dining, 4. Kitchen, 5. Utility, 6. Stair, 7. Bath, 8. Study/bedroom, 9. Upper living, 10. Parents bedroom, 11. Terrace.
Drawing: *Nye Bonytt*

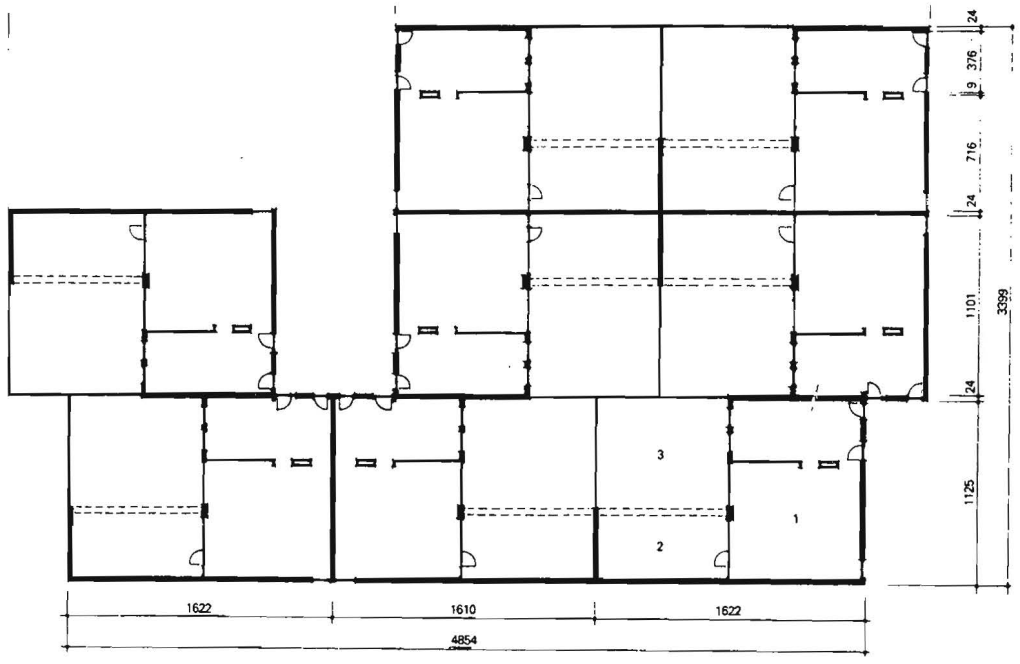


17. Alternative forms of extension.

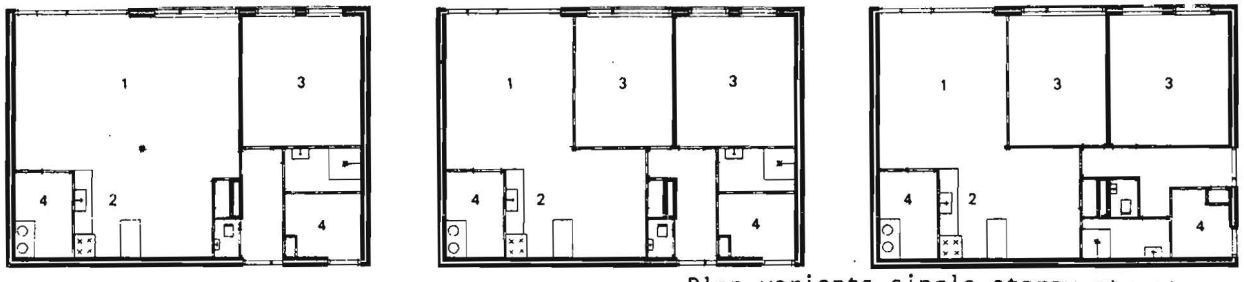


Options for expansion and additions

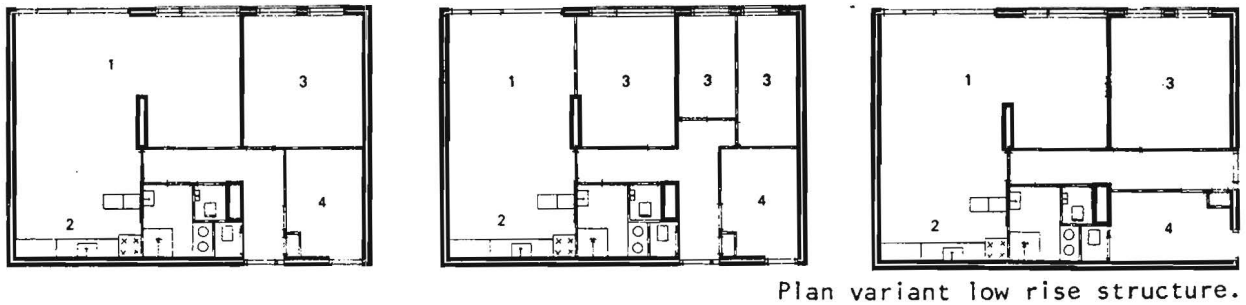
HULTBERG, LUND



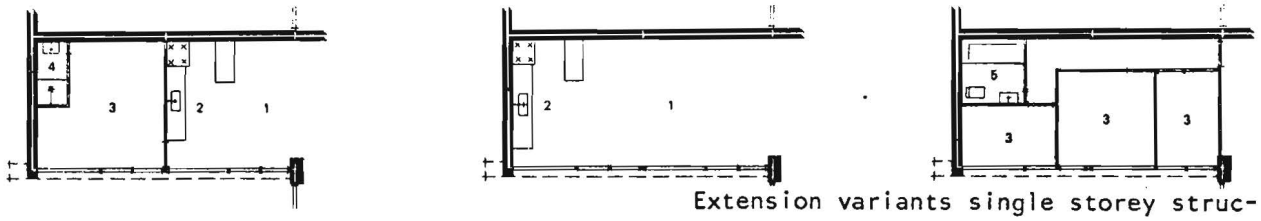
singly storey structure.



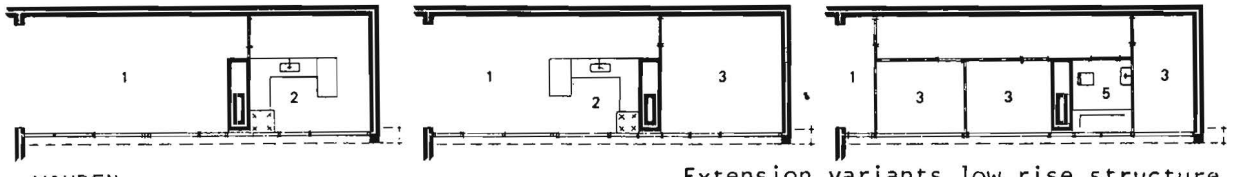
Plan variants single storey structure.



Plan variant low rise structure.

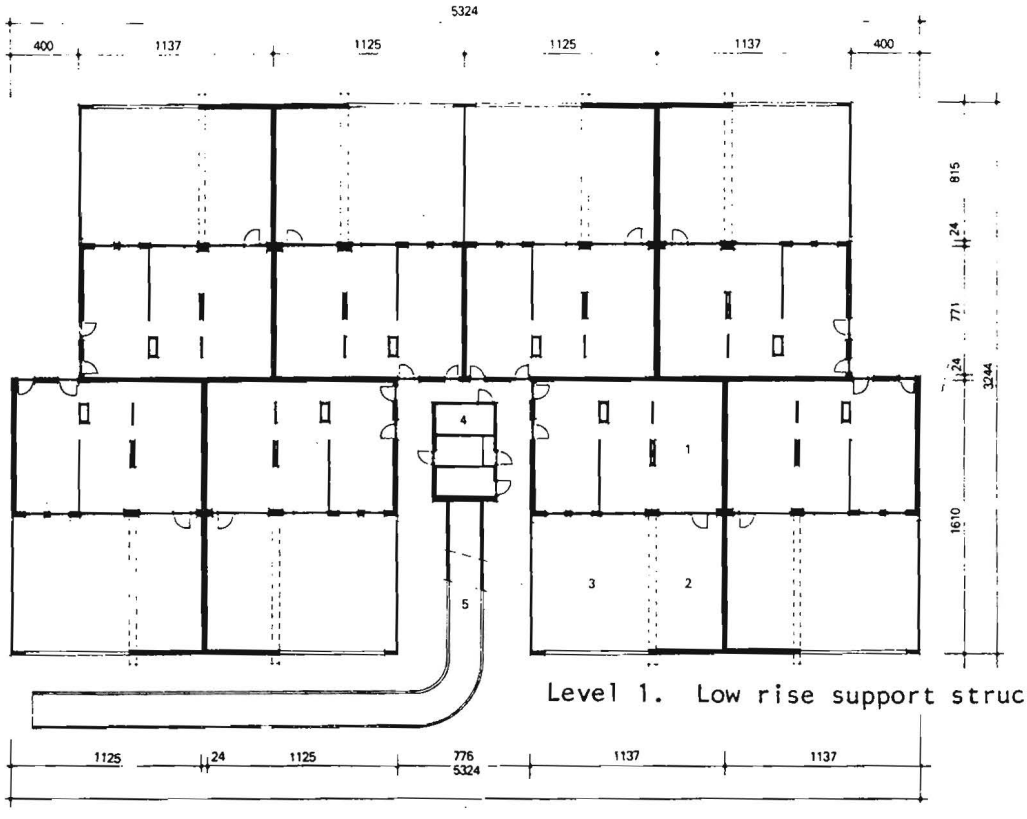


Extension variants single storey structure.

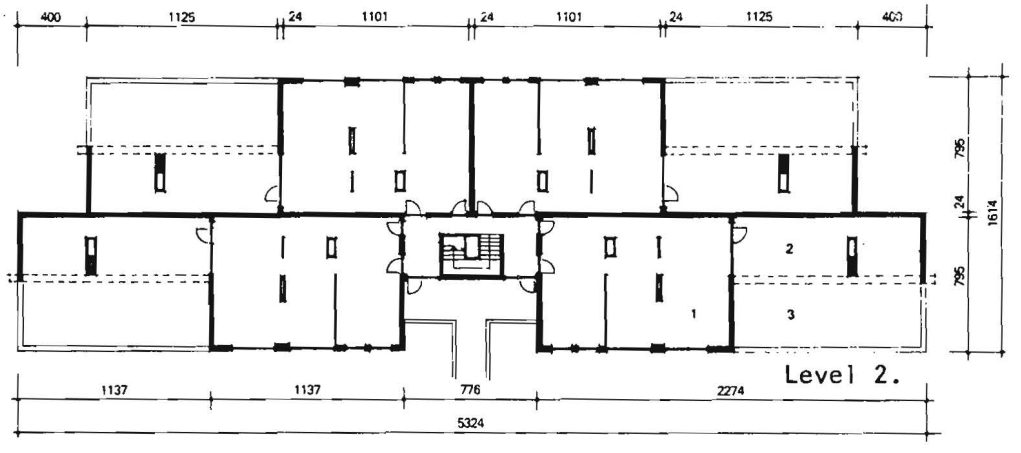


WAUBEN

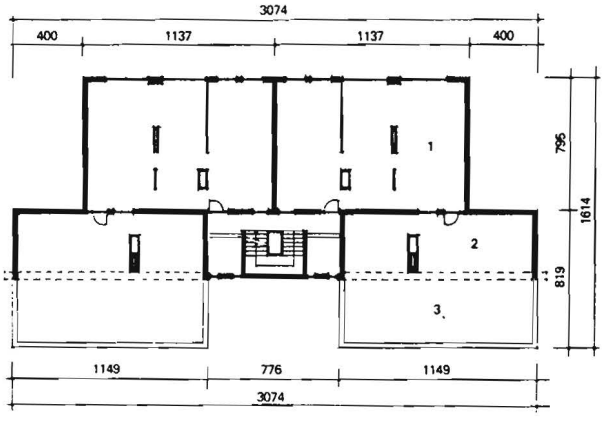
Extension variants low rise structure.



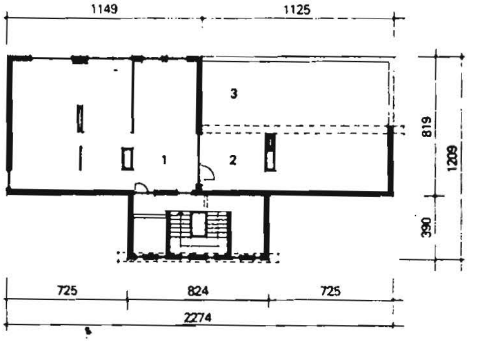
Level 1. Low rise support structure.



Level 2.



Level 3.



Level 4.

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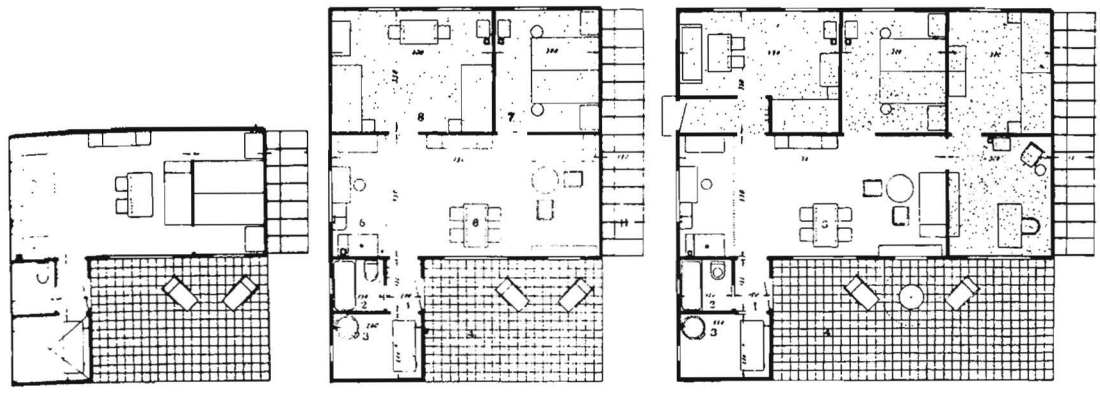
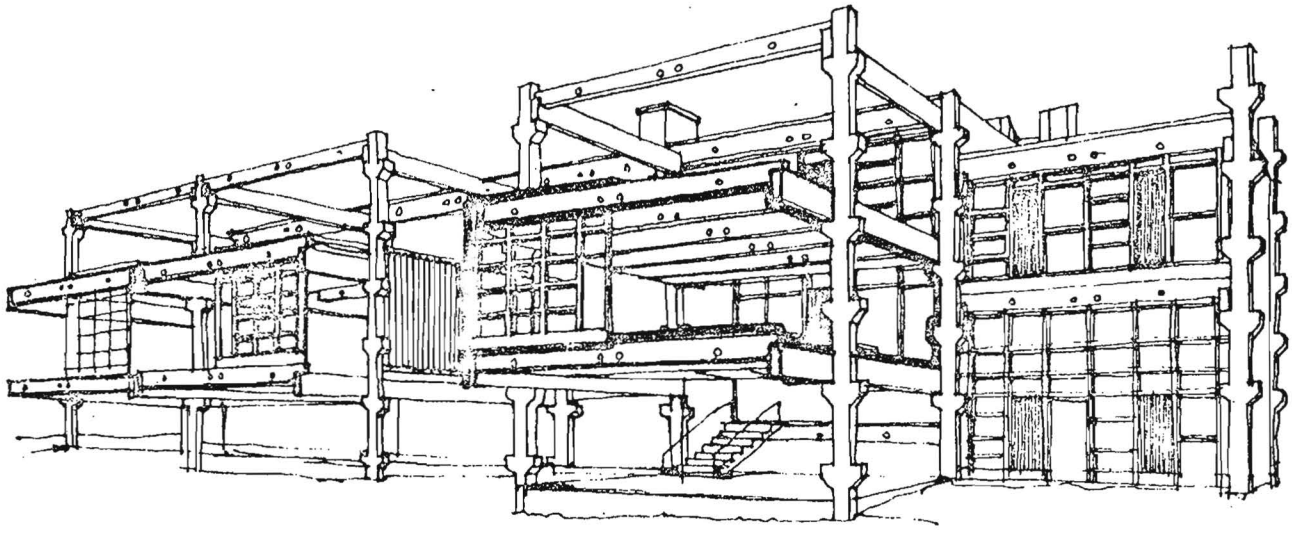
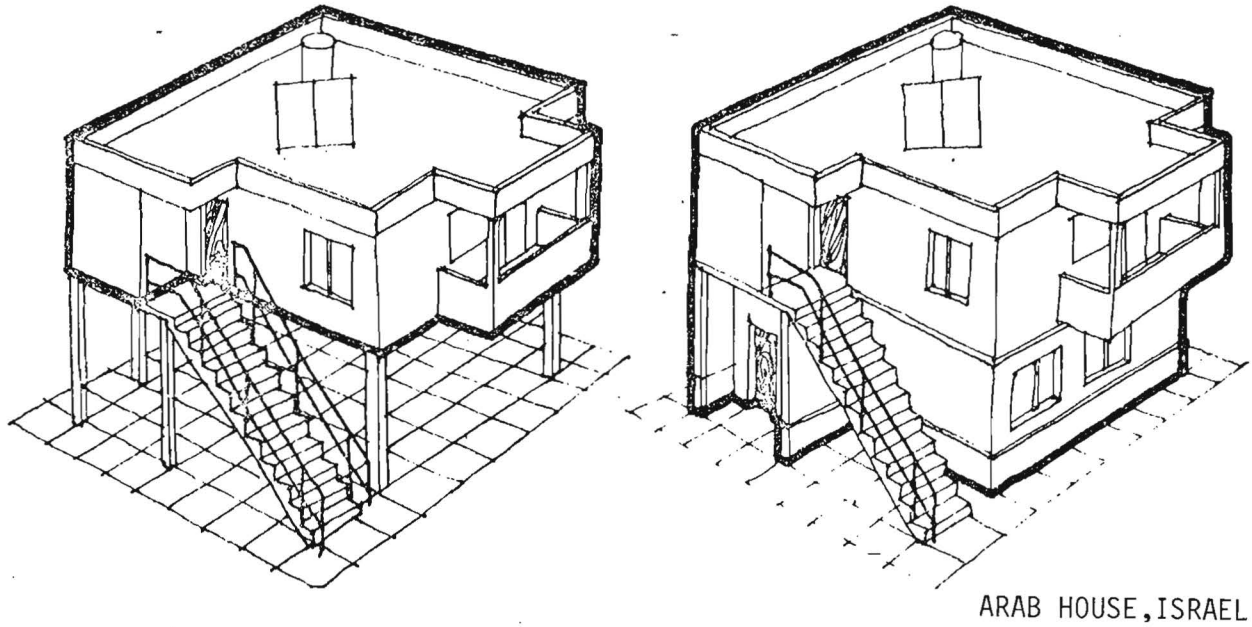


W. Gropius. Extendible prefabricated house worked on for Hirsch Kupker und Messingwerke A. G. in 1931

GROPIUS



STEIDLE, THUT



ARAB HOUSE, ISRAEL

2. NORMATIVE FACTORS

2.1. Introduction

We have previously defined the core-house concept as the defering of certain aspects of the construction of a dwelling from the "first build", the period prior to occupancy, to the period after occupancy. Thus it is characteristitc of the core-house approach that the dweller lives in his own quarters while they are being built. The motives are, as we have seen, to defer and transfer parts of the housing service potentially including design, staging, construction and financing to the responsibility of the dweller. Other than these general characteristics, the process is adaptable to various ad hoc conditions and requirements. These factors derive from local conditions which influence the form or content of the approach. Examples are the prevalent customs of space use or other cultural patterns, and common building types and building practices.

In the following section we define these normative factors and describe the type of influence which each may have on the core-house approach. The idea inherent in this review is the mapping of these factors in a form general enough to be universal in their validity. That is, they might be applied in the decision making process of planning a core-house project and selecting an appropriate strategy. The making of policy is really the first step in the process. The use of a tool such as the resources matrix described in the previous section comes after certain basic decisions have been made. Thus a logical order of thinking about core housing begins with normative decisions; continues with reference to typological decisions i.e. selecting types and the mixes of elements to be built or deferred and continues to a third stage of design.

Di Lullo has proposed a flow diagram of the design decision making process, and it is reproduced here for reference. In the third section of this work we will consider the problems of designing core houses and describe the relevence of the SAR method in the design process.

2.2. Cultural Factors

A number of factors deriving from cultural patterns or values may influence the formation of an approach to core-housing. Preferred building type may be an example of such factors. For reasons of local values, the range of functions involved in the housing process, the size and significance of the family, the meaning of privacy, the symbolic significance of the dwelling, etc. certain building types may be preferred in a particular situation. Building type, therefor, is one of the decisions which limit the range of possibilities open in any approach to core-housing. The variables of building type which are relevant to questions of the growing house are as follows:

Attached versus detached housing
What is project density. Are units physically attached.
Single ownership versus multi-family
Are the dwelling essentially sitting on an individual lot or are they vertically superimposed.
Proximity to ground
Must dwellings have contact with the ground

In addition to the type of building form or grouping of dwellings, another culturally determined aspect may be dwelling form, or residential type. Here we refer to the nature of plan form; an additional aspect, the functional contents of housing, is treated separately below.
Typical plan form variables are as follows:

Introspective versus outward oriented
Is the preference for inward or outward orientation, or is this not a factor.
Compact versus sparse plans
Are plans compact or is the integration of open space within the plan a common practice.
Open versus closed plans
Are activity spaces deliniated by partitions or are open plans in common usage.
The large and the small
Is there any particular sense of scale associated with the dwelling's appropriate size.

A third factor deriving from cultural values is the nature of boundaries. This is particularly significant, since core-housing grows, and the definition of rights is part of the problem of design vis a vis the cultural definition of privacy. A core-house is composed of a core, a field of expansion a boundary and rules and agreements regarding the field and its use. Boundaries may be subject to different interpretion.

Hard versus soft boundaries

Are boundaries built of implied.

Introvert versus extrovert boundaries

Are boundaries part of the dwelling or part of group or urban form.

2.3. The Growth Rationale

Determining the particular combination of motives for the core-house approach is an appropriate way to begin thinking about policy. An essential programmatic aspect is the definition of the rationale for growth. As we have seen in the introduction, the motives for growth may be diverse. Each potentially affects in a different way the determination of program and design policy.

Deferred expenditures

Perhaps, the most prominent of motives traditionally associated with core-housing. In the Third-world, this may mean providing shelter or minimal services. While in developed countries, the core is generally a small dwelling with expansion capability. Other than in extreme conditions such as site and services, the percentage of savings due to deferred construction is not clear. Expandible housing may require special details such as external walls which can be relocated; it also may involve completion of ultimate stage foundations and special provisions for the extension of electrical and plumbing. No doubt, the flexibility of deferring decisions until the period of occupancy costs money, as flexibility generally does. Thus this constitutes an area of special research interest.

The transfer of responsibility

A second motive traditionally associated with the core-house approach is the transfer of responsibility from an institutional authority or a designer to the user. This responsibility may include financial, design and/or constructional responsibility. Each type of "do-it-yourself" will operate most satisfactorily, if planned for initially. This is particularly true of self-help in the construction process. But preparing the ground for informed and intelligent decision making by the user may also engender special preparation in the form of the design or by some other means.[8]

2.4. Scenarios

- What are the cycles of change to which the core house must respond, and can then be classified? Generally this is connected with the cycles of change in family life.

Family cycle

The family cycle and its influence upon space use in the dwelling and changes in spatial requirements has been studied by various researchers. In planning for staged growth, some assumptions about rates of change and their effect upon the dwelling must be assumed. An analysis of the relationship between the growth and reduction of family size, the ages of members, the socio-economic level and potential activity lists are essential ingredients in the planning process.

Client profiles

Is there a standard family scenario or are there in any specific situation a variety of profiles of family and family cycles. The definition of this range must be accomplished.

Related to this information is the decision to accomodate variety either with standardization, with flexibility or with variety. That is, how should the variety of client profiles be recognized in the planning and design process?

Reversibility

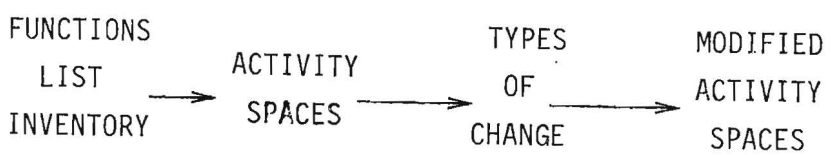
The core-house is generally a process involving growth. Reduction in size, i.e. as a result of the reduction in size of the family, may be added as a requirement to which the design approach must provide an answer. Here the implication is that as the size of the family decreases it can sell or rent unused space. This requirement

may complicate the design of core housing, but it is probably a realistic program requirement in dense urban applications of the core-house principle.

2.5. Functions

What are the specific characteristics of the functions list in any particular situation. The functions list - the list of activities and/or spaces to be accommodated may differ dramatically by culture, counry or socio-economic situation. The inclusion of activities and functions in addition to purely residential functions e.g. hobbies or animals, strongly differentiate many Third world schemes from those of European practice.

One starting point in residential programming is the preparation of such an activity list or list of function spaces. The growth scenario may be described as the modification, and additions to, the activities list and the relationship of the activities list to some standard list of functional spaces such as that of SAR. That is, a programming procedure would involve the relationship between activities, functional spaces and types of change. The following diagram indicates the logic of the relationship:



Ideally, this kind of analysis should be accomplished for each significant stage of change in the family cycle. It is conceivable that such a method might have value as an analytical tool to evaluate specific physical programs for the growing house.

2.6. Changes

Given certain scenarios and a functions list, what are the types of change which may take place in the dwelling as part of the process of growth?

Incremental/Addition

This is the addition of an increment of space to an existing space. The area of the space is increased. The plan layout or relative location of function spaces (basic variant) remains unchanged.

Addition

The physical addition is such that new function space(s) are created by the addition and the basic variant is changed by the additional function(s).

Addition and Modification

After the addition of new area, the internal organization (basic variant) is modified. Any combination of I, A, A+M are also possible.

Reduction

The area of the dwelling is reduced and the basic variant is changed by the elimination of functions.

There should be some correlation between the physical addition and the change in the list of functions due to growth of the family or the change of their spatial needs. Thus one method for describing the functional program for the core house is to associate functional activity with function spaces (rooms) and relate function spaces to types of change. Using SAR terminology for space classes and room names, such a matrix might appear as follows:

GLS	L	START	I - A	A	A & M	R
SLS	S1					
	S2					
	W					
	K1					
	K2					
	D					
U	T					
	B					
	U					

In order to program change, such a matrix must be plotted for each predicted change in family composition or change in space needs or useage. The physical system must accommodate these changes, with minimal restraints upon the user. An example of such a restraint would be the imposition of one fixed sequence of additions. Restraint is described in detail in section 4.

The types of change described above are generally predictable or classifiable within any specific socio-economic situation. Other types of change which may affect dwelling performance e.g. change due to the introduction of new technology such as the washing machine, are not specifically discussed here. The concept of obsolescense has been treated in detail elsewhere[9]. Such changes may conceivably occur within the life-cycle of one family, however, this is not a problem unique to core-housing.

2.7 Requisite Variety

Questions related to the functional aspects of growth are complex. Whether there exist typical scenarios in any particular socio-economic situation is a subject for research. Generally some assumption regarding the predictability or unpredictability of scenarios is necessary, particularly in urban situations and in cases in which a core dwelling is built and some commitment to the form of growth or to the scale of ultimate growth must be made.

The problem of typification of programmes for growth is typical of any housing program. That is, the diversity of client profiles often runs counter to the tendency to standardize deriving from produc-

tion, managerial or cost considerations. Thus physical provision will either be minimally deterministic on stages of growth and ultimate form, or it will provide a range of variation.

This range of variation wil tend to be limited by technical and cost considerations. So fixing or deciding upon the amount of variety required in any specific program is a matter of some importance. It is assumed that from the point of view of the user, maximum variation and choice should be possible. But this general statement of value has special meaning within the core-house concept.

- Some aspects of programmatic decision with respect to the range of variety to be provided are:

  Initial size: Is there one basic starting dwelling or a variety.

  Degree of growth: Are there several options for maximum growth.

  Differences of type: Shell type (sector groups).

One way in which to treat this problem is to consider the dwelling as successive stages each of which has a common beginning. From a basic or minimal core, each of the successive stages of growth may be a starting point for a different family composition.

With respect to growth, it may be linear, i.e. with one potential variant coming as a result of the addition. More likely to be the case is the situation of transformation through addition. That is, addition transforms the dwelling form; at each successive stage variants of sector group (shell form) or basic variant (plan form) are possible. Therefore , tree-like organization is more likely than linear, one variant, conditions. As di Lullo points out, the potential "fullness" of the tree structure is a measure of the flexibility and choice inherent in any particular approach. Thus, in comparison to the evaluation of supports, in which the number and types of variants in the relationships, Support: Sector Group; Sector Group: Basic Variant; Basic Variant: Sub Variant are the means of evaluating the residual freedom of the user; in the growing house it is the potential complexity of the tree structure which illustrates the freedom of choice to evolve from stage to stage with options at each stage.

All of this refers to spatial planning. Technical factors may impose further limitations of variety.

2.8 Sites

We differentiate in these next two sections between the terms "sites" and "lots". Site is used to refer to the physical characteristics of the building site; lot is used to refer to aspects of size, shape, and density of building area and the definition of rules and agreements related to the territorial rights of the users. That is, lots are connected with normative factors.

Various physical factors of sites may effect the selection of the specific strategy of core housing. Certain of these site factors, such as orientation, effect growing housing more or less as they effect any other type of housing. Others such as slopes or soil conditions may have a direct effect on the possibilities of additive growth.

Site Slope: Given that growth may be achieved through physical additions to building mass, the existence of a level or sloping site, will significantly affect the specific design strategy.

Soils: Soils are considered here as determinants in selection of foundation types. Difficult soil conditions e.g. in certain parts of the Netherlands, where sizeable foundations are required, may necessitate the construction of the foundation system for ultimate growth in the first phase.

2.9. Lots

The term lot, or plot, has particular significance in situations of one lot, one owner as is the case in many core-house projects in developing countries. In projects of multi-family housing the lot becomes a less relevant concept than that of "boundary". In the section dealing with design, we propose a typology of growing housing based upon building types, and here the concept of boundary is introduced as the limit of growth of the building type.

It is important, however, to make some general comments on lots. Interesting work on the subject has been done by di Lullo and later by Williamson on the relationship of lot shape (ratio of frontage to depth) to density, and efficiency of infrastructure.

Lot Shape

A complex factor because it is interconnected with decisions about density and dwelling type as well as directly affecting efficiency of layout. Purely on the basis of these factors, and assuming constant area, narrow frontage lots appear to be more efficient with respect to infrastructure costs than squarish lots[10].

Area

A wide range of lot areas were encountered in the survey of examples. Generally, this depends upon the functions to be incorporated in the residential program. An approximate average range from this study is between 50 m^2 and 130 m^2 for one ownership lots.

For lots of up to approximately 100 m^2, di Lullo proposes the following typology (frontage/depth)[11].

Squarish = 1:1, $1:1^5$

Rectangular = 1:2, $1:2^5$, 1:3

Narrow = $1:3^5$, 1:4, $1:4^5$.

Frontage

We assume that lot width has a direct effect upon building type, particularly with respect to the type of open frontage which exists, i.e. narrow frontages may result in narrow frontage dwelling types such as row houses, or patio row houses. Int he growth models developed in the next section, length of open frontage and potential for growth are correlated.

Standardization of Lot types

Layouts of the surveyed examples tended to provide one standard lot type. However, some cases were found in which there was a small range of lot type -generally, lot area - offered as a choice to the inhabitants.

2.10 Economics

This category represents a large series of factors having potential impact on the core-house approach. We mention some typical aspects.

Range of Options

Factors of cost will determine where in a theoretical range of options a particular program should fit. That is, what is to be provided in the first phase, or should a range of options be offered to the buyer. David Crane's proposal for Sadat City New Town[12] offers the following range of options:

- site and communal services
- basic utility core
- core shelter unit
- core house unit
- expanded core house.

In an additive manner the list provides a greater degree of completion with each stage. But an options range could be much more detailed offering also options of finish. In any case, economic considerations will determine the typical starting point as well as the existence and nature of the range of options.

Tenure

The nature of tenure, whether ownership or rental, will effect the types of options offered. Renters are a special case with respect to the growing house. Considerations of the implications of successive tenancy in growing houses should be the subject of further research.

Market Characteristics

As in any housing situation, the characteristics of the market -size, distribution, variety of clientele, sites, etc. has an impact on the economic logic of any particular proposal for the core-approach.

2.11 Legal-Administrative

This is a particularly problematic aspect of core-housing, vis-a-vis the legal necessity to grant permits and control building, which exists in most countries.

Building Laws

These generally recognize only ultimate size and request permits for all stages of building. This inhibits user initiative; they must somehow be made to conform to the realities of process architecture.

Housing Standards and Laws

Local housing standards may define space standards and dwelling sizes and types in public housing. Such standards will define the potential increments of growth.

Density

The possibility of increasing density through growth and potential subdivision also creates difficulties and must be taken into consideration in overall planning for neighbourhood facilities and services.

Mortgages, Financing and Rents

Financing also becomes problematical particularly where there is a lack of definition of ultimate size.

Covenants

More than one owner sites require covenants or some form of agreement between dwellers concerning rights of use, air rights, etc. within the space reserved for growth. As we shall see in the next section such covenants can be applied either by zones or within zones of growth. New terms must be created to distinguish between space available for growth (territory) and rights of use of such space (domain).

2.12 Related Factors

Not strictly normative factors, other aspects related to local conditions may be connected with normative factors.

Local Building Technique

Local building materials and systems may condition the selection of an approach to the core house or to the ability to provide programmatic options, e.g. self-help-construction, in the process. The technical implications of growth will be discussed in the final section.

Climate

There is obviously a direct relationship between climate, local details, building forms, etc. Climatic factors may condition possibilities and forms of additive growth due to requirements of ventilation and orientation. Furthermore, additive growth places particular demands of flexibility on the exterior wall. In certain climatic situations relocatable walls and details may be difficult or expensive to achieve.

2.13 Normative Factors Checklist

Building Type:

Attached - detached

Single ownership - multi-family

Proximity to ground

Plan Form

Introspective - outward oriented

Compact - sparse

Open - closed

Large - small

Boundaries

Hard - soft

Introvert - extrovert

Rationale

Deferred expenditure

Transfer of responsiblity

Scenarios

Family cycle

Client profiles

Reversibility

Functions

Method of description

Composition : activities list

Composition : activities spaces

Areas

Changes

Incremental addition

Addition

Addition and modification

Reduction

Obsolescence

Requisite Variety

Initial size

Degree of growth

Differences of type

Sites

Site slope

Soil condition

Lots

Shape: frontage - depth ratio

Area

Frontage effects

Density

Layout efficiency: infrastructure

Standardization - variation of lot types

Economics

Range of options

Tenure (ownership - rental)

Market characteristics

Legal Administrative

Building laws and permits

Housing standards and laws

Density (growth services and facilities)

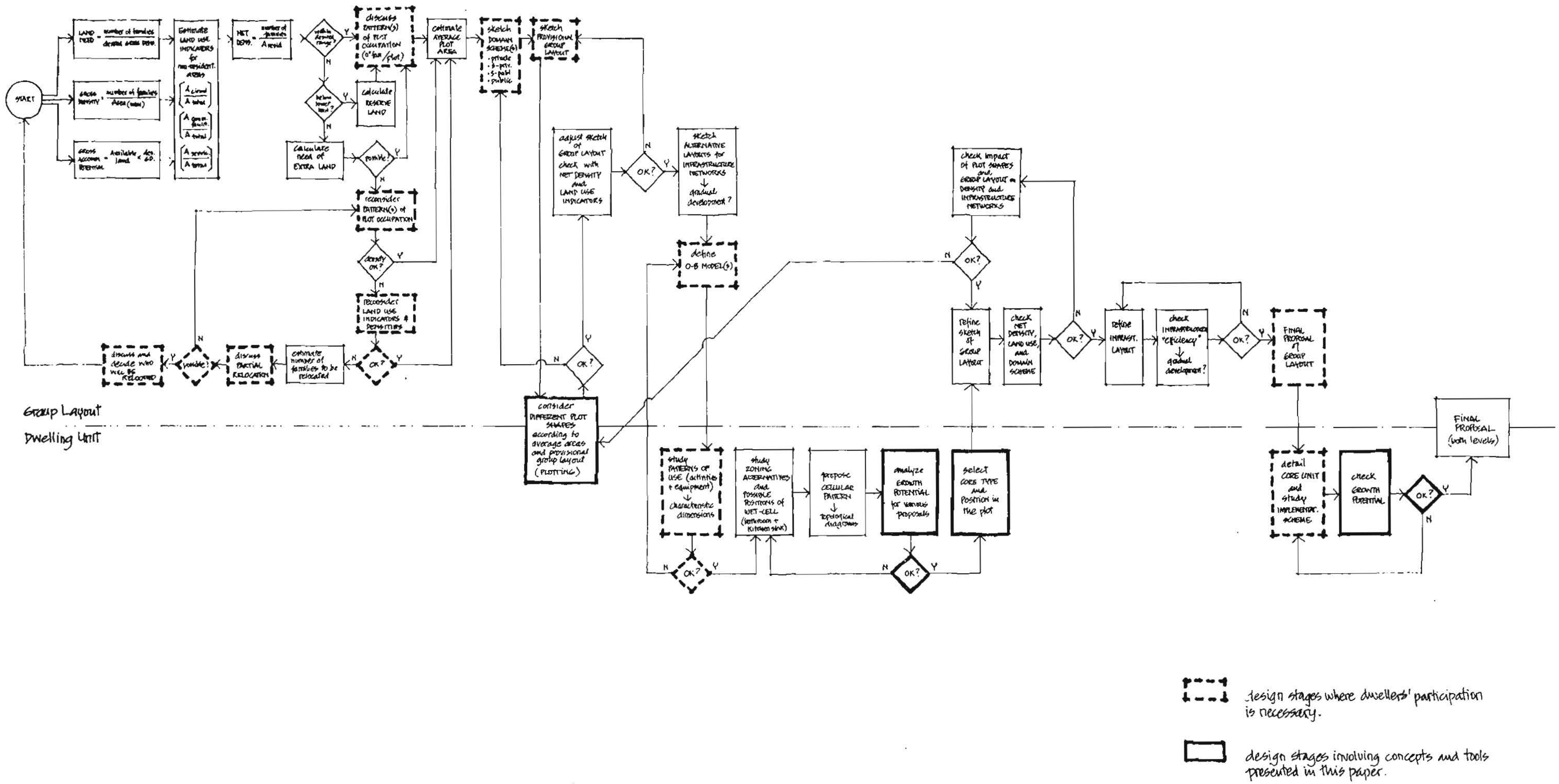
Mortgages, financing and rents

Covenants, territory and domain

Related Factors

Local building technique

Climate (orientation, ventilation and materials)


START
calculate need of EXTRA LAND
calculate RESERVE LAND
possible?
density OK?
calculate AVERAGE PLOT AREA
sketch DOMAIN SCHEME(S)
sketch PROVISIONAL GROUP LAYOUT
adjust sketch of GROUP LAYOUT check with NET DENSITY and LAND USE INDICATORS
OK?
sketch ALTERNATIVE LAYOUTS for INFRASTRUCTURE NETWORKS
gradual development?
define O-B MODEL(S)
discuss PARTIAL RELOCATION
consider DIFFERENT PLOT SHAPES according to average areas and provisional group layout (PLOTTING)
refine sketch of GROUP LAYOUT
check NET DENSITY, LAND USE, AND DOMAIN SCHEME
refine INFRAST. LAYOUT
FINAL PROPOSAL of GROUP LAYOUT
Group Layout
Dwelling Unit
FINAL PROPOSAL (both levels)
propose CELLULAR PATTERN
analyze GROWTH POTENTIAL for various proposals
select CORE TYPE and position in the plot
detail CORE UNIT and study IMPLEMENTAT. SCHEME
check GROWTH POTENTIAL
design stages where dwellers' participation is necessary.
design stages involving concepts and tools presented in this paper.

3. DESIGN FOR GROWTH

3.1. Introduction

In this section we consider the problem of designing for growth. The goal is to explore the use of SAR-methods and tools as an approach to the design for the growing dwelling. This research focuses upon the application of the core house principle in situations of multi-family housing. That is, in contrast to much of the work which deals with the core house principle applied in detached houses, this work considers the problems of growth in the multi-family, medium density situations which are characteristic of much western mass housing. Consistent with the findings of previous research, the present research emphasises the core house approach in low-dense, multi-family housing. Our previous research indicates that this appears to be a building type appropriate for the growing house principle. Secondly, this building type theoretically offers a logical compromise between the pragmatics of mass housing (density, concentration and cost) and the promise of environmental quality. This is an area in which the attributes of the core house may make good sense, that is, by providing the economies associated with core housing and the freedom of the right to build - but in a medium density, low-rise, multi-family situation. Finally, there is little theoretical work in core housing and virtually none in this specific area, an area so promising for its potential for development.

The section is divided into several parts. The first, 3.1, introduces some basic definitions of the morphological possibilities of growing dwellings. Section 3.2. continues these definitions with reference to the plan form and its implications for growth. Section 3.3. introduces the application of the SAR-method as a tool in the design of growing housing; throughout section 3 these ideas are developed. Section 3.3 also proposes a typology of growing dwellings deriving from the classification of growth zones in various building types. This is probably a realistic approach. Since the growing house includes spaces reserves into which it is possible to grow, zoning provides not only a means for describing and ordering these space banks, but a means for communicating and writing

rules about their use. The typology is illustrated by design works of students of the Design Methods Group, T.H. Eindhoven, who have developed projects based upon various of the building types.

The typology describes elementary units of growth which are single-layer, and include the growing principle of the building type. Section 3.4 discusses problems of combination and superimposition of the one-layered types, and their relationship to models of urban tissue. Section 3.5 considers the incorporation of these concepts and types within the methodology of SAR. Finally, in 3.6, certain design related subjects such as rule writing and the visual qualities of growth are considered.

3.2. The Morphology Of The Growing Dwelling

- We may assume that a core dwelling consists of four parts: a core space or dwelling which is provided for immediate occupancy; a field, or the reserve of space into which the core may expand; growth elements, which are constructed in the field; and a boundary which in some form limits the possibilities of horizontal and/or vertical growth. Using these four elements we may begin to discuss certain morphological possibilities which treat of their relationships.

  Isotropic growth

  Building plans are generally not isotropic. Orientation and the character of plan organisation tend to assume directions. Furthermore, the clustering of dwellings into dwelling groups or buildings tends to limit frontage. Therefore we may generalize that housing plans are not isotropic but that direction, orientation and frontage have significance. We may also assume that there is a relationship between plan form and growth potential, and because of this, isotropic growth is probably the exception in housing.

  Directionality

  We assume that plans have directions or orientations, and these orientations, determined by exposed frontage and the usually parallel circulation ways, denote the major axis of the plan. Growth in plan will either continue the circulation pattern or

add new elements to it. But in either case, growth responds to plan frontage, i.e. it extends the α-zone or adds on to it in some way, or it creates a new α -zone, that is a new zoning diagram. So directionality is a term which helps us to think about the nature of plan form and the potential for growth.

Continuity

This term refers to the physical continuity of floor levels in section. Additions may be either continuous or discontinuous in level. Additions to an α -zone can either be extensions of the axis or, if they are in the other axis, they may have to be discontinuous in section.

Contiguity

This term refers to the existence of physical connection between the core and the extensions in the field. The extension may be added to the α-zone, in which case it represents contiguous growth, or it may create a new α -zone in which case it represents discontiguous growth.

The Vertical Dimension

Up until now we have considered the characteristics of horizontal extensions to one storey dwellings. An assumption of this work is that one of the differences between the idea of a house as compared to that of an apartment is the ability to extend, modify and personalize the external surface of the dwelling; and that this ability is, among other things, related to the attachment or proximity to the ground. The vertical section of the building is therefore relevant to the growing house. With respect to unstructured growth, that is growth for which physical structure is not built in the first phase as it is, for example, at Hollabrun, there is probably some reasonable limit of distance from the ground which makes spontaneous, unregimented growth easily possible. If we assume that the building section contains more than one ownership, and that ease of addition and personalization decreases with distance from the ground we can conclude, as has been corroborated in our research, that an ideal multi-family section for growing houses would contain a maximum of two ownerships, none of which was more than one storey from the ground. Taking into consideration that both single level and multi-level dwellings are possible; and that both vertical as well as horizontal growth are

possible, the number of theoretical section which satisfy these criteria of proximity to ground are still considerable.

3.3. Plan Form and Growth

Is there a connection between plan form and the ability to grow; or are other factors such as size more important; and how do we evaluate the ability to grow. Let us consider these questions relative to the following terms: plot type, building type, frontage, plan type, zoning.

All other things being equal, there is evidence that size is an important factor with respect to adaptability[13]. In the case of plot size and proportions, there is generally a conventional relationship between building type, plot area and geometry. This generalization probably applies to all building types. Much of the available research is devoted to the plot form /plan form relationship in single ownership lots. Some of this research points to the logic of minimalization of lot frontage for reasons of efficiency of utility runs and infrastructure distribution [14]. In compact dwellings, i.e. without courtyards, we may assume that there exists a relationship between frontage (exposed exterior wall), plan zoning as a response to the form of frontage, and the way in which dwelling circulation patterns are integrated with zoning patterns, since the axes developed in the circulation diagram form a framework for the expanded dwelling. Thus we may postulate a positive relationship of plan form between:

frontage: zoning: circulation: expansion

Furthermore, we can assume that if size does affect adaptability in the case of growth, then all other things being equal, growth potential tends toward longer frontages, while infrastructure costs, as well as other costs, tend toward the limitation of frontages.

This is of course a broad generalization. What is significant is that we begin to recognize the relationship between the zoning pattern (and the related circulation pattern) of a single layered plan and the growth potential of that plan. What is implied here is that growth will maintain the integrity of the zoning principle (zone-

margin diagram) even, if the spatial uses (basic variant) are modified as a result of growth. That is, we assume that from a theoretical point of view, growth is a form of transformation in which the successive stages of development may be seen as a connected sequence. In the language of SAR we may restate this as follows:

> Growth is probably causally related to the zone-margin diagram (the spatial and circulation schema of the plan); to the sector group (the overall shape of plan envelope); and to the basic variant (the functional notation of utility of the zoned plan). But the zoning diagram will tend to maintain its integrity in all stages of the plan's development. Therefore, zoning diagrams may provide a convenient, if diagrammatic, way of studying the relationship between plan form and growth.

Given these assumptions we can already make certain distinctions relative to plan form and growth. One distinction involves plans possessing β-zones as compared to plans without β-zones. In climatic conditions such as those prevailing in Israel, there is a tendency to rely on natural ventilation and to minimize β-zones. Utility spaces and kitchens tend to be located in α-zones. Utility spaces and kitchens are equipment-oriented and generally sedentary. Therefore the zoning diagram, particularly distinctions between α-α plans, α-β plans and α-β-α type plans is related to both growth potential and the form of growth.

A second broad distinction of plan types are compact plans (minimumα-zones) and extended plans (maximum α-zones) such as atrium houses or row patio houses. The growth characteristics of these types will tend to be completely different just as the character of spatial zoning is distinctly dissimilar.

Is there a method for the study of the growth potential of plan types. We can describe growth as the evolution of basic variants through successive stages of development each stage adding a new function space, and the whole being organized in the form of a tree. Both the breadth of the tree (number of modified variants per stage) as well as the openness of the path system (number of alternative possiblities for development per stage) can be taken as

a measure of the extensibility of the plan, and of the degree of freedom of the users to choose their own course in time.
The student projects offer examples of the tree of growth as a tree of choice. The tree provides a conceptual framework for exercise another kind of choice. The respective participants - developer, designer, constructor, user can select their level on the tree. That is, the contractor may select to build only the apex of the tree and let the rest be developed by the users. Or he may decide to enter the tree at a more developed level and to provide a wide range of variation of types for sale.

3.4. A Typology of Growing Dwellings

In this section a classification is proposed which applies the designations and techniques of SAR 65 (supports and detachable units: building level) and SAR 73 (urban tissue). Given that both documents utilize the description of an abstractive spatial order of the built environment as the premise of the method, we have applied that form of convention to the problem of growth. That is to say, we have used the principle of organization of space into zones and margins as a basis for describing the potential field into which a dwelling can expand. Not only does the zoning principle offer a convenient language for handling the problem theoretically, but also, as we will discuss later, it offers a framework for communicating about the rules of use of the space reserves into which the dwelling grows. Thus both the conventions and the intentions of SAR appear to be most appropriate for the problem.

The classification is conceived as a means of communicating about the various types and analyzing their capacity to grow on the basis of characteristic plan types per building type. Consistent with the emphasis of this work upon prismatic (single-layer) growth in multi-family configurations, building type is the basis upon which the classification is performed. This enables us to limit the number of types and to order them according to the number of directions of potential growth characteristic of a dwelling in a particular building configuration. That is, building types can be classified by the morphological characteristics of frontage and their directions of extension. The classification assumes that the dwelling grows

out from a core, and no attempt has yet been made to include the large range of types which also grow inwardly.

The typology is based upon the relationship between the core dwelling, its field of growth, and the boundary which limits that growth. The core dwelling is the dwelling which may be occupied when the contractor leaves and the user assumes responsibility. The field, or field of growth, is that spatial reserve into which the dwelling may grow. This can be expressed as an organization of spatial zones and rules for usage of the zones can be agreed upon. The boundary is the physical or non-physical limit to growth about which rules may be written in order to characterized kinds of limits to growth as types of boundaries. For example a boundary may be an absolute or a relative limit about which an if/then statement may be written.

The Growth Models

The growth models are building types which have predominant directions of growth as follows:

- 1 directional growth
  linear organization; 1 frontage

- 2 directions; opposed sides
  linear organization; 2 frontages

- 2 directions; perpendicular relationships
  rotational organization; 2 frontages

- 3 directions; paired units
  reflected organization; 3 frontages

- 4 directions; free field
  4 frontages.

Three types of zones are used to describe the types and subtypes. These designations treat the growth models as elements in tissue models in which :

B = The Core

OB = The Field; part of the field which will be primarily built

O = The Field; part of the field which will be primarily open.

In fact, we can probably be more detailed in our description. For example we may say:

O will occur only between B and OB, or O is in fact a B/OB margin.

O zone, outside of the boundary may be added in the tissue model.

O or OB zones may be incorporated once or more within B zones. This would cover atrium and patio house types.

It should be possible to superimpose different subtypes within a type.

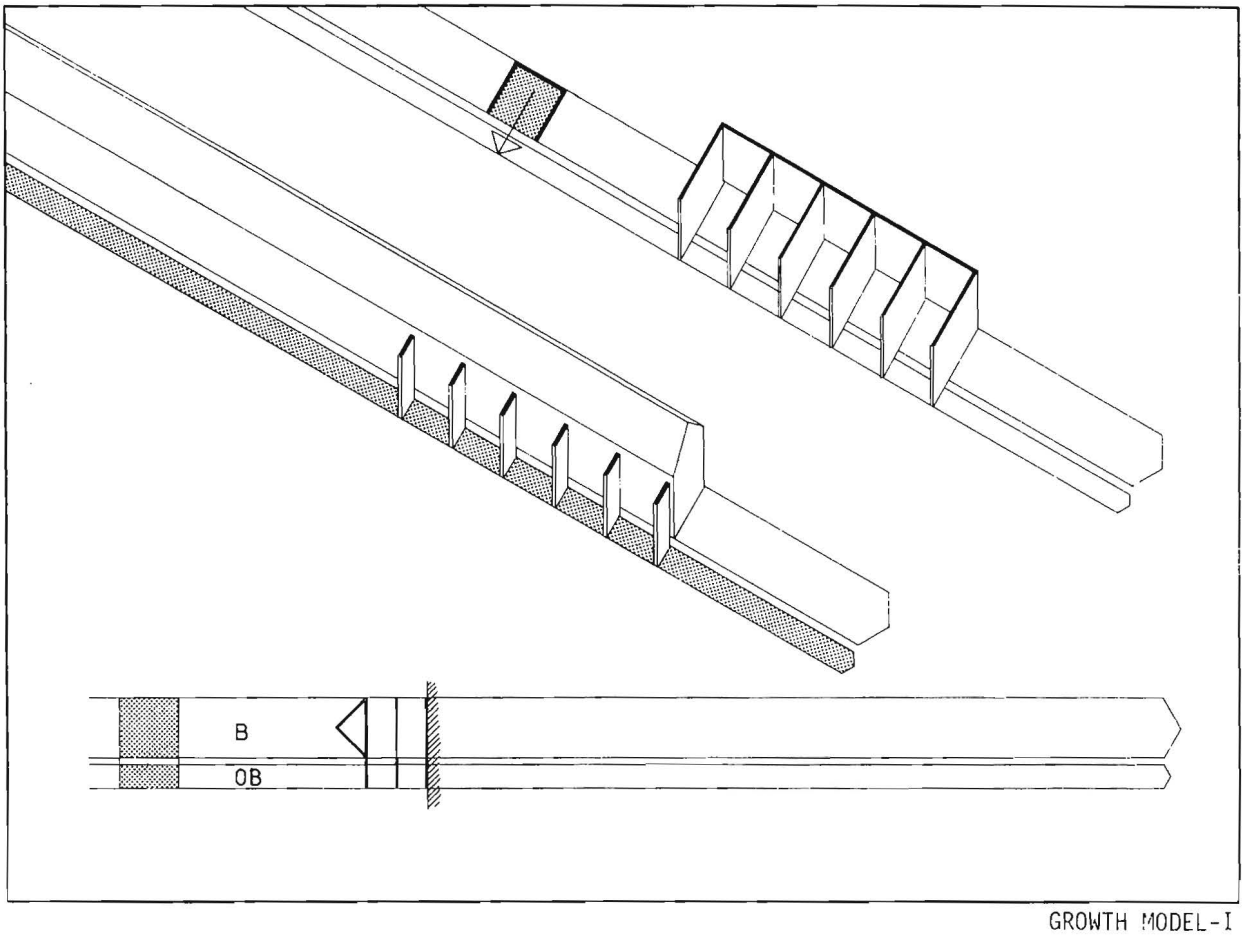
OB zones may be multi-zoned when the growth model is transformed into a support diagram.

OB zones may be or or both, depending upon the tissue model.

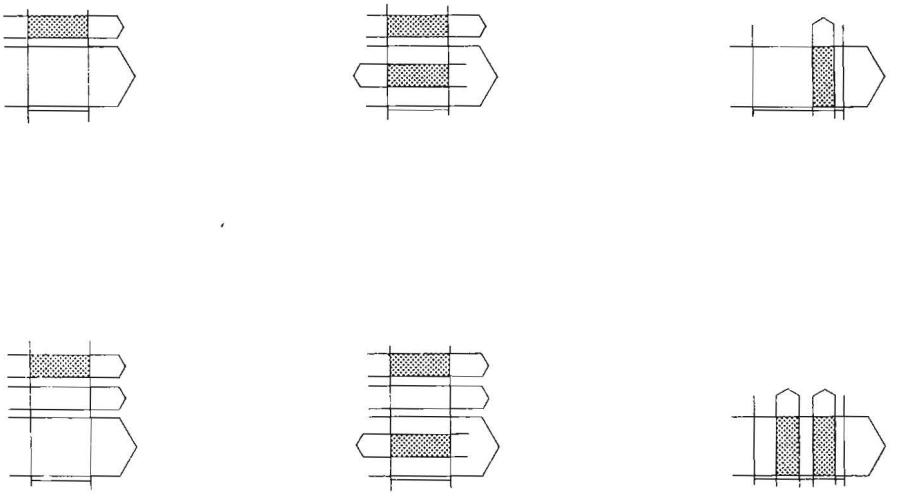
Another way of understanding the types is that the B and OB zones have a margin between them. This is what we have referred to as the O zone. Growth may be in the OB zone, the margin, or both. The models are then elaborated by the introduction of a more specific series of rules, e.g. "B zone can be used for 60% on the ground floor; for 40% on the second floor."

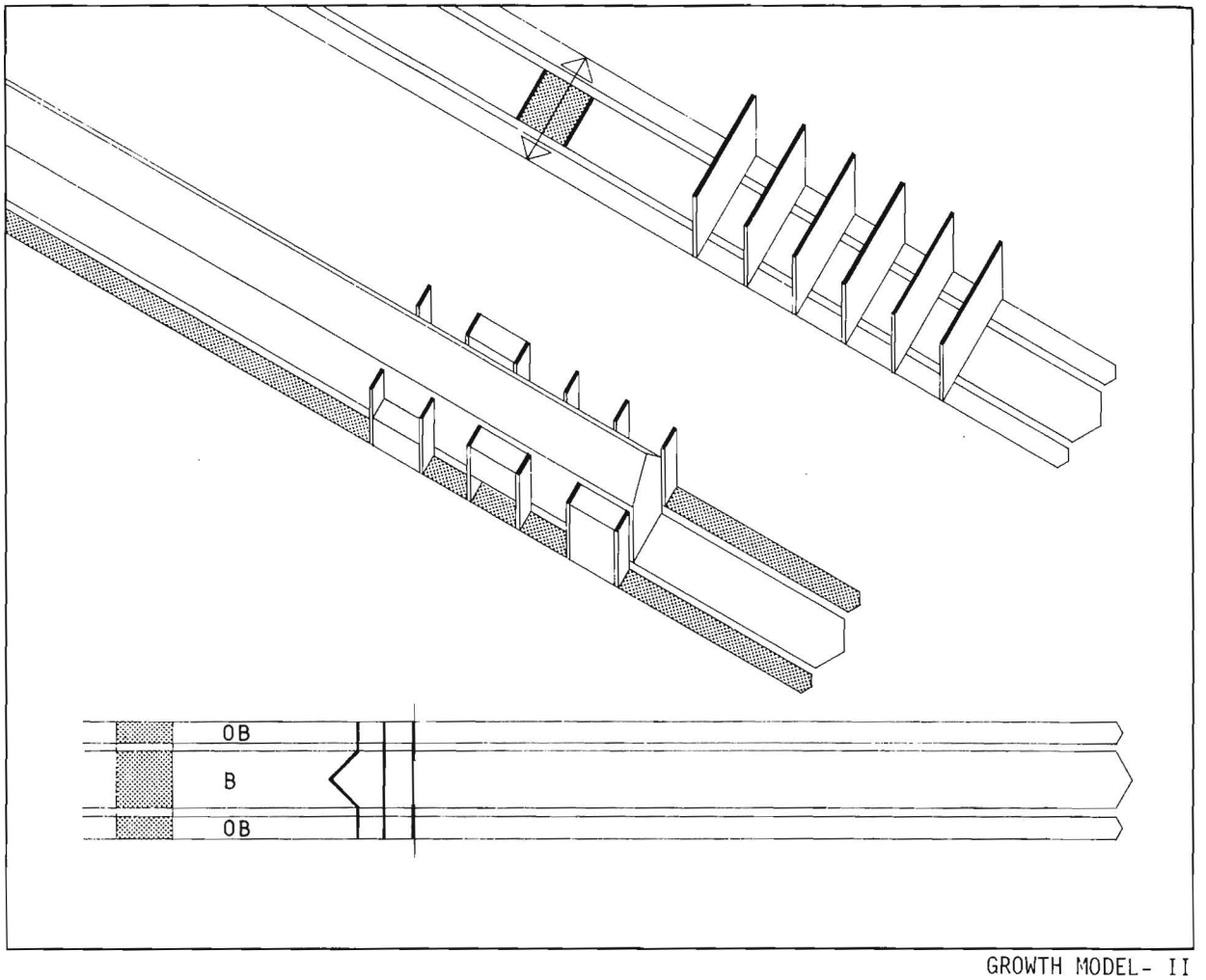
Growth Principle

Only when the growth model becomes part of a tissue model can we talk about the growth principle. The growth principle is the set of rules for the use of the growth model. It tells who, how, and how much of the field may be used. But only when the tissue model is complete can rules regarding the boundary be written. Since rules of boundary may be written in such a way as to permit the used of space beyond the boundary, e.g. as air rights, the growth principle becomes clear only when the tissue model and the rules of boundary are decided upon.

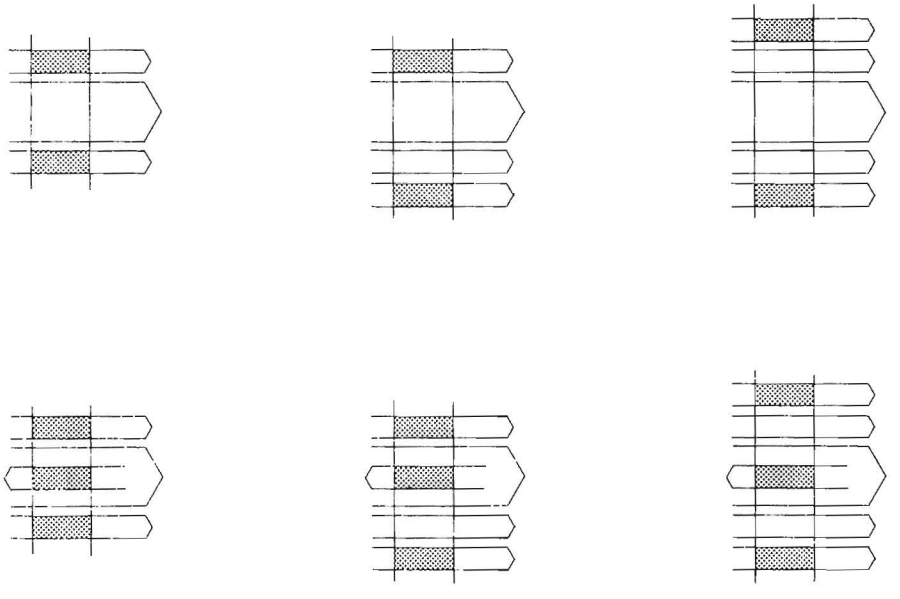


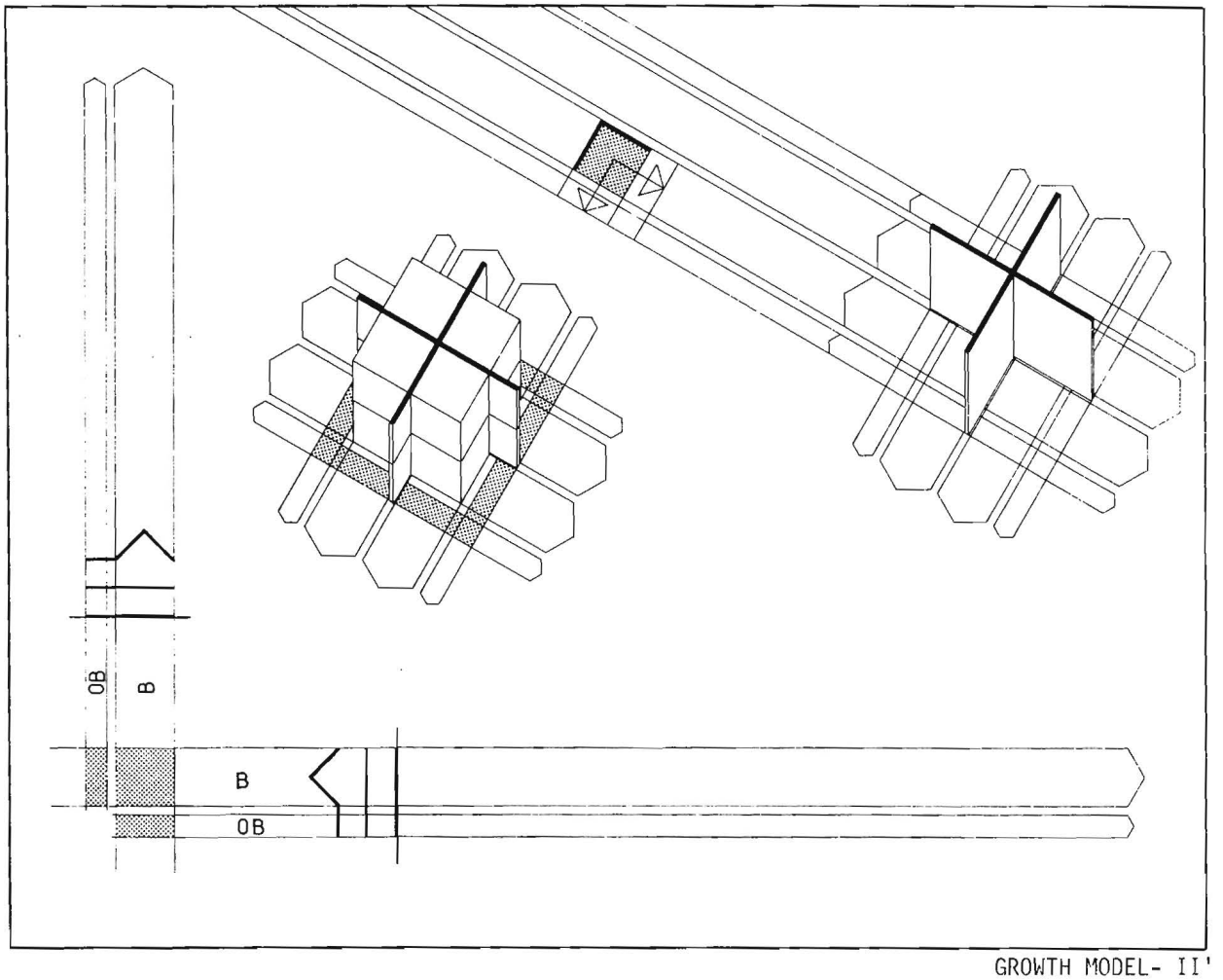
GROWTH MODEL-I



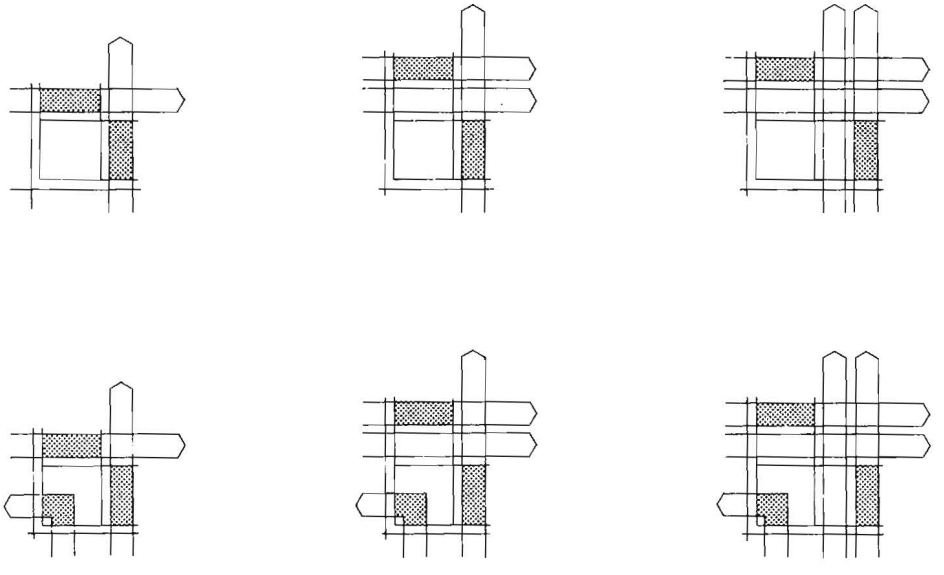


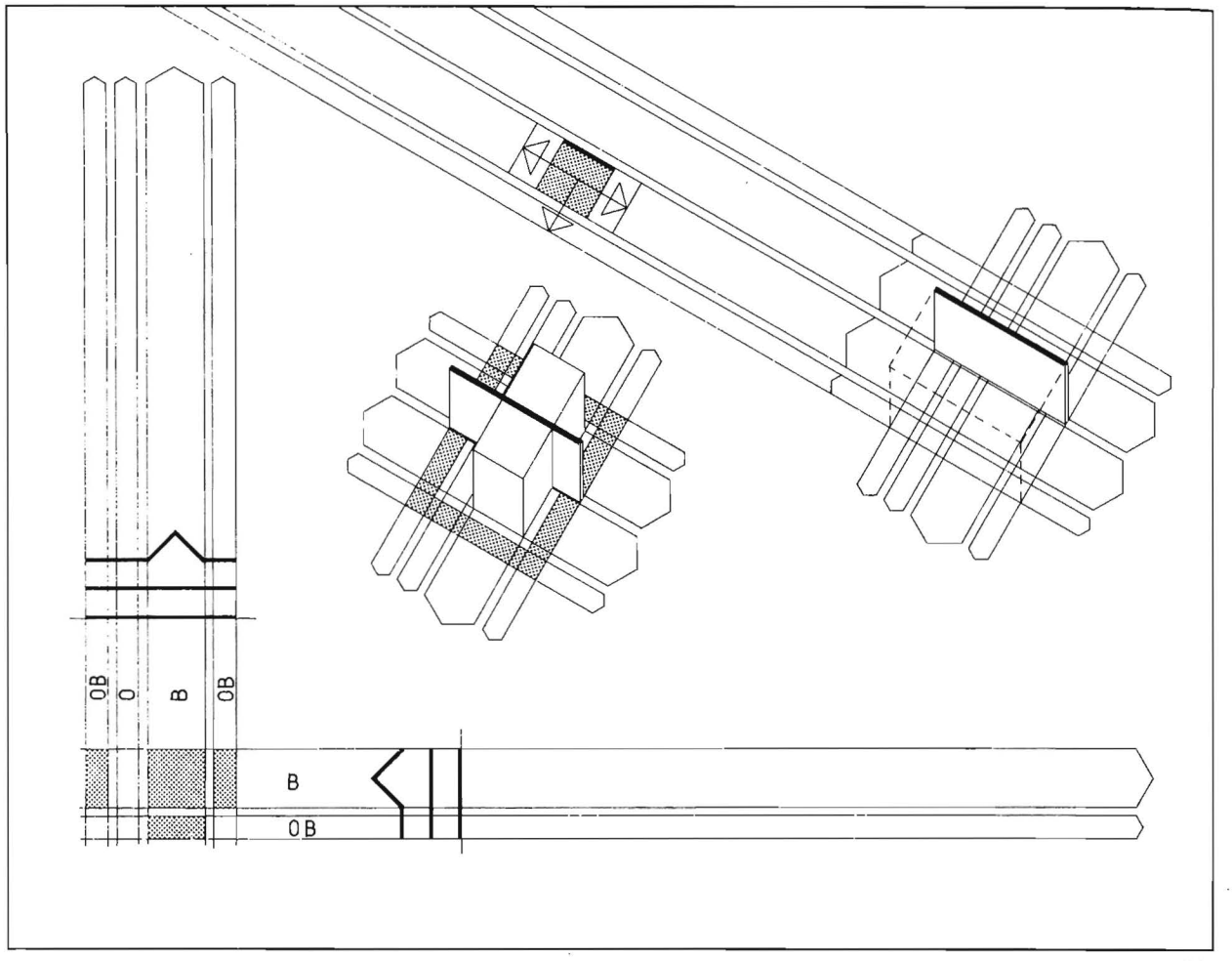
GROWTH MODEL- II



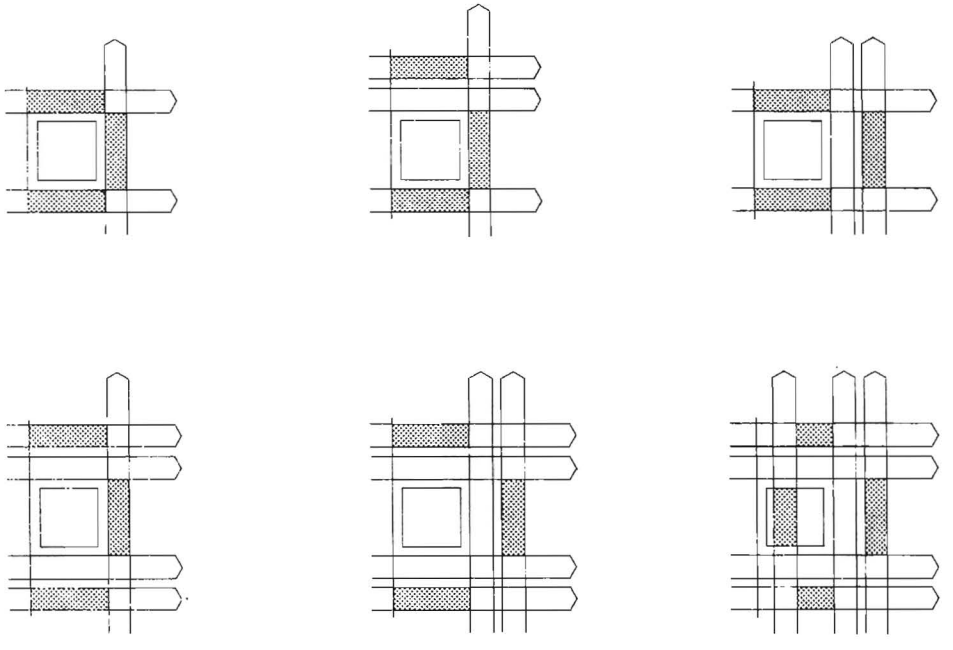


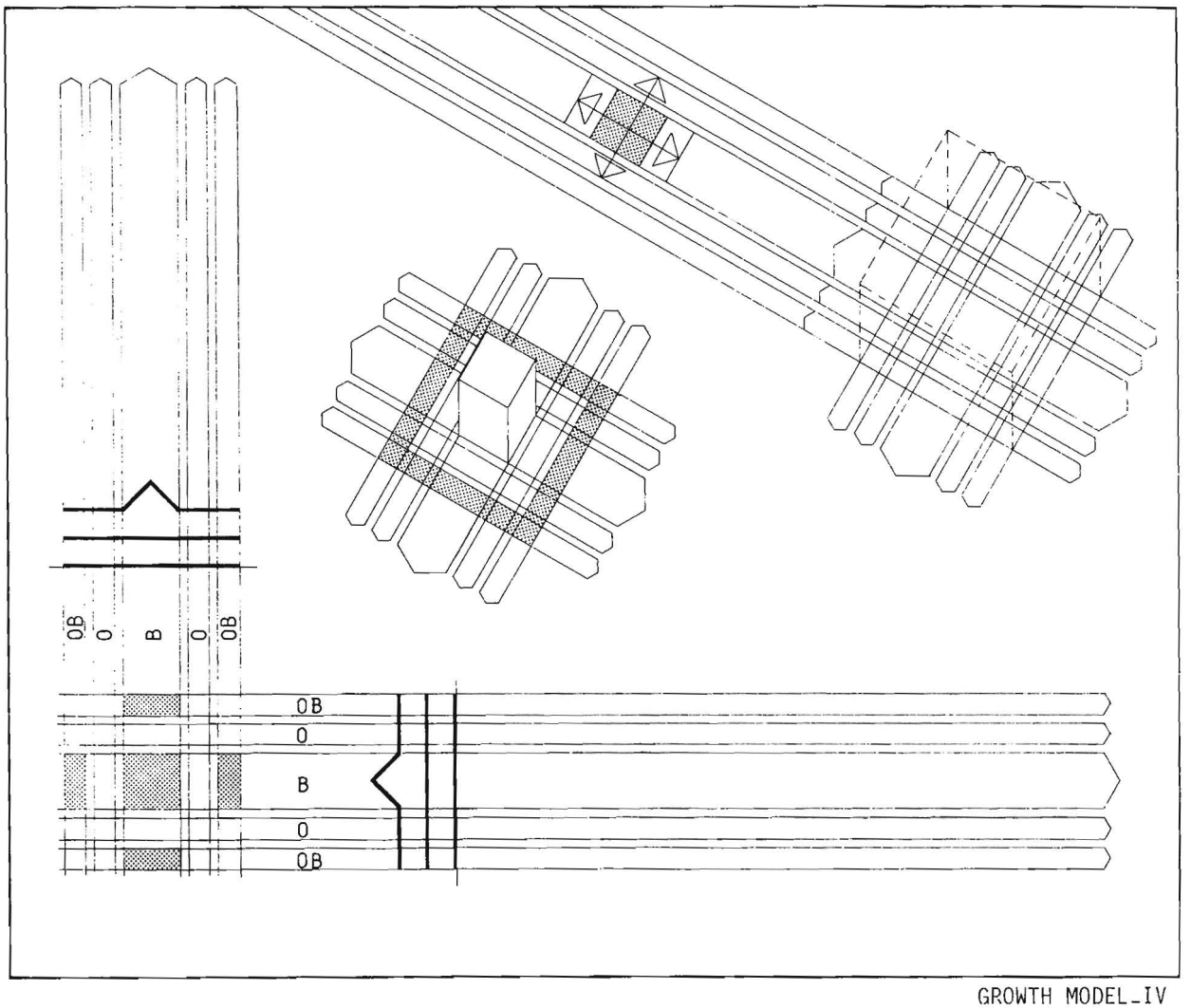
GROWTH MODEL- II'



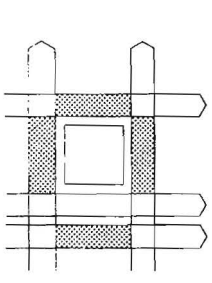
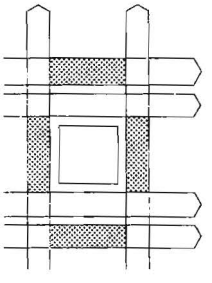
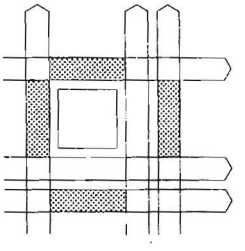
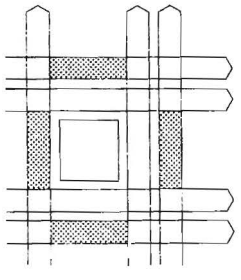
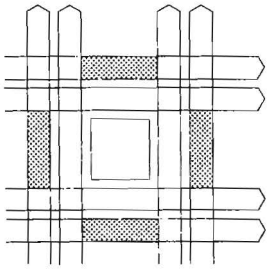
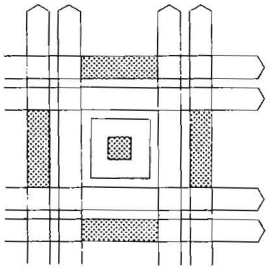


GROWTH MODEL- III





GROWTH MODEL_IV

Within any growth model the growth principle defines how the model may be used. It defines the relationship between core and field, the form of the first build, the direction of growth, the use of the horizontal and vertical dimensions, the rules of boundary, and potentially the agreements between neighbours regarding territorial rights. Therefore the growth principle is the agreement which limits the possibilities of growth and it is also the limit of theoretical variation.

3.5 Building Types and Characteristic Forms of Growth

Do these types exhibit certain characteristics of growth? The following analysis of the types is schematic and consists of a suggested research approach to this question. The dwelling types are analysed for the possibility of extension. The analysis utilizes the SAR method in the following steps:

- The Zoning Spectrum
- Zoning Type/Building Type
- Preferred Functional Locations
- Analysis Of The Types

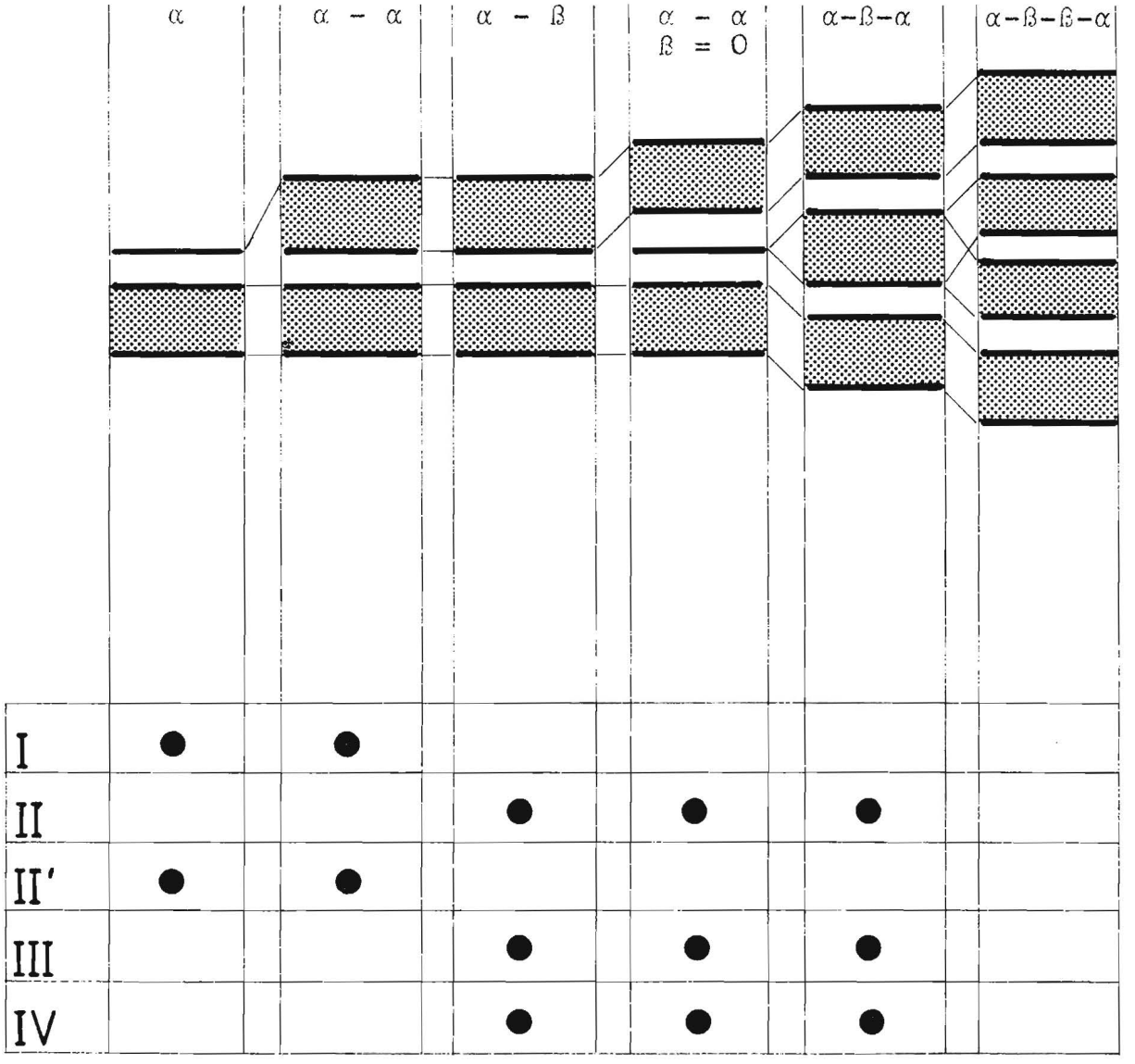
The Zoning Spectrum

The first step was to establish probable zoning diagrams for each plan type. This is demonstrated graphically in a spectrum of zoning diagrams connect ing in order 1, 2, 3 and 4 zone diagrams. Within the spectrum a matrix is created which places the building types in their probable relationships with zone types. This assumes that these are the five basic organizations of zones in supports and the five basic support types. There are thirteen resulting zone diagrams (undimensioned) and the remainder of the analysis is based upon these zoning diagrams.

Zoning Type/Building Type

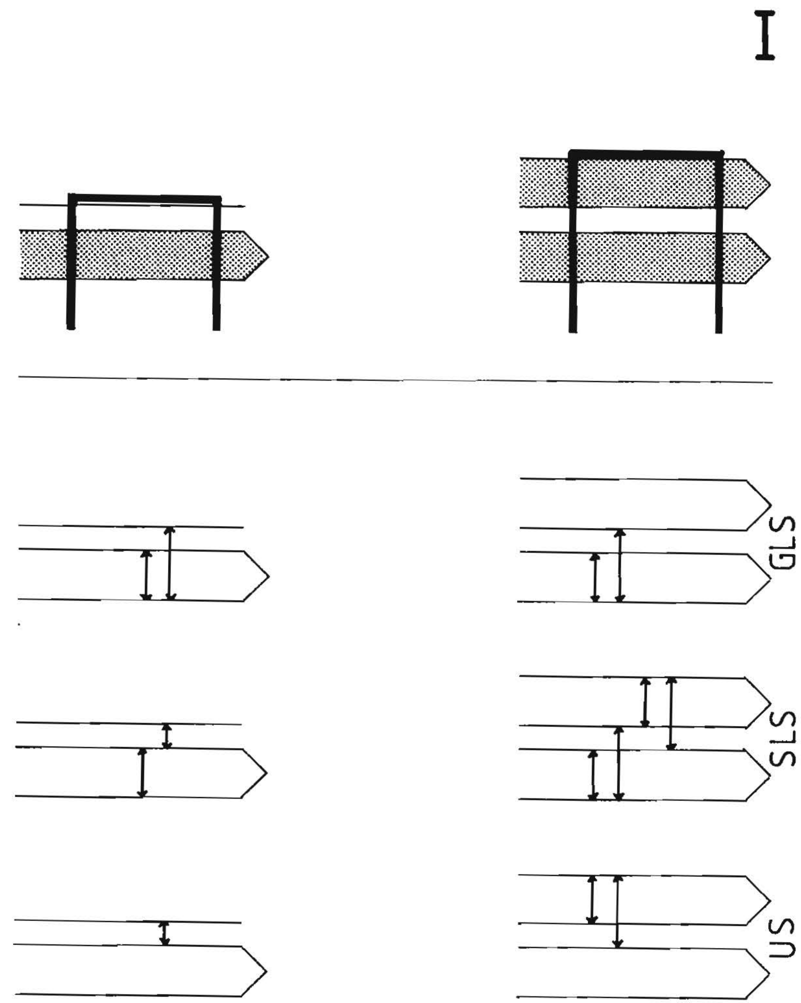
These are the thirteen variants of zoning of the study core dwellings.

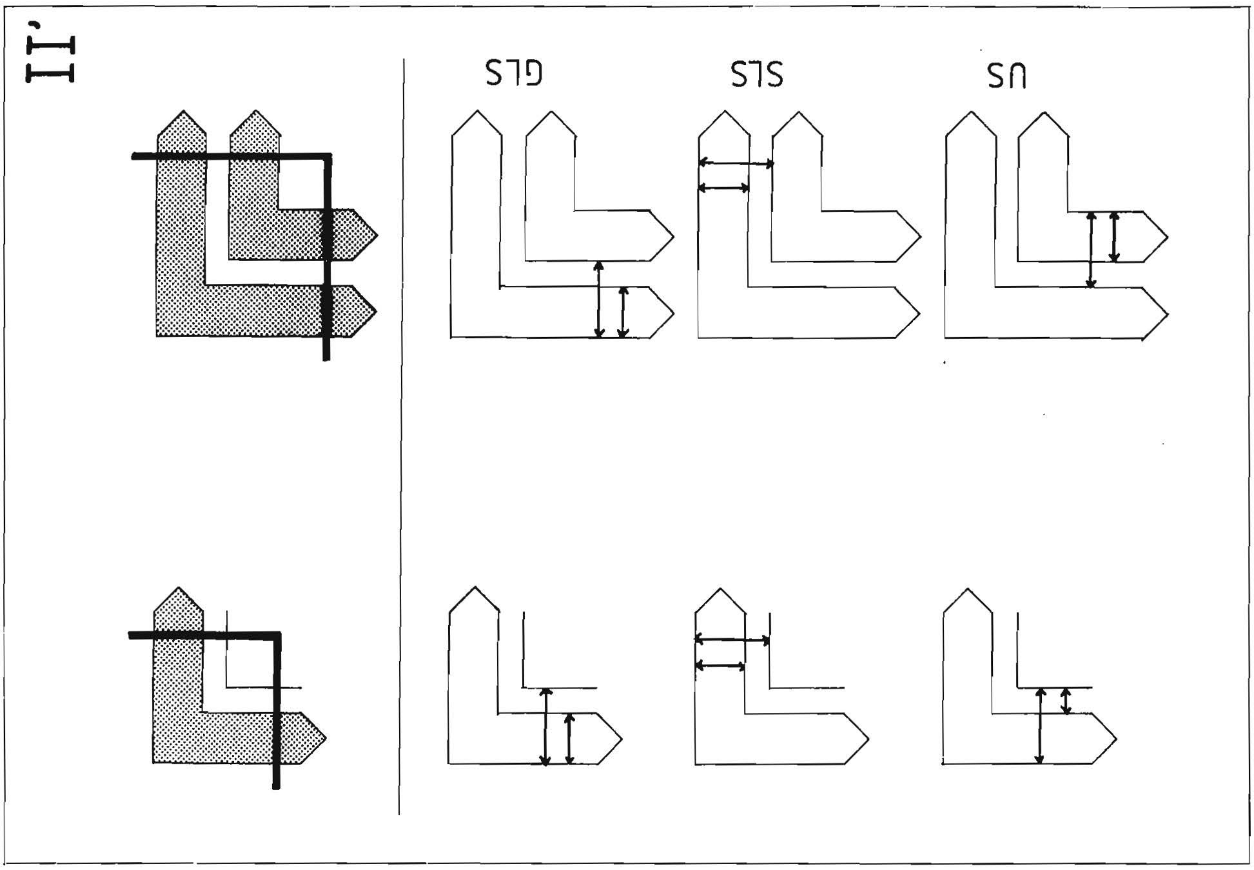
THE ZONING SPECTRUM

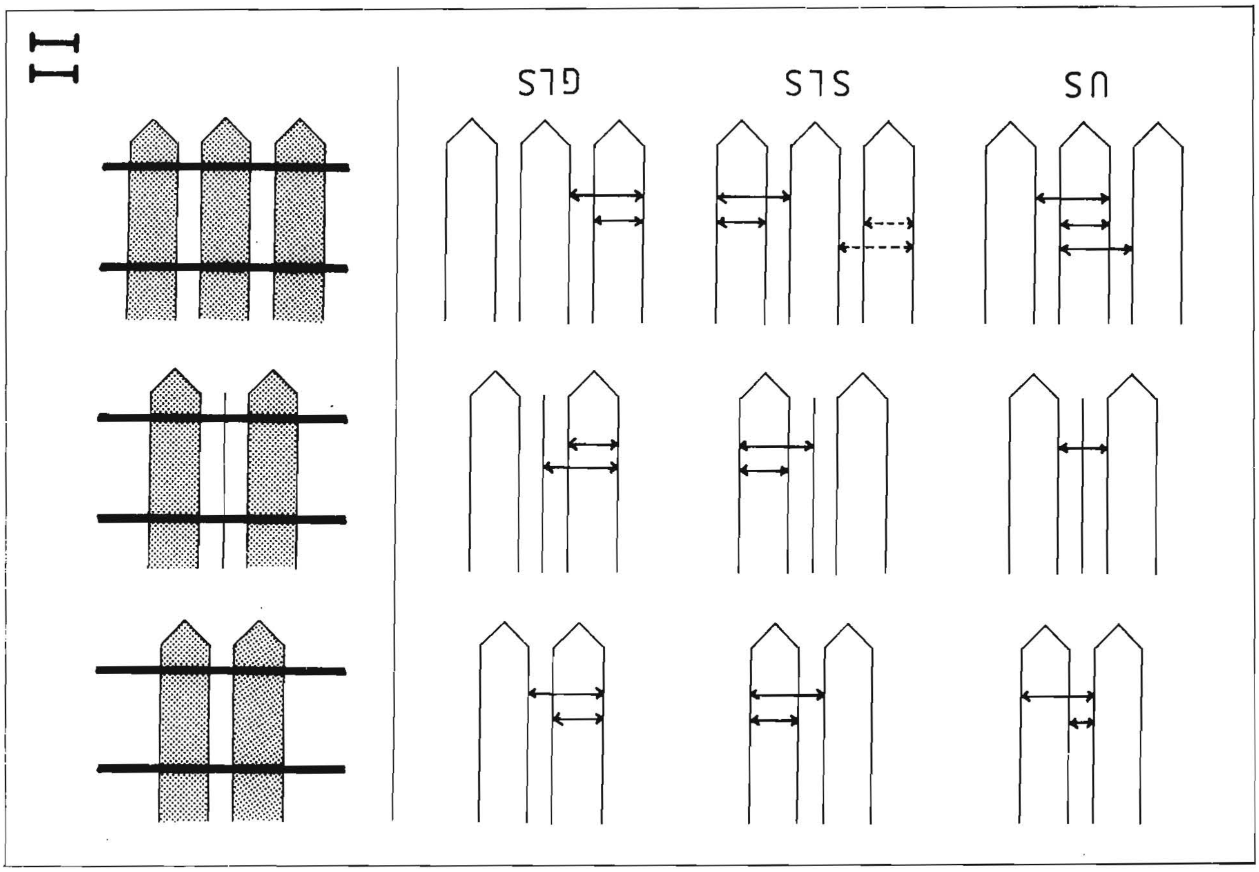


● = possible zoning diagram / building type

PREFERRED FUNCTIONAL
LOCATIONS
BY GROWTH MODELS




II'
GLS
SLS
US


II
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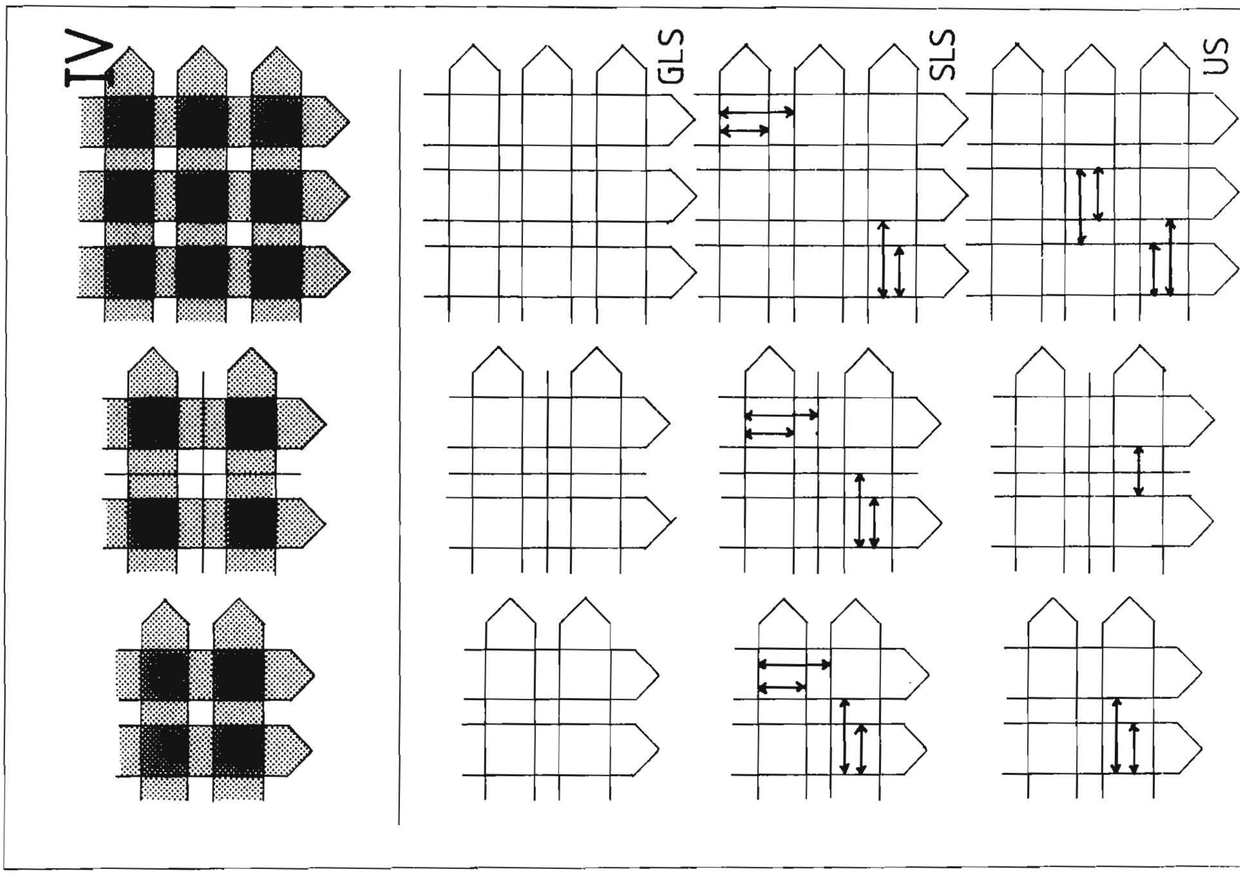
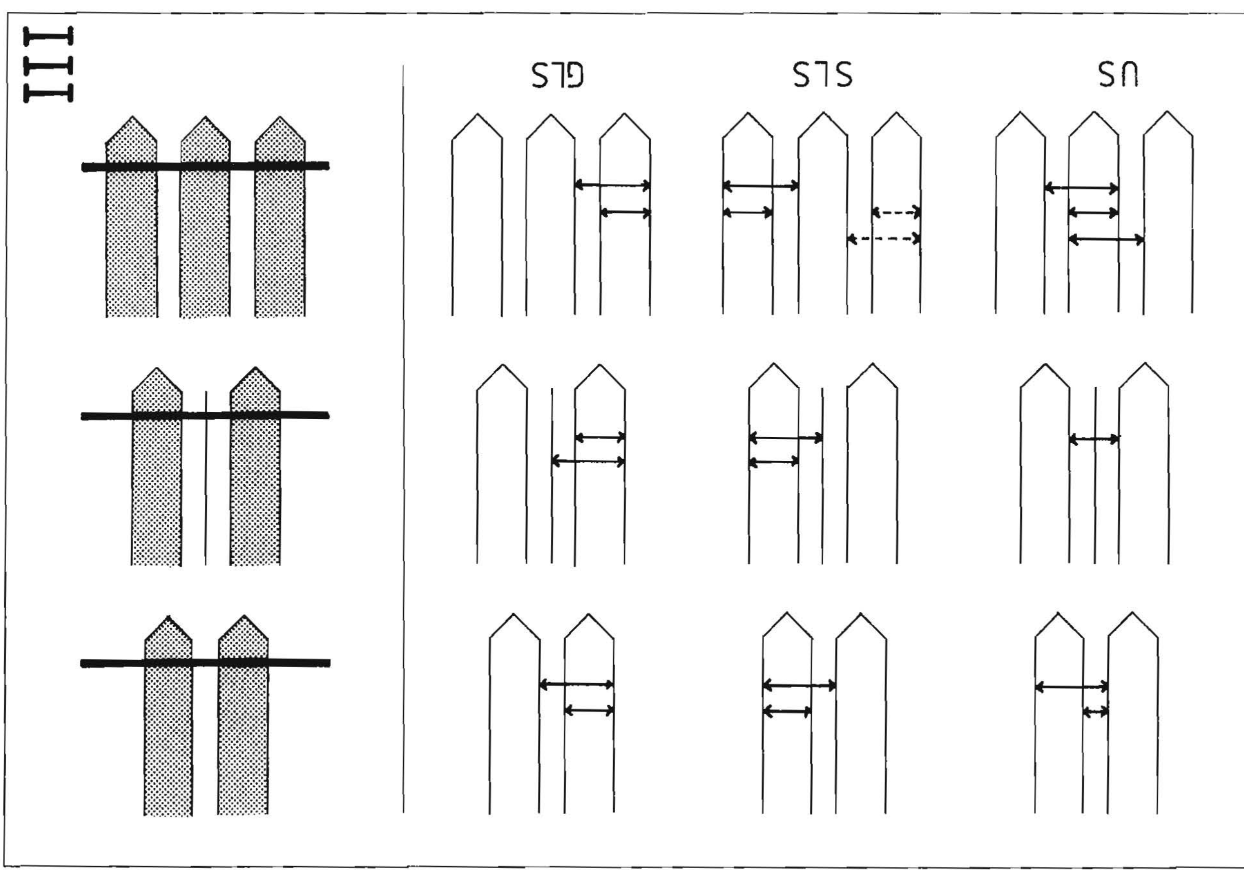

IV
GLS
SLS
US


III
GLS
SLS
US

Preferred Functional Locations

Preferred functional locations of functional space types are plotted within the zoning diagrams. The study assumes the existence of the space types according to SAR 65: GLS, SLS, US.

The Analysis of Plans

Type I

Type one is a one-frontage dwelling. It has two subtypes which are differentiated by the existence of an interior zone. That is, the two types are with or without kitchen and utility spaces in the α-zone.

The obvious limitation of this type is the existence of one direction of growth. Except for small incremental additions which might be made to the α - zone there exist two possibilities of horizontal growth, parallel to theα -zone but with an intervening court space, or as a leg running perpendicular to the α -zone. In both cases the form of the plan becomes strongly bifurcated. Except for points of potential connection to the core being possibly more numerous, the types are not appreciably different with respect to growth potential. Both are limited by the length of the original plan and the functional wisdom of creating a modification which attenuates the circulation diagram of the core. In all cases, this is not a good type in situations of cost or climate in which a compact plan is desirable.

Type II

The two frontage dwelling is found in row housing in which there generally is a limit to the frontage dimension. Such plans are often functionally zoned (day-night/public-private) from front to back in one-storey dwellings or by floor in two-storey dwellings. This type is most commonly encountered in the literature of core housing, possibly because it naturally combines the ingredients of individual freedom and the medium density of close aggregations. The two-storey plan works extremely well for achieving growth on both sides on both levels by adding to the building mass. One-storey plans have the problem of the form of functional zoning which may make additions somewhat remote from the opposite side of the plan, but in general the options provided by growth in two directions appear to offer greater flexibility than in type I.

This type is often found in patio-type core housing in the Third world in which both vertical and horizontal growth is possible. What of the additional possibility of the core expanding to the side before, or in addition to, its expansion front and back. An example of this is the Egyptian EMAD project[15] in which transverse zoning into alternating bands is used to define core and field. This form of transverse zoning into various types of transverse band systems offers certain interesting possibilities. The first is that the original lot type may be made of various combinations of A and B bands thus offering choice and variants for the first build. The second attribute which can be applied to the transverse band is that of reversibility, that is, a zone which can belong at various stages to either one of the two neighbouring dwellings, Ref. Section 1.6.

From the point of view of our typology such dwellings can grow in three directions and are considered under type III.

Type II'

This is also a two orientation dwelling. The orientation are at right angles to one another. It is a common plan type in point blocks with four, six or eight dwellings per floor. Subtype II'-b is the most common type with wet core and utilities located in the interior zone. The plans tend to be functionally zoned (day-night/public-private) by the orientations and is, in this respect, similar to type II. Its growth characteristics are also similar with the exception that, given the shape of the plan, extensions may be somewhat closer to the core than in the type II narrow frontage plan.

An interesting variation on this type is shown in the student projects. Not only is a two level type presented, but a zone of "passive growth" exists between the units. Active growth is defined as the volume and floor area which can be added to the dwelling at its exterior elevations. Passive growth is the area existing between dwellings which may be acquired by either neighbour. This latter form of growth, in width as compared to length, tends to continue the pattern of circulation in the extended plan with no need to cross the α-zone.

Four-directional growth is analysed more fully in type IV.

Type III

A three-orientation dwelling known as a two-family house or "two under one roof" in the Netherlands. In practice, this type is often connected with the garage or storage forming the joint between the two-family houses. Thus this type has all of the advantages of the two-sided growth of type II plus the additional possibility to increase the width in the direction of zoning. The subtypes differ with respect to the existence of an interior zone (K, T and stairs are the usual uses for this zone).

From a theoretical point of view this is an excellent type. The core plan has a clear orientation and potential expansion of all zones including the interior zone (compare with type II). Furthermore it provides an area between adjacent dwellings which is potentially reversible. This type is also suitable for large scale growth.

Type IV

This type in which the core is capable of growth in four directions is interesting as well as being problematical. It may be thought of as a free-standing house, or in the form of a core apartment, it is a core which has two exterior orientations and two interior orientations. An example of this type is shown in one of the student works.

The centralistic plan is particularly difficult to work with. It assumes all directions as equal, and the core potentially results in an interior space, if all four directions are expanded. However, if the geometric core is small, and is used exclusively for one primary function, such as living or family room, the plan form presents interesting possibilities. The size of the core is related to potential for additional area, and from our work this type as a growing apartment appears to be limited with respect to both ultimate size and plan variants, that is, limited relative to what one would expect from the type.

Despite these differences we have found certain positive characteristics associated with the type. The center can provide an option for in-building as indicated in the student project. The cruciform plan can be used in all orientations with the ability (dependent upon the width of the wings) to gain exterior exposure from either side. The interior zones of passive extension can be an area of reversi-

bility in which the space can belong to either of the two adjacent ownerships. Finally, the centristic plan perhaps because of its historic connotations, perhaps because of its symbolic qualities, has offered an interesting challenge and has demonstrated certain promise.

3.6 Packing, Stacking and Growth Tissue

In this section we introduce considerations of the morphology of grouping of core houses and the relationship between growth and grouping. We will briefly discuss two design variables: packing which we use here to describe combinations of growing dwellings in one layer and stacking which we use here to describe the vertical superimposition of growing houses.

Packing

Models of growth have been developed on the basis of support types. In order to fully understand the potentialities for growth in any type, it must be located in a tissue model. Only then can we finally define the characteristics of the limits, or boundaries, and other questions of design. In respect to the growing house as in all housing design the characteristics of the type are modified by the tissue model. There exist two interesting possibilities relative to packing. The first is the potential of multiple zones being created in the private-private interface. These zones become the subject of graded rules for the use of the space bank. The second possibility is the provision of a similar kind of gradation in the private-public interface.

Stacking

Rule writing for the use of space reserves must take into consideration the possibility of different ownerships superimposed vertically. There exist a variety of morphological possibilities for the superimposition of expansions of various levels including isotropic, alternating, spiraling, etc.

Growth Tissue

The growing house as a concept in mass housing is somewhere between support and tissue. That is, it includes not only support but the space reserve into which the support expands and which gains expression as part of the tissue model. In addition, it is within the tissue model that the growth principle gains its final

form. This duality of identity as growing support and as growth tissue creates some problems of method as we shall discuss below.

3.7. Design Method

The design of growing houses, being a design problem at the scale of both the support and the tissue as well require certain innovation in design method. Since the growth principle depends upon the tissue diagram the interdependency of the two levels is great. The typology may be a means to overcome the difficulty, as it provides a basis for developing tissue models with the use of the type and before detailed work is done on the support design.

Williamson has described a clearly articulated method for the various design levels: dwelling, support and tissue. This method, or the methodological steps per level, are intended for one-owner lots.

Dwelling Level

Some of the studies at this level are:

- cultural space patterns in house type
- space analysis, modules, functional utility, sector analysis by modular possibility, sector analysis and combinations.
- basis plots and zone-margin diagrams
- modular relationships of the plots

Support Level

- zoning alternatives per unit
- wet cell alternatives per block and unit
- domain alternatives per block
- support design
- height variations
- staging possibilities.

Tissue Level

- the morphology of open space
- the dimensions of open space
- optimization of service layout
- staging of infrastructure
- domain studies.

3.8 Design Related Factors: Domain, Territory and Urban Form

The differentiation between the terms domain and territory is significant in core housing. The distinction we make is that the former refers to the distribution of rights and functions within the tissue diagram as described in SAR 73, while the latter deals with the rights and use of the space bank and the qualities of the boundary. The components of domain have been classified as follows:

> "Public Domain which is mainly for circulation used by anybody and theoretically maintained by the public sector.
>
> Private residential land individually used, maintained and controlled.
>
> Semi-private area of shared utilization in condominium by a group, in which the users are responsible for control and maintenance.
>
> Semi-public urban area of community utilization in which control and maintenance are shared between the users and the public sector."

Territorial rights are defined by a set of rules and agreements which describe the rights of use of the adjacent owners of a space bank which is common to them. This space bank will usually be defined by zone-margin diagrams. Agreements written regarding growth into this space may be absolute, e.g. "party A can build in 50% of -zone" or conditional, e.g. "if party A builds in 50% of -zone, than party B can .....". Futhermore, territorial rights may be written with respect to gradated types of restrictions of various kinds of boundaries or for air rights.

Finally, the question of territorial rights and the purpose of boundaries brings us to the problem of urban image or urban form. Additive growth tends to be individually motivated with unpredictable quality in a cumulative sense, i.e. the visual quality of the whole is something more than an assemblage of individual elements. Yet unlimited freedom is the underlying individual value. Then how to reconcile the potential conflict of the public and the private? Should the public realm be a designed entity or the resultant of the individual initiative and expression. One potential reconciliation of this paradox is the development of two realms of expression, one for the freedom of the individual, one for the scale of the group and the city. The boundary may become a physical element behind and through which the dwelling may grow while the modulations and needs of the higher scales give form to the boundary wall. The student projects have explored this possibility.

4. RELATED STUDIES

In this concluding section we introduce related areas of study. Each of the subjects described schematically below has an important role in the design, use, or construction of core houses. Each is of general significance, and like many of the points already raised, is deserving of further study.

4.1. Definition Of Objectives

It is important to describe in specific terms the objectives of any particular project. As we have seen, the core housing approach is essentially a process whereby parts of the dwelling or parts of the dwelling construction process are deferred until after the user occupies the dwelling. The responsibility for completion of the dwelling or the construction process then becomes his to assume in his own way and at his own pace. There exists a great variety of particular attributes which can be made part of the objectives of a project. For example self-help in design or construction, or self-finishing of the dwelling, may be made part of the program. But in all cases, these objectives must be made explicit in order for a fitting "family of attributes" to be provided in a design solution. Design objectives should probably be ordered in several ways. There are two obvious methods for listing and ordering design objectives, by participant or by levels.

Participants and their objectives

We may differentiate a minimum of four participants in the process; designer, user, builder, developer or authority. Each has his own objectives which may be listed and ordered according to,

Levels and their objectives

We can distinguish at least three levels: infill, support and tissue.

In both cases the lists may be built in detail. For example the participants may be greater in number of categories or sub-categories. The levels may be further subdivided into elements. In any case a matrix of participants and levels of the environment

forms a convenient basis for organizing objec-tives. Obviously some of these objectives may appear mutually contradictory. It then becomes the designer's responsibility to provide that solution which maximizes opportunities for realization of the objectives.

Williamson has attempted to define general objectives by level.

Dwelling level

Develope approach to provision of growth at the capacity and fitting the resources of the user.

Respect cultural patterns of use and space appropriation.

Find a module which makes the plot the basis of the succession of elements forming urban tissue.

Tissue level

Promote user responsibility over territory.

Promote appropriate interaction of agents in the process.

Obtain effective layout in terms of infrastructure, services and utilities.

Promote community organization.

4.2. Restraint

The core house approach generally attempts to maximize opportunities for the user to decide, and even to do, for himself. Certain decisions taken initially by designers can limit or enhance the user's future freedom. These decisions may be of various kinds including spatial, material, or even legal-administrative. We refer to these limiting factors under the rubric of restraint. For the designer this is a subject of cardinal interest, since by definition his role is to set in motion a process which imposes the minimum constraints upon future development or is least deterministic. The subject of determinism in architecture, or the limits of transformation, is one of great general importance in design. Here we shall briefly review some of the categories of restraint as they apply in core housing.

Limits to Growth

Perhaps the most obvious kind of limitation in the growing house is the existence of some vertical or horizontal boundary, be it physical or otherwise, which limits the quantity of growth.

In physical terms, this may be the existence of a wall at the plot boundary as in the barriada, or the limitation may be provided by the existence of a structural or foundation system built before occupancy.

Planning Limitations

Limits to the increments of growth due to the planning system. This creates a limitation when the growth possibilities exist within a predetermined structure.

Technical restraint

Limits to the way in which the building must be built or the particular modules which must be constructed. This is due generally to the specific requirements of a structural system.

Constraints

All of the above represent limitations to size and increments of growth. Other types of limitations may exist for legal or administrative reasons. Such constraints may relate to architectural character or materials or to the maximum area which may be added to a core unit.

Agreements

In single-ownership plots, problems of coordination of additions between adjacent ownerships may be minimal, since they generally relate only to the area of common walls. In multiple-ownership lots or multi-family situations the agreements and rules which control the use of the land bank over time are much more complex. Growth in multi-family buildings may require synchronization of additions or some well-detailed form of agreement. The models developed in section 3 may be an aid in writing agreements. In any case, such agreements, even if written in a complex "if-then" form are difficult, since they seek to order growth while imposing the minimum of constraint on the respective parties.

4.3 Technology

We have little experience with the technical problems associated with the growing house. Much of what we can say with some degree of certainty is based upon extrapolation from conventional building situations. In this class are generalizations regarding the physical difficulty, excessive cost or disturbance which may be involved in

the addition of foundations or construction to building already standing and inhabited.

Much work will have to be done before we can develop knowledge of such problems. Each project of core housing should combine as an integral task follow-up studies which document the difficulties of the process of use, including the technical difficulties. Here we can suggest a tentative mapping of problem areas which are likely to exist. Before doing so, let us briefly consider a general class of technical problem which we shall refer to as redundancy. Redundancy is the extra provision which must exist in order to accommodate unpredictability. It may be necessary to provide extra capacity e.g. in foundations, simply because of the degree of unpredictability associated with where and how new building is going to be added to the original core. But the problem of redundancy, a problem because costs are associated with it, is general in the sense that it may apply to any of the parts or the sub-systems of building. Obviously, there exists a connection between the concepts of redundancy and restraint. In an architecture of uncertainty, with maximum freedom of choice and minimum restraint as a value, redundant provision may be the cost paid for freedom.

Another general class of problem we might refer to as "obsolescence due to additions". Technical systems may be designed to minimize the destruction of physical elements when growth is made. The obvious example is that of the exterior wall at the point of connection with new construction.

Let us briefly review some of the classes of technical problem:

Structure

Design for growth or unpredictability creates various types of problems for the structural system. We have already mentioned problems of the foundation. The structural elements may have to be designed and built in the first phase in order to accomodate growth. In addition, details may have to be prepared to accomodate future structural connections, e.g. future beams coming into columns, future vertical extensions of columns.

Details

External walls must be designed for future extensions. The simplest expedient appears to be provision of a future interior door at a present window opening. Possibly, temporary exterior walls should be built at points of potential expansion. Roofing details and roof drainage, both slopes and down-pipes, are typical problems of detail.

Technical Systems

Provision for extension of technical systems is a classic problem of growth. In detail, this refers to such potential problems as the extension of electrical circuits or the addition of new circuits to an existing system and electrical box; the extension of heating systems, the distribution of water and wastes, all of which may require free planning because of problems of detail such as pipe diameters, angles of drainage, circuits, metering, etc. . In addition to extensions as a problem, a second class of technical problem is that of changed conditions. Walls which were exterior are now interior, ventilation systems which were sized for one spatial volume, must accomodate new volume.

Technical systems bring into focus certain philosophical questions. How much freedom of choice must be provided, in what way and at what price. If we assume that the provision of freedom requires expenditure as well as planning, what kind of trade-off must be made between choice and control, and what kind of technical means may be developed to make growth easier, less costly and more user-interactive.

4.4 Participation

The core house approach has as one of its prime motives the enhancing of the participation of the user in the design and, possibly, the construction process. How can participation be enhanced and how does it operate in the growing house?

The Medium Of Communication

How can communication and interaction in the design process be enhanced? One of the means is the identification of critical decisions in the design process, and the institutionalization of

interaction of participants in design. This implies the existence of a flow diagram of critical decisions and some form of descriptions of alternatives. We illustrate one example of such a flow diagram. The literature of participation is rich and examples of techniques can be found, inter alia, in the work of Sanoff. Fuchs has done a study of techniques for assisting people in deciding on the form of expansions.

The Medium Of Design

Can media for assisting in a process of design of the growth of the dwelling be developed. Such media which assist the dweller to design for himself might be in the form of games. One such game would provide modular blocks representing potential additions. This would aid the user in visualizing the physical possibilities and the connection between plan decisions and the visual implications of growth. Such two and tree-dimensional media may also be means to assist in the process of design interaction between neighbours in which more than one ownership may exist in a land bank. The growing house can adapt from the tradition and tools of participation which have been developed by the SAR and its users.

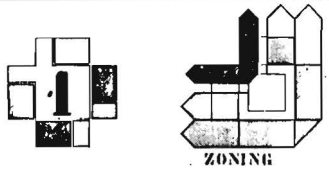
The Medium Of Construction

How to develope user responsive building systems? This is a key subject for future work. Terner has pointed out how certain building activies such as plumbing or electric installations are especially difficult for the owner-builder, and how the development of a new technology such as PVC piping can change that condition. Mitchell's work of the 1960's in the development of user-interactive structural systems in light-weight concrete is still pioneering. The question of the relationship between self-help and industrialized components, both for support and de tachable units, is important. There is a long tradition of interesting work in this area (do-it-yourself/industrialized kits), among which the work and philosophical leadership of SAR has been prominent.

4.5 Evaluation

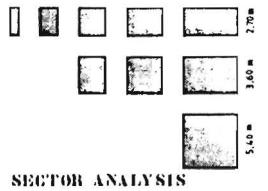
What criteria do we have for evaluating the appropriateness of a particular design for a particular situation. Various methods for evaluation may be adapted to use in core house design. One such method is the quantitated evaluation of models proposed by Caminos and Goethert in the Urbanization Primer. This is a quantitative method for evaluating the efficiency of plot layout. It has been employed by Williamson in a problem of core house design, but this method bears no direct relationship to the problem of the growing house.

More directly related to this problem is the SAR method which equates the generation of design variants with adaptability and uses this as a measure of the degree of choice which is the right of the user. The SAR method may be employed to study the relationship between "core basic variants" and "developed basic variants". Di Lullo has pointed out the relationship between basic variants and graphs. His suggestion that graph theory may be a tool for studying the growth potential of plan types is a most promising area of research. Implied in his work is the value attributed to open-ended evolution of the dwelling, that is, growth which offers options for variants at each stage of development, or in other words, for the complexity of the tree of growth.

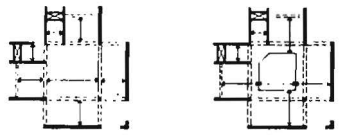


ZONING

E entrance
W wet core
K kitchen
L living
D dining
S sleeping
T terrace
St study
O other



SECTOR ANALYSIS

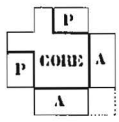


CONSTRUCTION

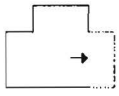
G·1254

ACTIVE AND PASSIVE GROWTH

THESE ARE THE TWO TYPES OF GROWTH. PASSIVE GROWTH IS FOR SALE TO OR FROM YOUR NEIGHBOUR. CORE PLUS PASSIVE GROWTH IS BUILT IN THE FIRST BUILDING PHASE. ACTIVE GROWTH TAKES PLACE IN THE FILTER BETWEEN PRIVATE AND PUBLIC AREAS: THE ZONE OF FREEDOM.



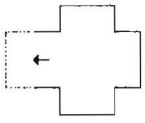
FREE TIME · DO IT YOURSELF



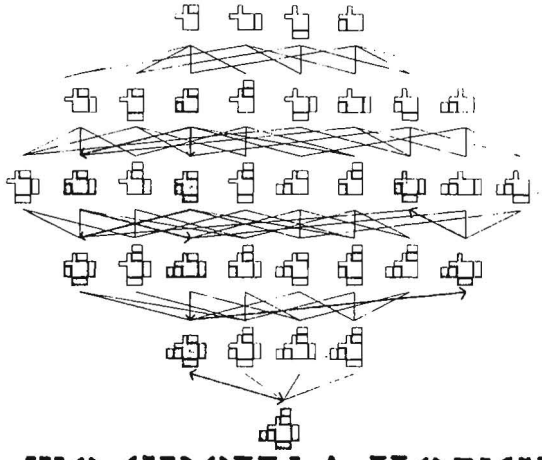
A HOUSE BECOMES YOUR HOUSE WHEN YOU KNOW THAT ON A SUNNY SATURDAY AFTERNOON YOU CAN START WORKING ON YOUR EXTRA BEDROOM. THE CONSTRUCTION IS ALREADY BUILT, ONLY THE INFILL HAS TO BE ADDED. INFILL MATERIALS ARE LIGHT AND EASY TO HANDLE.

REVERSE AND TRANSFORMATION

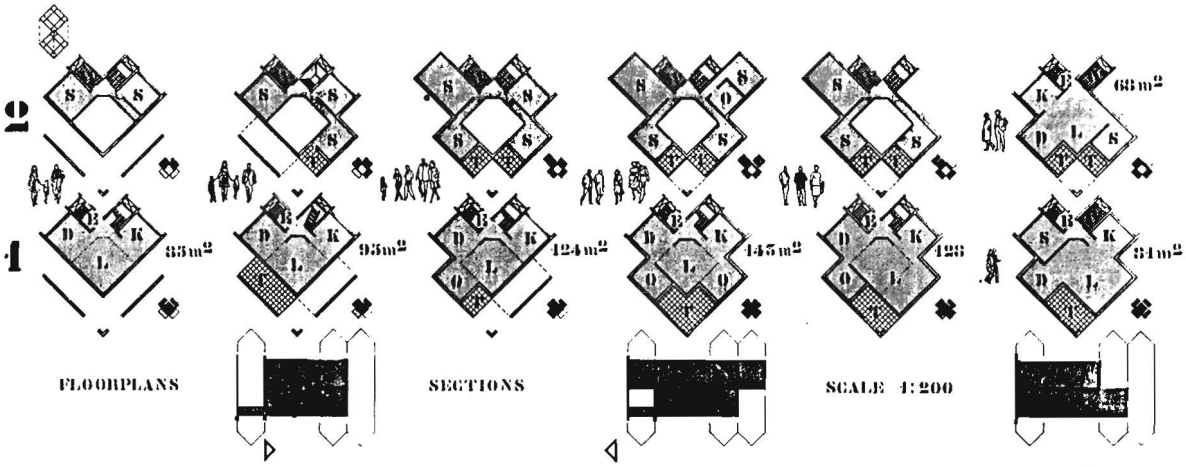
A HOUSE BECOMES YOUR HOUSE WHEN YOU CAN BUY A ROOM FROM THE RETIRED PEOPLE NEXT DOOR. THE PARTITION IS MADE OF LIGHT INFILL MATERIAL AND CAN EASILY BE TAKEN OUT.



— THE TREE OF GROWTH —



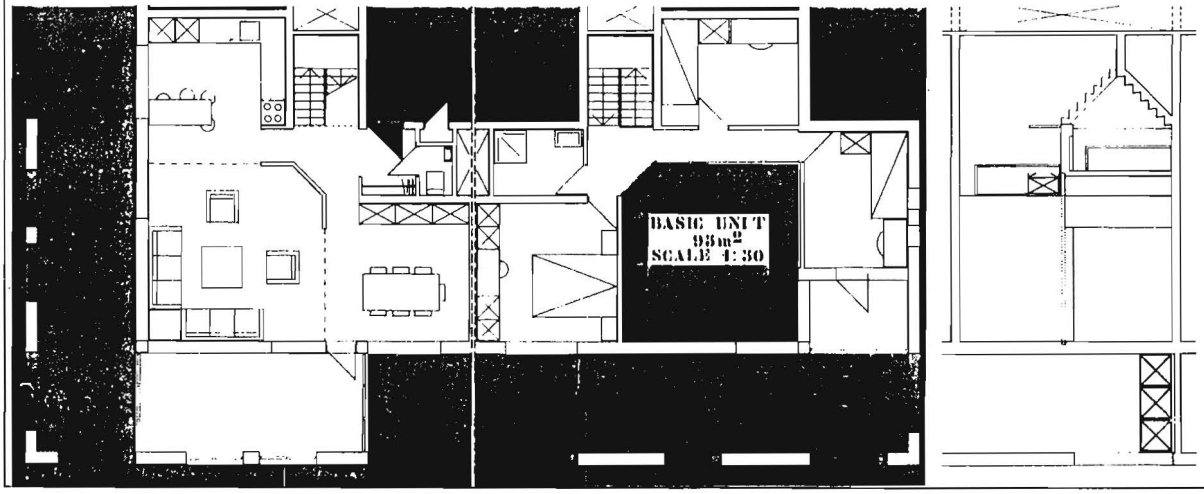
TO GROW A HOUSE TO GROW A HOUSE

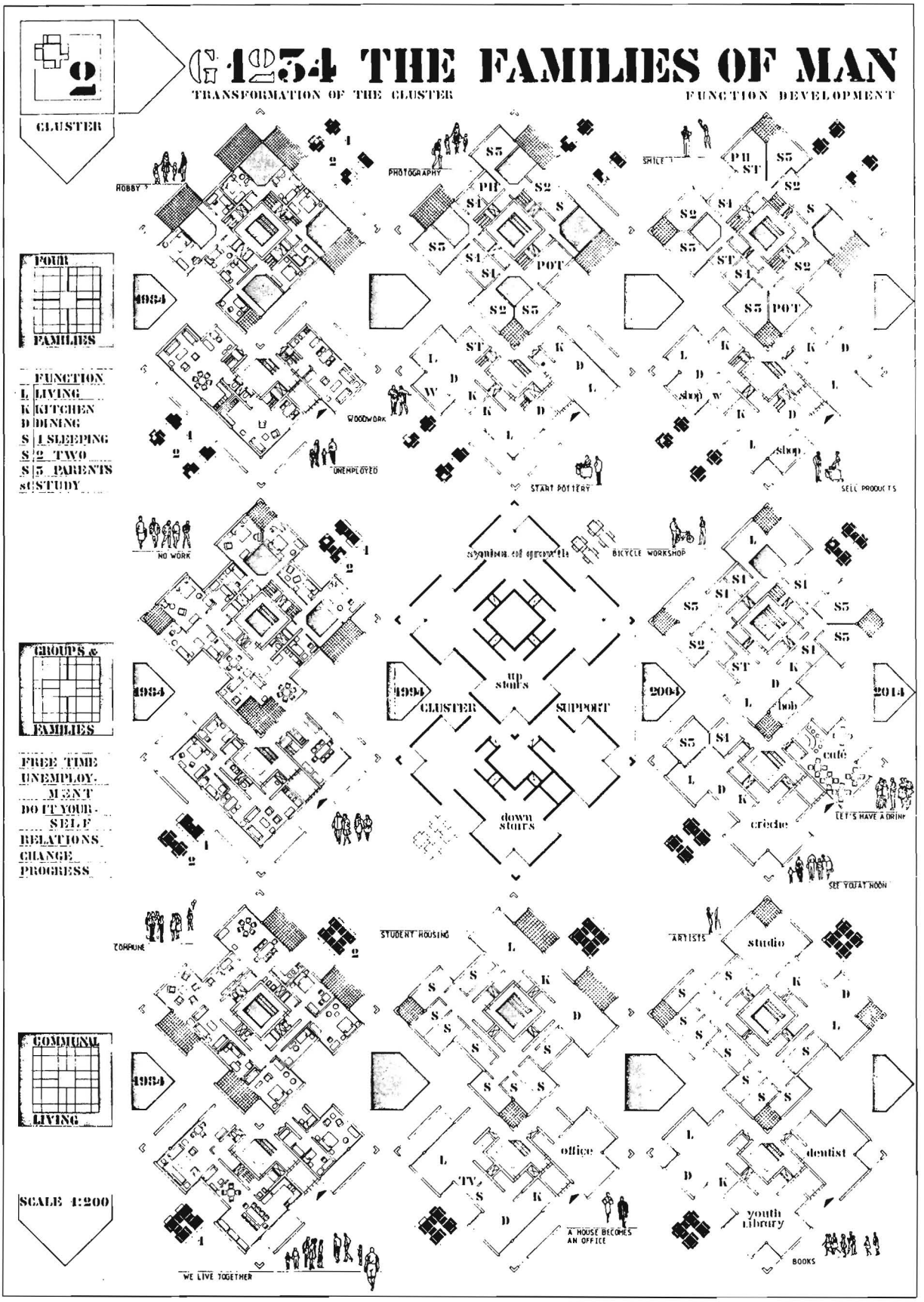


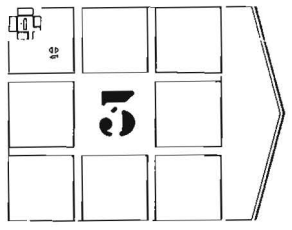
FLOORPLANS

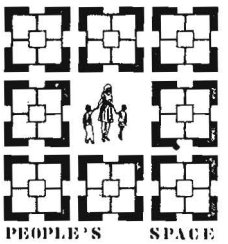
SECTIONS

SCALE 1:200

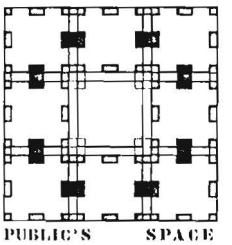



2
CLUSTER
1954 THE FAMILIES OF MAN
TRANSFORMATION OF THE CLUSTER
FUNCTION DEVELOPMENT
FOUR FAMILIES
FUNCTION
L LIVING
K KITCHEN
D DINING
S 1 SLEEPING
S 2 TWO
S 5 PARENTS
S STUDY
1954
1994
2014
ROBBY
PHOTOGRAPHY
SMILE
WOODWORK
UNEMPLOYED
START POTTERY
SELL PRODUCTS
GROUPS & FAMILIES
FREE TIME
UNEMPLOY-MENT
DO IT YOUR-SELF
RELATIONS
CHANGE
PROGRESS
NO WORK
up stairs
CLUSTER
SUPPORT
down stairs
BICYCLE WORKSHOP
shop
café
LET'S HAVE A DRINK
SEE YOU AT NOON
COMMUNAL LIVING
COMMUNE
STUDENT HOUSING
ARTISTS
studio
office
TV
A HOUSE BECOMES AN OFFICE
dentist
youth library
BOOKS
WE LIVE TOGETHER
SCALE 1:200

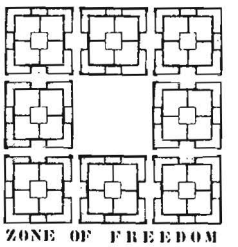




PEOPLE'S SPACE

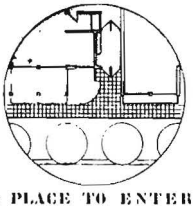


PUBLIC'S SPACE

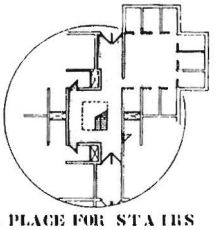


ZONE OF FREEDOM

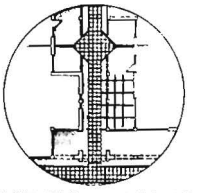
G 1974



A PLACE TO ENTER



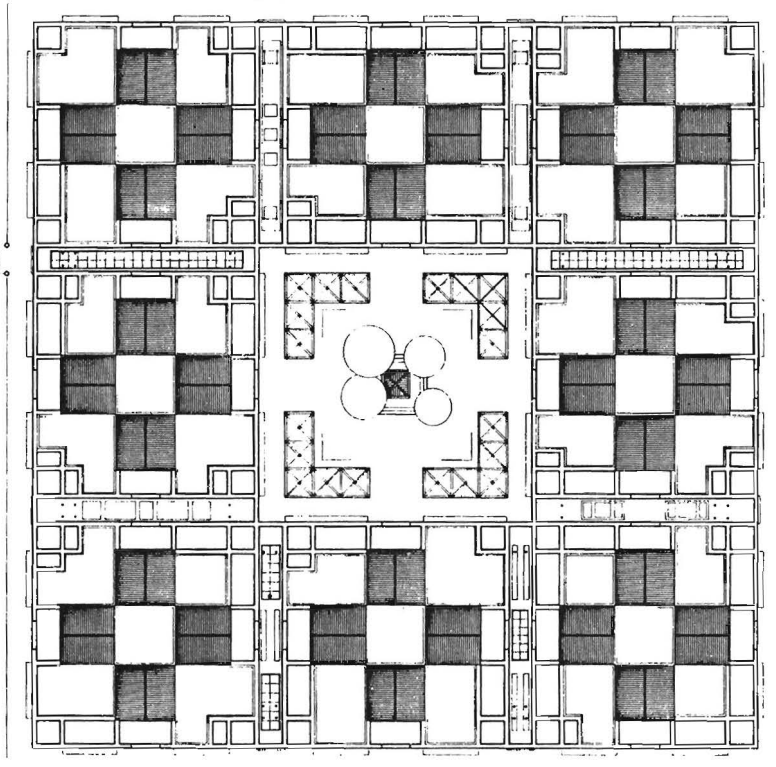
A PLACE FOR STAIRS

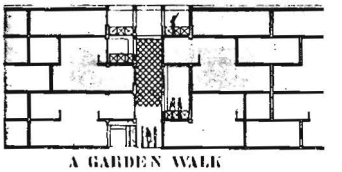


PEOPLE'S GARDEN

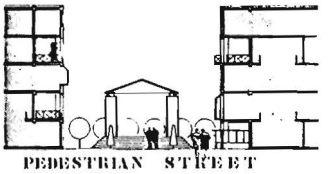
SCALE 1:200

FACES PLACES GARDENS & SPACES.

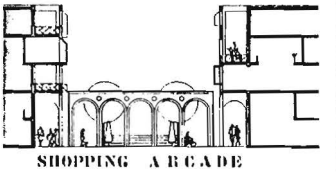




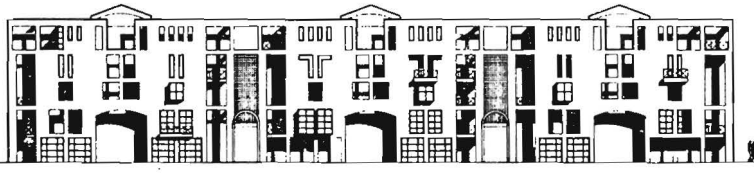
A GARDEN WALK



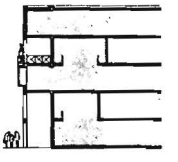
PEDESTRIAN STREET



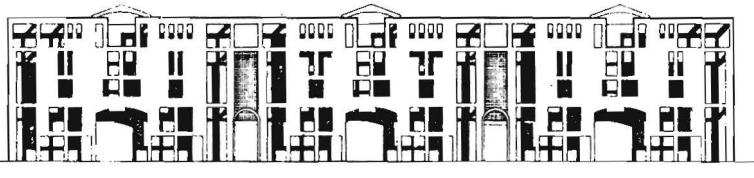
SHOPPING ARCADE



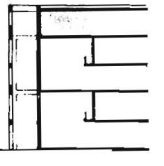
1994



AFTER



1964



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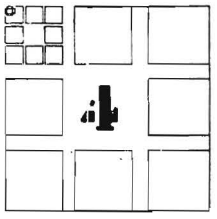
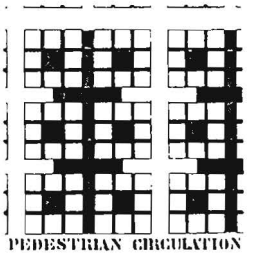


VEHICULAR CIRC. & PARKING



PEDESTRIAN CIRCULATION

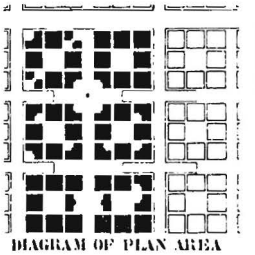
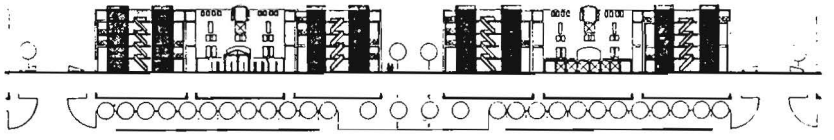


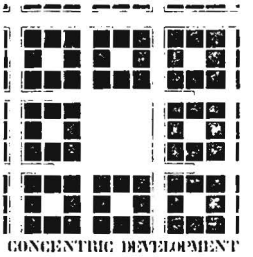
DIAGRAM OF PLAN AREA

G 1234 TO MAKE A TOWN



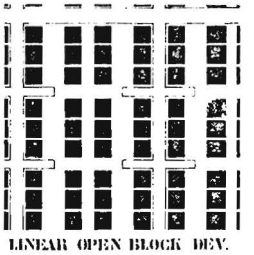
MODELS OF URBAN FORM

WHEN USING URBAN FABRIC, ARCHITECTS AND PLANNERS ARE GIVEN A HIGH DEGREE OF FREEDOM IN DESIGN WHILE QUALITY IN URBAN FORM IS CONSISTENT BECAUSE OF IT'S WELL DEFINED SET OF RULES.

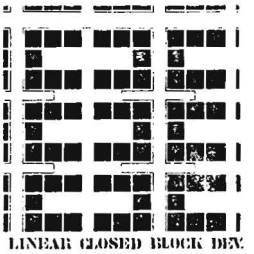


CONCENTRIC DEVELOPMENT

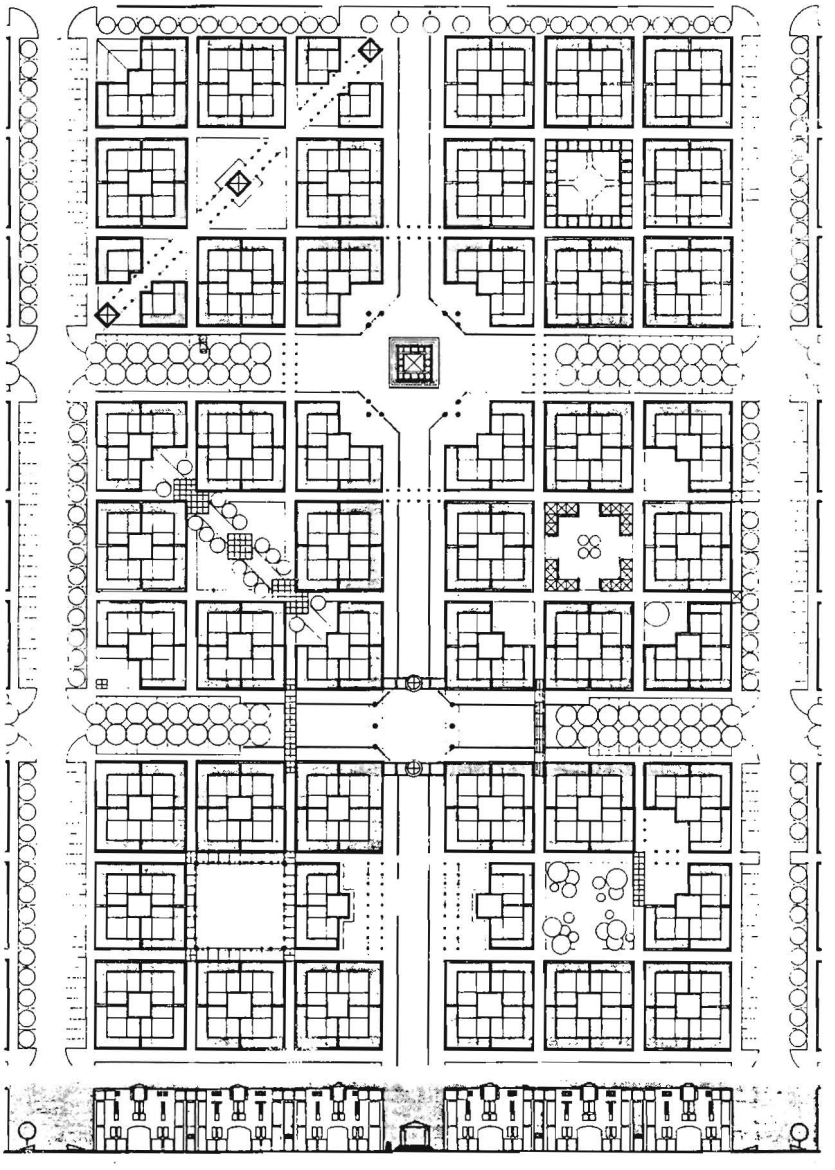
BASICALLY TWO TYPES OF URBAN BLOCK DEVELOPMENT EXIST, CONCENTRIC AND LINEAR. THREE EXAMPLES ARE SHOWN.



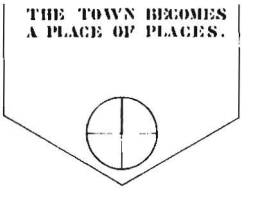
LINEAR OPEN BLOCK DEV.



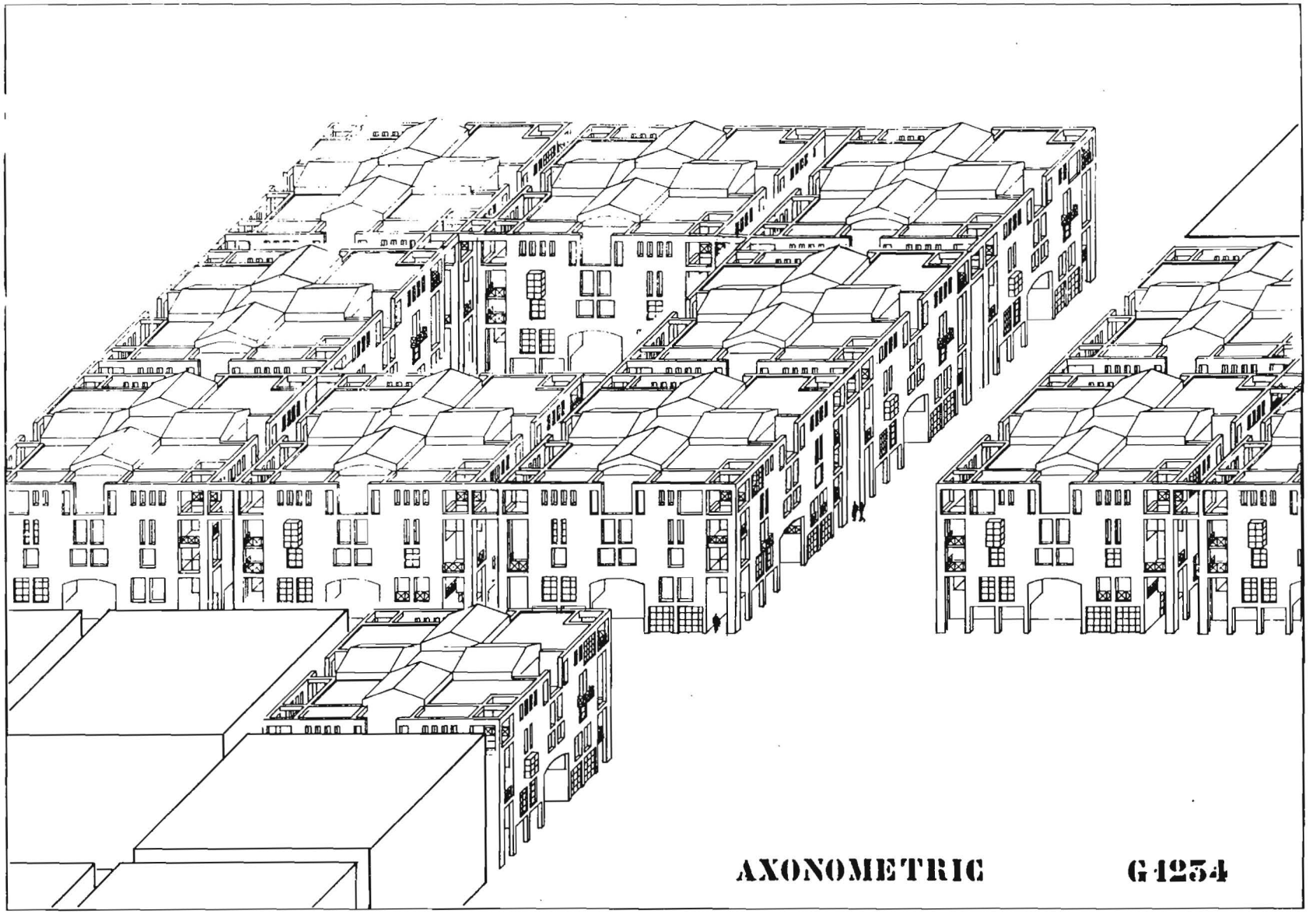
LINEAR CLOSED BLOCK DEV.

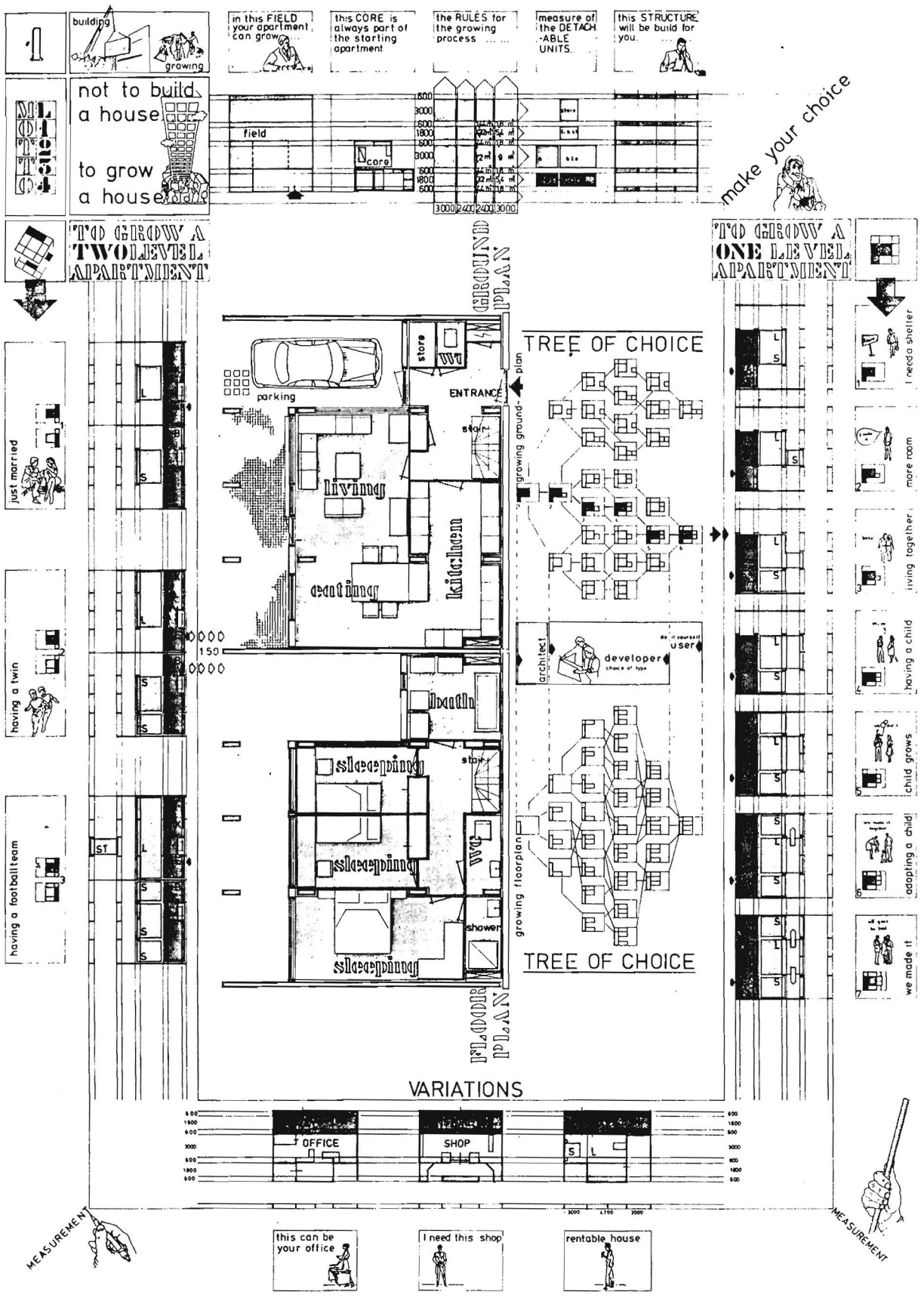


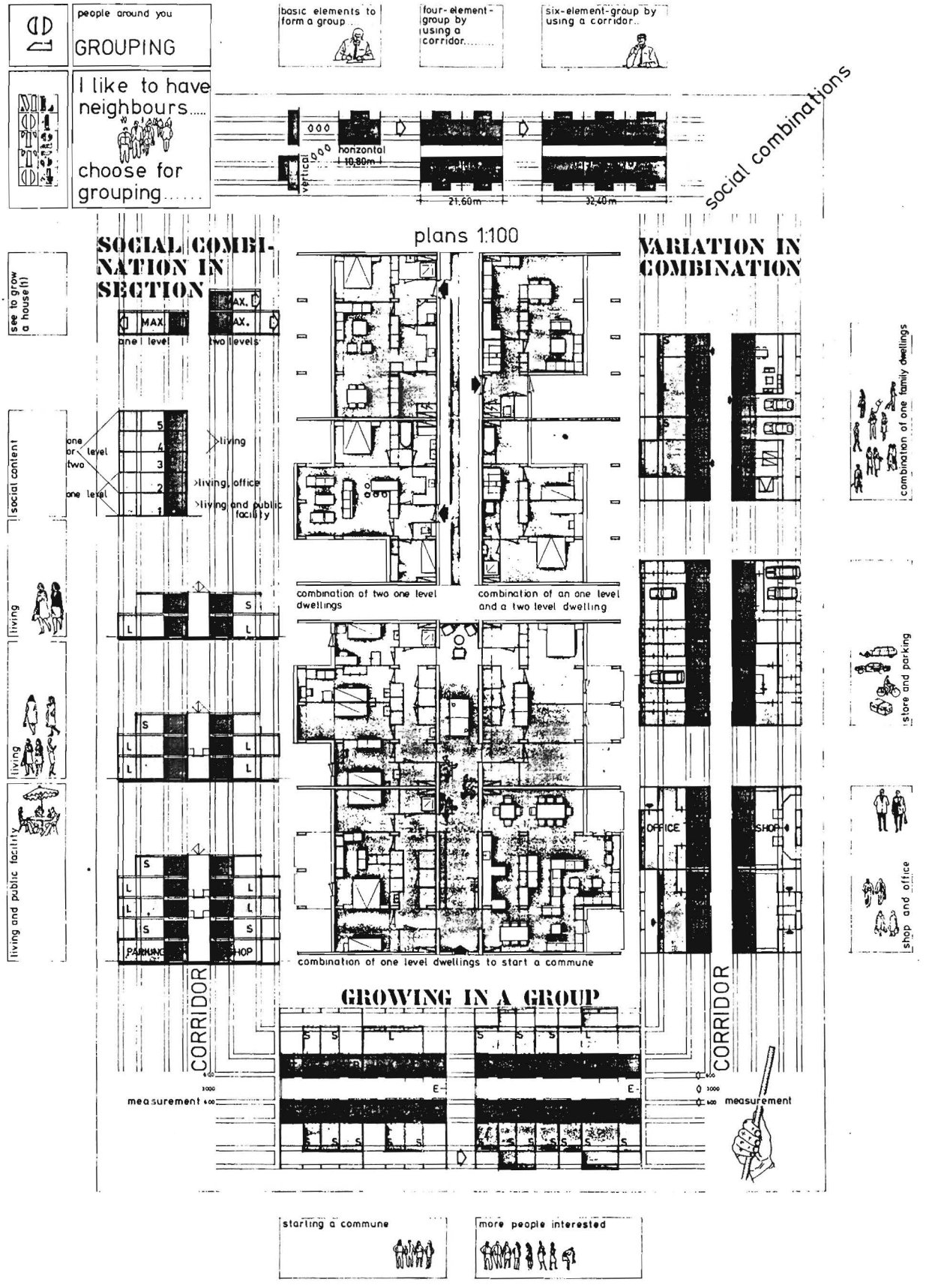
THE TOWN BECOMES A PLACE OF PLACES.

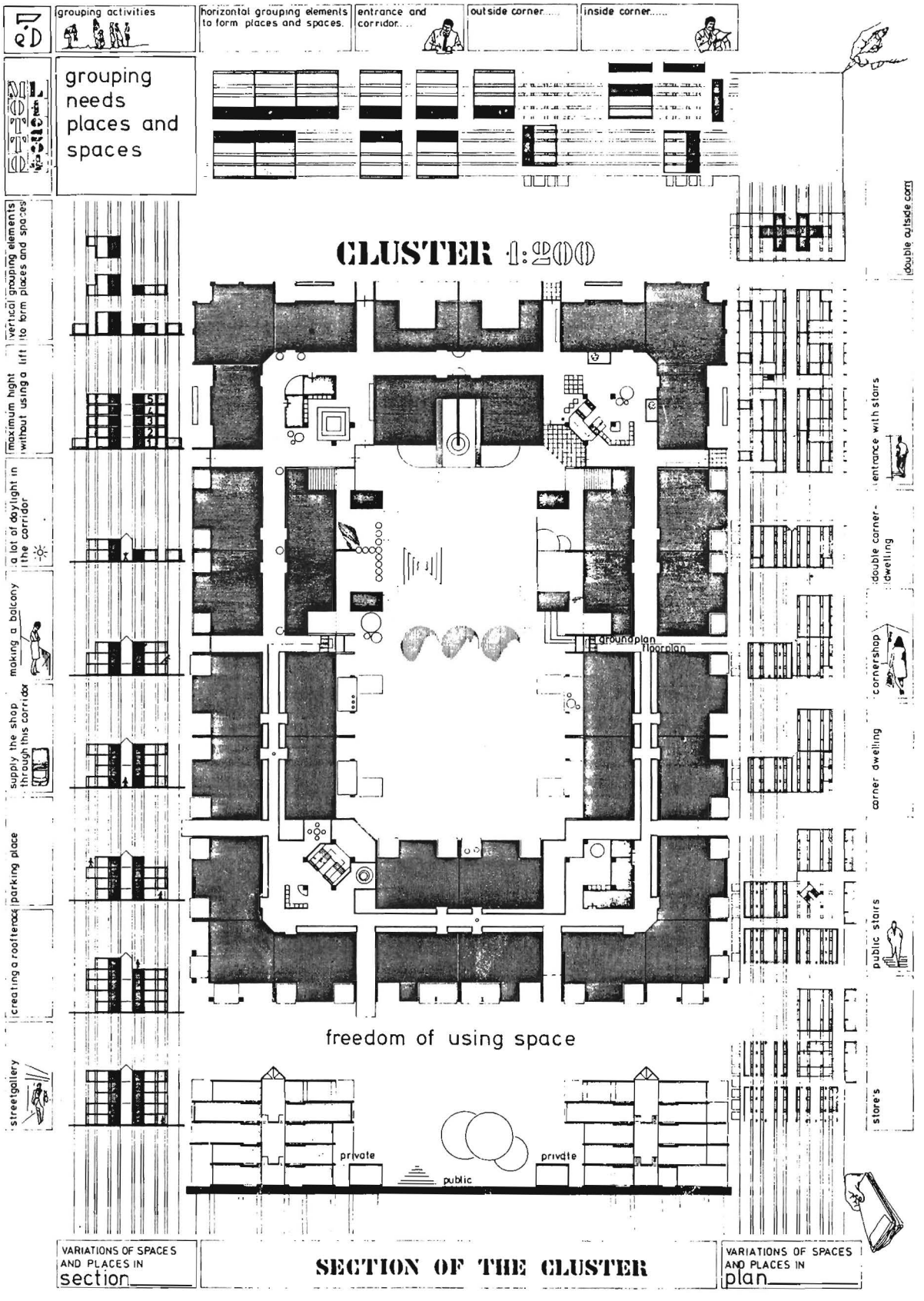


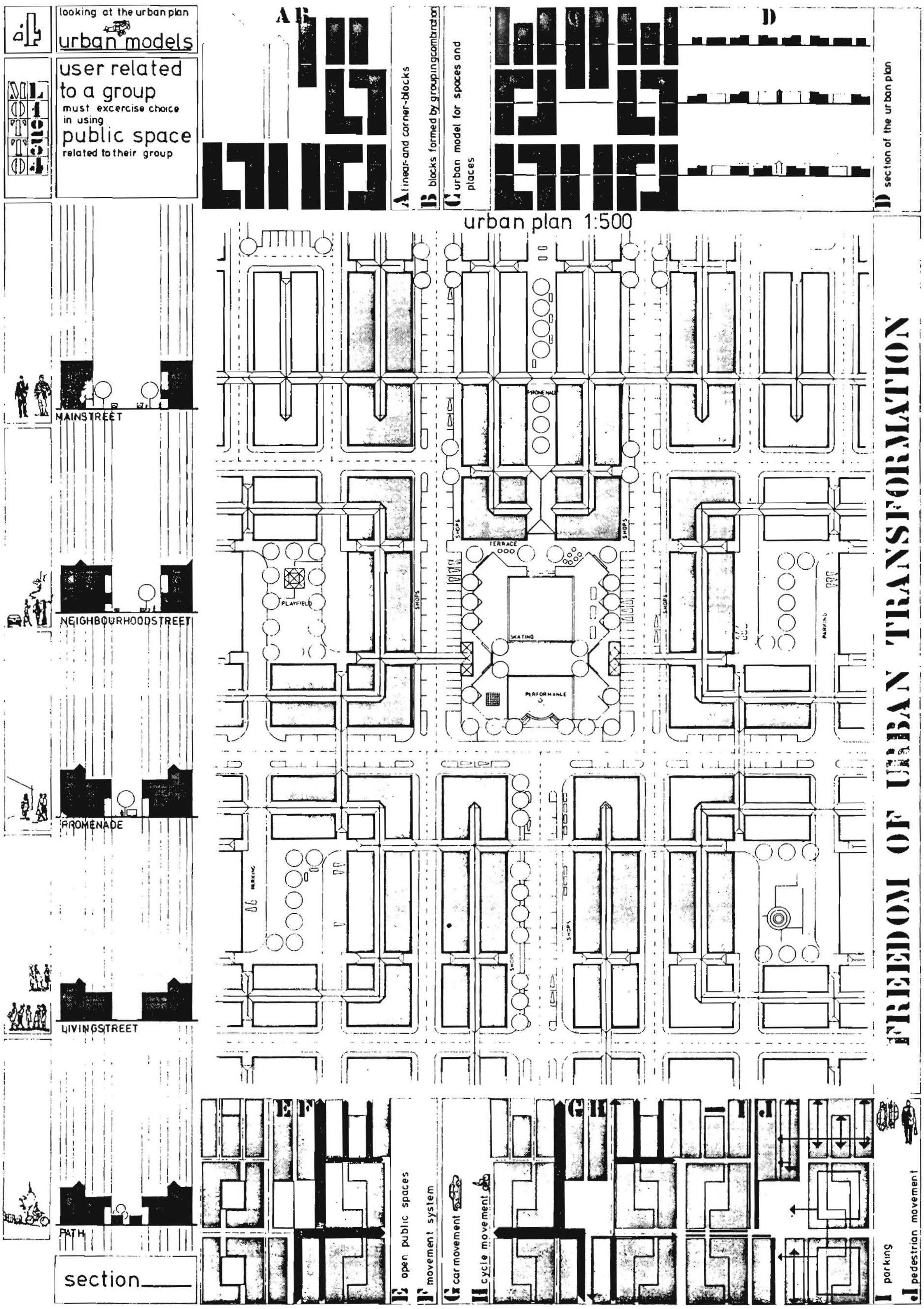
PLAN AREA, SECTION AND ELEVATION : SCALE 1:300 ALL DIAGRAMS : SCALE 1:2300


AXONOMETRIC
G-1234


building
growing
in this FIELD your apartment can grow
this CORE is always part of the starting apartment
the RULES for the growing process
measure of the DETACH -ABLE UNITS.
this STRUCTURE will be build for you.
not to build a house
to grow a house
field
core
make your choice
TO GROW A TWOLEVEL APARTMENT
TO GROW A ONE LEVEL APARTMENT
GROUND PLAN
FLOOR PLAN
store
WC
parking
ENTRANCE
stair
living
kitchen
eating
bath
sleeping
sleeping
sleeping
wc
shower
TREE OF CHOICE
growing ground-plan
growing floorplan
TREE OF CHOICE
architect
developer
user
just married
having a twin
having a football team
I need a shelter
more room
living together
having a child
child grows
adopting a child
we made it
VARIATIONS
OFFICE
SHOP
this can be your office
I need this shop
rentable house
MEASUREMENT
MEASUREMENT


people around you
GROUPING
I like to have neighbours.....
choose for grouping.....
basic elements to form a group
four-element-group by using a corridor.....
six-element-group by using a corridor..
vertical
horizontal
10,80m
21,60m
32,40m
social combinations
plans 1:100
SOCIAL COMBINATION IN SECTION
MAX.
one level
two levels
see to grow a house (1)
social content
one or two level
one level
living
living, office
living and public facility
combination of two one level dwellings
combination of an one level and a two level dwelling
combination of one level dwellings to start a commune
VARIATION IN COMBINATION
OFFICE
SHOP
CORRIDOR
measurement
GROWING IN A GROUP
starting a commune
more people interested
combination of one family dwellings
store and parking
shop and office

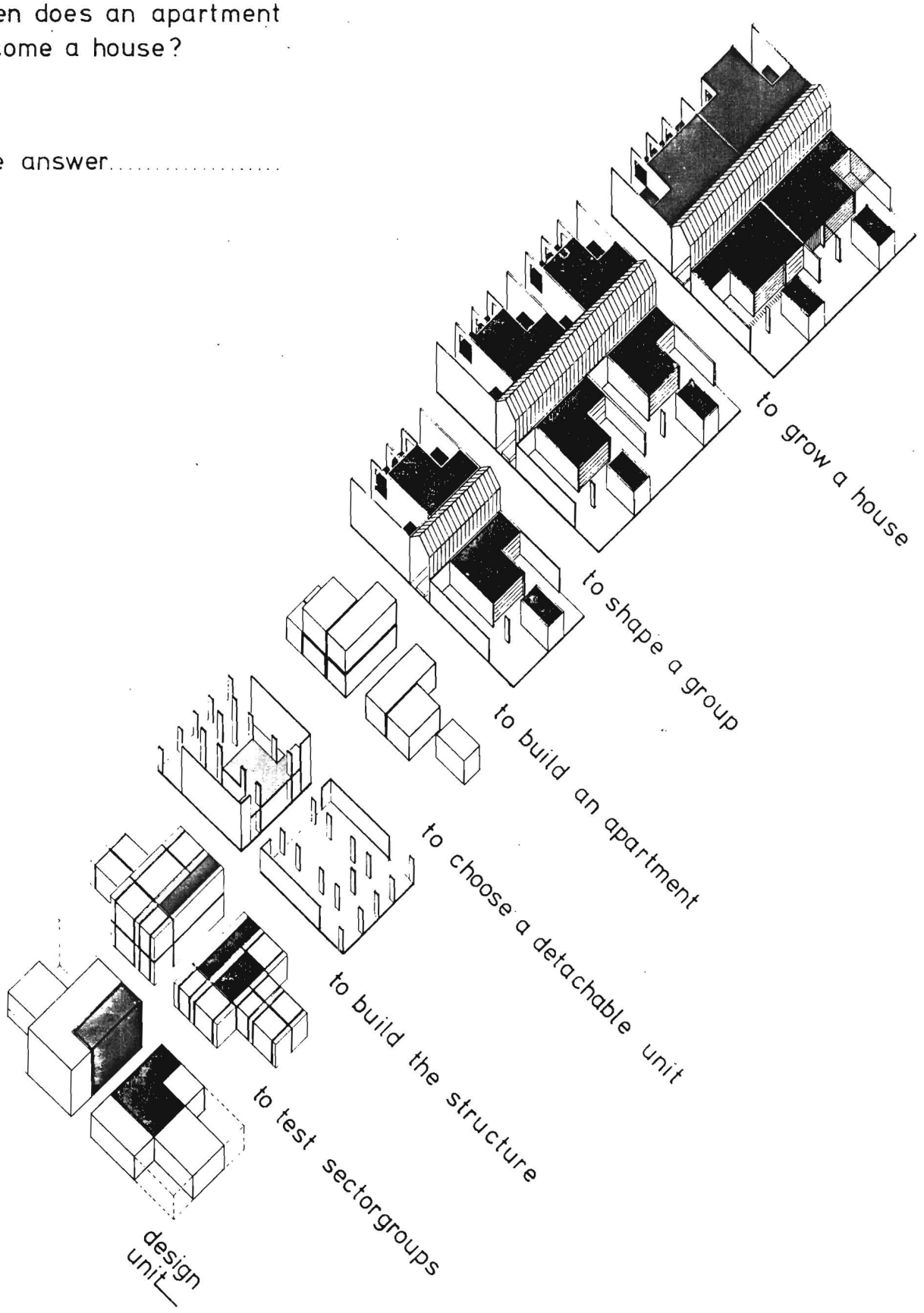

grouping activities
horizontal grouping elements to form places and spaces.
entrance and corridor...
outside corner.....
inside corner.....
grouping needs places and spaces
CLUSTER 1:200
vertical grouping elements to form places and spaces
maximum hight without using a lift
a lot of daylight in the corridor
making a balcony
supply the shop through this corridor
parking place
creating a rooftenace
streetgallery
double outside corn
entrance with stairs
double corner-dwelling
cornershop
corner dwelling
public stairs
store's
groundplan
floorplan
freedom of using space
private
public
privdte
VARIATIONS OF SPACES AND PLACES IN section
SECTION OF THE CLUSTER
VARIATIONS OF SPACES AND PLACES IN plan


looking at the urban plan
urban models
user related
to a group
must excercise choice
in using
public space
related to their group
A B
A linear-and corner-blocks
B blocks formed by groupingcombination
C urban model for spaces and places
D
D section of the urban plan
urban plan 1:500
FREEDOM OF URBAN TRANSFORMATION
MAINSTREET
NEIGHBOURHOODSTREET
PROMENADE
LIVINGSTREET
PATH
section
PLAYFIELD
TERRACE
SKATING
PERFORMANCE
SHOPS
PARKING
E F
G H
I J
E open public spaces
F movement system
G car movement
H cycle movement
I parking
J pedestrian movement

MOTTO L1954

When does an apartment become a house?

The answer.....



NOTES

1. Bouwcentrum International Education (BIE) publishes various types of reports, some of which are listed in the bibliography. The B.I.E.-bulletins, the so-called "blue reports", are student projects and studies.

2. The author's research with the sociologist Dr. Naomi Carmon on user-initiated modifications to public housing in Israeli renewal neighborhoods. Reports and articles on this research are available through the Center for Urban and Regional Planning, Faculty of Architecture and Town Planning, Technion.

3. A series of research papers on growth and aging in buildings were published by Cowan between 1963 and 1965 in the Transactions of the Bartlett Society. (Vol. 1, pp. 53-84; Vol. 3, pp. 63-88); and Weeks, (Vol. 2, pp. 85-106).

4. C. Alexander, Notes On the Synthesis of Form, Harvard University Press, Cambridge, Mass., 1964.

5. P. de Arce, "Runcorn Transformed" in International Architect, Vol. 1, No. 4, 1981.

6. The chambered nautilus was used as a model for the growing museum. In Oeuvre Complète, 1938-1946, pp. 16-21 and 1957-1965, pp. 164-177.

7. John Turner, AHAS, Ltd. 5 Dryden St. London WC 2E 9NW.

8. Sergio Fuchs experimented in a research project supervised by the author: Self-help Housing Rehabilitation: An Approach to User Participation In the Design Process, Technion, Israel, 1982.

9. Inter alia, John Turner, "Designing for Obsolescence", The Architect's Journal, 18, Oct., 1967,, pp. 940-941.

10. H. Caminos, R. Goethert, The Urbanization Primer, World Bank, Washington, 1976.

11. R. di Lullo, Evolutionary Housing Design, B.I.E., Staff Paper, 1981.

12. D. Crane, Sadat City project is briefly described in the Joint Research Team on Housing In Egypt Report, 1979.

13. The relationship of size to degree of adaptability is considered in the Cowan Studies, Op. Cit.

14. Caminos, Goethert, Op. Cit.

15. For the E.M.A.D. project see Open House, Vol. 5, No. 2, 1980.

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