# The Control of Complexity

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How can we design large projects without necessarily imposing uniformity and rigidity where variety and adaptability over time are desirable? How can the big project nevertheless do justice to the small scale?

There are good reasons to believe that variety and adaptability yield a better match between the built environment and the life it shelters. Moreover, the state of the art in building technology suggests that there is not necessarily a conflict between efficient production and variety of form. In fact, variety might be the logical outcome of efficient production.[1]

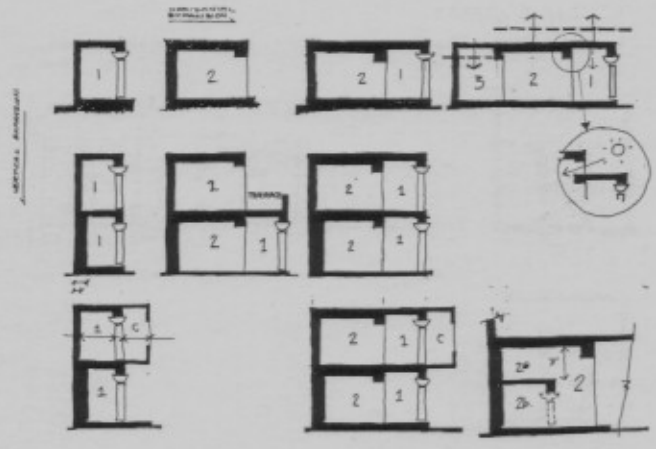
If neither the use nor the technical means dictate uniformity and rigidity of built forms, design skills may become the weakest link in the chain. The design of complex, varied forms that are adaptable over time and nevertheless easy to control and to build demands new methods and skills.

In turn, such new methods and skills must come from a good understanding of the structure of complex artifacts. And much can be learned from the study of environments with a high degree of spatial complexity to find out what their structure is and what processes could make them come about. In this context, the studies done by Fernando Domeyko are most valuable. His meticulous documentation of vernacular environments of high density in cities like Santiago (Chile), Madrid, Cambridgeport, Córdoba, and others gives us a wealth of information to be interpreted and studied. An interest in these environments has nothing to do with a romantic yearning for past conditions. We are not looking at them to copy but to learn how today structures of similar sophistication and resilience may come about in accordance with the means we have today. In a similar way, Maurice Smith of MIT has studied the Portuguese hill towns and found consistencies in dimension and spatial organization that are useful for present day designing. What we look for and what we are interested in here are systemic properties from which complex environmental organizations can be built.

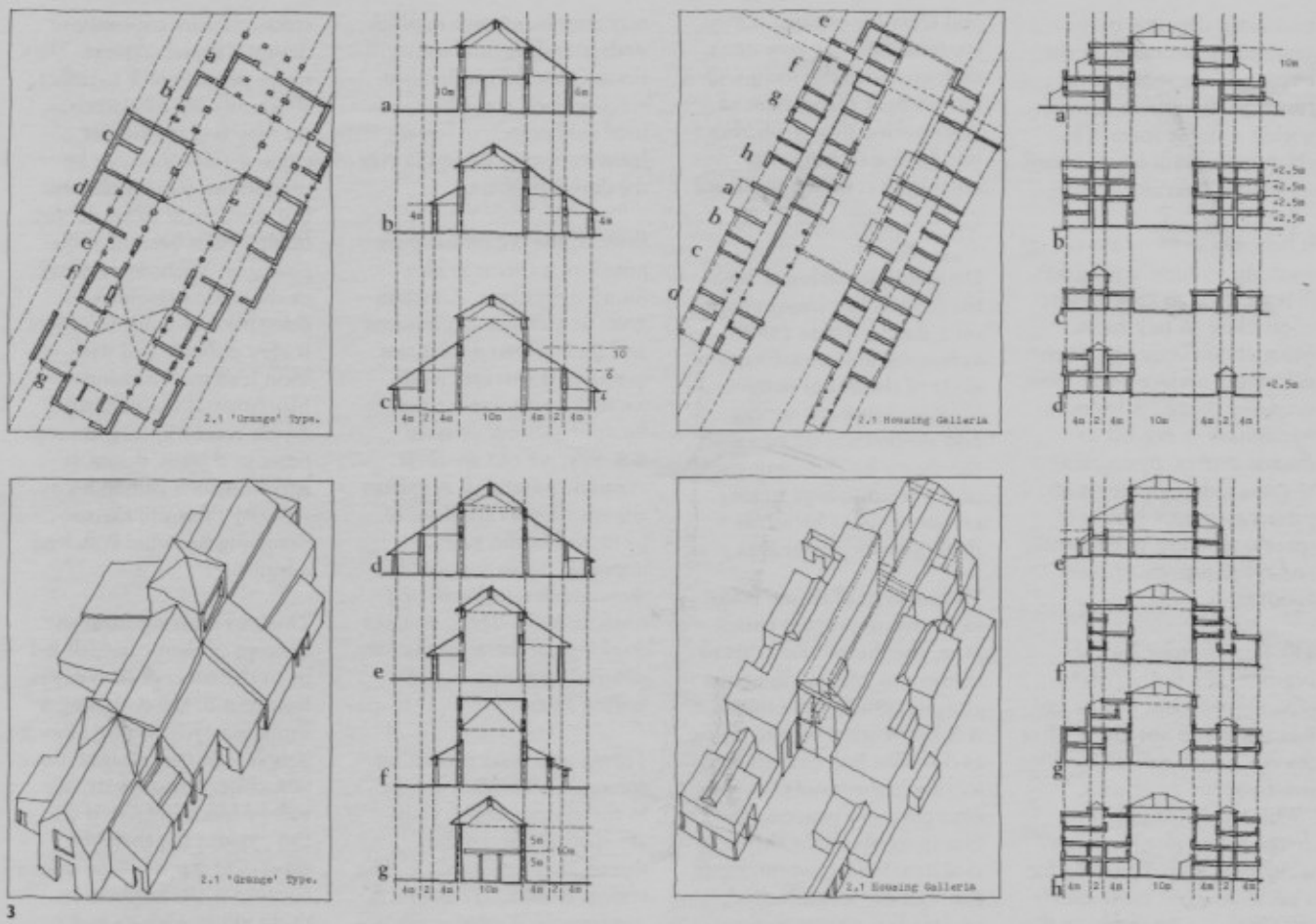
In what follows, I will discuss a number of issues that have to do with understanding complex environmental forms and their design manipulation. These are, if you like, areas of knowledge and skill of interest in a search for new methods. They have been the subject of discussion and experimentation in my course on design methods and theory in the post-professional degree program (M.S. Architecture Studies) at MIT.

## Transformation

First, and possibly most importantly, it should be



**1 Thematic development of a section following a growth pattern in which new kinds of spaces are developed.** Starting from the upper left-hand corner, horizontal expansion is from left to right and vertical expansion from top to bottom. From a class assignment by Solomon Benjamin, M.S. Arch. St. program, Massachusetts Institute of Technology.

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**2 Thematic exploration of a contained form.** The study focuses on the transition from the outside space of the courtyard toward the inside spaces around it, resulting in a number of different concentric screens. From a class assignment by Sergio Palleroni, M.S. Arch. St. program, Massachusetts Institute of Technology.

**3 Thematic transformations of a section.** Inspired by the "grange type" of the Benedictine monasteries in France during the Middle Ages, the various sections join into a directional building organization. From there, the same zones serve a different section principle called "housing galleria". The two section principles also share the dominant central space relating to smaller spaces on the periphery. From a class assignment by John R. Dale, M.S. Arch. St. program, Massachusetts Institute of Technology.

reasoning depends on programmatic premises. In the approach suggested here, function becomes a variable within a stable form. This relationship will be discussed separately later on.

It becomes evident when working without a program that we lack an appropriate vocabulary to talk form. Most of our language when discussing architectural form is related to use. A broader vocabulary is needed to discuss moves, directions of moves, developments of patterns, juxtapositions of spaces, relations of elements, and other aspects of form making.

The third barrier for the beginner is a feeling of directionlessness. "How can I design if I do not know what the end result will be like?" is a frequent complaint. "Why would you need to design if you already knew?" is my response. The need for a prior image is most keenly felt when we do not trust the form as something to work with. There is nothing wrong with having such an image, but it is not a prerequisite and may be a hindrance. When we speak with other people, we need not know what the result of the conversation will be either. We may come out of the conversation with a better sense of the issue; in fact, we may have changed our mind. When we are concerned about "doing our own thing" and feel we must be on top of the form all the time, we cannot relax and trust the process. Once students find out how one's dialogue with the form will always bear the imprint of one's personality—whether one likes it or not—the complaint is no longer heard.

## Theme

Designing in dialogue with the form is like improvising on a theme. There can be variations and transformations of the initial pattern. We can elaborate, we can add subthemes, we can shift the theme by changing some of the relationships among components or by introducing new components.

The concept of theme leads us to two important issues. First, the theme allows us to connect to others. Someone else, recognizing the theme, will know what we are trying to do. This link enables us to work together once the theme emerges in the process. The nice thing about the theme is that it makes us communicate through the form. Indeed, under ideal circumstances, thematic communication can be without words. One could simply supply a series of transformations, and someone else could continue the thematic development. Experimenting with thematic developments this way makes us appreciate the power of implicit conventions in designing. Much of what we do is based on unspoken understandings. We already share many common values and principles before a dialogue starts. Making form transformations in a thematic way establishes such implicit understandings and conventions. Once the mechanism is recognized, it can be used deliberately to foster teamwork and cooperation in the design process.

Second, the communicative power of a theme is also found in systems. A system gives us a choice of elements and their allowed relations in space. It emerges when we seek to establish rules. By approaching systems this way, we can see their thematic potential. A system always allows variations of form within the rules it imposes; it can support the thematic development of a configuration. Thus, systems thinking can be a means for generating variety by following rules.

Theme and system both set constraints on what we do. In the system, constraints are spelled out; in the theme, they are implicit. The system is rules, the theme is convention. A system usually allows for many themes, but a theme always implies something systemic. Both hold people together in that they imply a group of those who follow their constraints. Indeed, both are, in their own way, the product of people agreeing on a set of constraints. The explicitness of the system makes it more generally transferable. The implicitness of the theme is bound more to a social body.

By comparing themes and systems, we find how their rules and conventions give design a social context. They make people work together. Working only by ourselves, we may find implicit or explicit rules that can be used to master complexity. But if we want to work with others, rules become indispensable. Without systemic or thematic principles, delegation of work to others is very difficult and will soon lead to confusion. Moreover, if we want to divide responsibility among peers in a team, we must agree on such principles as well. By their use thematic designing becomes a shared adventure.

Thus, by starting from the concept of theme, which led us to the concept of systems, we begin to see designing as something happening among people. No one designs alone in architecture anyway. We will be less defensive if we can explain the thematic aspects of our work to others because it allows them to think along with us and it makes us free to change the elaboration of the theme or choose a different theme without loss of control.

## The Nonthematic

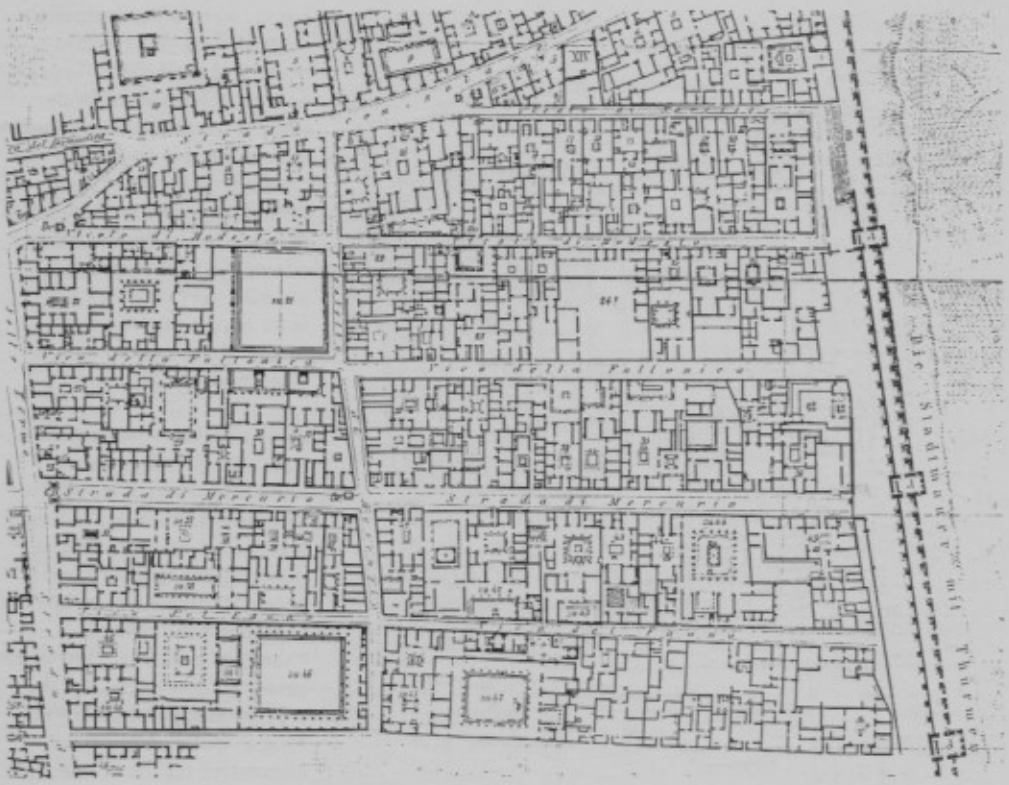
Once the thematic is understood as a means to guide our actions and connect to others, we realize we are also free to divert from the conventions we follow. At any point elements can be introduced and moves can be made that go outside the theme. The thematic and the

nonthematic define each other because the special cannot exist without the conventional, and it is the tension between the two that brings out qualities of form. It is therefore important to understand that both the thematic and the nonthematic are part of the design effort and that both can be subject to agreements and rules. Since each one makes the other possible, we cannot argue which is more interesting. The way we orchestrate the thematic and the nonthematic is what designing is about.

## Type

Once the thematic is understood as something we can share, the concept of type can be brought into focus. When we study house types from different places and cultures, we find how they represent very complex combinations of systems. The type can be described in many ways, as a spatial system, as a combination of technical systems, as a system of facades and decorations. All descriptions can be valid and yet they do not exhaust the type. There is always another way to describe a type emerging in real life.

Types are shared properties within a culture. Everyone, builder, designer, user, is familiar with them. Yet types, such as the Venetian Gothic palace, the Amsterdam renaissance townhouse, the Georgian terraced house, or the Pompeian courtyard



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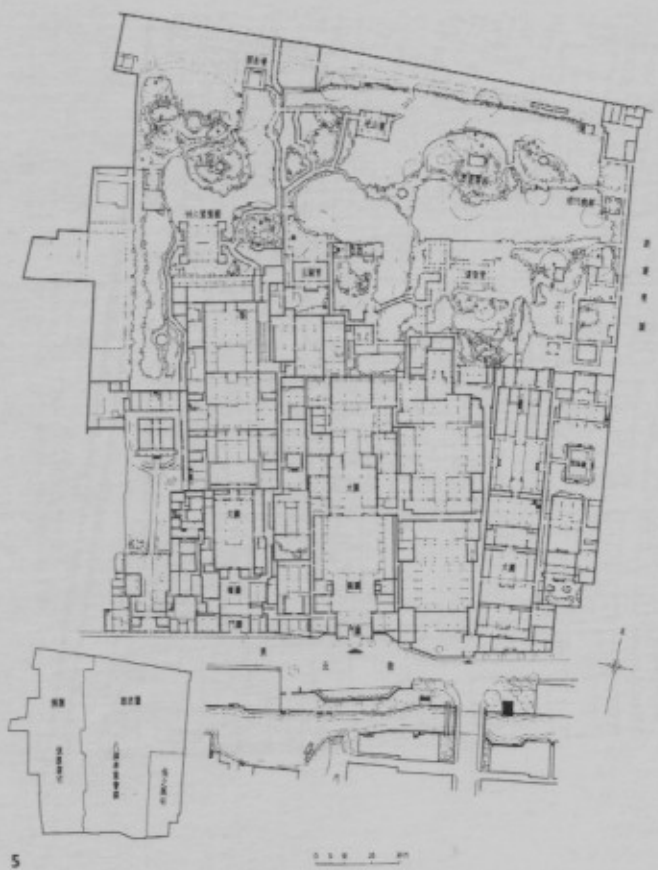
**4 Pompeii as an example of a continuous architectural field.** The urban tissue shows variations of a house type. The house units are formed by the combination of atrium, peristyle, and garden, with cell-like rooms around them. Note how large houses have a larger atrium and peristyle, but that the size of the rooms is not much different with the size of the house; there are only more rooms. While all houses have an atrium, only the larger houses have a peristyle. Although their number may vary, the relations between the spaces that make the house is always the same, for instance the peistyle is always behind the atrium and both are surrounded by cell-type rooms.

This field can be read in both ways as discussed in the text. First, as a deployment of walls and columns, following certain continuous patterns across the whole field. See for instance the cells lining the streets. Second, as a combination of territorial units. Closer scrutiny shows that the latter are not the same as the house units by which we recognize the type. Openings in party walls, for instance, suggest the combination of two or more "houses" into one territory. Irregularities in party walls also betray exchanges of spaces from one house to another in the course of time.

Detail of the map in Overbeck, Pompeii, Leipzig, 1866.



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**5 Zhuo Zheng Yuan estate and garden,** Zu Chou, China, example of a continuous architectural field. From: Liu Dun-Zhen, *Zu Chou: Classic Chinese Gardens,* China Architectural Industrial Press, Beijing, 1979.

house, were never formally described by those who made and used them. Types only exist in a social body. Once we realize this we find how futile it is to discuss typology in terms of form only. The power of the type is that it is never explicated but allows a social body to produce very complex artifacts with a minimum of formal designing and a maximum of efficiency.

As shared know-how within a social body, the type is known through acts, not through description. Indeed I found that students have no difficulty making a reasonable instance of a type after studying a number of examples for a day. However, being asked to describe the type produces much labor, long disputes, and little conclusive results. Each observer stresses another aspect. Each description is inevitably a reduction and therefore destroys the holistic power of the type. The type exists as long as we follow the conventions it implies. The living type need not be explained because it is already shared knowledge; hence its efficiency and coordinating power.

## Field Deployment

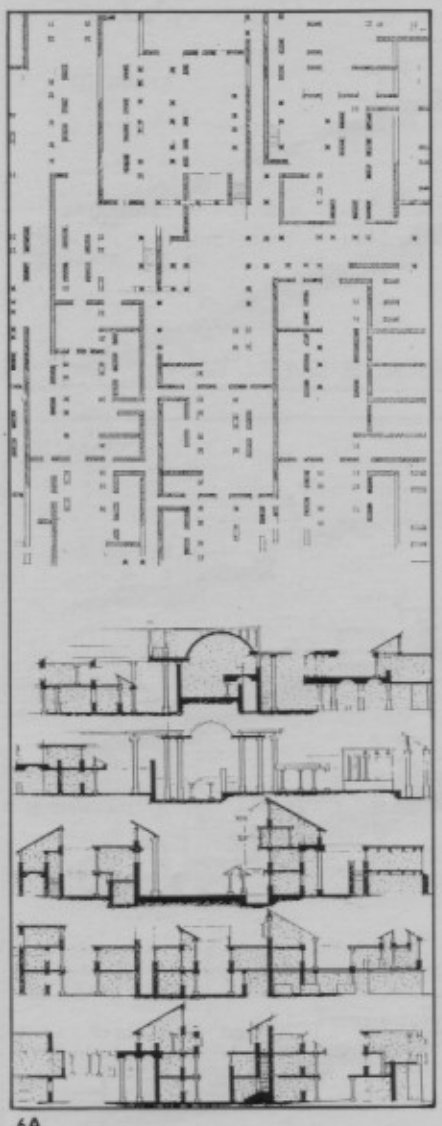
Once the thematic development of forms is understood, we need not think of self-contained forms that grow and transform, but we can use the same approach for the creation of large continuous fields. The theme can work its way across the field, making instances and reiterations without ever repeating exactly the same form. In environmental design, urban tissues are examples of continuous thematic fields.

To control the deployment of such fields, a number of issues must be studied. One has primarily to do with tools: we need a formal geometry to help us organize such fields. The other has to do with a better understanding of complex forms: we need to know about their hierarchical structure.

## Geometry

Geometry in design has to do with the placement of parts. It organizes where things go. To make the position of each part in our field unambiguous but manipulable, we need placement rules. These rules should facilitate the thematic development itself, making a link between theme and field. The formulation of such placement rules is accomplished by means of a grid.

A grid, by nature, is predominantly homogeneous and continuous. However, we may not want the field to be fully homogeneous. The introduction of zones to which we designate particular properties allows us to articulate distinctions in the whole. The zone, similar to the way it is used in urban



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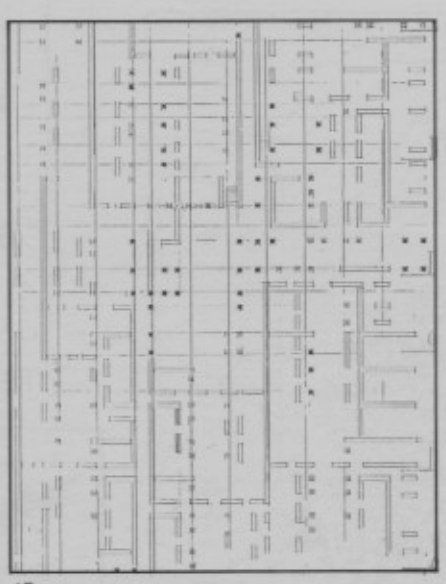

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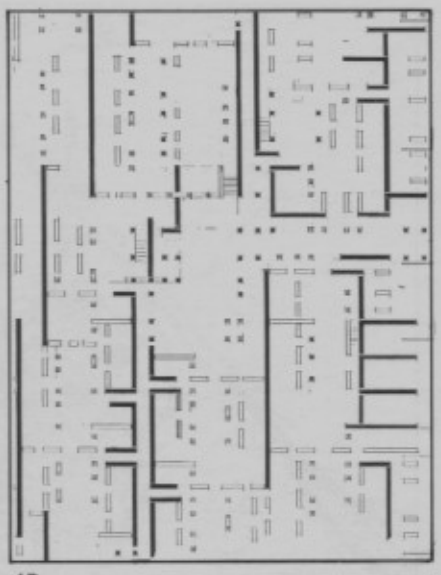

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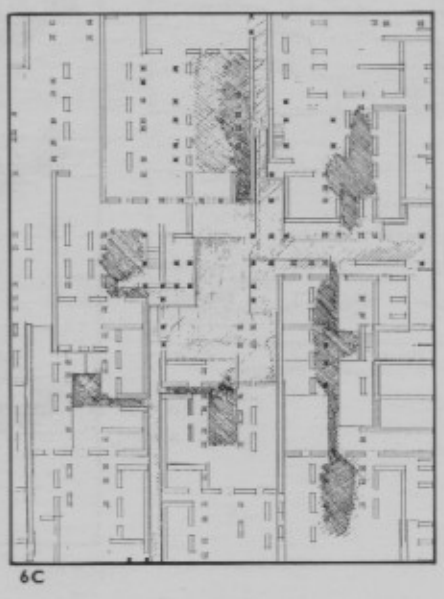

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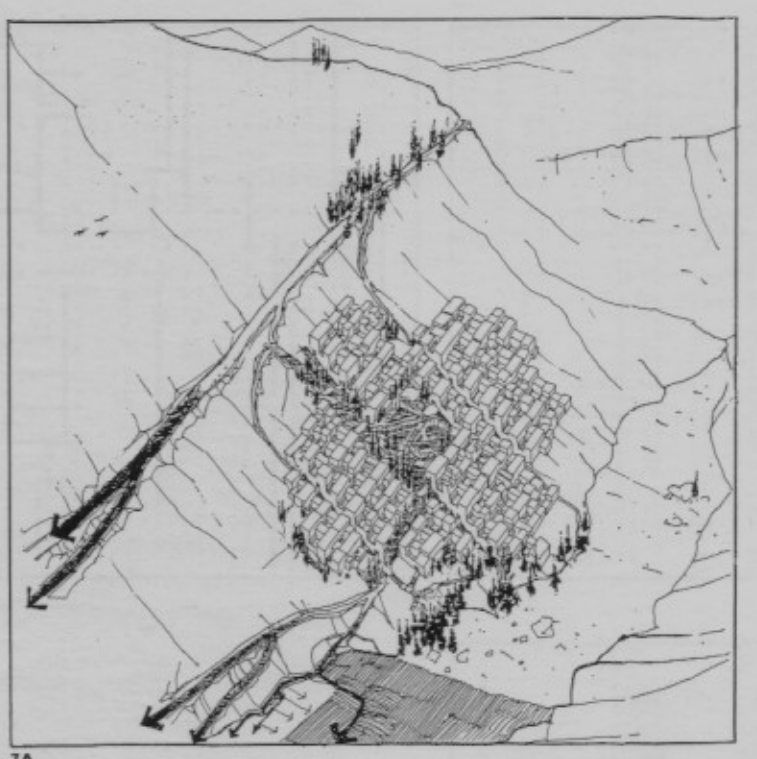
**6 Study in continuous field deployment.** A. Plan and sections. B. The grid superimposed on the plan. Note that the two axes of the grid have different modules, producing a direction to the field. C. A territorial interpretation of the field. D. Distinguishing the different layers of the deployment. Long walls, combined with shorter perpendicular ones, as given in black, make a first layer. Subsequent layers are made by strings of short walls or piers in two directions and two kinds of columns. From a class assignment by Margaret Lew, M.S. Arch. St. program, Massachusetts Institute of Technology.



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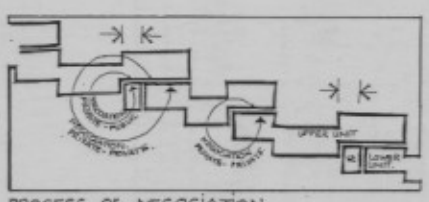


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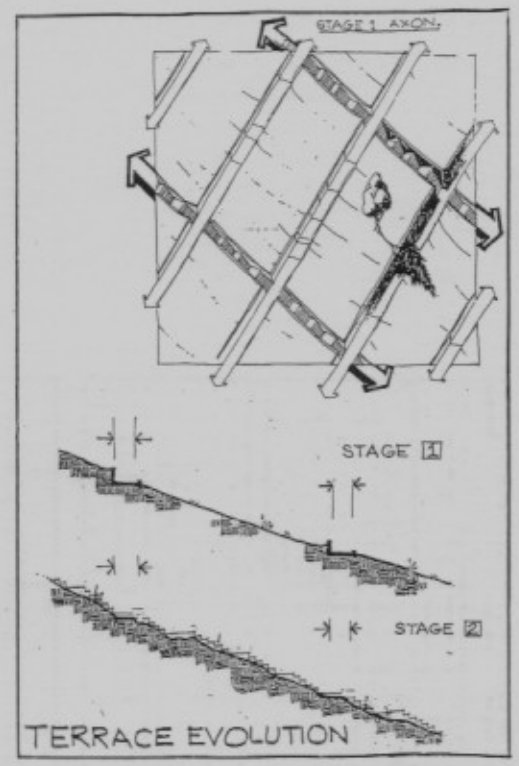


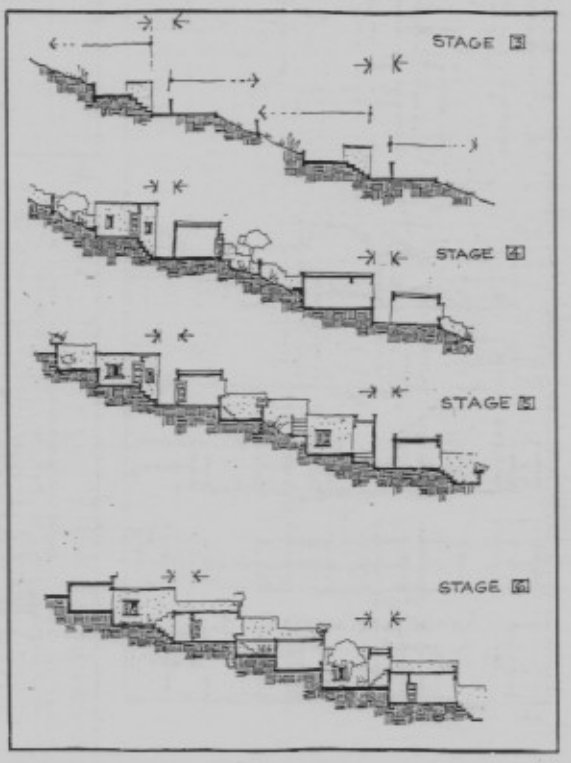


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**7 Study for a field deployment inspired by the settlement type found in Ladakh, northern India.** A. Overview. B. Diagrammatic section of the housetype and possible space negotiation between territories. C. Sections of the subsequent layers used in the development. Project by Solomon Benjamin, M.S. Arch. St. program, Massachusetts Institute of Technology.

legalization, is an abstraction of site conditions; it allows us to state what is, and what is not, allowed in a particular area. When our exercise is formal and not bound to a particular site, the zones themselves help us to establish "site conditions." By attaching various deployment constraints to zones, the field is no longer neutral and must be responded to. Of course, in real site cases, the zones and the rules attached to them are expressions of conditions we note in the site.

Zones and grids are tools developed for the specific needs of thematic development of larger fields. As such, their discussion is inevitably technical in nature and only of interest to those who engage in such deployments. Grids have a bad name in architectural circles mainly because they are confused with dull and repetitious gridlike forms. But we must not confuse the tool with the form. As a tool, used with appropriate position rules, the grid allows for the generation of extremely complex and varied arrangements. It is the arrangement we ultimately see, not the grid.

In a broader context, zones and grids are of interest because they constitute a new geometry in design. Geometry has always been the hallmark of architectural skill. Where ruler and compass allowed the Renaissance architects to produce formal organizations of a predominantly self-contained kind, we seek a geometry of fields, and one that is by itself continuous—albeit varying from place to place—allowing us to make formal arrangements of a different nature.

## Hierarchy

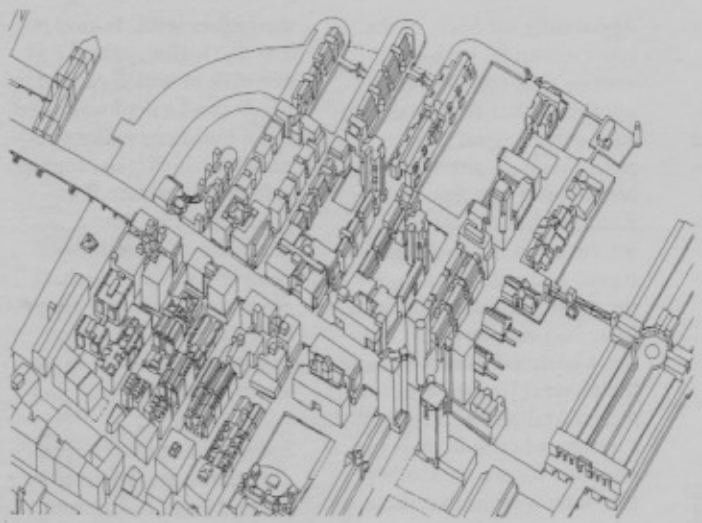
We are all familiar with the notion that rooms make the house and houses the neighborhood and neighborhoods the town. Large things are made out of small things, and complex forms are inevitably hierarchical in structure. But to make the idea of hierarchy useful in design, we need to be more precise about this concept. In the analysis of complex forms, two kinds of hierarchies must be distinguished. When we say that the small makes the larger we refer to a part-whole hierarchy, a hierarchy of assembly. In building we may say that the bricks make the wall and the walls make the house. Here the wall is a part out of which a house may be built, and the bricks are the parts of which the walls are made. But when we say that the furniture makes the room or the houses make the neighborhood, we speak metaphorically. We cannot assemble a room out of furniture or a neighborhood from houses. We can, however, place and arrange furniture in a room, and we can build and demolish houses in a neighborhood.

Apparently we have, in the latter example, terms for entities that contain one another rather than make up each other's constituent parts. Such an alternative hierarchical concept distinguishes realms of intervention. I can design a room, and you can design the arrangement of furniture in it. You can design a neighborhood and determine the context by the layout of streets and public places, and I design a house in it. When complex forms are studied this way, we find that there is a hierarchy of discrete physical parts on different levels that constitute realms of control. Each design intervention takes place on at least one such level. Relative to the level on which we are designing we always find a higher level which is part of the physical context offered us. Similarly, a lower level will be accommodated by the design we make. This kind of hierarchy we may call a "control hierarchy," or "dependency hierarchy."

In control hierarchies we find two important aspects of designing combined. First, we see the complex form composed of systemic physical realms, or "levels," which are individually manipulable over time. The vertical relationship of such levels in control hierarchies is one of loose fit (in contrast with the part-whole hierarchy). The lower level can change without disturbing the higher level. In this way the highways make a network in which secondary roads can be deployed, and office buildings make structures in which partitioning systems constitute floor plans. It is this innate flexibility that enables complex artifacts such as cities to change and adapt over time and allows us to inhabit buildings in different ways.

Second, because the levels are realms of intervention, we find these hierarchies defined in terms of control. A level exists because there is a party out there that operates on it. In complex artifacts, we discover the levels of intervention by trying to change things. In fact, our general distinction between interior designers, architects, urban designers, and city planners reflects the reality of control hierarchies.

Knowledge of control hierarchies can be utilized in continuous architectural fields one level at a time. In urban design, we first make the road network and next arrange the buildings in the blocks. In building, we first deploy, for instance, the larger structure of columns and floors and next distribute facades and infill walls. Each deployment on one level allows alternative deployment on lower levels. Once this principle is recognized, we can use it more fully. The large field need not be a juxtaposi-



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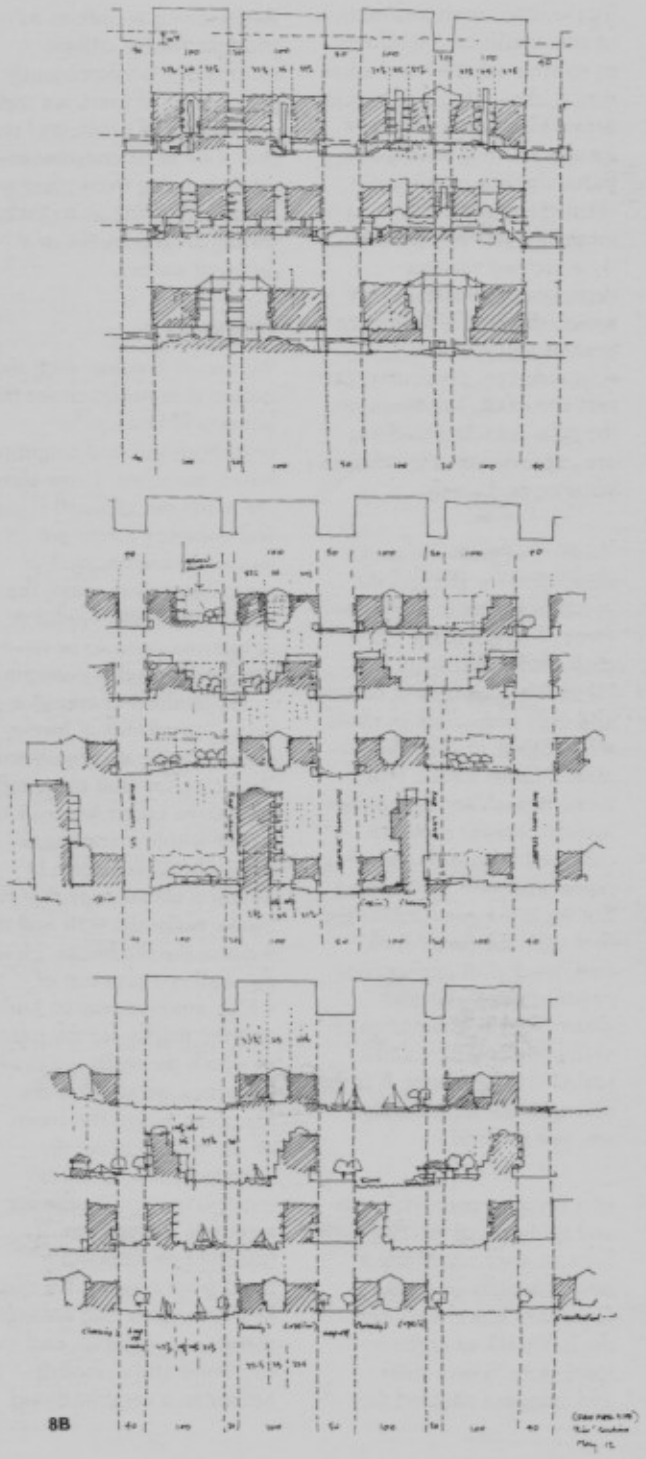

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**8A Study for Fort Point Channel, Boston,** based on thematic field deployment of predetermined building types. Overview.

**8B Sketches for building sections** arranged in the zoning of fig. 8A. From the thesis project by John R. Dale, M.S. Arch. St. program, Massachusetts Institute of Technology.

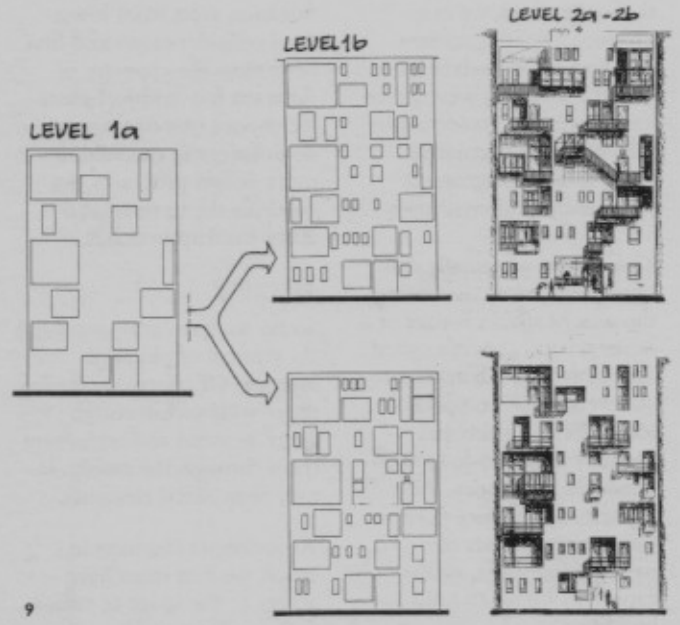
tion of already vertically integrated entities, such as houses put next to one another, but can be the deployment of walls and columns over the whole field, followed by facades over the whole field, to be followed by infill walls over the whole field, followed by kitchens and sanitary equipment over the whole field. Thus we begin to see the field as horizontally organized: layer after layer of distinct deployments. In each layer, we need not repeat a same combination ever but can stay with thematic variations. When all layers are in place, the result can be extremely complex and varied. Yet each instance is fully under control, and local changes are possible on each level, and each time we can test its impact on lower levels.

## Capacity

We recognize a room's function by the arrangement of furniture and equipment in it. Given the location and dimensions of a space, we may decide, for instance, that it can be used as a bedroom or as a study. We can test this by arranging the furniture in the same space in two different ways. This is how what we call the "function" of a configuration (in this case the configuration of walls making a room) can be expressed by another configuration of a lower level. The concept of "function" as it is used in architectural design is linked to the relationship between two levels of intervention. We can explore the "capacity" of what we produce on one level to hold configurations on a lower level. In a similar way, the urban designer may demonstrate how buildings can be built by other parties in the context of the streets and public spaces he has laid out.

Seen this way, the concept of function becomes part of the transformational development of the complex form and we learn about function by the study of the relation between levels of intervention. When we decide that a certain space must have a certain function, we mean that this space, when it is designed, must be able to hold an arrangement of objects that stands for the use we have in mind. This arrangement must conform to norms we deem representative for this use. We may, for instance, call a space a "one person bedroom" if it can hold a bed, a closet, a chair and a table, all arranged in appropriate relations.

Although we cannot make a lower level arrangement before the higher level context is in place, the expectations we have for lower level use can guide higher level design. The function does not dictate the space, but we can demand that the capacity of the space hold a certain function and test it by inserting an appropriate lower level arrangement. Coming from




**9 Layered field deployment applied to a facade design.** Each stage serves as a constant "higher level" context for the next. From a study for an apartment building by Christina Gryboyanni, M.S. Arch. St. program, Massachusetts Institute of Technology.

the higher level, we may produce a spatial context first and ask ourselves what uses it may have: we explore its capacity by projecting in it a variety of alternative lower level arrangements representing different uses.

Thus, what we usually call "function" when discussing the uses of spaces is part of a more general concept called "capacity," which applies to all levels of the complex form. We can study the capacity of a facade to hold windows and doors, the capacity of an office floor to hold arrangements of partitioning walls, or the capacity of a lot to hold a building.

The concept of capacity can be applied to the layered field deployment discussed earlier. Each pass across the field with a lower level system is a comment on the capacity of what was already in place. When, for instance, we first lay out a field of bays using different bay widths in various combinations, we may next study the capacity of bay combinations in the field for holding subdivisions by infill walls and other elements and make such lower level decisions while we go across the field once more. Capacity studies, therefore, can be conducted locally for each part of the field.

It is easy to see, then, how we can work from the bottom up as well as from the top down. We might, for instance, start from lower level considerations and first determine the capacity of different bay widths before we choose two or three for deployment in the field. In most design processes, we combine the upward and downward approaches.

## Territory

So far we have only discussed the control of physical systems. Of course we deploy them with architectural space in mind and transform them through the manipulation of material elements.

To distribute elements in space, we first must have access to the space in which they go. Territory is space controlled by one party, which must have the ability to keep things (and people) out. This is the basis of all use of space. We cannot dwell someplace unless we have certainty of some territorial control.

Territory, defined this way, is not the same as architectural space. The house, as an architecturally defined volume, for instance, may not define the territory of its inhabitants simply because it stands in a garden and the territorial boundary is at the curb where the lawn begins. A fence, to give another example, may be a territorial boundary but it can also be just a barrier to keep animals from wandering away.

Territory as a token of inhabitation is always an interpretation of a given physical organization. When a culture is familiar to us, we are very adept at reading territorial clues. We read easily signs of inhabitation such as plants placed on a doorstep, the room's door ajar, the towels and umbrellas arranged on the beach and avoid the embarrassment of trespassing. We know instinctively the difference between a ceremonial gate and one that defines a territorial boundary.

From a methodological point of view, territory is an independent variable relative to the physical arrangement it inhabits. Given such an arrangement we always can project a number of plausible territorial interpretations. This is true on all scales of the environmental form because territories have their own hierarchy, distinct from the dependency hierarchies we discussed earlier. In each territory we find included territories. In the condominium, for example, individual households are included territories. The common space is public space of the larger territory. Indeed, in all cases, a territory contains two kinds of spaces: those occupied by the included territories, which we call "private" spaces, and the space left free to be shared by the inhabitants, which we call the territory's "public" space.

Thus, we can have public space on all levels of the territorial hierarchy. For instance, the public space in the condominium is, in turn, private when we step out into the street. The concept of public space is therefore a relative one, and it is this relativity that accounts for the confusion of terms we often encounter such as "public," "semi-public," "private," and "semi-private."

This is not the place to elaborate on the theory of territoriality in environmental design, but enough has been said to make a few points. The territorial organization as a separate variable is methodologically useful. Once a territorial organization is determined in a given field, we can, within each territory, deploy lower level arrangements to serve this territory. Thus, territorial organization divides a field into self-contained areas guiding further deployment. Not all lower level development, given a first deployment as context, needs to be divided into territories, but each such division frames lower level arrangements.

Territorial structure reflects patterns of inhabitation. Seen this way, the territory is the most general expression of use and function, and it interprets indeed the given context in a manner similar to the way a lower level arrangement interprets it functionally. We could say that an arrangement of the furniture in a room is a

functional interpretation, but it also reflects a territorial interpretation in the larger context of the house. Conversely, as we have seen, a territorial interpretation of the floor plan will "frame" the arrangement of furniture in the rooms.

In the design process, we should consider not only the territorial structure of inhabitation but territorial divisions among designers. The field can be given a territorial interpretation to guide the division of design responsibility within a larger team. Each designer will have a "territory" in which to make design decisions within the "public" space that is the joint responsibility of the team. Such divisions of design responsibility in a large project are most successful when the design territories correlate closely with the expected territories of use. This division of work is preferred to an arbitrary segmentation of a field where there is no "public" space to relate individual design efforts and interface conditions lack clarity. It is also an alternative to dividing the work in layers such that each design party is responsible not to a part of the field but to a level across the field. In the design of most complex environmental forms, a judicious combination of such "horizontal" and "vertical" divisions of the form for the purpose of delegation of design responsibility is best.

## Final Remarks

This quick survey of methodological opportunities in the design of complex environmental forms can, of course, be no more than a sketch. What has been said may seem familiar to the extent that it gives more formal expression to concepts we deal with regularly: control hierarchies, territorial organization and division between public and private space, capacity analysis, type, and theme. Methodology should indeed always confirm what we already do in the sense that it can only be successful if it facilitates common practice and gives us power to deal with problems we are already confronted with.

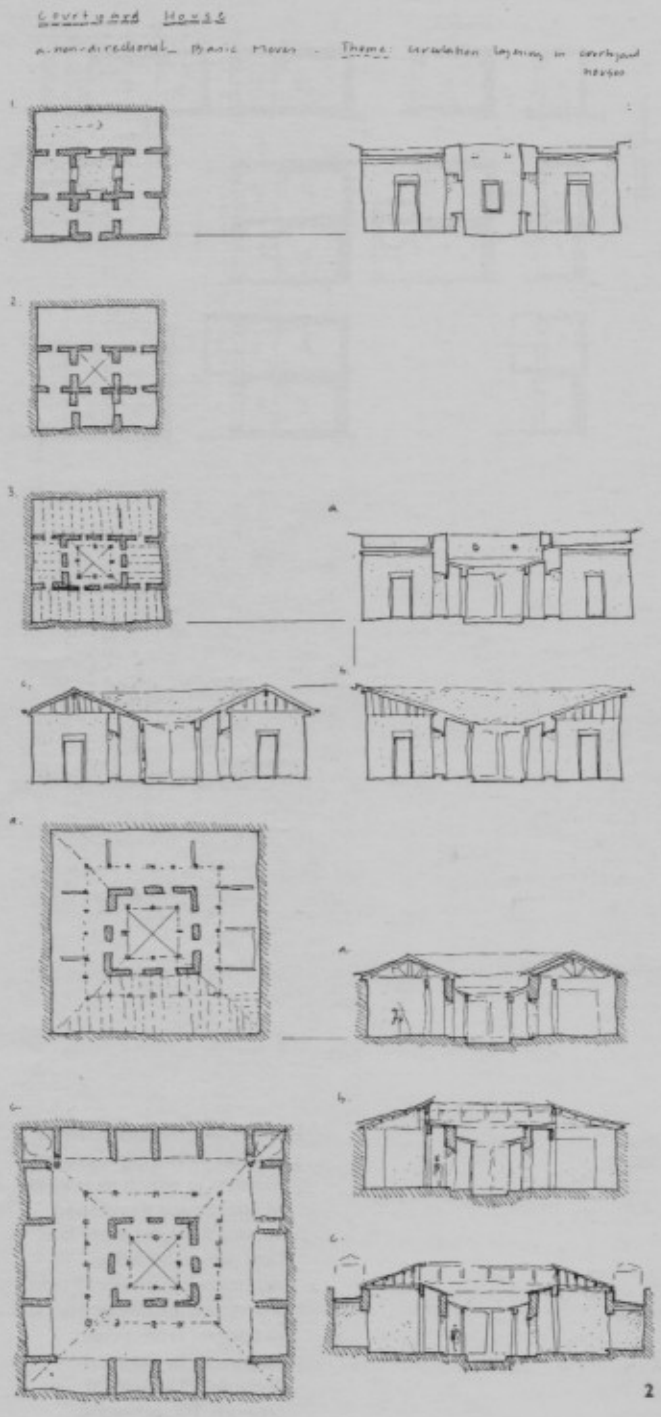
At the same time, these familiar elements can be brought into a new perspective by applying two interrelated concepts not normally equated with design: change and control. By looking at the architectural form as an instance of a continuous process of change, we become interested in the mechanisms of transformation. That we can learn from change is not new. In all observations, scientific and otherwise, change and movement reveal the structure of what is observed. In our case, change is brought about by people designing, making, and inhabiting the environment. We have to deal with human constructs, and hence the complexities we observe are of our own making. Therefore, the structure we find is a reflection of patterns of control. We begin to see the complex form as a social artifact, and its hierarchical and territorial structure is, ultimately, a product of convention.

Such conventions we find reflected in the concepts of theme, system, and type. All three make us see form as shared, reflecting values we hold in common. A theme is what we design when we want others not only to understand what we do but participate in the development of the form. A system is the product of formal rules accepted by all who use it. A type, as we have seen, is a complex form principle, containing many themes on various levels, which lives outside formal description in the social body that applies it.

Thus the concepts on which rest the methodological tools discussed here run somewhat against the grain of traditional design attitudes. We tend to stress the constancy and immutability of the architectural form and do not readily take change into consideration when designing. We have not been taught how to share our designing with others. The myth of the master deciding everything confuses authority—based on skill and experience—with centralized control of decision-making. We need new attitudes that allow the qualities of daily life in the environment—variation in spatial development, thematic richness, and adaptability over time—to support our architecture in an efficient way. Without such qualities, environmental forms will maintain the poverty and rigidity we all deplore.

NOTE

1 Evidence of how efficiency can produce variety instead of uniformity can be found in recent developments in housing technology in the Netherlands. Builders, architects, and developers, now cooperate for the introduction of infill systems. These systems comprise interior partitioning, kitchen and bathroom equipment and the plumbing and wiring that makes equipment work. Industrialized infill systems, if designed correctly, yield considerable savings in on-site labour and overall construction time. The dwelling's shell (called "support") and its infill are treated as separate, complementary, systems. The shell offers independent dwelling territories which can have their own infill configurations. The result is that no two dwelling plans need be the same for reasons of efficiency. See also N. J. Habraken, "Reconciling Variety and Efficiency in Large-scale Projects" in: *Large Housing Projects; Design, Technology, and Logistics,* ed. Margaret B. Sevcenco, pp. 46–53. Designing in Islamic Cultures, 5. Cambridge, MA: Aga Khan Program for Islamic Architecture.



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noted that architectural form may result from a process of transformation. Suppose we set up, by way of demonstration, two columns and a lintel spanning them. This primitive configuration, when studied, leads to a number of alternative next moves. We may expand with another column and beam. This may be done in alignment with the first beam or at an angle to it. Or we may repeat the portal at a distance parallel to the first, which would allow us to put planks from beam to beam and make a floor or roof. The choice of any of these steps leads to new alternatives.

This basic exercise gives us the ingredients of a design attitude. We see in the form at hand the moves available to us. We enter in a dialogue with the form. Our freedom is in choosing the next move; our skill is in choosing what leads us in the general direction we must take to satisfy a demand or a strategy; our knowledge and experience lie in being able to find many alternative moves.

The result of such a humble beginning, if the process is continued, can be very complex and very rich. But nothing in it needs to be done by happenstance, and all steps are accounted for technically as well as architecturally.

This very beginning is initially found difficult by many designers for a number of reasons: First, it can only be done from a knowledge of and interest in the way the building is actually built. Columns have certain properties, and these suggest next moves. There is a difference between a concrete portal or a steel one or free-standing columns with a lintel on top. All three alternatives are interesting to work with, but the moves we can choose from them are different. When the design is too abstract, anything goes. There can be no dialogue with the form. In short, one can only work this way if one believes a building can only be designed when one knows how it is built. I should point out here that the same knowledge about building allows us to generalize. For instance, we may decide later whether to use concrete or steel portals while we reject early on the free-standing column. The requirement that we design from a knowledge of the building system does not mean that we must decide everything now or cannot change our mind as we go.

A second difficulty students have with this exercise is that there is no program. They are asked not to think of any guiding functional demands. For those trained in a culture in which one justifies one's architecture functionally, this is difficult. Even designers who embrace the idea of an autonomy of the form find out how heavily their design