This article describes a new way of analyzing the functions of a building so that the design may more accurately reflect every requirement of the program

THE THEORY AND INVENTION OF FORM

By Christopher Alexander

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Today more and more design problems are reaching insoluble levels of complexity. This is true not only of moon rockets and computers, whose complexity is internal, but also of towns and buildings, which have acquired a background of needs and activities so diverse, and so intricately related, that it is becoming extremely difficult to grasp them fully.

At the same time that design problems increase in complexity, their character is changing very rapidly. New materials are developed all the time; social patterns alter quickly; the culture itself is changing faster than it has ever changed before.

To match the growing complexity of problems there is a rapidly growing body of information and specialist experience. This information is hard to handle; it is widespread, diffuse, unorganized. Moreover, the quantity of information is now beyond the reach of the individual designer. The various specialists who retail it are narrow and unfamiliar with the form-makers' peculiar problems, so that it is never clear how the designer should best consult them. In addition, since cultural pressures change so fast, any gradual development of form, like that which took place in traditional societies, has now become impossible. Bewildered, the form-maker stands alone. He has to make clearly conceived forms at once, without the possibility of trial and error over time.

If we look at the lack of organization and lack of clarity of the forms around us, it is plain that their design has often taxed their designer's cognitive capacity well beyond the limit.

The following argument is based on the assumption that physical clarity cannot be achieved in a

This is a theory about the process of design;
the process of inventing physical things which display a new organization
and form in response to function . . .

form until there is first some programmatic clarity in the designer's mind and actions; and that for this to be possible, in turn, the designer must first trace his design problem to its earliest functional origins and be able to find some sort of determining pattern in them.

Ideally, then, a form should reflect all the known facts relevant to its design. In practice, however, the average designer scans whatever information he happens on, consults a consultant now and then when faced by extra-special difficulties, and introduces this randomly selected information into forms otherwise dreamt up in the artist's studio of his mind. The information needed to produce an integrated form has gotten out of hand—and well beyond the fingers of the individual designer.

The idea that the capacity of man's invention is limited is not so surprising, after all. In other areas it has been shown, and we admit readily enough, that there are bounds to man's cognitive and creative capacity. We know, for example, that there are limits to an individual's capacity for mental arithmetic. But to solve a difficult problem in arithmetic we need a way of setting it down so that the problem becomes more clear. Ordinary arithmetical convention gives us such a way. Two minutes with a pencil on the back of an envelope lets us solve problems which we could not do in our heads if we tried for a hundred years.

At present we have no corresponding way of simplifying design problems for ourselves. These pages describe a way of representing design problems which does make them easier to solve. It is a way of reducing the gap between the designer's small capacity and the great size of his task.

Definition of the Design Problem

The ultimate object of design is form.

Every design problem begins with an effort to achieve fitness between two entities: the form in question and its context.

The reason that iron filings placed in a magnetic field exhibit a pattern—or have form, as we say—is that the field they are in is not homogeneous. If the world were totally regular and homogeneous, there would be no forces, and no forms. Everything would be amorphous. But an irregular world tries to compensate for its own irregularities by fitting itself

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* This example is based on one given by W. Ross Ashby in "Design for a Brain," 2nd edition, New York, 1960, page 155

. . . A form that fits its purpose
is a response to many specific physical relationships,
each of which must be solved successfully . . .

to them, and thereby takes on form. The form, then, is that part of the world which we decide to shape, while leaving the rest of the world as it is. The context is that part of the world which puts demands on this form; anything in the world that makes demands of the form is the context. In other words, the form is the solution to the problem; the context defines the problem. Fitness is the relation of mutual acceptability between these two. In a problem of design we want to satisfy the mutual demands which the two make on one another.

To characterize the fit between form and context, let us consider a simple specific case.

Fit and Misfit Variables

It is common practice in engineering, if we wish to make a metal face perfectly smooth and level, to fit it against the surface of a standard steel block, which is level within finer limits than those we are aiming at. We ink the surface of this standard block and rub the metal face against the inked surface. If the metal face is not quite level, ink marks appear on it at those points which are higher than the rest. We grind away these high spots and try to fit it against the block again. The face is level when it fits the block perfectly, so that there are no high spots that stand out any more.

Since the context is fixed, and only the form variable, we may distinguish good fit from bad experimentally, by inking the standard block, putting the metal face against it, and checking the marking that gets transferred.

In design we cannot define the context as levelness can be defined, but we can still detect specific misfits which correspond to high spots on the block. A place between stove and cabinet which you can't reach with a broom, rainwater coming in, over-crowding and lack of privacy, the eye-level oven which spits hot fat right into your eye, and the front door you cannot find, are all misfits between the house and the lives and habits it is meant to fit.

Wherever an instance of misfit occurs in the form-context ensemble, we are able to point specifically at what fails and to describe it. It seems as if in practice the concept of good fit, describing only the absence of such failures and hence leaving us nothing concrete to refer to in explanation, can only be explained indirectly; the incongruities in an ensemble are the primary data of experience. Good fit in every-day experience is the absence of all possible misfits.

With this in mind, we should always expect to see the process of achieving good fit between form and context as a negative process of neutralizing the incongruities, or irritants, or forces, which cause the misfits to occur.

We are now in a position to define the design situation as follows: if we divide an ensemble into form and context, the fit between them may be regarded as an orderly condition of the ensemble, subject to disturbances in various ways, each a potential misfit.

We may summarize the state of each potential misfit by characterizing it as a binary variable. If the misfit occurs, we say the variable takes the value 1. If the misfit does not occur, we say the variable takes the value 0. Each binary variable stands for one possible kind of misfit between form and context. The value this variable takes, 0 or 1, describes a state of affairs that is not either in the form alone or in the context alone, but a relation between the two. The state of this relation, fit or misfit, describes a particular aspect of the whole ensemble. It is a condition of harmony and good fit in the ensemble that none of the possible misfits should actually occur. We represent this fact by demanding that all the variables take the value 0.

We can now say that the task of design is not to create a form which meets certain conditions, but to create such an order in the form-context ensemble that all the variables will take the value 0. The form is simply that part of the ensemble over which we have control. It is only by manipulating the form that we can create order in the ensemble.

Subsystems of Variables

At any moment in a form-making process, each of the variables involved is in a state of either fit or misfit. As form-making proceeds, so the system of variables changes state. One misfit is eradicated, another misfit occurs, and these changes in their turn set off reactions within the system that affect the state of other variables. We shall perhaps understand this process better if we make a simple picture of it.

Imagine a system of a hundred lights.* Each light can be in one of two possible states. In one state the

. . . These physical relationships interact, and a problem can be solved only when these interactions can be patterned into small and relatively independent sub-systems . . .

light is on. The lights are so constructed that any light which is on always has a 50-50 chance of going off in the next second. In the other state the light is off. Connections between lights are constructed so that any light which is off has a 50-50 chance of going on again in the next second, provided at least one of the lights it is connected to is on. If the lights it is directly connected to are off, for the time being it has no chance of going on again, and stays off. If the lights are ever all off simultaneously, then they will all stay off for good, since when no light is on, none of the lights has any chance of being reactivated. This is a state of equilibrium. Sooner or later the system of lights will reach it.

Description of the Successful Design Process

This system of lights will help us understand the history of a form-making process. Each light is a binary variable, and so may be thought of as a misfit variable. The off state corresponds to fit; the on state corresponds to misfit. The fact that a light which is on has a 50-50 chance of going off every second, corresponds to the fact that whenever a misfit occurs efforts are made to correct it. The fact that lights which are off can be turned on again by connected lights, corresponds to the fact that even well-fitting aspects of form can be unhinged by changes initiated to correct some other misfit because of connections between variables. The state of equilibirum, when all the lights are off, corresponds to perfect fit or adaptation. It is the equilibrium in which all the misfit variables take the value 0. Sooner or later the system of lights will always reach this equilibirum. The only question that remains is, how long will it take for this to happen? It is not hard to see that, apart from chance, this depends only on the pattern of interconnections between the lights.

Let us consider two extreme circumstances:

1. On the one hand, suppose there are no interconnections between lights at all. In this case there is nothing to prevent each light's staying off for good, as soon as it goes off. The average time it takes for all the lights to go off is therefore only a little greater than the average time it takes for a single light to go off, namely 2^1 seconds or 2 seconds.

2. On the other hand, imagine such rich interconnections between lights than any one light still

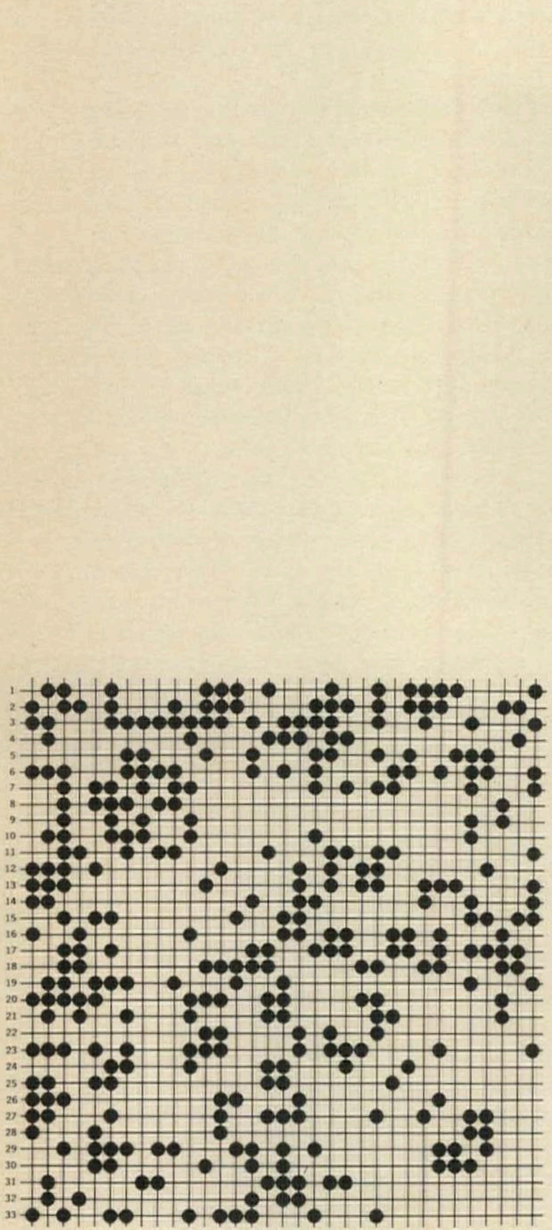


Diagram of interaction between 33 misfit variables in a problem. From "Community and Privacy" by Serge Chermayeff and Christopher Alexander. © 1963 by Serge Chermayeff, all rights reserved

. . . The form that the building will take derives from these sub-systems of physical relationships . . .

on quickly rouses all others from the off state and puts them on again. The only way in which this system can reach adaptation is by the pure chance that all 100 happen to go off at the same moment. The average time which must elapse before this happens will be of the order of 2^{100} seconds, or 10^{22} years.

The second case is useless. The age of the universe itself is only about 10^{10} years. For all intents and purposes the system will never adapt. But the first case is no use either. In any real system there are interconnections between variables which make it impossible for each variable to adapt in isolation. Let us therefore construct a third possibility.

3. In this case suppose there are again interconnections among the 100 lights, but that we discern in the pattern of interconnections some 10 principle sub-systems, each containing 10 lights. The lights within each sub-system are so strongly connected to one another that again all 10 must go off simultaneously before they will stay off; yet at the same time the sub-systems themselves are independent of one another so that the lights in one sub-system can be switched off without being reactiviated by others flashing in other systems. The average time it will take for all 100 lights to go off is about the same as the time it takes for one sub-system to go off, namely 2^{10} seconds, or about a quarter of an hour.

A Vital Lesson

Of course, real systems do not behave so simply. But 15 minutes is not much greater than the two seconds it takes an isolated variable to adapt, and the enormous gap between these magnitudes and 10^{22} years does teach us a vital lesson. No complex adaptive system will succeed in adapting in a reasonable amount of time unless the adaptaton can proceed sub-system by sub-system, each sub-system relatively independent of the others.

This is a familiar fact. It finds a close analogy in the children's sealed glass-fronted puzzles which are such fun and so infuriating. The problem, in these puzzles, is to achieve certain configurations within the box: rings on sticks, balls in sockets, pieces of various shapes in odd-shaped frames—but all to be done by gentle tapping on the outside of the box. Think of the simplest of these puzzles, where half a dozen-colored beads, say, are each to be put in a hole of corresponding color.

One way to go about this problem would be to pick the puzzle up, give it a single energetic shake, and lay it down again, in the hope that the correct configuration would appear by accident. This all-or-nothing method might be repeated many thousand times, but it is clear that its chances of success or negligible. It is the technique of a child who does not understand how best to play. Much the easiest way—and the way we do in fact adopt under such circumstances—is to juggle one bead at a time. Once a bead is in, provided we tap gently, it is in for good; then we are free to manipulate the next one that presents itself, and we achieve the full configuration step by step. When we treat each bead as an isolable sub-system, and take the sub-systems independently, we can solve the puzzle.

We may, therefore, picture the process of form-making as the action of a series of sub-systems, all interlinked, yet sufficiently free of one another to adjust independently in a reasonable amount of time. It works, because the cycles of correction and re-correction, which occur during adaptation, are restricted to one sub-system at a time.

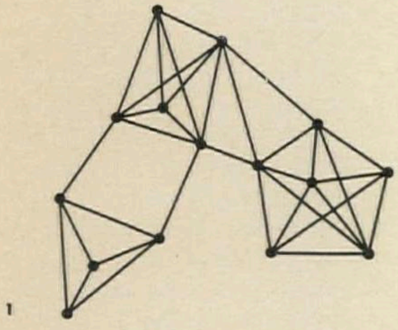
Structure of the Design Process

Here is the problem. We wish to design clearly conceived forms which are well adapted to some given context. We have seen that for this to be feasible, the adaptation must take place independently within independent subsystems of variables. To explore the structure of these sub-systems, we must use the concept of the set.

A set, just as its name suggests, is any collection of things whatever, without regard to common properties, and has no internal structure until it is given one. A collection of riddles in a book forms a set, a lemon and an orange and an apple form a set. The elements of a set can be as abstract or as concrete as you like. It must only be possible to distinguish them from one another.

Let us be specific about the use of set theory to picture design problems. As we have said, a design problem presents itself as a task of avoiding a number of specific potential misfits between the form and some given context. Let us suppose that there are m such misfit variables: $x_1 \, . \, . \, . \, x_m$. These misfit variables form a set. We call the set of these m misfits M, so that we write $x_i \, M$ (for all i, $i = 1 \, . \, . \, . \, m$).

. . . Once the physical relationships of a problem are stated, there will be a best form for that problem as stated . . .



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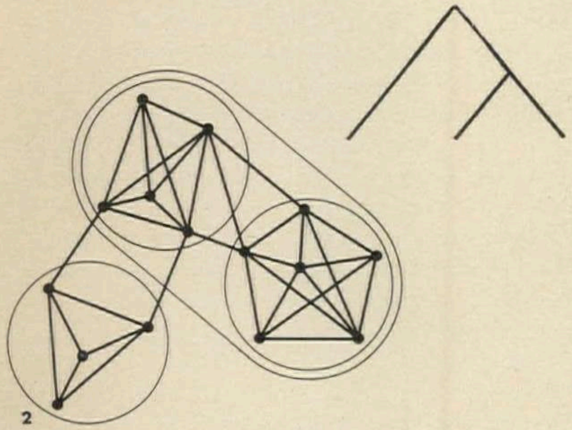

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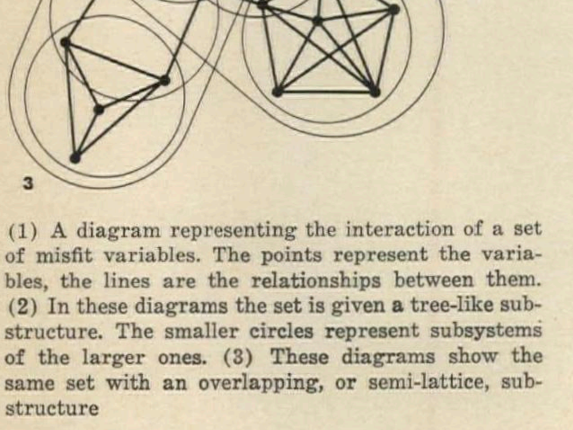


3

(1) A diagram representing the interaction of a set of misfit variables. The points represent the variables, the lines are the relationships between them. (2) In these diagrams the set is given a tree-like substructure. The smaller circles represent subsystems of the larger ones. (3) These diagrams show the same set with an overlapping, or semi-lattice, substructure

The great power and beauty of the set, as an analytical tool for design problems, is that its elements can be as various as they need be, and do not have to be restricted only to requirements which can be expressed in quantifiable form. Thus in the design of a house, the set M may contain the need for individual solitude, the need for rapid construction, the need for family comfort, the need for easy maintenance, as well as such easily quantifiable requirements as the need for low capital cost and efficiency of operation. Indeed, M may contain any requirement at all.

When it stands alone, the set M has no structure. To give it structure we need a second set, the set of interactions. We know that misfit variables interact. Some of them interfere or conflict with one another, as the designer tries to solve them, others have common physical implications, or concur; and still others do not interact at all. It is the presence and absence of these interconnections which give the set M the systemic character already referred to. We represent the interactions by associating with M a second set L, of non-directed, signed, one-dimensional elements called links, where each link joins two elements of M, and contains no other elements of M.

The two sets M and L together define a structure known as a linear graph or topological 1-complex, which we shall refer to as $G(M, L)$ or simply G for short. A typical graph is shown above left (1).

We must now explore the structure of this graph. The most important and most obvious structural characteristic of any complex entity is its articulation—that is, the relative density or grouping and clustering of its component elements. We will be able to make this precise by means of the concept of a decomposition.

Informally, a decomposition of a set M into its subsidiary or sub-system sets is a hierarchical nesting of sets within sets, as is shown in the second drawing at left. The diagram beside it brings out the tree-like character of the decomposition. It refers to precisely the same structure as the other. Each element of the decomposition is a sub-set of those sets above it in the hierarchy. If some sub-sets overlap, the structure shown in diagram three results.

It is easy to see that the existence of the links makes some of the possible decompositions very much more sensible than others. Any graph of the type $G(M,L)$ tends to pull the elements of M to-

. . . even though a better statement of the problem may always yield a still better form

gether in natural clusters. Our task is to make this precise, and to decide which decomposition of *M* makes the most sense, once we have a given set *L* associated with it. Each sub-set of the set *M* which appears in the tree will then define a sub-problem of the problem *M*. Each sub-problem will have its own integrity, and be independent of the other sub-problems, and can therefore be solved independently.

The reader may well ask how such a process, in which both the requirements and the links between requirements are defined by the designer from things already present in his mind, can possibly have any outcome which is not also already present in the designer's mind. In other words, how can all this process really be helpful? The answer is that, because it concentrates on structure, the process is able to make a coherent, and therefore new, whole out of incoherent pieces.

The decomposition of the problem, is a way of identifying the problem's major functional aspects. But what kind of physical form, exactly, is the designer likely to realize with the help of such a program? Let us look at the form problem from the beginning.

The Organization of Form

The organization of any complex physical object is hierarchical. It is true that, if we wish, we may dismiss this observation as an hallucination caused by the way the human brain, being disposed to see in terms of articulations and hierarchies, perceives the world. On the whole, though, there are good reasons to believe in the hierarchical subdivision of the world as an objective feature of reality. Indeed, many scientists, trying to understand the physical world, find that they have first to identify its physical components, much as I have argued in these notes for isolating the abstract components of a problem. To understand the human body you need to know what to consider as its principal functional and structural divisions. You cannot understand it until you recognize the nervous system, the hormonal system, the vasomotor system, the heart, the arms, legs, trunk, head, and so on as entities. You cannot understand chemistry without knowing the pieces of which molecules are made. You cannot claim to have much understanding of the universe until you recognize its galaxies as important pieces. You cannot understand the modern city until you know that, although roads are physically inter-twined with the distribution of services, the two remain functionally distinct.

Scientists try to identify the components of existing structure. Designers try to shape the components of new structures. The search for the right components, and the right way to build form up from these components, is the greatest physical challenge faced by the designer. *I believe that if the hierarchical decomposition is intelligently used, it offers the key to this very basic problem—and will actually point to the major physical components of which the form should consist.*

When we consider the kinds of physical relationships which are likely to be suggested by sets of requirements, at first it seems that the nature of these relationships is very various. Some will define overall pattern properties of the form, like being circular, being low rather than high, being homogeneous. Others will be piece-like rather than pattern-like, that is they define pieces of which the whole form is made. Actually the distinction between pattern-like and piece-like relationships is more apparent than real.

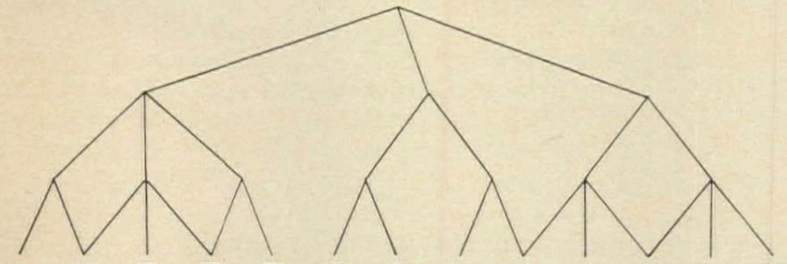
This is the general rule. Every relational aspect of a form, whether piece-like or pattern-like, can be understood as a structure of components. Every form is a hierarchy of components, the large ones specifying the pattern of distribution of the smaller ones, the small ones, though at first sight more clearly piece-like, in fact again patterns specifying the arrangement and distribution of still smaller components.

Every component has this twofold nature: it is first a unit, and second a pattern, both a pattern and a unit. Its nature as a unit makes it an entity distinct from its surroundings. Its nature as a pattern specifies the arrangement of its own component units. It is the culmination of the designer's task to make every physical relationship both a pattern and a unit. As a unit it will fit into the hierarchy of larger components that fall above it; as a pattern it will specify the hierarchy of smaller components which it itself is made of.

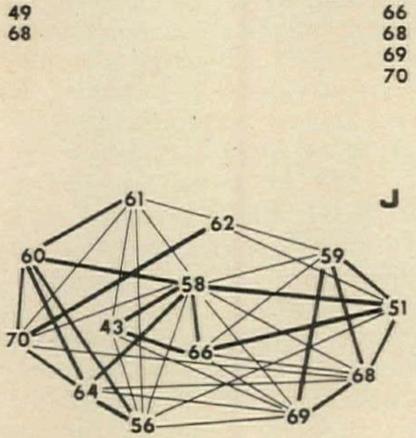
The hierarchical composition of these relationships will then lead to a physical object whose structural hierarchy is the exact counterpart of the functional hierarchy established during the analysis of the problem; as the program clarifies the component *sources* of the form's structure, so its realization, in parallel, will actually begin to define the form's *physical* components and their hierarchical organization.

This example, an analysis of a condominium, shows what happens when the theory explained on the foregoing pages is applied to an actual building program

According to the theory presented in this article, it is necessary to identify each of the components of a design problem, find their relationships to each other, and then arrange them into relatively independent sub-systems, if the problem is to be solved successfully. The following pages list 72 requirements for a condominium, taken from a master's thesis at the University of California by Donald M. Koenig. Below each fit, misfit requirement is a list of the other variables with which it interacts. The diagram shows the result of a mathematical analysis designed to separate the set of requirements into a heirarchy of sub-sets, each of which has the closest possible relationship within itself, and the least possible relationship to any of the other sub-sets. The numbers in the diagrams represent the requirements on the list. A diagram of a typical sub-set, J, is also shown.



A	B	C	D	E	F	G	H	I	J	K	L	M
44	4	1	12	17	29	30	34	38	43	7	11	11
45	5	2	13	20	31	31	55	40	51	8	23	50
46	10	3	14	21	32	33	56	41	56	9	51	53
47	12	6	15	24	35	34	57	42	58	11	53	65
48	13	10	16	42	39	36	58	43	59	15	58	66
	14	13	17	52		37	64	53	60	18	59	71
	16	25	19	54		38	69	56	61	51	65	
	17	26	20			64		66	62	59	66	
	20	27	22					69	64	66	67	
	22	28	49						66	68	68	
	44	49	68						68	69	69	
	46	63							69	72	72	
	48								70			
	49											



The mathematical basis of this analysis, and references to the computer programs required, will be found in appendix 2 of "Notes on the Synthesis of Form" by Christopher Alexander, pages 174-191

1. A new complex in an existing build up area should not violently upset or destroy the established urban pattern of that area.

1 interacts with 2, 3, 6, 8, 24, 25, 28, 43, 49.

2. A new complex should minimize the effect of zoning restrictions that dictate the form or surrender portions of available construction space through an arbitrary rule.

2 interacts with 1, 3, 5, 6, 10, 25, 26.

3. A new complex should not block natural light from the surrounding areas.

3 interacts with 1, 2, 6, 26, 27, 28.

4. No form of use should preclude future change.

4 interacts with 5, 7, 10, 12, 13, 16, 49, 71.

5. No part of the complex should be more "permanent" than it need be.

5 interacts with 2, 4, 10, 12, 13, 16, 22, 30, 44, 48.

6. Open space required to give light and to relieve the anxiety of overcrowding must not waste valuable land.

6 interacts with 1, 2, 3, 10, 13, 19, 25, 27, 28, 30, 63.

7. Owners should be able to feel independent and uncrowded, or to group together and interact socially; whichever they desire.

7 interacts with 4, 8, 9, 10, 15, 18, 50, 59, 62, 66, 72.

8. People wishing to identify themselves with a particular status level need a means of reinforcing this status identity.

8 interacts with 1, 7, 9, 15, 22, 24, 51, 62.

9. It should be possible to include a variety of "income-status" groups within the complex.

9 interacts with 7, 8, 10, 15, 18, 22, 59, 62, 66, 72.

10. The units available within the complex must not restrict the choice of different orientations, costs, sizes, shapes, locations, etc., that owners may desire.

10 interacts with 2, 4, 5, 6, 7, 9, 13, 26, 46, 49, 62, 63.

11. A dwelling unit should be effectively isolated from disturbing noises outside the unit boundaries.

11 interacts with 13, 14, 16, 18, 19, 23, 26, 50, 51. 59, 65, 69, 70, 71, 72.

The ultimate object of design is an enviroment . . .
which has no relationships in it that are not working to some specific purpose

12. Changes and additions made within a unit must not interfere with other units or common areas.

12 interacts with 4, 5, 13, 14, 15, 16, 20, 22, 42, 44, 48, 49, 53.

13. While the subdivision of units cannot be allowed, it should be possible to expand a unit after purchase.

13 interacts with 4, 5, 6, 10, 11, 12, 14, 17, 19, 20, 22, 25, 26, 43, 48, 49, 63, 68.

14. Unit ownership will include both the space enclosed and the enclosing materials and will exclude load-bearing structure common to other units and any exterior surfaces not considered acceptable for individual ownership.

14 interacts with 11, 12, 13, 16, 17, 19, 20, 22, 25, 44, 49, 54, 68.

15. An owner should be able to express his status or individuality without discomforting other owners.

15 interacts with 7, 8, 9, 12, 16, 20, 21, 22, 24, 33, 52, 66, 68.

16. An owner should have substantial control of the interior physical characteristics of his unit without affecting other owners or units.

16 interacts with 4, 5, 11, 12, 14, 15, 17, 22, 46, 48, 49, 68.

17. An owner should feel that his unit is a physically tangible object of ownership.

17 interacts with 13, 14, 16, 19, 20, 21, 49, 51, 54, 68.

18. An owner should be able to use his own unit as he wishes without bothering other owners.

18 interacts with 7, 9, 11, 59, 72.

19. An owner should have a sense of ownership of his "own piece of sky," "roof over his head," etc.

19 interacts with 6, 11, 13, 14, 17, 20, 49.

20. An owner should have as much control as possible over the exterior appearance of his unit so long as it does not offend other owners or threaten their property values.

20 interacts with 12, 13, 14, 15, 17, 19, 21, 22, 24, 25, 49, 52, 54, 67, 68.

21. If a unit is poorly maintained, this should not affect the value or use of other units in the complex.

21 interacts with 15, 17, 20, 24, 42, 45, 52, 54.

22. An owner should be able to increase the market value of his unit if he desires without adversely affecting other owners or units.

22 interacts with 5, 8, 9, 12, 13, 14, 15, 16, 20.

23. Activities within the unit should not be seen or heard by others unless the owner wishes it.

23 interacts with 11, 24, 51, 58, 66, 68.

24. Activities in an area should not lessen the value or desirability of areas visually adjacent.

24 interacts with 1, 8, 15, 20, 21, 23, 27, 42.

25. The quality and quantity of light desired in a unit should not be dictated by physical characteristics outside the unit over which the owner has no control.

25 interacts with 1, 2, 6, 13, 14, 20, 27, 49, 53.

26. There should be as few spaces as possible within the unit that have no access to natural light and air.

26 interacts with 2, 3, 10, 11, 13, 49.

27. A unit should have a "view" without the nuisance of direct sun glare.

27 interacts with 3, 6, 24, 25.

28. The attempt to provide new space for automobiles in high density areas should not take so much space that it increases the distance between the urban elements served.

28 interacts with 1, 3, 6, 29, 30, 31, 33, 49.

29. Space allocated to one type of parking (e.g., public, private, visitor, etc.) must not remain vacant when another type of parking requires additional space.

29 interacts with 28, 31, 32, 35, 41.

30. Automobiles need to be located in space that cannot be occupied more efficiently or economically by some other use.

30 interacts with 5, 6, 28, 33, 34, 36, 38, 39, 40, 41, 49.

31. The volume of parking space required per automobile in a parking facility should be minimal.

31 interacts with 28, 32, 33, 34, 36, 38, 41.

32. There must be covered parking space available for one automobile per unit plus additional spaces as required by any commercial units.

32 interacts with 29, 31, 35, 39, 49.

33. An owner should be able to leave his car as close to his unit as possible.

33 interacts with 15, 28, 30, 31, 34, 36, 37, 38, 39, 64.

34. A person using commercial parking facilities should be able to leave his car close to the street and as close to the commercial units as possible.

34 interacts with 30, 31, 33, 36, 37, 38, 56, 57, 58.

35. Commercial or public parking should not usurp necessary private parking spaces.

35 interacts with 29, 32, 39, 53, 58.

36. A driver should be able to enter and leave a parking space without wasting time and effort.

36 interacts with 30, 31, 33, 34, 37, 38, 53, 64.

37. Parking should not confuse or disorient a person.

37 interacts with 33, 34, 36, 38, 64.

38. Drivers should be able to discharge and pick up passengers near normal pedestrian access ways without interfering with normal pedestrian or vehicular traffic.

38 interacts with 30, 31, 33, 34, 36, 37, 42, 53, 56, 64, 65.

39. Parked cars should be secure from tampering or theft.

39 interacts with 30, 32, 33, 35, 51, 56, 60.

40. Service vehicles require easy access from the street to pickup and delivery points in the complex.

40 interacts with 30, 41, 42, 43, 69.

41. Service vehicles may be required to park temporarily.

41 interacts with 29, 30, 31, 40, 42, 43.

42. Access to units for trash, delivery, service, etc., should be possible without interfering with normal pedestrian access.

42 interacts with 12, 21, 24, 38, 40, 41, 43, 44, 52, 53, 69.

43. The necessity for rights to an easement should be avoided if the purpose for which it is normally granted can be accomplished without using an easement.

43 interacts with 1, 13, 40, 41, 42, 44, 45, 53, 56, 58, 61, 66, 69.

44. Utilities need to be easily accessible for repairs, additions, alterations, etc., but should not be visual or physical obstacles.

44 interacts with 5, 12, 14, 42, 43, 45, 46, 47, 48, 71.

The crucial quality of shape, no matter of what kind,
lies in its organization,
and when we think of it this way we call it form

45. Utility systems should not function in such a way that malfunction or repair in one unit will interfere with other units.

45 interacts with 21, 43, 44, 47, 52, 54.

46. Each unit plumbing system should be easily and economically connected to common plumbing.

46 interacts with 10, 16, 44, 47, 48, 49, 50, 63.

47. No utility system should contain expensive duplication of material or service.

47 interacts with 44, 45, 46, 48, 50.

48. The plumbing system should not excessively limit the range of possible fixture locations within the unit.

48 interacts with 5, 12, 13, 16, 44, 46, 47, 49, 50.

49. Commonly owned load-bearing structural members must not restrict the use of areas in which they are located.

49 interacts with 1, 4, 10, 12, 13, 14, 16, 17, 19, 20, 25, 26, 28, 30, 32, 46, 48, 69, 71.

50. The initial cost and the cost of maintaining common areas from which any owner does not benefit should be minimal.

50 interacts with 7, 11, 46, 47, 48, 52, 53, 62, 63, 66, 68, 71.

51. It should be easy to distinguish common areas from individually owned areas.

51 interacts with 8, 11, 17, 23, 39, 56, 58, 59, 62, 66, 67, 68, 72.

52. An owner should not be able to seriously impair the proper maintenance of common areas.

52 interacts with 15, 20, 21, 42, 45, 50, 53, 54, 72.

53. An owner should not be able to obstruct the use of any common areas.

53 interacts with 12, 25, 35, 36, 38, 42, 43, 50, 52.

54. Owners should be free of any unnecessary maintenance worries.

54 interacts with 14, 17, 20, 21, 45, 52, 68.

55. Use of commercial units should not interfere with the use of dwelling units.

55 interacts with 56, 57, 58, 64.

56. Use of commercial units should not interfere with common areas intended solely for use by dwelling units.

56 interacts with 34, 38, 39, 43, 51, 55, 57, 58, 60, 61, 64, 69.

57. Commercial units should be oriented for public use as well as for use by other owners in the complex.

57 interacts with 34, 55, 56, 64, 69.

58. The public should not be able to encroach on an individual owner's domain except when specifically visiting him.

58 interacts with 23, 34, 35, 43, 51, 55, 56, 59, 60, 61, 64, 66, 68, 69, 70.

59. The use of common and individually owned areas should not be allowed to conflict.

59 interacts with 7, 9, 11, 18, 51, 58, 62, 65, 66, 68, 69, 72.

60. The public should not be able to reach private common areas.

60 interacts with 39, 56, 58, 61, 64, 70.

61. The privacy of private common areas must not be disturbed by activity in public areas.

61 interacts with 43, 56, 58, 60, 62, 70.

62. Private common areas should be equally accessible to all unit owners and should not favor use by only some owners because of location.

62 interacts with 7, 8, 9, 10, 50, 51, 59, 61, 70.

63. Amenities or lack of amenities should not be unfairly apportioned, because of location, to units that are otherwise similar.

63 interacts with 6, 10, 13, 46, 50.

64. Access routes to dwelling units should be convenient for owners but should discourage public use.

64 interacts with 33, 36, 37, 38, 55, 56, 57, 60, 68, 69, 70, 71.

65. All accesses should allow safe and non-disturbing use by children.

65 interacts with 11, 38, 59, 66, 70, 71, 72.

66. No owner going to and from his unit should feel that he is encroaching on a second owner's domain; nor should the second owner feel that his domain is being encroached on by the first.

66 interacts with 7, 9, 15, 23, 43, 50, 51, 58, 59, 65, 67, 68, 69, 72.

67. An owner should feel a "sense of arrival" prior to entering his unit.

67 interacts with 20, 51, 66, 68.

68. An owner should have ownership or control of some part of the domain that extends outside his door.

68 interacts with 13, 14, 15, 16, 17, 20, 23, 50, 51, 54, 58, 59, 64, 66, 67, 69, 70.

69. Elevators should be easily accessible to units but the operation of an elevator should not infringe on an owner's domain when he is not using the elevator.

69 interacts with 11, 40, 42, 43, 49, 56, 57, 58, 59, 64, 66, 68, 72.

70. It must be possible to reach private common areas from the unit without going on paths also open to the public.

70 interacts with 11, 58, 60, 61, 62, 64, 65, 68.

71. Every floor used for dwelling units must have two separate fire exit ways and each unit must have at least one path to an exitway that cannot reasonably be blocked by fire.

71 interacts with 4, 11, 44, 49, 50, 64, 65.

72. The implementation of any social rules, sanctions, or safeguards created to preserve harmony among the condominium owners, must not be made difficult by the physical form of the complex.

72 interacts with 7, 9, 11, 18, 51, 52, 59, 65, 66, 69.