ON FORMAL PRINCIPLES FOR FORM-MAKING:
notes and sketches on making associative built-form

by
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June, 1985

Submitted in partial fulfillment of the requirements
for the degree of Master of Architecture
at the Massachusetts Institute of Technology
June, 1989

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To my parents
and Tina
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Submitted to the Department of Architecture
on May 19, 1989, in partial fulfillment of
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Form-making is the purposeful arrangement of
forms for a specific objective. This includes
selecting forms and establishing spatial
relations among these forms. Since form making
is not a random act, there are rules that it
must follow. These rules determine the result of
the design, or they prescribe the process of
designing. There are two types of rules: form
rules and procedural rules. Form rules are the
main interest of this thesis.

Wright once wrote: "Style is important. A
style is not. There is all the difference when
we work with a style and not for a style."
Working with a style is to choose a set of rules
with which one works. The choice of the rules is
not incidental. Form rules select forms and
prescribe the probable relations among them.
These rules must subscribe to a particular
perspective. The choosing of these rules is a
subscription to this specific view-point.

This thesis intends to establish some
principles of formal behavior, from the
"associative built form language," as form
rules. It will identify each of the principles
and describe the nature of the principles. It
will explore the capacity of these principles as
working rules. It will also establish the bounds
of applicability of these principles for
choosing the appropriate principles in each
particular problem/context. In accepting these
principles, there is the presumption that form
making should be committed to reinforcing/
intensifying the associative environment. The
nature of this associative built environment
therefore must be described.

The goal of this thesis is to formalize the
principles of formal behavior as form rules. It
demonstrates the applications of these rules for
describing forms, and for making associative
built-form. The form rules are applied to
selected design problems as part of a
form-making process.

Thesis Advisor: Barry Zevin
Title: Lecturer, Department of Architecture
ACKNOWLEDGEMENTS

For the calls, the visits,
the ever-so-persistent nudges,
the guidance, the friendship, and infinite patience
  Barry Zevin;

For their wisdom
  Aaron Fleisher, John Habraken, Imre Halasz,
  Waclaw Zalewski;

For his helping hands
  Chang-Li Lin;

For those who stood by me
  The quiet, the wild,
  The patient, the frenzied,
  Long time, short time,
  Forever,
  Friends:
  For giving, giving, and giving;

For his soups and quiches,
his reluctant tolerance,
his mindful mind,
  Maurice Smith;

I say,

Thank You.
ON FORMAL PRINCIPLES FOR FORM MAKING:
Notes and Sketches on Making Associative Built Form

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I. ON ASSOCIATIVE BUILT FORM
Form is the central issue of form-making. An explicit understanding of form is integral to formulating an explicit framework for form-making. Such an explicit understanding of form can be articulated in a form language which systematically presents the ranges of possible form phenomena.

The "associative built-form language" describes built forms through their formal attributes and formal behaviors. In particular, this form language is steered by the notion of association in observing built form. Built form, in its most generic sense, is a form produced as the result of a series of actions or forces. The specific understanding of built form here is its relation to use, and the particular use related to man's activities. The associativity with which the language is concerned, then, is to be examined on at least two levels: the associativity of a built form to fundamental orders of nature, and the association of built form to the environment as a result of man's cognitive relationship with
the physical reality.

It is crucial to differentiate associativity from associativeness. Associativity is an inclusive collection of behaviors pertaining to association, and not the exclusive collection of associative behaviors. It is the range of behaviors of association, where its two polar opposites are associative and disassociative. An association requires at least two participating bodies: a reference and a subject; that is, a subject associating with a reference. A set of references, with which a built form associates, are prescribed in the associative built-form language. They are four of the continuities observable in the environment: the continuity of landscape, light, access, and time. The associative built-form language is then a systematic description of built form and its relation to these four prescribed continuities.

Associativity is a range of characters pertaining to the ability of having associative behavior. Association is a projected connection of one party toward an object party. This projection can be either positive or negative. A positive projection engages the two parties in an inclusive manner that produces an associative
relationship. A negative projection discourages the two parties from forming an inclusive relationship. It promotes disengaging behavior between the two. The relationship is then disassociative.

The associativity of a built form is assessed according to its ability to positively acknowledge these four continuities. A built form is associative toward a particular continuity when it intensifies or reinforces that continuity. A built form is disassociative when it counters or resists a continuity.

Continuity is a state of order. An order is an invention of man's comprehension about reality, congruent with all his previous inventions. Orders are agents with which man relates to his environment. The chief function of man's intervention in nature is to establish an ordered state, otherwise not provided by nature, which is sympathetic to various goals of man's activity. The continuity of landscape, of light, of access, and of time are four basic ordered states on which subsequent orders of built form can be based. These continuities are references with which man can relate to his environment. His interventions in the environment are
therefore bound by these references in some capacity. In order to achieve a specific ordered state, it is imperative not to dismiss the generic orders. A localized order is established to propagate the larger order. The larger order then must be recognized. This recognition, however, does not prescribe the nature of the relationship between a specific order and its generic order. A specific order is determined by its own immediate context to acknowledge the generic order positively or negatively. Thus a built form produced for a particular circumstance is associative or disassociative toward the four continuities. An associative built form intensifies the continuities; and a disassociative built form transforms them.

Landscape is the physical collective of man’s environment. It is the totality of land, water bodies, vegetations, living creatures. It is the inclusive collage of material, color, light. The continuity of landscape is the continuity of the collection of physical elements that are present, and the observable relationships between the elements. This relationship is the natural order of the landscape, which is
established by the natural growth of families of elements.

Light is the source of life. It is light which activates the living. Light enables man to see. Without light, man loses all visual perception of his environment. His understanding of his surrounding is greatly dependent on his visual comprehension. Light makes possible such comprehension. With light, man can see shape, color, and even texture. Light has a ubiquitous presence in nature. The continuity of light is then the presence of light itself in its natural state.

Access enables movement from one location to another location. Movement is present in transferring of material, in growth of living objects, and particularly in man's relocating his physical presence from one locality to another. Direction is an essential attribute of movement. The direction of a movement is established by forces contributing to the movement. The continuity of access then includes the continuity of direction of movement.

Time is an indefinitely continued existence. It is a dimension in which events of reality are placed in a temporal sequence. The continuity of
time is the acceptance of time and the historical sequence of event. To preserve its continuity is to preserve, perpetuate, and propagate historical events.

Associative built-form language is a systematic description of formal attribute and formal behavior of built form in reference to these four constants of the environment. The form language classifies built forms into form families according to formal attributes. It establishes systems of formal organizations from formal behaviors. The term "associative" is delineated through reciprocal relationships of use, form, and territory, and their general relations with landscape, light, access, and time.

A description of form centers on its formal attributes is a description of its external physical characteristics. The form families range between minimal framework to maximal surfacing: each family is characterized through density of material, and manner of construction (of the material). The six basic form families are:

1. single-sided surfaces
   continuous ground-forms,
2. **two-sided surfaces**
   inhabited ground-forms,

3. **partial containments**
   extrusions/channels,

4. planes,

5. screens(→ 3-D),

6. lineal frameworks.

The behavior of a form is an externally observable activities of interactions amongst parts of the form. Formal behavior is thus a description of intra-formal relations, of how the parts of a form interact with one another, to form the whole. The description is an agent for understanding the structure, exposing fundamental characters, and revealing inherent properties of a form. Some behaviors of built form are categorized in the following three systems:

1. field organization,
2. territorial control,
3. self-stability/alternation.

The extent of use of the associative built-form language is beyond recognizing physical facts of form. In the process of generating form, the language is an effective tool for organizing and assembling form.
congenial to basic orders of nature: the continuities. It is in this context that "associative" takes on another meaning: the associative use of the form language.

A form language describes form phenomena congruent with man's understanding of his physical reality. This however, does not prescribe the way in which one utilizes this understanding. In form making, one makes decisions based on the ability to relate these form facts with the required use. An associative relationship can be established between form facts and use through a historical understanding of a form and its possible uses. This association is the result of one's understanding of the physical world, and is a reflection of one's culture. An associative use of the language is to reinforce this association of form and use.

The reciprocal relationship between territory, use, and form further delineates the term "associative". Use takes place in a territory. A territory is a form inhabited. Form is a physical realization of use. Use, so articulated in physical terms, and through construction, prescribes a form within which the use can
occur. Form and use do not therefore determine for one another. Their relationship is a mutual correspondence. This corresponding pair provides the specification of a territory. Thus an understanding of territory elucidates the reciprocal relationship of form and use.
"Associative built-form language" describes built form on two levels: its formal attributes and its formal behavior. A formal behavior is an observable order of relations amongst parts of a form. A principle of formal behavior describes, then, how the parts of a form interact with one another to form the whole. This description is an agent for understanding the structure, exposing fundamental characteristics, and revealing inherent properties of form.

A principle of formal behavior has two primary roles: 1) providing an order to the spatial relations between parts of a form; and 2) specifying and identifying the relevant parts. A behavior of form is an observable characteristic of a form resulting from the interactions of its parts. A formal principle describes this interaction as an ordering relation. This ordering relation relates participating parts to a reference. It is then necessary to specify what and which of the parts are relevant to a behavior. Without identifying
the parts related, a relation is only an abstract and meaningless notion. In order to understand and evaluate the implications of a relation, one must assume among the participating, a common set of properties relevant to the relation.

A principle of formal behavior is established from observations about form. An observation is made necessarily within a particular framework. The principle it delivers is therefore bound by the limits of this framework. There are two sources for these limits. A framework has a set of premises on which all of its inferences and conclusions are based. These premises then set the first set of limits for a description, or a principle of formal behavior. The second source of the limits is the observer: what he intends to observe and what he anticipates to achieve.

Associative built-form language is a framework with which one makes an observation on built form. The fundamental assumption of this form language is that the environment consists of at least four continuities: landscape, light, access, and time; and, that these continuities must be acknowledged in a positive manner. The principles, therefore, describe only formal
behaviors which assert these four continuities.

In addition to these four continuities, the form language also assumes a reciprocal relationship between form, use, and territory. Territory is inhabited through use. Thus the understanding of form cannot be without the understanding of use and territory.

A territory is a defined area. It can be examined through three of its attributes: demarcation, dimension, and direction. Demarcation bounds the territory. It separates the territory from its surroundings. Dimension gives territory its size. Territory is related to use through its size. And direction associates territories with movement. While these are not the only three territorial attributes, they are, however, the most pertinent for relating a territory with the four continuities. A territorial attribute can be expressed materially or spatially, as material definition or spatial definition of a territory. Both types of definition require physical elements for their manifestation. The difference lies in the way in which physical elements are used to articulate the definition. For example, a wall is a material demarcation. The wall, as
an actual barrier, is the demarcation between the two territories on either side. On the other hand, a structure line occupied by columns is a spatial demarcation. This demarcation is further reinforced by the beam over the column. This demarcation in contrast with a wall is not an actual barrier. Its function as a demarcation is, nevertheless, preserved.

Thus a description of a built form becomes a description of territories, with their attributes, and the physical elements that manifest these attributes. The principles of formal behaviors are then about the interactions of territories, and the interactions of the territories' physical elements. These physical elements are in turn forms that can be further described as territories.

These principles are useful both as descriptive tools and generative tools. On the most basic level, these principles are vocabularies for describing built form. Together as a group, they form a system or a framework for observing the environment. In particular, they induce the observer to perceive the environment in terms of associativity. As generative tools, the principles provide
relations for arranging territories. By using the principles positively, the form made can extend, or reinforce, the associative built environment. The principles are also effective toward hindering, or restraining disassociative built form.

These formal principles are classified into three systems:
1) field organization,
2) territorial control, and
3) self-stability.

Field organization and territorial control are systems of spatial relations for intensifying continuities. Self-stability is a system of spatial relations for transforming continuities.

These principles, generatively, are organizing principles of territories. In speaking of organizing territories one is proposing a structure for understanding the relations of the territories. Such a structure is a referencing system. With these principles one can establish the references for the purpose of organizing territories.

Each reference can be accepted as a constructional reference or a perceptional
reference. A constructional reference is pertinent to the production process which includes both designing and building. A perceptual reference provides a reference an observer can either visualize or experience.

In designing, a reference is selected for intensifying or transforming one of the continuities. Variable territories are then organized by the referencing element. In the process of building, such a reference becomes a constructional reference. The reference may initiate a system to be developed. A building system may be chosen to realize this reference.

Each built form exists as part of the environment which is perceived with the understanding of the continuities. Each built form is then also perceived with the same general understanding derived from visual or experiential cues. The reference provided by each built form is a part of, and enhances, those larger continuities. Territories organized by such referencing systems are articulated with physical elements that constitute either visual cues or experiential cues to the reference.
The three systems of formal organization are outlined as follows:

I. FIELD ORGANIZATION
   <<variable territorial packing>>
   A. Directional Field
   B. Double-directional Field

II. TERRITORIAL CONTROL
    <<references/intensification>>
    A. Center
    B. Edge
       1) registration
       2) mirroring
       3) lateral displacement
    C. Open Field

III. SELF-STABILITY
     <<methods for territorial self-stability>>
     A. Dimensional Self-Stability
     B. Reciprocity
     C. Reversal
I. Field Organization

A field is a specified area for a specific purpose, or with a consistent character. To organize is to propose a structure. Field organization is the way in which fields can be structured. Directional and double-directional are two types of field organization. These two types of field organization describe territorial packing according to its direction of generation/movement. A field, in this particular sense, is then understood as a specified area of packed territories. The two field organizations also can be viewed as demarcation systems. A demarcation system prescribes the manner in which territories are deployed. It is crucial to recognize that a "field", in this section, is accepted as a collection of packed territories which vary in size and shape, and that field organization is about the packing arrangement of territories.
I-A. Directional Field

A directional field is characterized by four
criteria: 1) the field is itself directional;
2) each territory, in the field, is also
directional; 3) the territories are
directionally packed; and 4) the packing
direction, as well as every individual
territorial direction, conform to the field's
direction of generation/movement.
(diag. 2.1) Directional field can also be
described as a directionally demarcated field.
All demarcations conform to one direction, which
is the direction of generation/movement of the
field.(diag. 2.2) Territories, or zones defined
by these demarcations, thus are directional as
well. A directional field is then a
directionally intensified field.

A directional field is a directional
territory. However not all directional
territories are directional fields. A
directional territory can be comprised of
non-directional parts; (diag. 2.3) it can also
be of directional parts packed
multidirectionally; (diag. 2.4) or it can also
be of directionally packed directional
territories. (diag. 2.5) It is essential in a directional field that the direction of its highest order parts reinforce the direction of the field. By arranging the direction of the parts in the direction other than the direction of the field, the parts do not reinforce the direction of the field. This territory then cannot qualify as a directional field.
Plan
Robie House
(1906-09)
Chicago, Illinois, USA
Frank LLoyd Wright

(directional field):
dimarcations, articulated by walls, are running in parallel; these demarcations intesify the direction of the street.
Plan.
School Extension
(1978)
Aldorf im Welzheimer Wald, West Germany
Behnisch & Partners

<<directional field>>:
rows of classroom buildings are arranged in parallel; this arrangement establishes a directional access system.
Plan
Cappuccini College,
University at Urbino
Urbino, Italy
Giancarlo de Carlo

<<directional filed>>;
each dormitory building
follows the contour of
the slope to form a
directionally organized
groupe; the building
groupe intensifies the
slope of the hill.
Pietra Secca, Italy.

{(directional field)}: the roofs are directionally deployed when viewing from the bottom of the hill; this display of the roofs reveals a directional organization on the houses to which the roofs belong.
I-B. Double-directional Field

A double-directional field has two principle directions of generation/movement. Specifically, the two directions are normal to one another. Each territory is positioned according to one of the two principle directions. Double-directional field also can be described as orthogonal demarcation system, for example a uniform grid, (diag. 2.6) or a tartan grid. (diag. 2.7)
II. Territorial Control

Territorial control is a relation with which a reference bounds parts of a territory, or a group of territories. There are three categories of territorial control: center, edge and open field. Across these categories, the location of the reference changes from being "inside" the controlled domain to being "outside" the controlled domain; and the appearance of the reference changes from singular to ubiquitous. The severity of control diminishes from center to open field.
II-A. Center Control

In Center control, a reference is located at the center of a territory or the center of a group of variable territories. This central reference can be a point or a line: center or axis. Territories or sub-territories sharing a central reference are arranged about this reference such that the territories reinforces the centrality of the reference. Center controlled arrangements include circular, radial, or axial.
II-B. Edge Control

An edge is a boundary line or zone of a region or territory. There are three types of edge control: registration, mirroring and lateral displacement. The geometry of a territory, or the arrangement of territories, can be established by a reference edge. The reference is not situated inside its controlled domain; it is located outside of its controlled domain. An edge control tends to offer more degrees of freedom than a center control.
II-B(1). Registration

In registration, an intensified reference line/zone behaves as a continuity. Against this reference, variable territories as well as built definitions can be deployed optionally.

(diag. 2.8) Registration does not determine the geometry of each territory. It prescribes the way in which a territory may be positioned. It determines only the geometry of arrangements of territories.

A territory can engage the registration zone minimally by abutting to the registration zone.

(diag. 2.9) A territory may engage the registration zone more territorially by overlapping the registration zone. (diag. 2.10) The territories can be packed next to one another. By bordering one another, the territories form a larger continuous territory.

If the demarcations between the territories disappear, the result is a territory with a constant, straight edge on one side and laterally displaced edges on the other side.

(diag. 2.11)
North Elevation
W.R. Thorsen House
(1908)
Berkeley, CA
Greene & Greene

((registration)):
the lintels are grouped
into forming three
horizontal registration
lines, on two levels,
with which the
fenestration is
organized.
Plan
J.J. Glessner House
(1885-87)
Chicago, Illinois, USA
Henry Hobson Richardson

<<registration>>:
the straight back wall
and the flanking service
corridor form a
registration zone for
the garden facing rooms
which the corridor
serves.
Rouge River Glass Plant,
Ford Motor Company
(1922)
Dearborn, Michigan, USA
Albert Kahn

<<registration>>:
the floor is the
registration level that
it is a continuous
leveled reference for
the truss beams, at
varying heights, and the
monitors, in various
sizes.
St. Clement’s Catholic Church at Bettlach
Water M. Forderer

<<registration>>:
each top ledge of a facade wall is a registration line for the surface relief of the wall, that the top edge maintains a constant level from which the bottoms of the relief are optionally displaced.
Plan
School
(1956-62)
Lunen/Westfalen
Hans Scharoun

<<registration>>:
the main access is the
registration zone to
which the auditorium and
the two wings of
classrooms are
connected.
Plan
Prefectural
Sports Center
Osaka, Japan
Fumihiko Maki

<<double registration>>: the access lobby is the registration zone which connects the four separate sports facilities of various sizes, and that the facilities are deployed not according to any additional alignment.
II-B(2). Mirroring

In mirroring, territory or a built definition is reflected or transformed in reference to an edge. The positional relation between the original and the reference is preserved as the relation between the mirror image and the reference. In the simplest case of mirroring, this action produces a simple reflection. (diag. 2.12) With transformation, mirroring can produce either a form variant, (diag. 2.13) or a size variant of the original form. (diag. 2.14)
"De Dageraad" Housing
(1919-22)
Amsterdam, Holland
Peter L. Kramer

<<mirroring>>:
the two facades on the
two sides of this
building corner mirror
each other to intensify
the corner; the
mirroring is such that
each facade element has
a corresponding parts in
the other facade.
Cliff Houses
Cuenca, Spain

<<mirroring>>: the two projecting bays mirror at the bay size as well as the disposition of their large-small pairs of windows.
Elevation
Baker House at MIT
(1947-48)
Cambridge, Ma
Alvar Aalto

<<mirroring>>:
the two "exterior"
stair-box mirrors each
other against an
vertical edge over the
building entrance house.
Plan
Municipal Kofu-en
(1985)
Funabashi, Japan
Atelier Zo

<<mirroring>>:
the indoor and outdoor
dining room mirrors each
other that: the interior
dining room takes a
semicircle shape which
is defined by columns
and curved wall, while
its outdoor counterpart
also assumes this
semicircle shape that is
defined simply by ground
level change.
Plan
Carpenter Center for
Visual Arts at
Harvard University
(1961-64)
Cambridge, MA
Le Corbusier

<<mirroring>>:
the two principle
elements of the center
mirror one another
across the ramp.
Plan
F.L. Higginson House
(1881-83)
Boston, MA
H.H. Richardson

<<mirroring>>:
the library and the
lounge serve semipublic
functions of the house;
they are thus related to
have similar shape and
are located on two
opposite corners of the
plan.
II-B(3). Lateral Displacement

Lateral displacement is the way in which an edge is laterally shifted from the line of the direction of the generation/movement of a family of edges. A system of laterally displaced edges is an "active" built definition that each pair of laterally displaced edges establishes a zone. Each one of these zones is an added definition. (diag. 2.15)

There are two basic types of lateral displacement: uniform and earned stepping. In the case of the uniform lateral displacement, the direction of the lateral shift is constant. (diag. 2.16) "Earned" stepping, on the other hand, alternates the direction of the lateral shifts as well as the measure of the displacement. (diag. 2.17)
Facade
Block of shops and flats
at Bassersdorf
Canton Zurich
Walter Forderer

<lateral
displacement>>:
window sills are
vertically displaced,
particular at the corner
where the sills are
higher to intensify the
corners.
Plan
Winker & Goetsch House
(1939)
(1939)
Lansing, Michigan
Frank L. Wright

{lateral displacement}:
the living room is
defined by three
demarcations/walls
laterally displaced from
one another such that
the living room is
opened to the landscape.
Section
Boa Nova Tea House
(1958)
Leca da Palmeira,
Portugal
Alvaro Siza

{lateral displacement}:
instead of being a
continuous sloping roof,
the roof is divided into	hree sections that each
section vertically
displaces from its
neighbor, allowing light
and air to enter.
Addition
Smith House
Harvard, Ma
Maurice Smith

<<lateral displacement>>: the eaves laterally displace from one another in response to the plan configuration.
Section
Domo Champuloo
(1985)
Shuri, Okinawa
Atelier Zo

<<lateral displacement>>: the low roofs take the uniform stepping configuration, while combining with the upper floor to form an "earned" stepping configuration which allows diagonal connections between the two areas in section; the top roof is also displaced vertically from the lower roof to allow galzing.
Section
Einstein Tower
(1920)
Postam, Germany
Eric Mendelsohn
Longitudinal Section
National Gallery in Messina
(1974)
Messina, Italy
Carlo Scarpa
Entry Elevation
Gran Colombia School
(1939)
Caracas, Venezuela
Carlos Raul Villanueva
II.C. Open Field

In an open field, containments are deployed in the field such that the continuity of the field is preserved. This condition prescribes a low density as well as a scattered concentration of the containments. It is possible that the disposition of any two containments may be regulated by an agent, center or edge. However, since the density of the containment remains relatively low, these regulating agents do not impose any impact on the open field as a whole. (diag. 2.18)
Facade
Protestent Center
at Monheim
North Rhine-Westphalia
Walter Forderer

<<open field>>:
The windows are
punctures in the wall
such that the wall does
not prescribe the
fenestration pattern,
neither is the outline
of the wall constrained
by the windows.
The Malm Funeral Chapel  
(projet, 1950)  
Helsinki  
Alvar Aalto

<<open field>>:

each chapel is an isolated room, a containment, so arranged with the other two to define a public area sharing by all three.
Site Model
Olympic Park
(1987-72)
Munich, West Germany
Behnisch & Partner

<<open filed>>:
each sport's facility is a containment; and all are separated from one another as to preserve the continuum of the landscape.
Plan
Tokuda Residence
(1985)
Natsumidai, Japan
Atelier Zo

<<open field>>:
each circular form is
either a privacy or a
light well; by deployed
them in an open-field
manner, they define the
areas of the house while
maintain an open
quality.
III. Self-Stability

Stability is the state of being firmly fixed or established. More importantly, the established condition is not easily changed, altered or destroyed. Self-stability is a state of stability occurring independently of an outside agent. The stability of a territory is not established as a consequence of its context. Often, a self-stable territory achieve its own stability by disengaging itself from the stability of its context. Territorial self-stability can be obtained through the following three methods: dimensional stability, reciprocity, reversal.
III-A. Dimensional Self-Stability

A territory is dimensionally stable when there is a dimensional system present. A dimensional system is a family of dimensions, and each dimension occurs in a consistent fashion. In an associative family of dimensions, each dimension has some corresponding use; and, the family is additive, in that smaller dimensions add up to a larger dimension. An additive dimensional system does not subscribe to proportion nor to subdivision. A dimensional system establishes self-stability through dimensional alternation and dimensional equality.

Dimensional alternation occurs when at least two dimensions or measures alternate in an A-B-A-B fashion. The simplest example of this alternation occurs in demarcation systems for field organization. The dimensions of territories alternate between two dimensions.

Dimensional equality is present when a corresponding pair of measurements are equal but with positions normal to each other.
Red Square and Black Square, 1915
K.S. Malevich

<<dimensional-stability>>:
the positioning of the two squares are controlled by the dimensions of the squares and a derivative, which is equal to a third of the small square's dimension; this derivative dimension measures the so call "hinge."
External Elevation
Gavina Store
(1961-63)
Bologna, Italy
Carlo Scarpa

<<dimensional-stability>>
a consistant dimension can be measured from the three openings; and the positioning dimensions of the openings (from the edges) are both dimensionally equal pair of measurements.
Plan
Plaza de las Flores
Cordoba

<<dimensional-stability>>
the plaza is a self-stable square measures equally in both orthogonal directions;
the well is self-stable that its a square "object" and it displaces from the walls in both directions by it own dimension.
Plan
Carré House
(1956-59)
Bazoche-sur-Guyonne
(France)
Alvar Aalto

<<dimensional-stability>>: the house is self-stable that it measures equally in both orthogonal directions; at each stops: entrance and porches, dimensionally equal pairs can be measured.
III-B. Reciprocity

Reciprocity is a condition of mutual territorial exchange. An exchange occurs when part of a territory is present in the domain of another territory, while part of the second territory occupies part of the first territory. There is a zone of reciprocity created by these reciprocating parts of the two territories. (diag. 2.19)

Physically reciprocating forms provide the opportunity for two otherwise non-relating territories to engage with one another territorially.
Facade Panel
Banca Popolare Piazza Nogara
(1973-78)
Verona
Carlo Scarpa

<<reciprocity>>: the upper portion of the facade panel terminates before the double columns and retruns, the main panel below then extends further beyond; the return in the panel provides a reciprocating configuration of the panel and "space" around it.
Pavillon Suisse,  
Cite Universitaire  
(1930-32)  
Paris, France  
Le Corbusier  
& Pierre Jeanneret

<<reciprocity>>:  
the access stair, large  
landing and facilities  
are housed in the tower  
external to the  
rectangular box of  
dormitory rooms; this  
protrusion is the  
intermediary zone  
between the close  
private areas and the  
open landscape.
Plan
Carre House
(1956-59)
Bazoche-sur-Guyonne
(France)
Alvar Aalto

<<reciprocity>>:
the indoor and outdoor areas engage spatially through lateral displacements of the house's perimeter walls.
Plan
Sunset Medical Building
(1936-39)
Los Angeles, Ca., USA
R.M. Schindler

<<reciprocity>>:
the front edge of the house forms a reciprocating configuration with the outdoor; particularly on ground floor, the entry is defined in plan as well as section as a transitional zone.
III-C. Reversal

Reversal is a specific type of alternation: alternation between two extreme opposites. Some pairs of opposing conditions are: light and dark, left and right, up and down, solid and transparent, concave and convex.
II. ON FORM MAKING
Form making is an exercise in designing, specific to form. In form making, form is central to the process of designing, and form is the resulting design. With form as a central concern, the understanding of form then becomes a crucial requirement. This understanding includes the recognition of form’s intrinsic nature and the correlation between form and use. All design constraints and variables, within the domain of form making, thus are only related to form. The constraints and variables are formulated and discussed only in reference to form.

The process of designing comprises of two fundamental activities: 1) identifying and describing the problem; 2) providing solutions, and testing them to the specifications of the problem. Designing is then understood as a kind of search process. It searches concurrently on two levels. It searches for requirements to the problem. It also searches for a solution meeting
the specification of the problem requirements. The first level of search is somewhat peculiar, in that the object of the search is not apparent. This search is, in a manner, a game of speculation. The second level of search is solving. These two levels of search follow a "spiralling" pattern, in that each informs and grows on the other. The aim of the search is to provide a solution with characteristics conforming to the specifications of the problem requirements.

A problem can be described as a set of constraints on a set of variables. Constraints are design specifications. A set of constraints bounds a "region" of alternative solutions. Each point within this "region" is a variant that has specifications conforming to the problem requirements. Variables are attributes of a variant. They are the parameters of a design problem. Solving the problem is to provide values for these variable. The values provided are then the attributes. Thus, variables determine the degree of freedom of a design. Variables and constraints are not predetermined. A designer selects constraints and variables in order to delineate the "region" of variants.
A problem needs to be differentiated from an issue. In designing, a design is a problem, and not an issue. A problem is the condition for which a desirable state is sought. This desirable state is the design condition, which is specified by constraints. According to these constraints, variables selected by the designer form a satisficing solution to the design condition. An issue is a compound problem in that the specification for which its requirements can not be defined or delineated. That is, an issue is a problem for which its constraints are sought. Without constraints, the desired state becomes unattainable. This is not to say a solution does not exist. Such a solution however can not be reached through the process of designing, as designing is understood.

Designing is the process of producing a design. Its motivation originates from a desire to control: to improve or to rectify an existing condition for an alternate desired condition. A design then is always specific to a set of requirements. These requirements, or constraints, are incorporated into the process of designing, since constraints bound the
"region" of search in designing. Designing and design are then integral to one another, in that designing produces design and design initiates designing.

Form making is a recursive process which includes: identifying a problem state, providing an order to this problem state, substituting this order with a desired order. Form making, realized through the general framework of designing, is then a search process comprised of two principle activities: 1) articulating, which includes identifying and defining, the desired form; and 2) elaborating on this form, and verifying that this elaborated form meets the specifications of the form desired.

A desired form is identified as being capable of hosting specific purposes or uses. This form is specified by a set of constraints. These constraints are rules and conditions. Specifically, they are formal relations which comprise of spatial relations and their participating elements. A formal relation is then a constraint involving a set of participating elements, the variables.

The elaboration of the desired form is to
select specific variables. These variables are specific physical elements. A designer chooses variables on which the constraints impose their orders. The result of relating these specific physical elements, variables, through the formal relations is a probable solution to the specified, desired form.

The resulting form, solution form, is verified by the specification of the desired form's requirements. These requirements include constraints other than formal relations. This confirmation might fail on two levels. The resulting form might fail the verification test due to the selection of variables, that is, some of these variables may not be appropriate for achieving the desirable form. On the other hand, the resulting form might satisfy the specifications of the desirable form, and yet, the resulting form may not be acceptable as the desired form. This occurs as the result of inadequate definition of the desired form.

Each probable solution form, in turn, initiates another search for the desired form. This search is a speculation or an invention. However, it is not without reasoning. The speculation is always based on previous
experiences. Each speculation provides an addition to the set of constraints which initially actuates the search. The process of form making is the recursive process of the two search procedures. The form making process arrives at a "satisficing" state when it provides a specific form identical to the desired form.

The main concern of form, in form making, is understanding its nature and its relation to use. Form, in its most generic sense, is the result of a series of actions or forces. The understanding of form does not remain on the abstract level of form as a notion. The physicality of form is of major consequence in form making. This level of understanding about form is particularly crucial for relating form to use, and in particular, use related to man's activities. Use provides the purpose for the process of form making. Without use, form making is an inconsequential and meaningless process of arranging objects and manipulating these arrangements.

"Form in everything and anything, everywhere and at every instant." Sullivan wrote in
Kindergarten Chats, "According to their nature, their function, some forms are definite, some indefinite: some are nebulous, others concrete and sharp; some symmetrical, others purely rhythmical. Some appeal to the eye, some to the ear, ... But all, without fail, stand for relationships between the immaterial the material, the subjective and the objective - between the Infinite Spirit and the mind."[1] Sullivan had written this passage about the nature of form, the very perplexing nature of form that can be both definite and indefinite. Form has not only many faces, it is also everywhere. The usage of the word "form" seems to have an all inclusive quality. This very generous quality offers the word to be used in a liberal if not profuse fashion.

The perplexing nature of form's definition can perhaps be attributed to its lexical developments. In its historical usage, "form" simply implied shape. Through its development in the English language, however, form has acquired a myriad of definitions, of which two meanings are principally relevant: "(i), a visible or outward shape, with a strong sense of the physical body: 'form is most frayle, a fading
flattering showe' (1568); and (ii), an essential shaping principle, making indeterminate material into a or specific being or thing: 'according to the diversity of inward forms, things of the world are distinguished into their kinds' (Hooker, 1594)."[2] These two meanings are the extremes of the range of senses pertaining to form. External and superficial on the one end, and inherent and determinant on the other end. Image, shape, outline, appearance, and body are aspects associated with the first sense. Composition, structure, arrangement, pattern, system, and order are aspects associated with the second sense.

The differential between the two extreme senses of form is clearly large. And the natures of the two are quite opposite: external, internal; material, immaterial; physical, abstract. This state of opposition creates a tension, or even bonding, providing unity for the range of meanings pertaining to form. The amorphous nature of this unity is perhaps its most significant quality. The two meanings of form are the two faces of the same coin. What "form" is must be understood in terms of the relationship between the two opposing meanings.
These two opposite meanings of form are seemingly contradictory. They are however two aspects of a unity. The first aspect of form is its attribute. The second aspect of form is its behavior. A formal attribute is a description of an object's external characteristics, the appearance of a physical body. A behavior is a description of an externally visible interaction of parts of an object, the organizing principle of an object. Each of these two aspects is capable of being described individually. However, a comprehensive understanding of form requires the presence of both.

In order to discuss form explicitly, it is necessary to describe form systematically. This systematic description of form is a form language which describes form through its attributes and its behaviors. Formal attributes can be described according to: "form families", size, categories, media, time and place. Formal behaviors can be presented as systems of organizational principles. These two aspects of form are translated into variables and constraints for delineating form. An attribute is a variable. A behavior is a constraint that regulates the attributes.
Form is the result of a series of actions or forces; or that form is the totality of these actions or forces. These forces include use, particularly, in the context of form making. Thus, a force is translated into a use which contributes to the totality of a form. A use can be a contributing determinant in the process for producing a specific form. It is then a determinative factor, not to be mistaken as an essential factor for producing a form. A use can imply the form if the form is made such that the specific use can occur in it. However, form can be identified to host a specific use. The relationship between form and use is then a mutual association.

The understanding of form and use involves an inclusive association of form with use. In the process of form making, a form is selected for a specific purpose. This purpose includes providing the "opportunities" for desired uses to occur. This requires the understanding of a form's capacity to host activities. It also necessitates the understanding of a use's nature and its implication to form. The pairing of form and use is not derivative, and is a function of mapping.
Form making is a function of mapping a form to a use. This mapping is achieved through a search process of articulating a desired form, and elaborating on this form with formal attributes and behaviors. A desired form is proposed to satisfy the requirements, which include use. This form is described with organizational principles and "unspecified" physical attributes. This form is elaborated with specific physical elements belonging to the family of "unspecified" attributes. The resulting specific form then can be evaluated against the specification of the requirements. An incongruence of the specific form to the specification initiates the next cycle of search.

Notes:

IIB. Notes on Sketches
SK1: JOHNSON ATHLETIC CENTER
directional field:
To intensify landscape continuity, some elements are built and some are landscape elements.
OPEN FIELD:
To define a public open area (the hockey rink), containments and/or privacies are deployed in a directional field.
MIRRORING:
To intensify the secondary field direction, the major interior and exterior access stairs reflect one another in plan, while varying in size.
LATERAL DISPLACEMENT:
To mark the entry, the facade edge moves back. It also resolves the primary and secondary directions.
RECIPROCITY:
To reinforce the directional change and to exchange with the landscape, edges are intensified by an interlocking series of earned steps.
LATERAL DISPLACEMENT:
The roofs in elevation are laterally displaced to mark the entry.
SK2: N52-THIRD FLOOR

Adaptive reuse of an existing warehouse building
for architecture studios and offices
OPEN FIELD:
Containments are deployed to define the collective, which includes public access and ramp; and semi-public large studios.
DIMENSIONAL STABILITY:
Because stops must be dimensionally self-stable, at every access stop equivalent dimensions recur.
RECIPROCITY:
To mark a stop at studio entries, the edge of the use territory steps back from the other edges, forming a dimensional self-stability.
SK3: NORTH-EAST SECTOR

Museum, classrooms, laboratories and offices.
Mixed use occurs on two levels along the street edge.
DIRECTIONAL FIELD:
To reestablish the large landscape direction (that of the Charles River), building blocks of similar size and shape are directionally deployed.
Appendix A: 3 sketches
SK1: Johnson Athletics Center
SK 2: N52 - 3FL.
PARTIAL ELEVATION

PARTIAL PLAN
SK·3 Northeast Sector
SITE PLAN

0 50 100 200
Constraint is the limitation imposed on an action. Thus, constraint-based designing is the process of designing with imposed limitations. Should designing be restrained by limitations? Do limitations facilitate designing? Can limitations motivate design propositions? Problems can often be expressed in some combination of constraints and criteria. In a typical linear programming problem, for example, the criteria are functions that are to be maximized or minimized, and the constraints are bounds on the magnitude of the variables. Design is a special type of problem. Design can be described as a set of constraints on a set of variables. Variables are attributes of the design problem. Each variable has a value. This value may be fixed, or, it may be determined by the designer, or, it may be determined as a consequence in the process of designing. A collection of constraints bounds a "region" of alternative solutions, or variants. Each variant is a specific point inside the "region".
It conforms to the specifications, or constraints, of the design. Variables determine the degree of freedom of a design. Constraints control the boundary of the design. The variables and constraints are not predetermined. The designer chooses variables and constraints in order to delineate the "region" of variants. The choosing is the designer designing.

Designing is the process of producing design. Although designing may seem idiosyncratic, or lacking in structure, but it need not be. There is no definite boundary wherein the design process lies. This is not crucial. Within this undefined boundary, many aspects of designing can be rendered, and a general framework of the process can be articulated:

"Designing can be (is) understood as a process of incrementally defining an initially ill-defined problem, and concurrently proposing and testing possible answers. That is, not finding the solution to a problem, but finding a solution to the problem. Articulating (including inventing and modifying) the question, and exploring possible alternative answers (or design), are two fundamental activities ..."[1]

Thus, designing follows a type of search procedure. It searches on two levels. It searches for requirements to the problem. It
also searches for a solution meeting the specifications of the problem requirements. The first level of the search is somewhat peculiar, because there is nothing there to find. This search is, in a manner, an invention, a speculation. Invention or speculation, it cannot be meaningful without scrutiny. The second level of search is solving. Solving ascribes a speculated solution to the specifications of the design. It also requires scrutiny.

The basic operation of designing is search. The reasoning is scrutiny. Search provides variants satisfying the constraints, scrutiny legitimizes such a claim. At the same time, constraints define the site where the search occurs. Without constraints, there is no ground for scrutiny.

The search cannot be random, nor can it be exhaustive. Randomness offers no control. Thus, a random process is meaningless. An exhaustive search is too consuming, if not impossible. It is equally meaningless. The search must be purposeful and structured. The first aim of the search is to locate a region of feasible solutions. The stated specifications of the design establish bounds within which the search
shall occur. This region may be enormous. Additional constraints are required to reduce the size of the region, or the number of probable solutions.

The design - the question - therefore, needs to be described, speculated, assessed, and invented before designing can proceed. This is the activity of 'articulating the question'. The articulation does not need to appear in a final state. The description gains more clarity as more is being speculated and assessed about the design. Each character added to the description is an added constraint for the invention. These constraints may be derived from two areas of a designer's knowledge: the understanding of the problem and general working knowledge about designing.

A depiction of the problem establishes the bounds of a feasible region. The boundary of the search is delineated. The process of search can be confined. This makes the search intelligent. The narrowing of the feasible region increases the likelihood of finding a "satisficing" solution with less resources, time and energy. The use of an exhaustive search is possibly conceivable, but will require excessive
resources. Furthermore, most problems will demand a solution for more than one variable. The magnitude of the search region must be reduced as much as possible. Since constraints establish the boundary of the search region, they also determine the size of the region. The manageability of the feasible region depends on the constraints of the design problem.

The process of searching is meaningless if the search can not be scrutinized. The process of scrutiny is desired on two levels: both internal and external to the search process. By placing the search process under scrutiny, each aspect of the search process is logically constructed. There should be no occurrence of inconsistency within the search process. The process of scrutiny will also help to eliminate ambiguity. Ambiguous design process does not necessarily produce bad design. However, ambiguity contradicts the desire for explicit design knowing and reasoning. Through scrutiny, the search process is conventionalized. It will not be taken as idiosyncratic, or whimsical. It will have a substantiated foundation.

The second cycle of search and scrutiny deals with exploring possible answers. Whereas the
first search procedure speculated about possible solutions to the design problem, the second search procedure confirms one of the speculated solutions to the specifications of the design requirement. The exploration has two tasks: finding and testing a solution: finding, or selecting a variant within the bounded region of solutions; testing, or conforming the solution to the design specifications. Design has been described as a collection of constraints over a set of variables. Constraints are the specifications. Variables are attributes of the design problem. Some variables of a variant can be prescribed. Some need to be determined as a consequence of the constraints and known variables. This is solving.

"To solve is to calculate some properties (variables) of a design, based on other properties (variables) of the design and the relations (constraints) of the design."[2] The search for a "satisficing" solution is the selecting of a variant. It is possible that a set of constraints and variables is specific enough to yield only one solution. More often, solving yields several solutions. This is expected. Each solution is a variant fulfilling
the condition of the imposed relations on
desired attributes of the design. The solutions
all shares the same set of constraints. They
differ in their respective sets of variables. A
variable can acquire its value, as prescribed by
the designer. It can also inherit its value,
from the calculation of other variables and the
constraints. The designer makes choices among
the sets of variables. The choices need not be
arbitrary. The choosing is the designer
designing.

The theory of constraint-based designing
stipulates "that designing is exploring regions
of feasible solutions; that feasibility is
derived from the constraint chosen by the
designer; that choosing constraints is how the
designer uses his knowledge." This stipulation
requires "that every exercise of design
knowledge be construable as the choice of
constraints becomes the invention."
Furthermore, "(the) purpose of the theory is to
make explicit design knowing and reasoning."[3]
This intention of making the design knowing and
reasoning explicit carries two underlying
assumptions: that design knowing and reasoning
can be made explicit; and that this explicitness
is desirable for designing.

Is an explicit process of designing a more effective way of designing? This is not always true, at least not at the present time. The proposition for an explicit process of designing first aims at providing a good theory about design and designing. It is not a theory about good design or designing. If this is a good theory about designing, then a theory of good designing is more approachable. A theory of good designing will be more concerned with producing a good design. It is then that one can assess the effectiveness of an explicit process of designing.

The requirement of making each design choice construable is important. A construable design choice is amenable to analysis. Each design choice can be scrutinized for its validity. It can be evaluated for its implications. It can be manipulated for an alternative choice. A construable design choice is also amenable to combination with others. It is the combinations of construable design decisions that produce an explicit designing process. Explicit designing is made up with discrete design decisions that one can describe and justify.
To describe and to justify is to understand.

It is helpful for the designer to understand the business of his designing. Understanding designing and designing can have rather intricate implications on one another. The relationship between human understanding and expression has been expressed as follows:

"... the sensuous spiritual nature of mankind manifests every inner process to sensuous perception and in every outer expression mirrors inner process. In being perceived the outer expression provokes the same inner processes by projecting itself into the perceiver."

[4]

Likewise, how one understands his designing is reflected in his way of designing. In order for a designer to improve upon the way he designs, he must understand his designing.

The motivation for designing originates from the desire to control: to improve or to rectify an existing condition for a desired condition. To obtain control of a design, the process of designing needs to be controlled first. To control designing is to manipulate parts of the process, to prescribe conditions for it, to direct the proceedings, to specify the procedures, to terminate the process at the desired moment, etc. It is the acceptance that this process of design has assumed a structure;
that it possesses procedures susceptible to identification as well as analysis. The process, as a whole, or in part, must admit verification.

Verifications may be logical or factual. Both varieties can be hosted in the constraint model. This allows the designing to be modified against logical or factual truth. This modifying ability increases the certainty of obtaining a calculated and desired result.

"Constraints are the rules, requirements, relations, conventions, and principles that define the context of designing."[5] Constraint is used as the building block of an explicit design process. This design process promotes explicit design knowledge and design reasoning. The explicit reasoning permits a designer to better control his action, and hopefully, the design as well. Making the design knowledge explicit implies that the designer can articulate this knowledge. This ability helps the designer to reflect upon his own understanding of the design problem, and it also enables him to communicate with others. Thus the knowledge can be shared. The knowledge is conventionalized.
The capacity of the constraint model is enormous. It also must have its limit. The model is, and must remain, as a tool, a vehicle for design. Designing is the process, not a motivator. The process, however powerful, needs a designer, like a car needs a driver. The role of a designer can not be substituted. Designing also differs from design. Designing is generic, design is particular. The process can remain the same for different design problems. Each design, produced using the same process by the same designer, may differ from other designs. For each design, the designer defines the intention and provides the motivation. The process is the consistent framework in which the designer works. The process is like a formula. It establishes the relations among particulars. It can even restrict the range of participating particulars. It, however, does not make final selection of the particulars: the designer does. The designer chooses the constraints and variables about a design problem.

The constraint model is useful. It enables the designer to make each choice with justification, and rationale, such that the choices are construable. Constraint designing makes a design
less arbitrary or accidental. It insists that design should be intelligent, understandable, as well as modifiable.

Notes:

2. ibid, p62.
3. ibid, p55.
5. Gross, p56.
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