form and process in architectural design

THE GRID

RICHARD SCHERR

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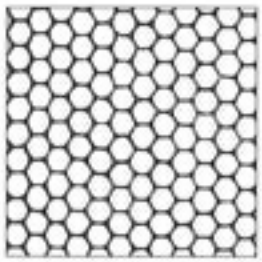
Contents

CHAPTER ONE



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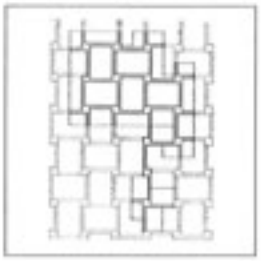

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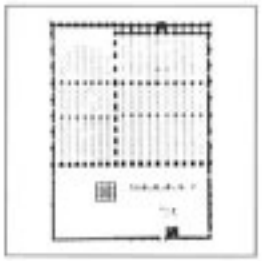

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1. Honeycomb
2. U.S. Public Land Survey
3. Mondrian, "Broadway Boogie-Woogie"
4. Le Corbusier, Venice Hospital, Circulation Pattern
5. Egyptian Worker's Village, Tell El Amarna
6. Cordoba, The Great Mosque

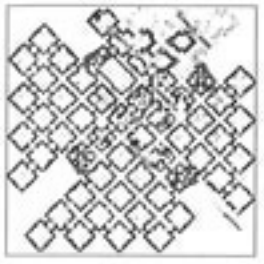
THE GRID AS A BASIS OF DESIGN

The use of the grid as an agent of formal order is found in many examples throughout the natural and manmade world. In nature, gridded organization can be discovered in the formations of certain rocks, crystals, shells, and the cellular habitats of various insects (Fig. 1). The grid is more prevalent as an organizing principle in manmade artifacts, as it is predominantly a product of the mind, an intellectual construct intended to achieve a rational order for the constructed artifacts of man's environment. We find the grid used as a basis for organization in much of our art, architecture, industrial design, as well as the organization of our cities and large-scale environments. It is found in an almost infinite variety of forms and scales, from the smallest component computer micro-chip to the subdivision of much of the central United States (Fig. 2). The scale, physical characteristics and intentions of a painting by Mondrian (Fig. 3), the circulation and structural system of Le Corbusier's Venice Hospital project (Fig. 4) and the street layout of many of our cities may be radically different from one another. Yet in terms of organizational concept, they are all based upon the same essential principles of order.

The grid can also be found as an organizational device throughout the history of architectural and urban development. Thus, the plans of an Egyptian workman's village (Fig. 5), a medieval cathedral, an Islamic mosque (Fig. 6), a 19th century market, and a 20th century office building (Fig. 7) share some basis for comparison. One can say the same for a Roman town plan, such as Timgad (Fig. 8), an Indian town plan (Fig. 9), Cerda's 19th century extension of Barcelona (Fig. 10) and a housing development by James Stirling (Fig. 11). If one can analyze each of these works objectively, and without taking into consideration differences of style, imagery, functional type, scale, or cultural context, it will be found that their underlying form is essentially based on similar principles of gridded order.

The use of the grid in the 20th century has generally not been based on ideal design intentions, but rather on largely pragmatic, or operational concerns. Its incorporation has often been a result of its ease and speed of use and development, the inherent characteristics of modern industrialization, construction methods, and land survey techniques. It is this purely functional, non-inventive use of the grid, which brings to mind characteristics of regularity, repetition, absence of differentiation, neutrality, and lack of response to local characteristics and demands.

Many buildings and cities based upon gridded order on the surface seem to be unimaginative and dull. Such examples abound in the pervasive redundancy of the gridiron plan throughout the United States,



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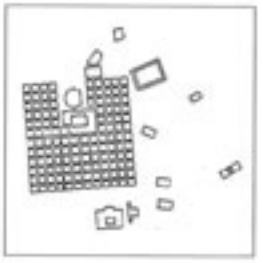

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7. Herzberger, Central Beheer Offices
8. Timgad, Algeria
9. Jaipur, India
10. Cerda, Barcelona, Spain
11. James Stirling, Runcorn New Town, England

with its repetitive blocks and right-angled intersections. Many of the grid cities were generated by the infinite extension of the Public Land Survey coordinates that articulates much of the mid-west regions of the United States into a one mile by one mile grid of highways and property boundaries. The orthogonal grid system was used simply because it was the most economical to survey, the quickest to build, and easiest to understand and navigate.[1]

In terms of architecture, the nondescript proliferation of warehouses, factories and speculative offices of little enduring quality or character, which have filled these gridirons, have often employed similar repetitive grids to generate the building's form. The reasons are pragmatic. These buildings can be executed quickly and economically. Buildings that are little more than flexible spatial sandwiches of repetitive horizontal or vertical structural continue to be the normative building block of the city to the present day.

The problem here is not the use of the grid *per se*, but the inappropriate use of the grid as a design tool. There is nothing inherent in the form of grids that leads to dull, unimaginative buildings, or cities. Most designs use the grid in its most reductive manner, and fail to investigate the many possibilities of alternative development. The fact is that repetition and consistency are only the most obvious, initial characteristics of grid system. With appropriate manipulation and transformation, i.e. design development, the grid can have as much vitality and variability as forms derived from other kinds of systems.

In many designs, there has not been an effort to extend the formal limits of gridded structures beyond its most basic, simplistic manifestations. Part of the reason is related to a lack of understanding of what the range of possibilities might be, and how to utilize the grid as a tool rather than as a preconception, or prescription of some specified end result. The proper utilization of the grid is not simply the incorporation of its form, but the conscious selection of the grid as a process of design, which is characterized by defined rules and procedures, and adaptive to the needs and conditions described by the given problem.

The following chapters will attempt to explore the utilization of the grid as a comprehensive theory of design, and to redefine its possibilities for utilization in architectural and urban design. This will be accomplished by defining the grid's characteristics and functions, illustrating alternative forms of representation and transformation, and graphically delineating case studies of types of grid forms and transformations as examples of how to use the grid as a design tool. The emphasis is on defining the grid not as a limited, pre-determined goal that automatically dictates form, but as a process of formal derivation composed of intermediate stages of development and transformation controlling the design process. The diagrams and illustrations are not of completed buildings or comprehensive designs, but only earlier, fragmentary statements of concept and vocabulary that can ultimately generate physical design solutions. The attempt consists in making visible the "in-between" stages of a design process and the utilization of a particular design tool that can bridge the difficult gap between inspiration and realization.

1. Reps, John. *The Making of Urban America*, Princeton, Princeton University Press, 1965, pp. 226-27.

PLATE III

DIMENSIONAL STRUCTURE

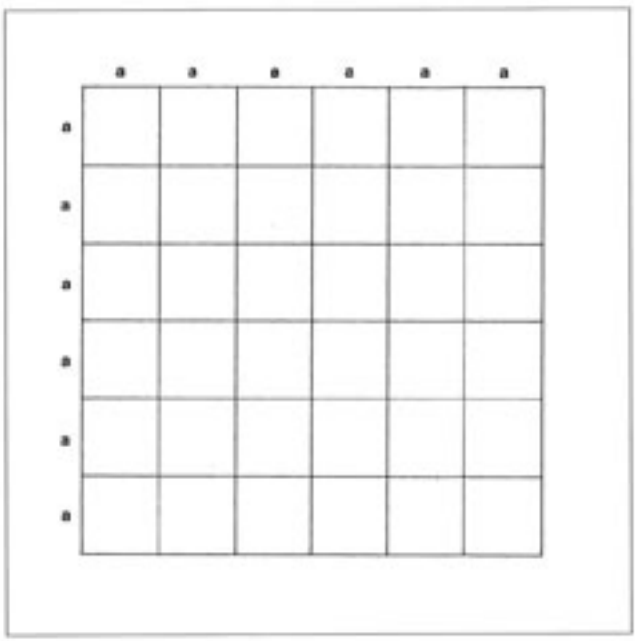
Grids can be modulated non-hierarchically or hierarchically, and articulate singular or complex organizations within a defining field.

1. EQUAL UNITS:
A modulated field which generates a repetitive, non-hierarchical spatial organization.

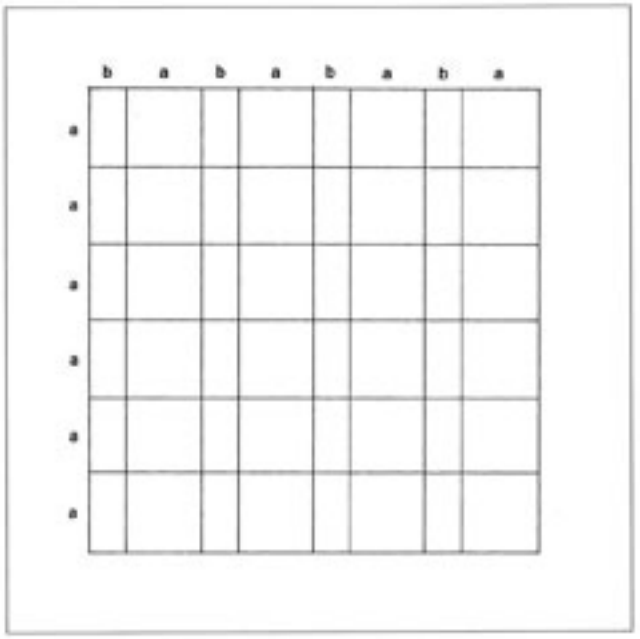
2. UNEQUAL UNITS
SINGLE COORDINATE:
A modulated field which generates a repetitive, non-hierarchical spatial zoning along one axis, and a hierarchical spatial zoning along the other axis.

3. UNEQUAL UNITS
DUAL COORDINATES:
A modulated field which promotes hierarchical spatial zoning along both vertical and horizontal axes.

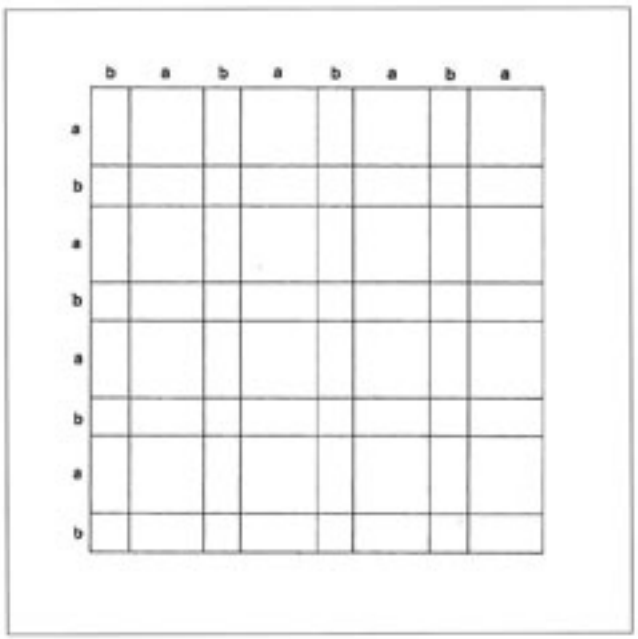
4. UNEQUAL UNITS
COMPLEX STRUCTURE:
A modulated field that promotes unequal spatial zoning along vertical and/or horizontal axes.



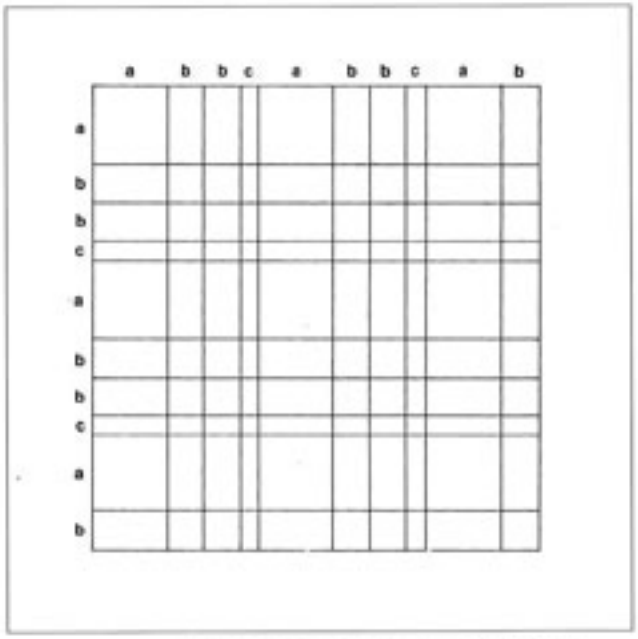
1. EQUAL UNITS



2. UNEQUAL UNITS / SINGLE COORDINATE



3. UNEQUAL UNITS / DUAL COORDINATES



4. UNEQUAL UNITS / COMPLEX STRUCTURE

PLATE IV

DIAGONAL FIELDS

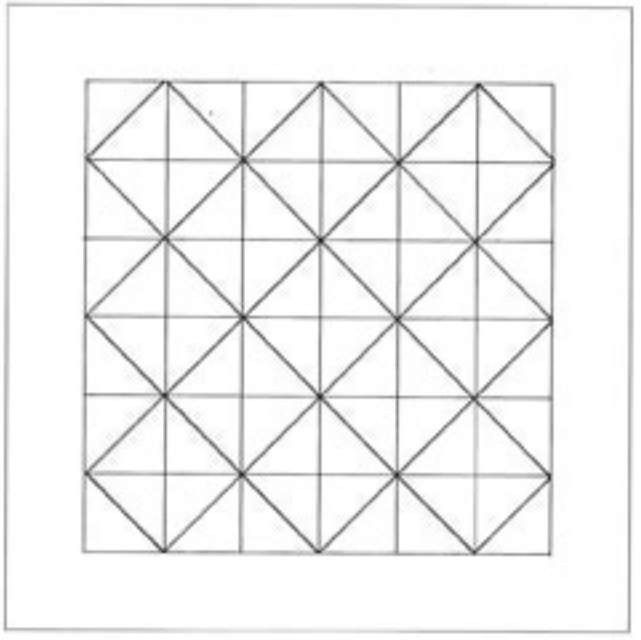
Fields are capable of being redefined by absorbing the imposition of new fields rotated from the original grid, suggesting alternate strategies of positioning or defining new form within the field.

1. GRIDDED IMPOSITION:
The generation of a diagonally imposed field articulates a triangular grid, resulting in two alternate scales of superimposed grids.

2. LAYERED IMPOSITION:
The generation of a diagonally imposed parallel field articulates a triangular grid, resulting in a stratified spatial order.

3. MULTIPLE MODULES:
The generation of a diagonally imposed, hierarchical field creates multiple scales of both gridded and triangular units.

4. FRAGMENTS:
The generation of portions of a diagonally imposed field allows for the selective emphasis or denial of elements placed in the field.



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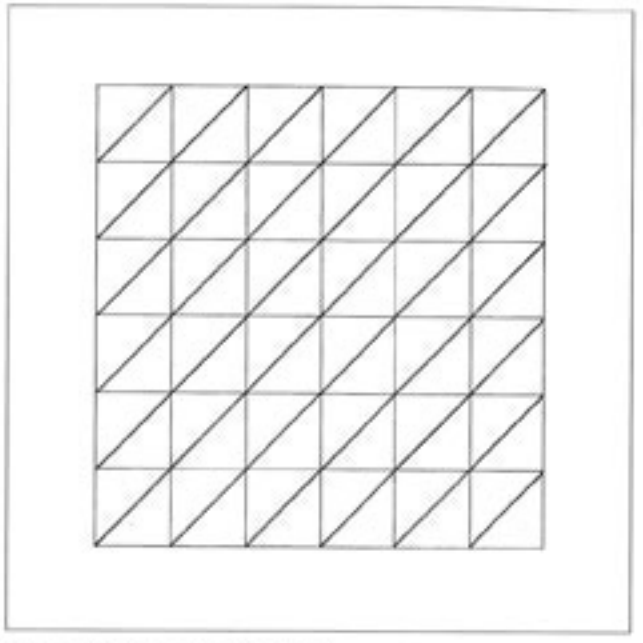
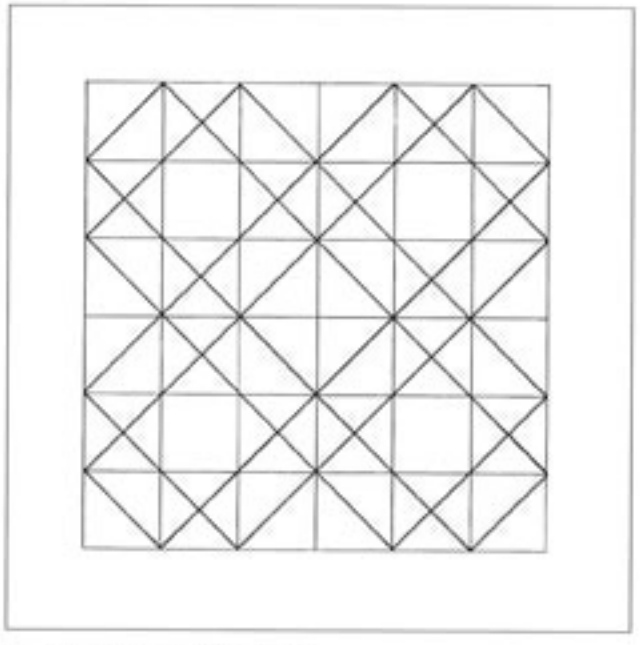
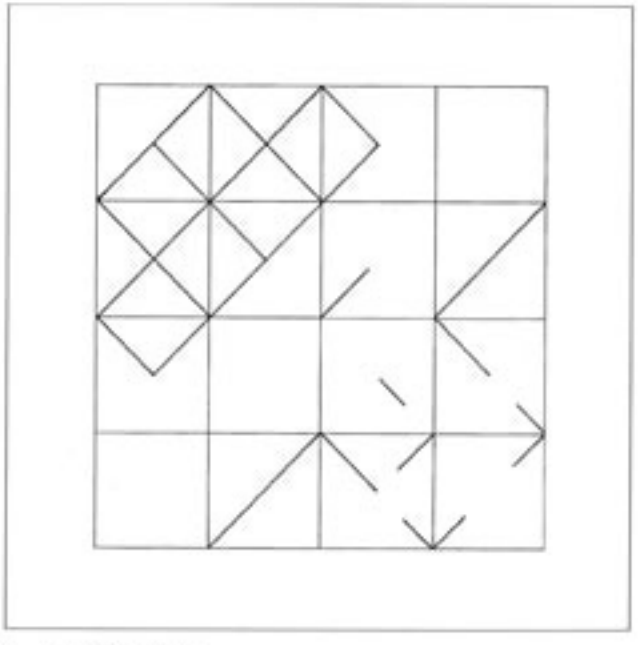


2. LAYERED IMPOSITION



3. MULTIPLE MODULES



4. FRAGMENTS

PLATE XV

ROTATION

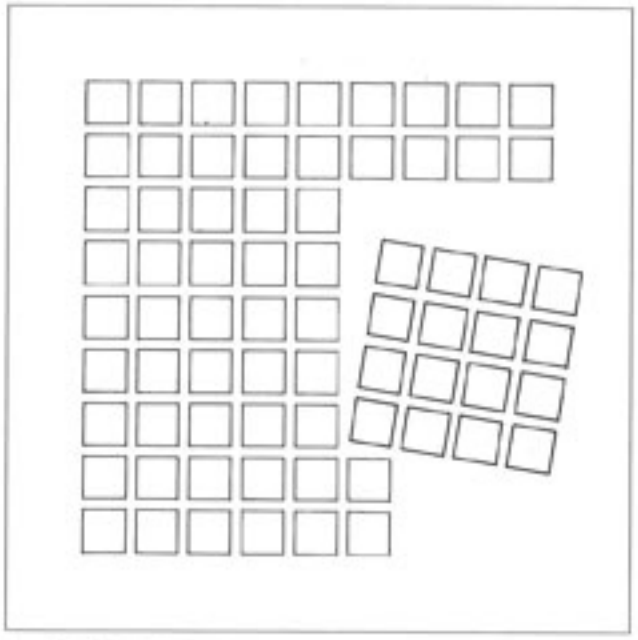
Gridded fields can be adjusted by shifting a portion of the total field off from its dominant axis.

1. ARTICULATED FIELD:
The shifted field is separated from the existing field by removing intermediary units.

2. CONTAINED FIELD:
The shifted field remains adjacent to the existing field by deforming/carving intermediary units.

3. ATTACHED FIELD:
A connective joint is developed between the shifted and existing fields to stabilize or lock the rotated field in a fixed position.

4. OVERLAPPED FIELD:
A portion of the field is shifted while maintaining the form or the existing grid.



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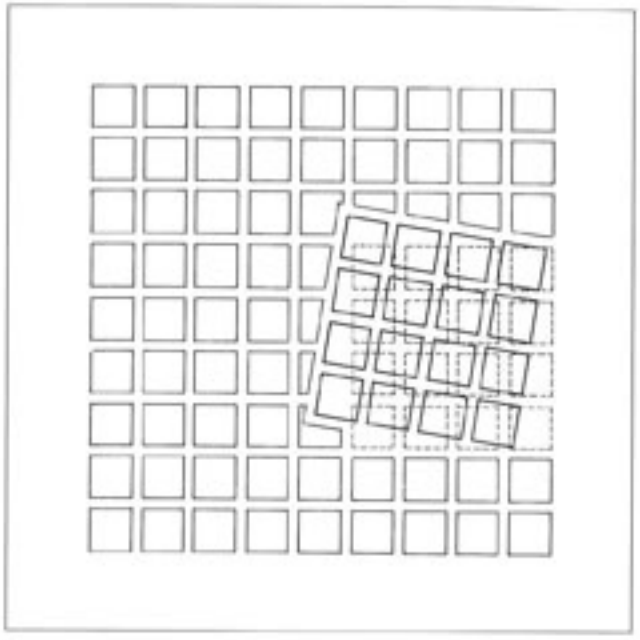
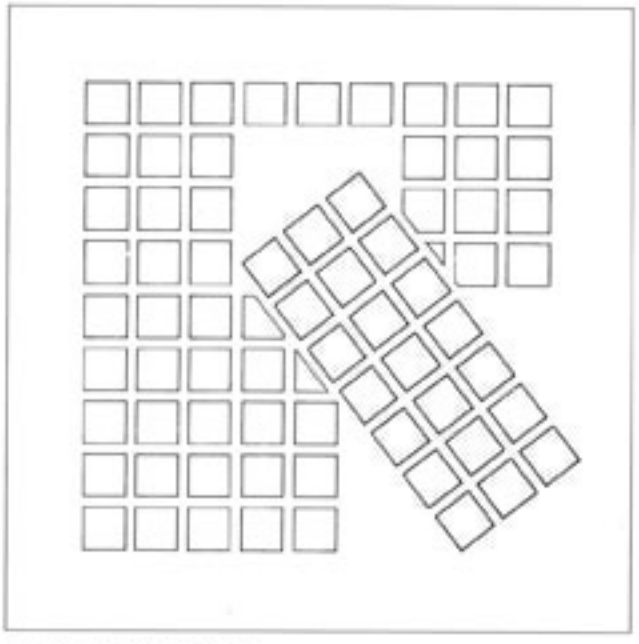
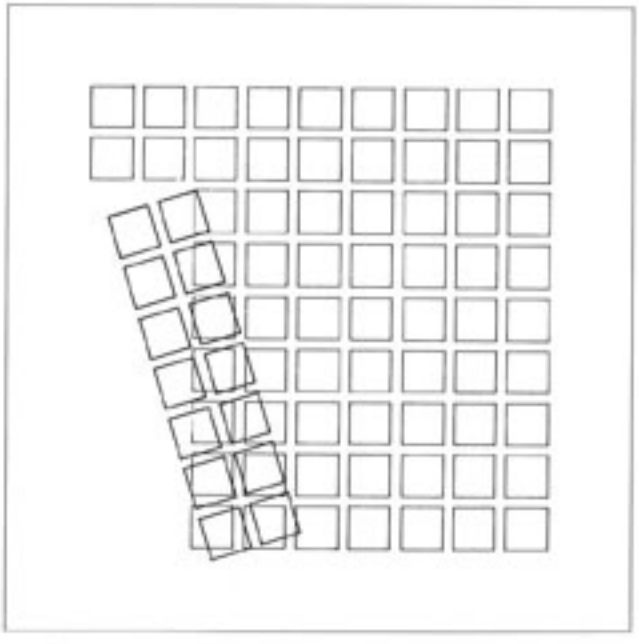


2. CONTAINED FIELD



3. ATTACHED FIELD



4. OVERLAPPED FIELD

PLATE XVII

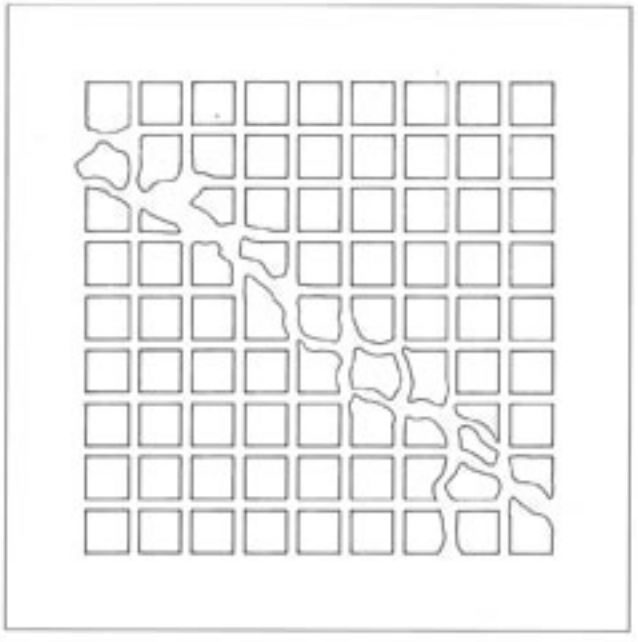
STRUCTURAL SEAMS

5. WARP:
Adjacent units are deformed through unequal sizing or re-contouring to develop a zone of division between two fields.

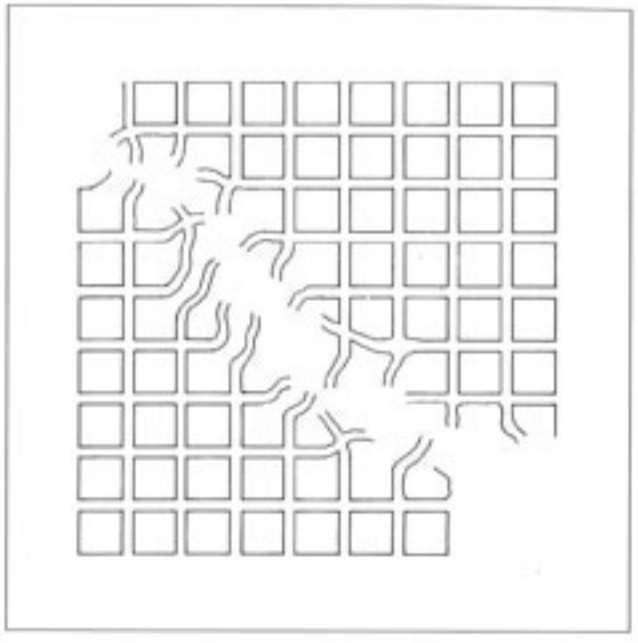
6. DISINTEGRATION:
Adjacent units are decomposed or partially erased while other units maintain their original configuration.

7. DELETION
GRID SUBSTITUTION:
Adjacent units are removed which allows for the replacement of new fields within the original field.

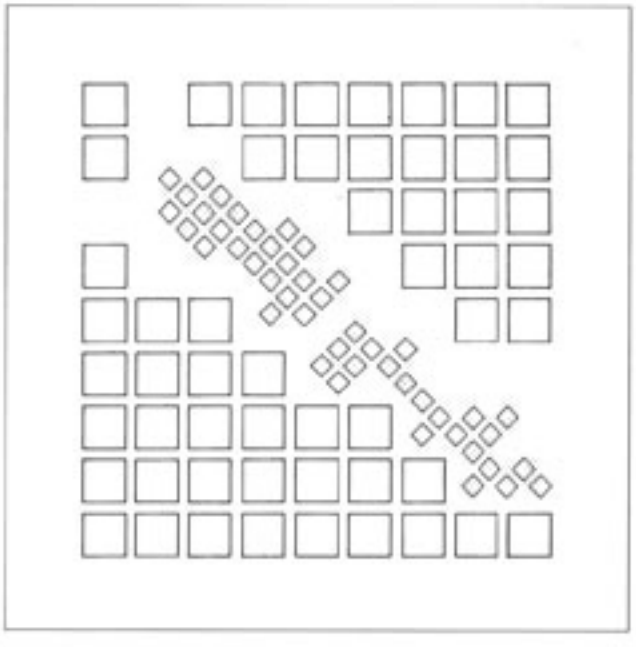
8. DELETION
UNIT REPLACEMENT:
Adjacent units are removed which allow for the replacement of unique from and spaces within the field.



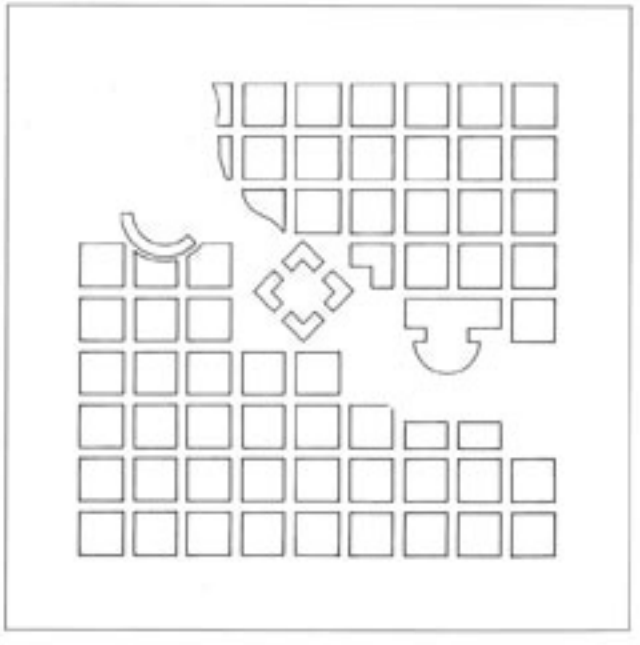
5. WARP



6. DISINTEGRATION



7. DELETION / GRID SUBSTITUTION



8. DELETION / UNIT REPLACEMENT

PLATE XX

INFRASTRUCTURAL CONTROL

The type of infrastructural control within a field depends on the nature of its physical language, whether based upon a system of points, lines, or shapes.

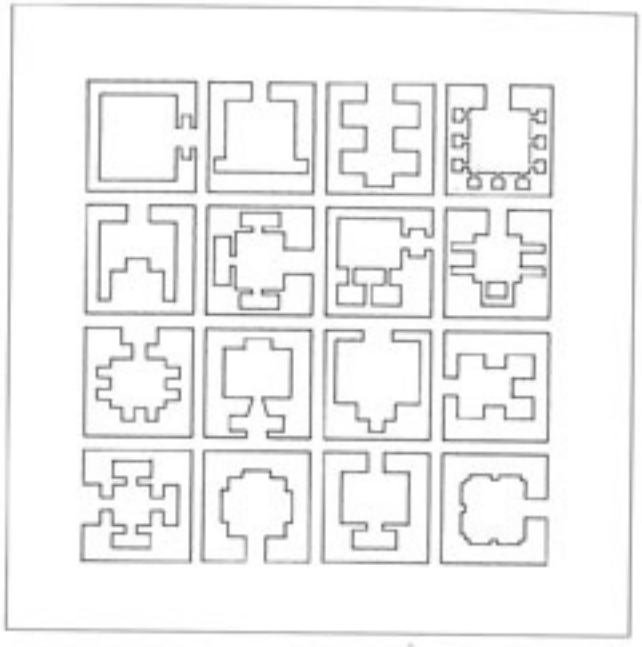
1. VARIABLE EDGE / UNIT:
The field formed as a repetitively shaped unit allows for the selective articulation of defined edges within the grid.

2. VARIABLE SHAPE / UNIT:
The field formed as a repetitively shaped unit allows for the selective articulation of internal spaces within the grid.

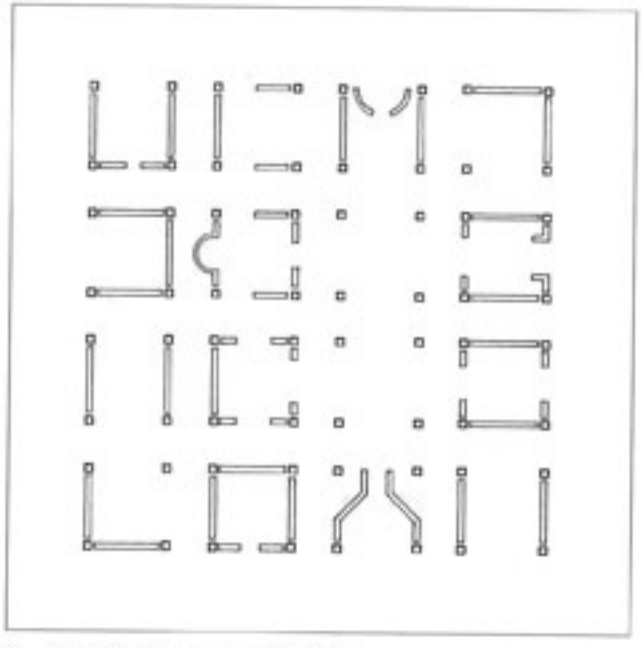
3. VARIABLE LINE / POINT:
The field, formed as a repetitive matrix of points allows for the irregular placement of lines added to the grid.

4. VARIABLE SHAPE / POINT:
The field formed as a repetitive matrix of points allows for the irregular definition and size of shaped spaces within the grid.

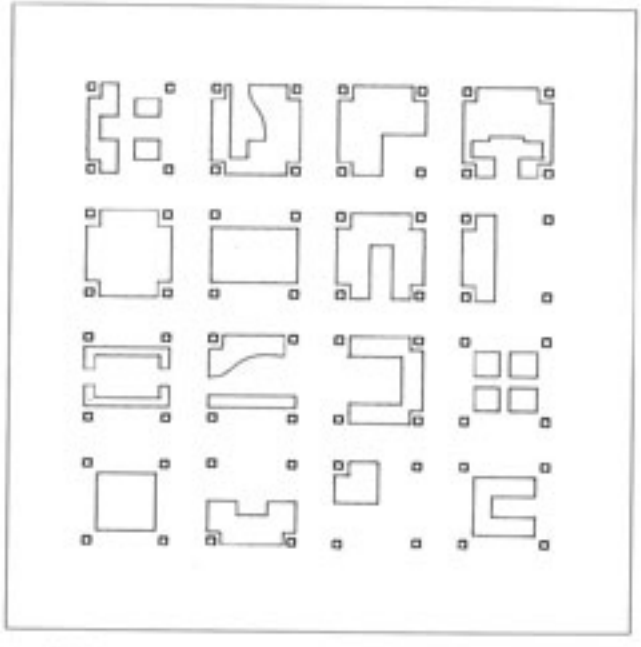
1. VARIABLE EDGE / UNIT



2. VARIABLE SHAPE / UNIT



3. VARIABLE LINE / POINT



4. VARIABLE SHAPE / POINT

PLATE XXI

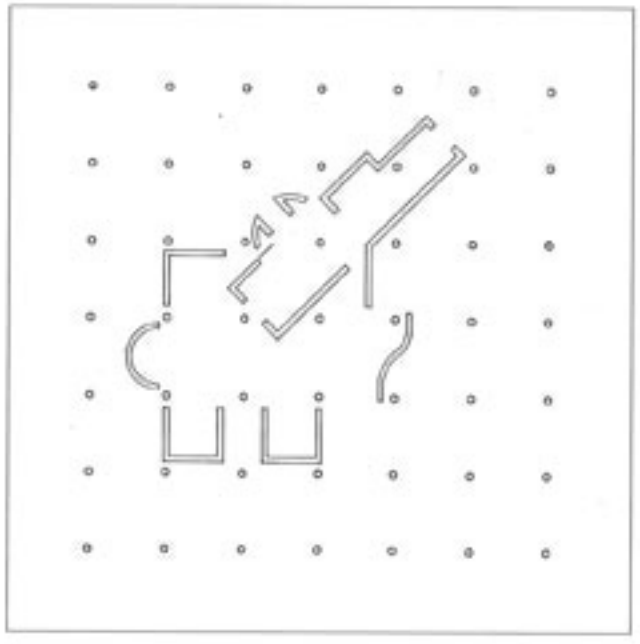
ORGANIZATIONAL CONCEPTS

1. FREE PLAN:
A variety of infill forms can be articulated within the defined field to establish selective reinforcement or non-alignment within the field.

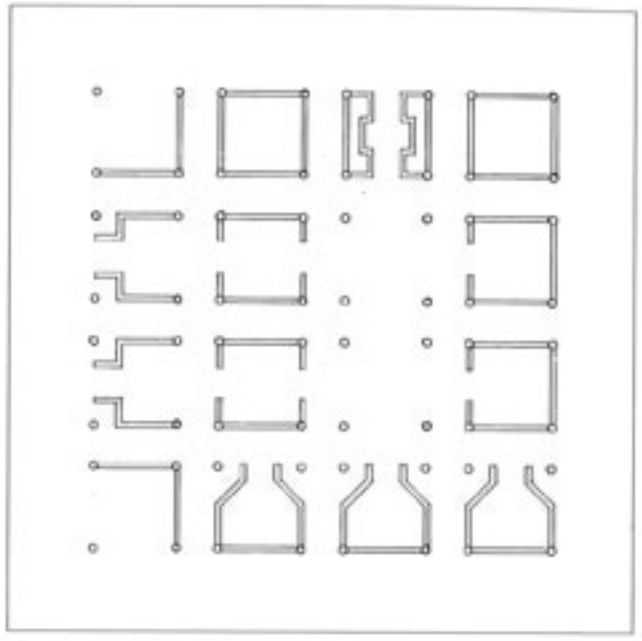
2. REPETITIVE MODULE:
The alignment of infill form with the modulation of the field creates reinforcement of a repetitive series of spatial units.

3. SPATIAL LAYERING:
The alignment of infill form with the parallel modulation of the field creates reinforcement of a directional series of spatial layers.

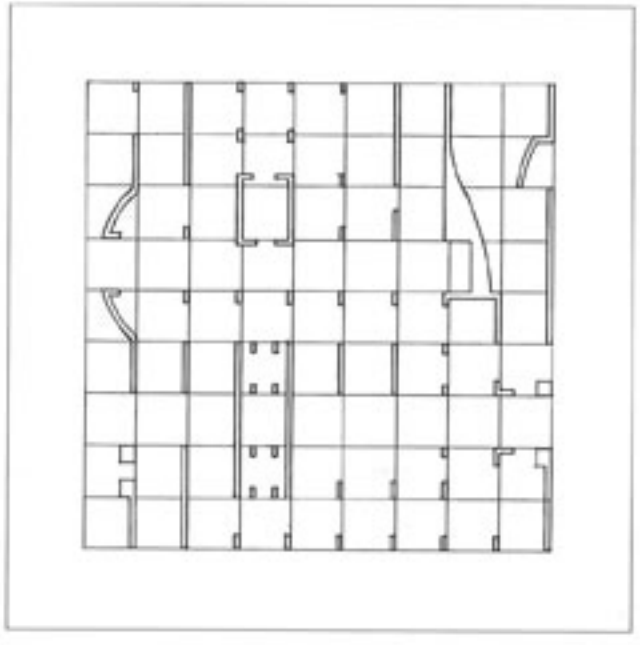
4. FIGURE vs. FIELD:
The field is expressed as areas of defined versus background space, both open and closed, which allows for the selective addition or subtraction of defining form.



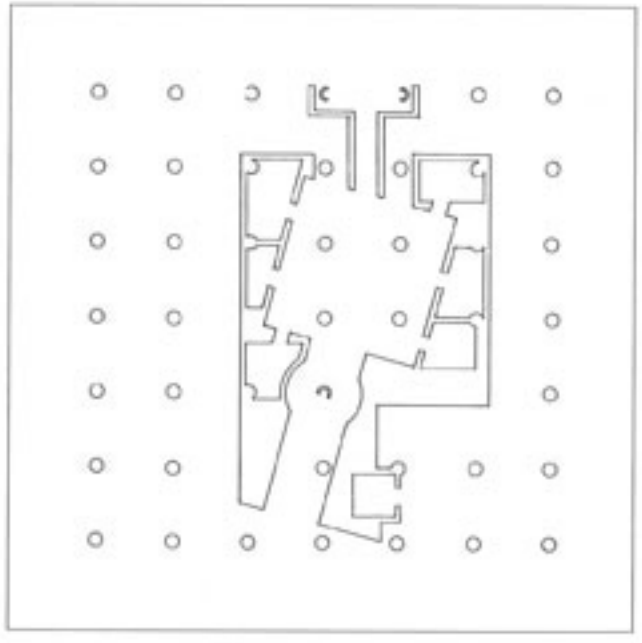
1. FREE PLAN



2. REPETITIVE MODULE



3. SPATIAL LAYERING



4. FIGURE vs. FIELD

PLATE XXII

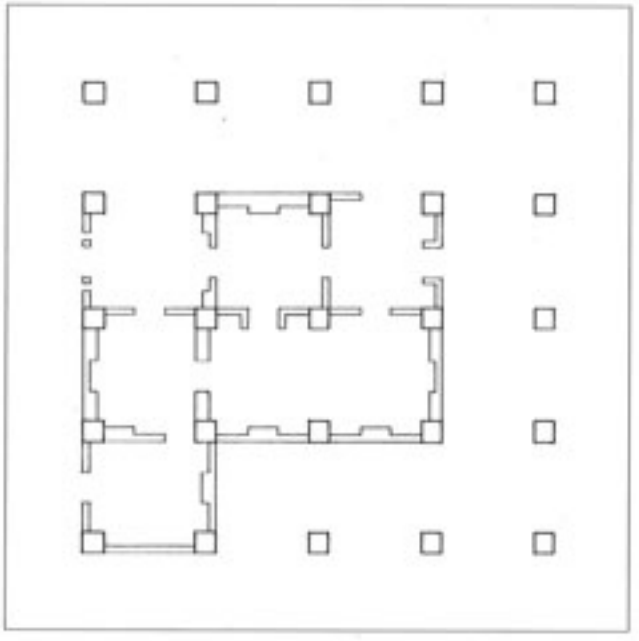
ORGANIZATIONAL CONCEPTS

5. INFRASTRUCTURAL CONSTANT vs. VARIABLE INFILL:
The field is defined as an invariable, repeating order that acts as a reference upon varied or inconsistent form placed within the grid.

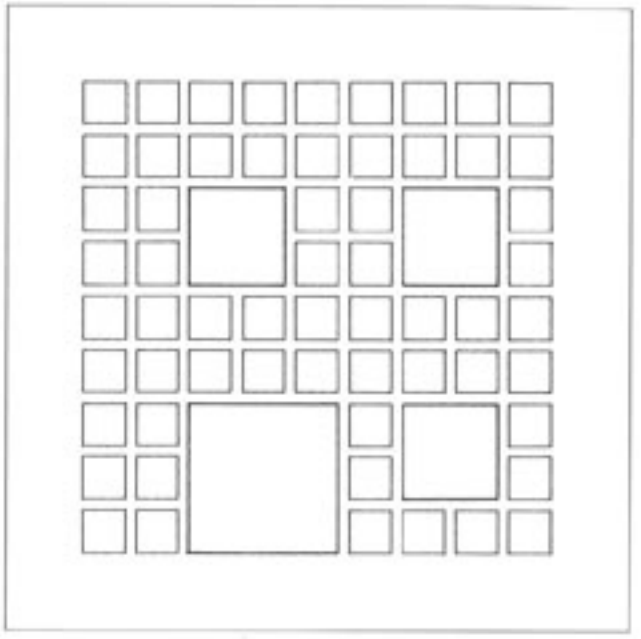
6. HIERARCHICAL UNITS:
The combination of gridded units into larger conglomerate units can accommodate unique variables imposed within the grid.

7. UNIQUE UNITS WITHIN REPETITIVE FIELD:
The selective extraction of units within the field can allow for the insertion of particularized forms and spaces.

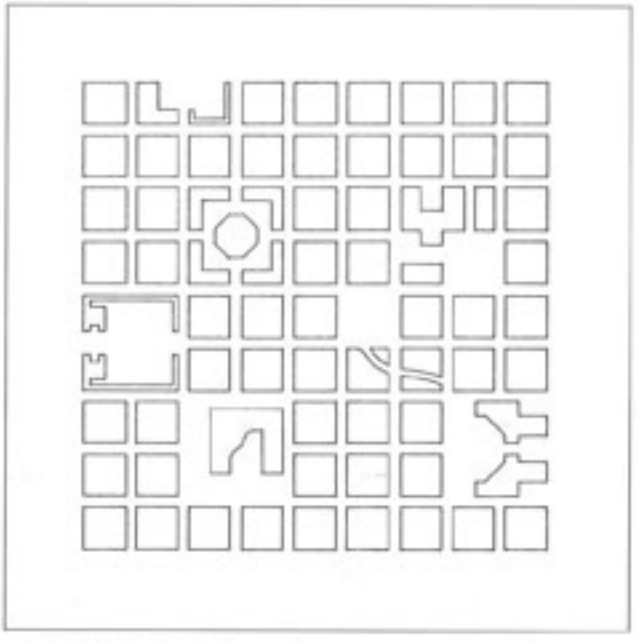
8. FIGURAL UNIT WITHIN FIELD:
The extraction of a combination of adjacent units can allow for the definition of a complex, composite form within the grid.



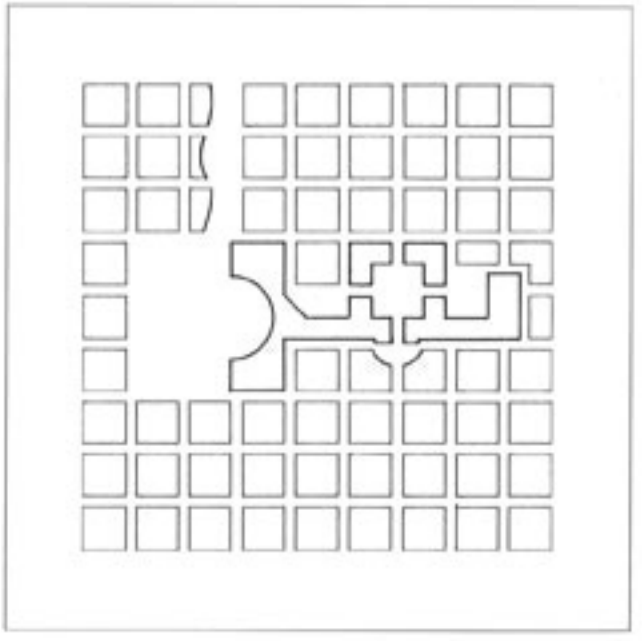
5. INFRASTRUCTURAL CONSTANT vs. VARIABLE INFILL



6. HIERARCHICAL UNITS

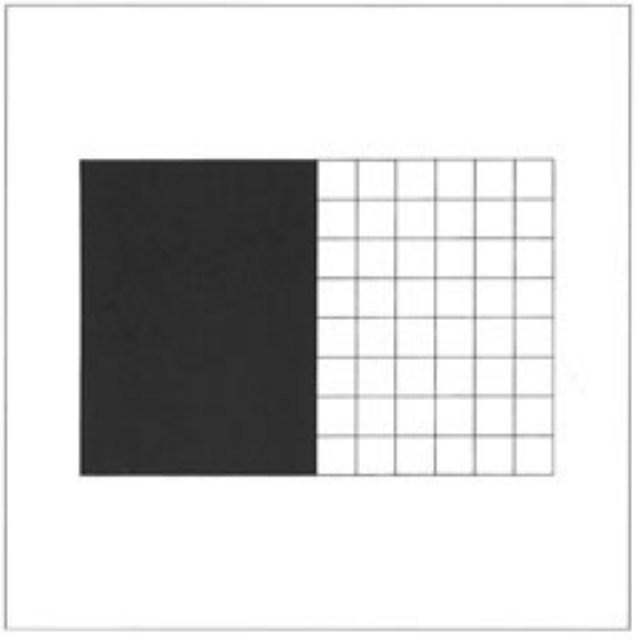


7. UNIQUE UNITS WITHIN REPETITIVE FIELD



8. FIGURAL UNIT WITHIN FIELD

SOLID/VOID DISPLACEMENT



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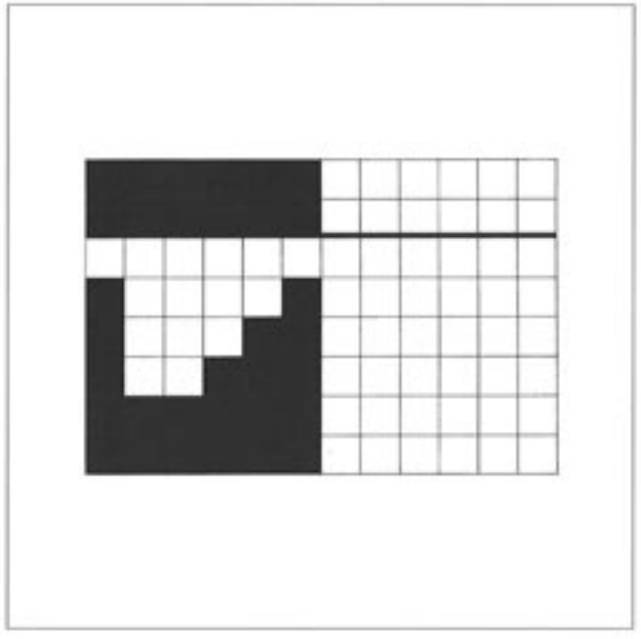

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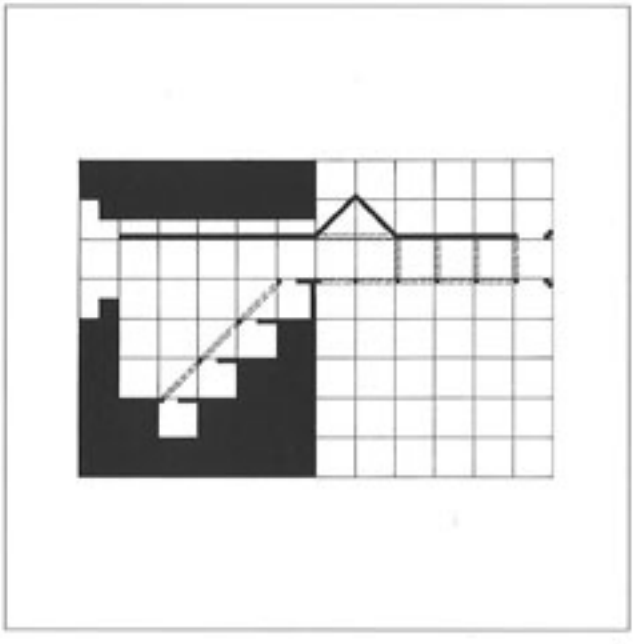

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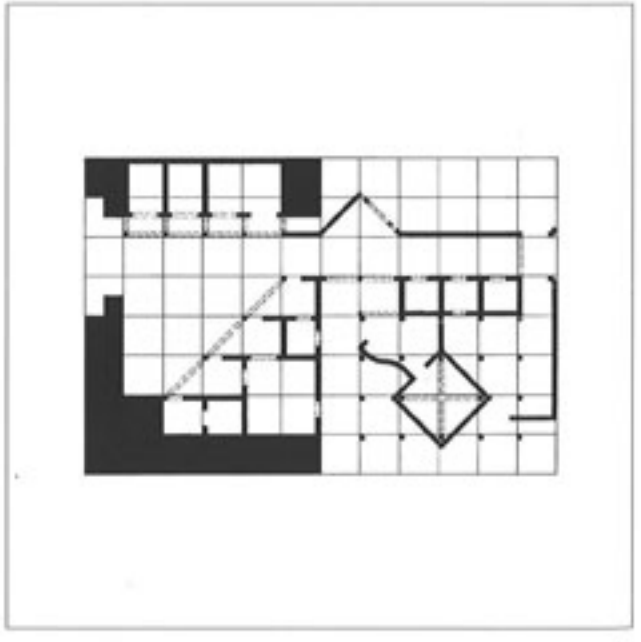

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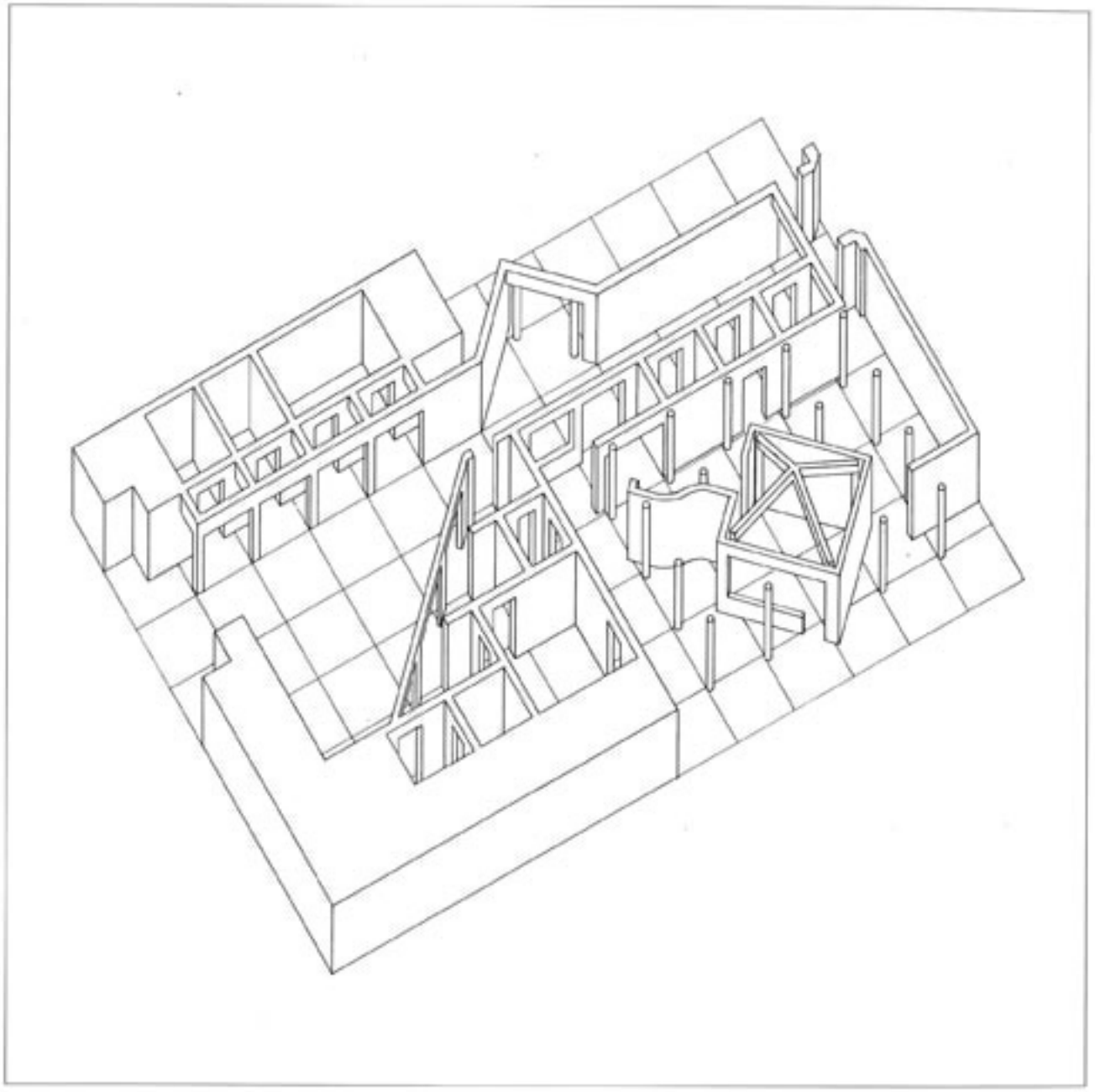
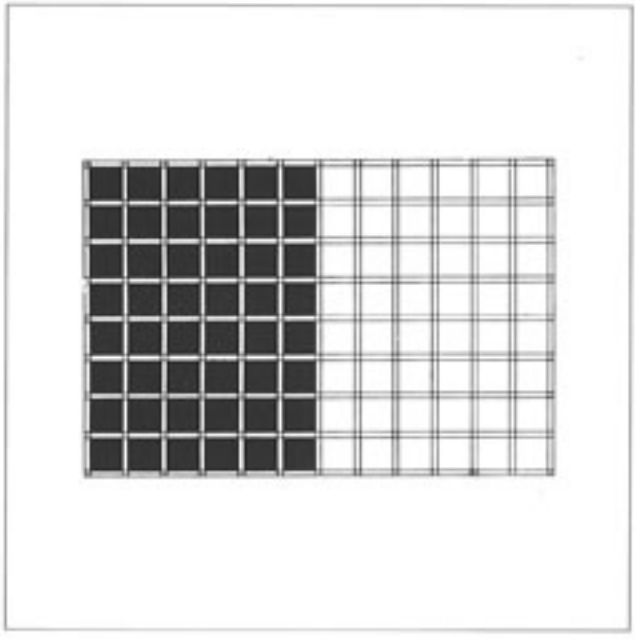


AXONOMETRIC

FIGURAL DISPLACEMENT



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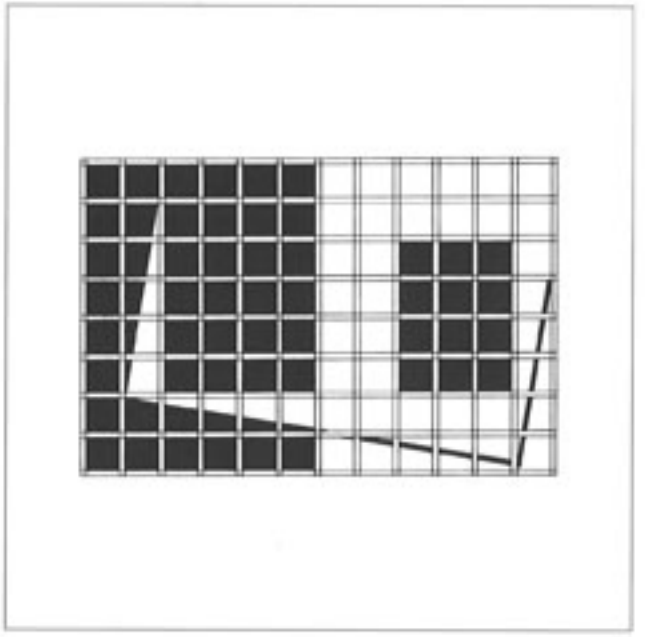

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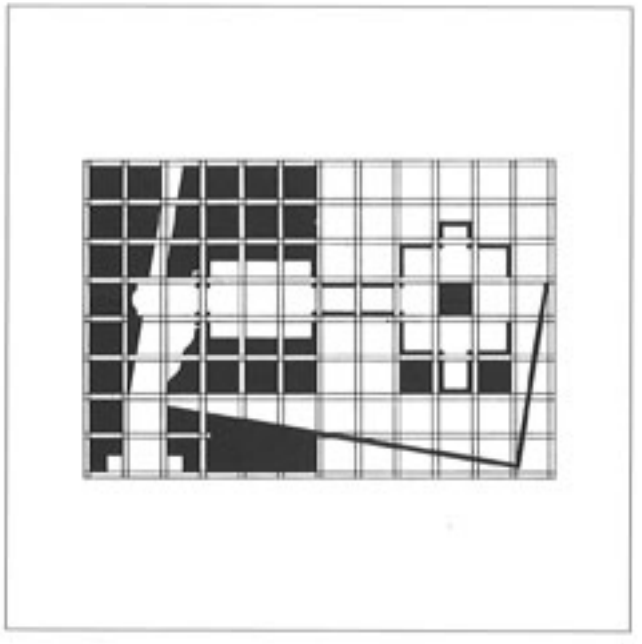

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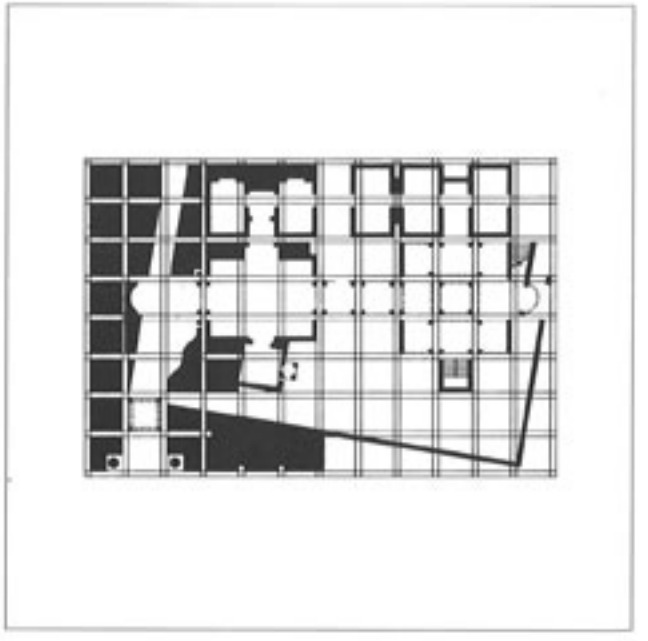

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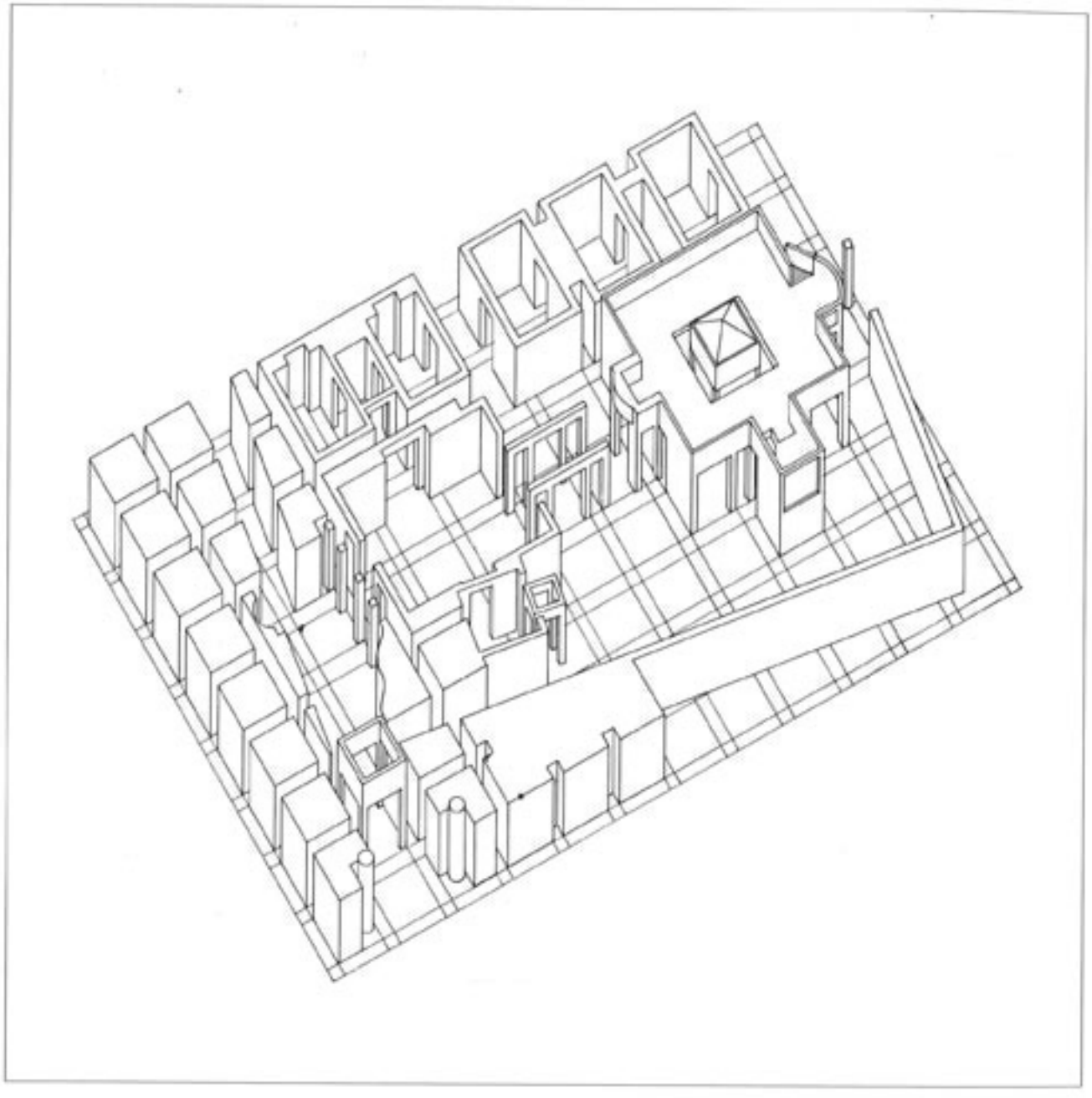
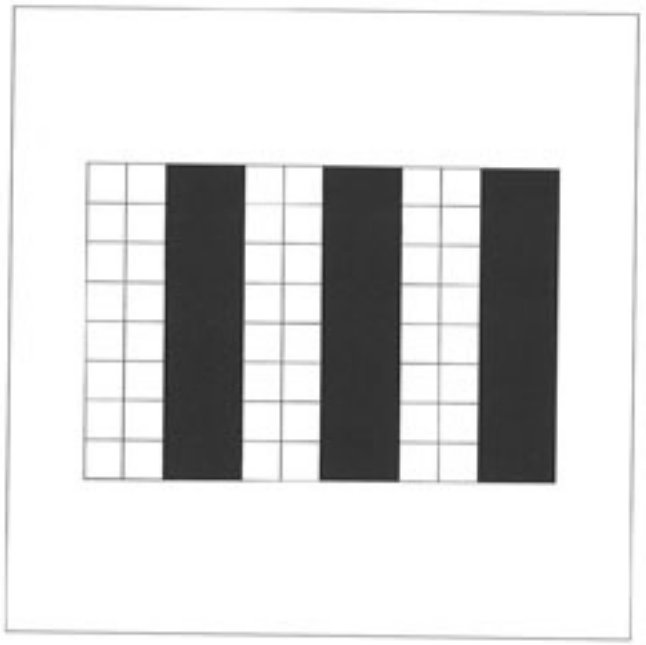
FIGURAL DISPLACEMENT



AXONOMETRIC

SOLID/VOID LAYERING



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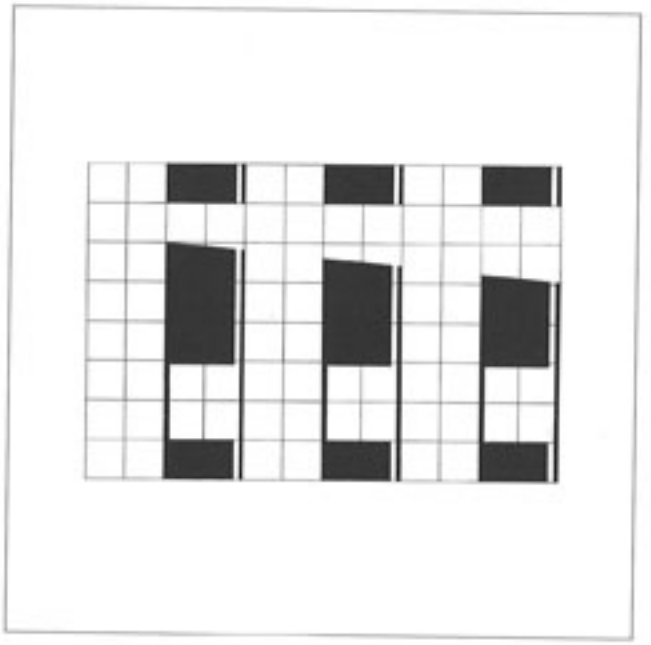

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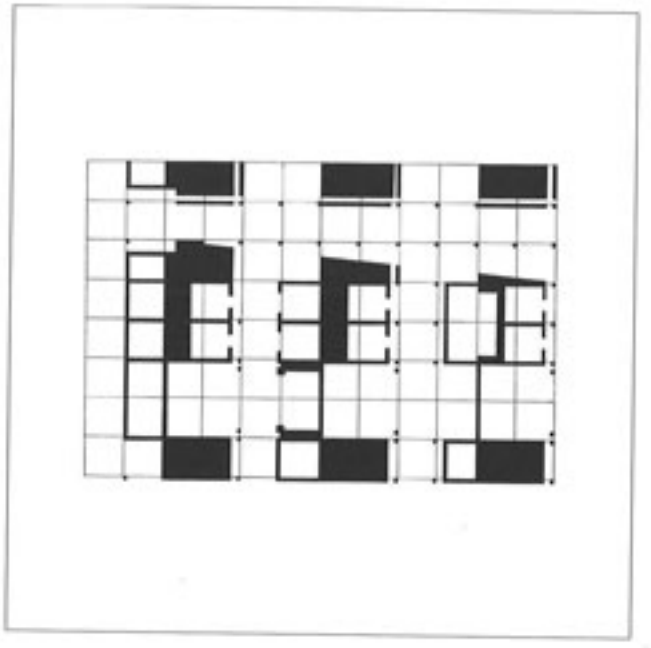

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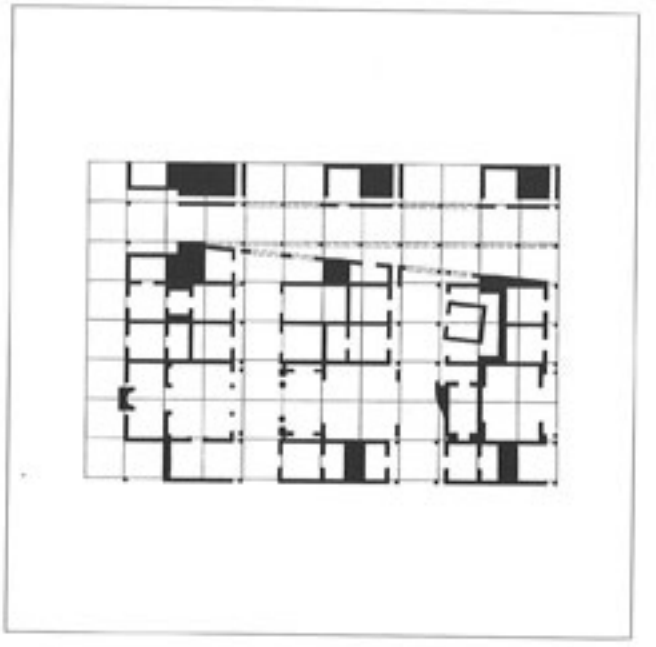

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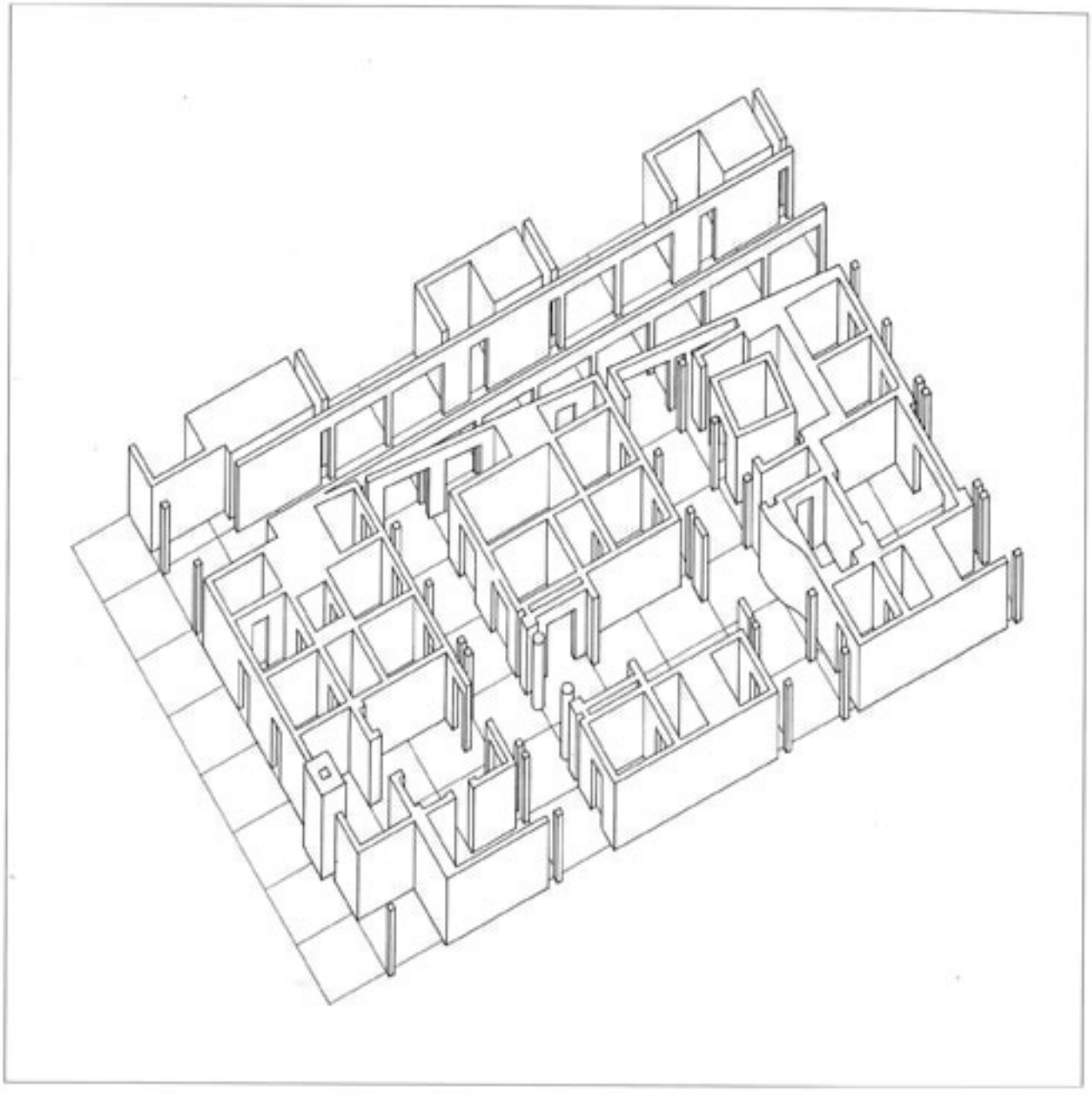
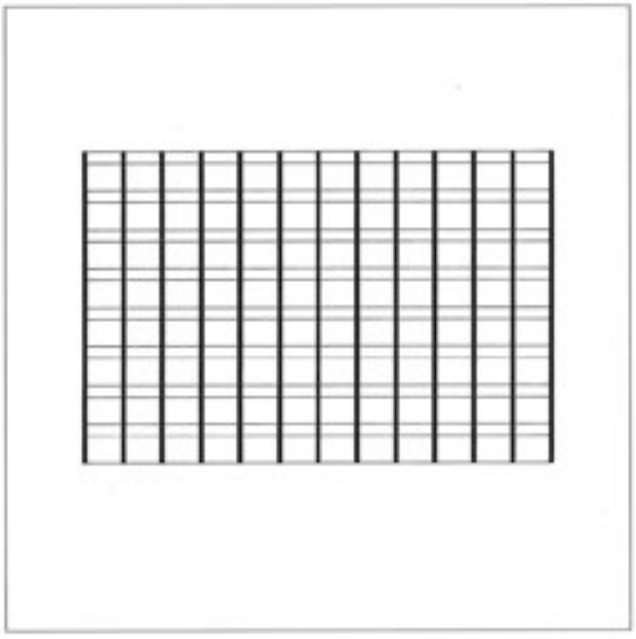


AXONOMETRIC

PARALLEL LAYERING



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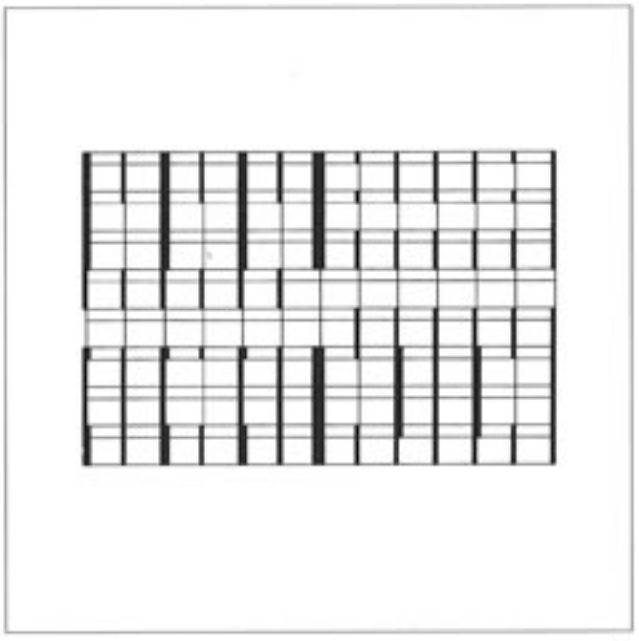

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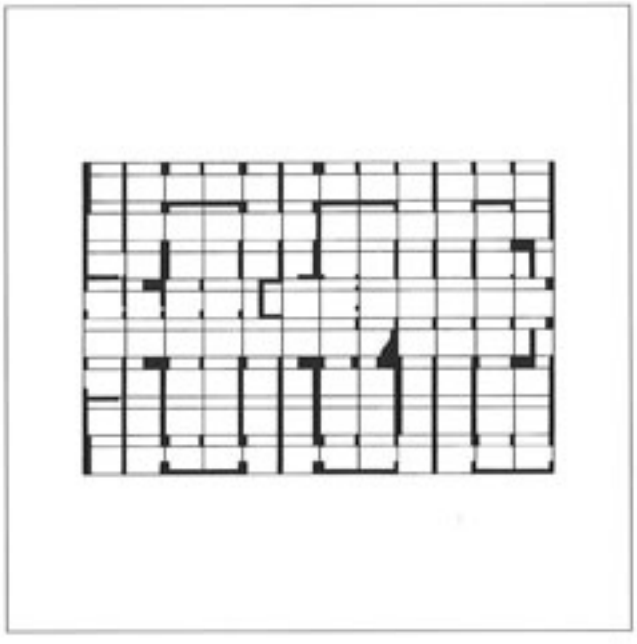

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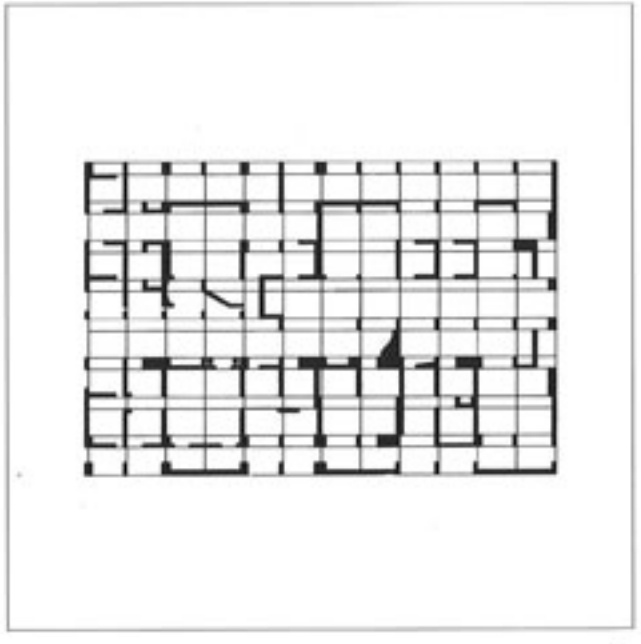

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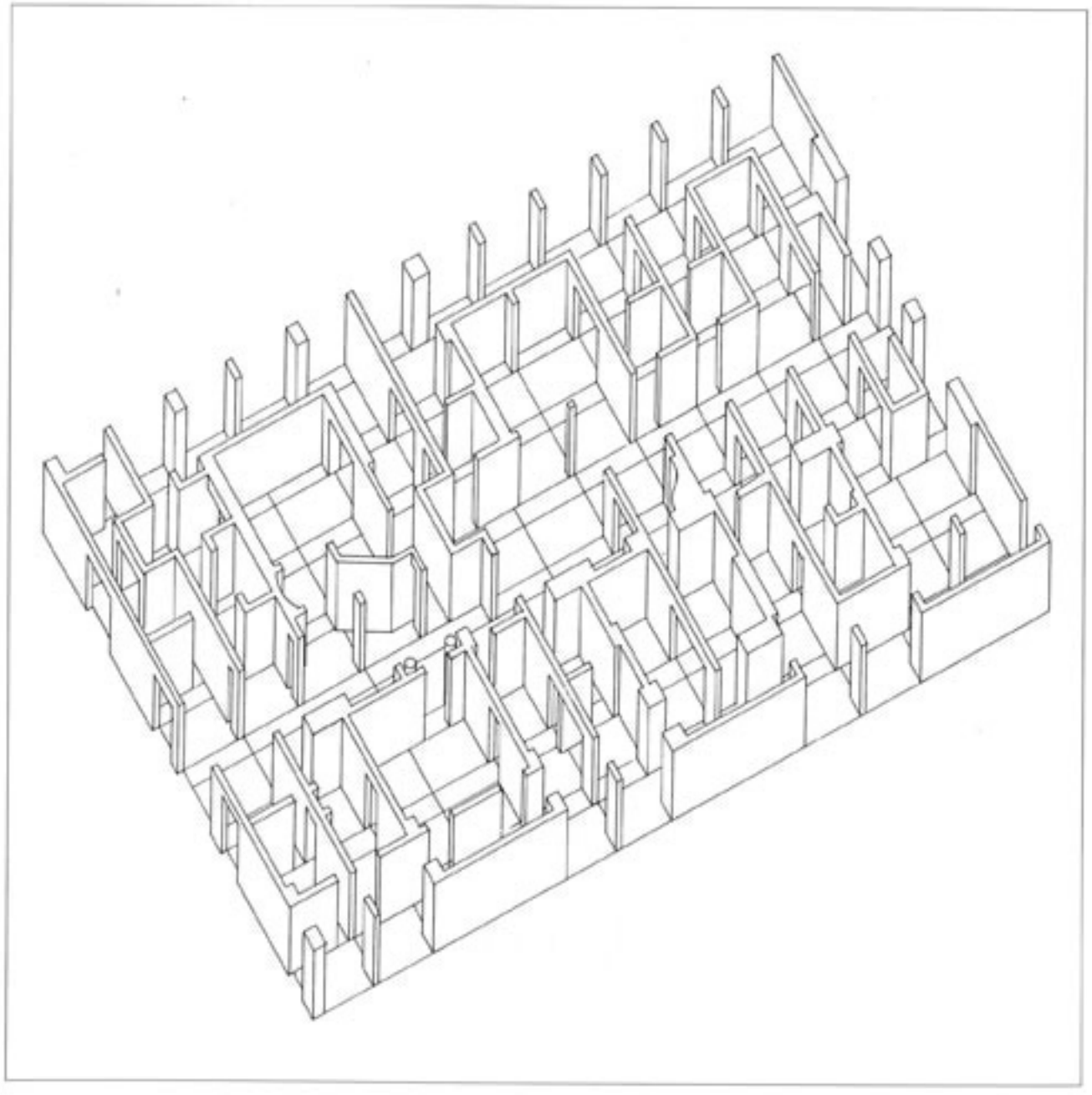

AXONOMETRIC