JALI (SCREENS) IN THE ARCHITECTURE OF INDIA

SUBMITTED IN THE PARTIAL FULFILMENT OF THE REQUIREMENTS
OF THE DEGREE OF MASTER OF DESIGN IN VISUAL DESIGN

UNDER THE GUIDANCE OF
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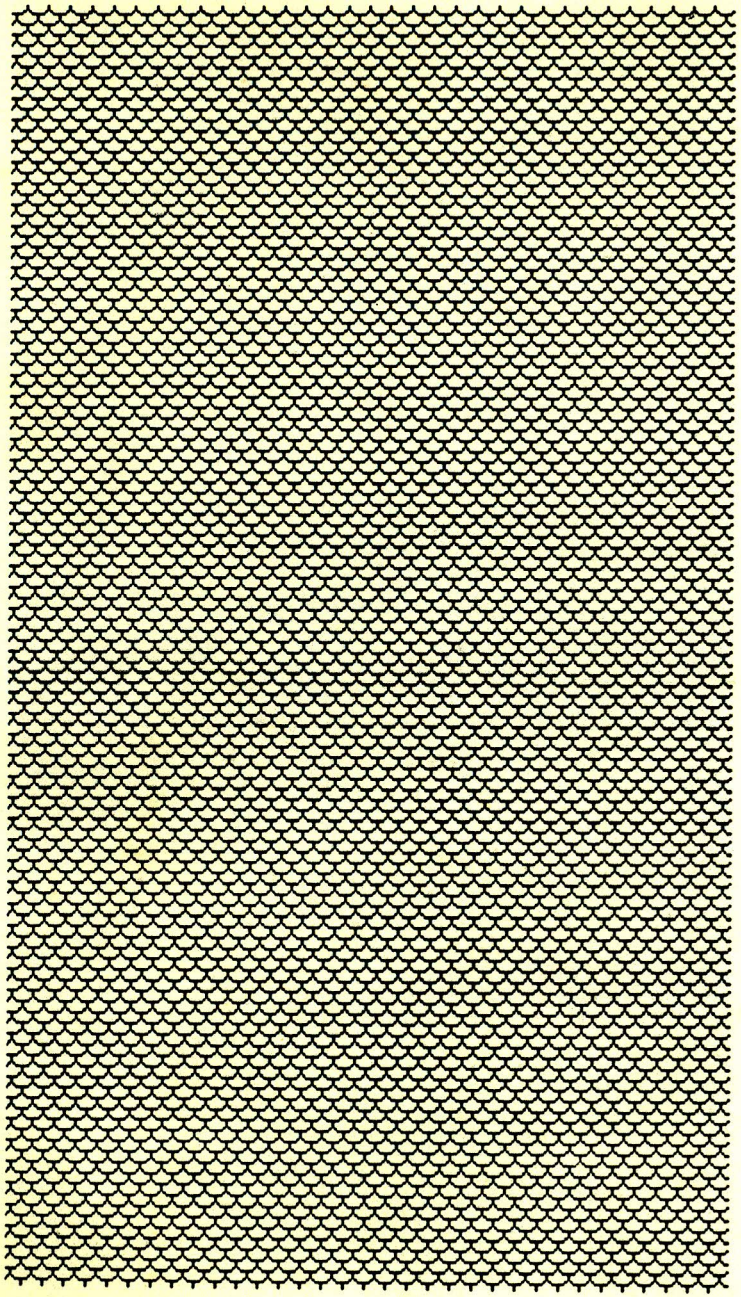


Special project entitled " **Jali (screens) in the Architecture of India** " by **Varsha. S. Sathye** is approved in partial fulfilment of the requirements of the degree of **Master of Design in Visual Communication**

Signature **Date**

10TH JUNE 1994.

Guide

Examiner

Acknowledgements

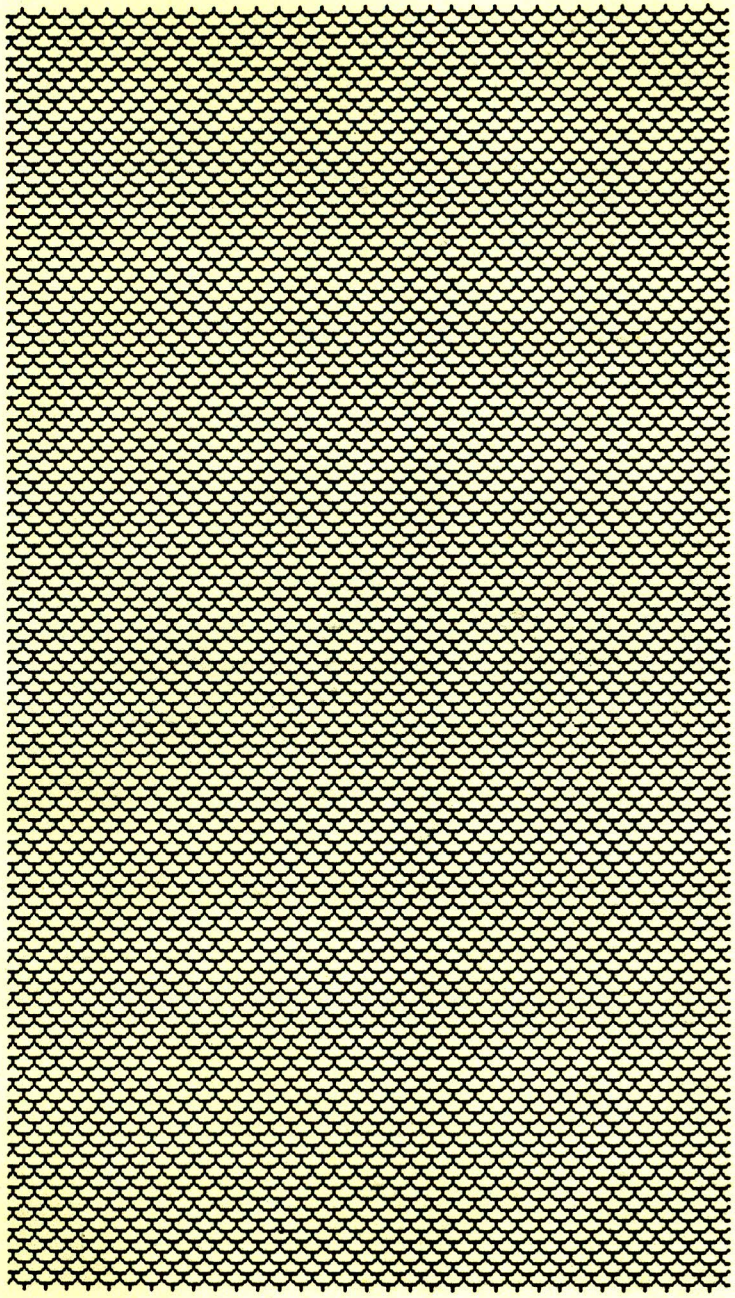
I owe my sincere thanks to Manisha Phadke, my guide and Prof. Athavankar for his valuable suggestions.

varsha. sathye

JALI (screens) in the Architecture of India

Guide : Manisha. Phadke
student : Varsha. Sathye

arrangement both emerge from simplicity and unity and return towards it, they exhibit some fundamental relationshipswhich become heirarchy

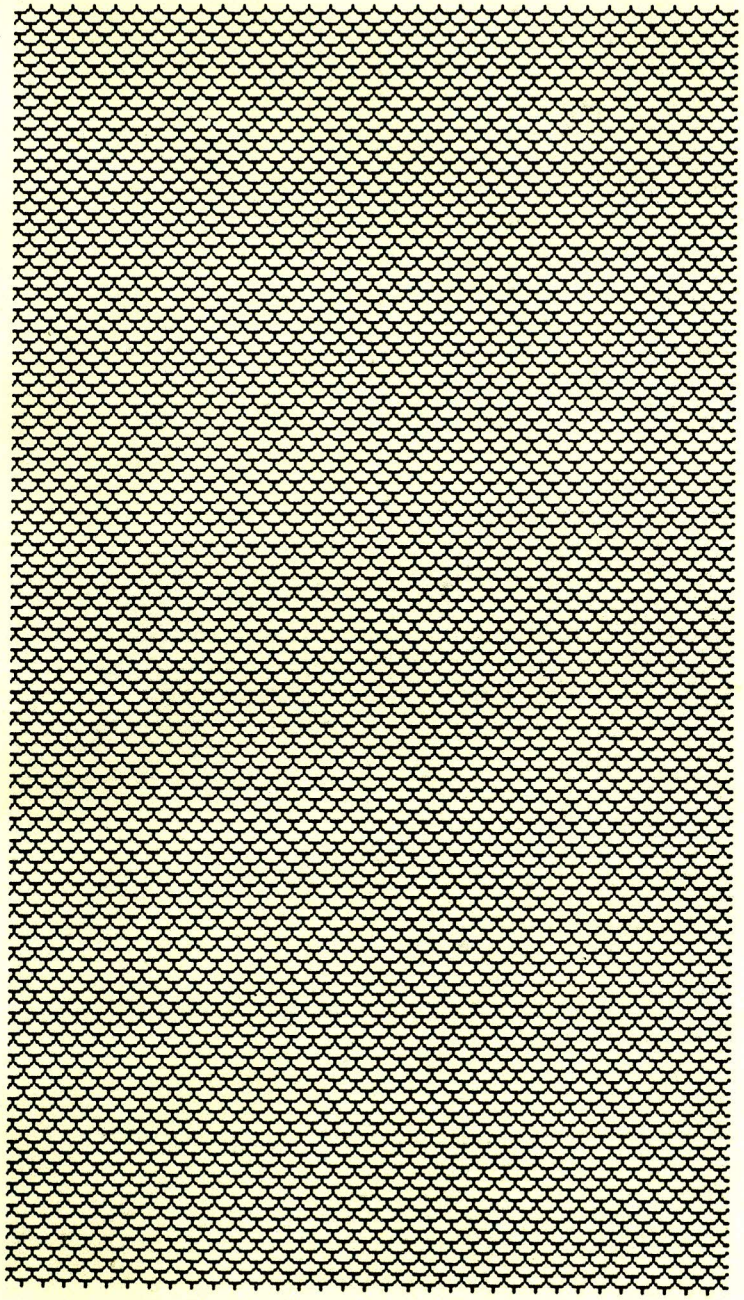


Jalis, three dimentional lattice screens. These screens make interesting surface patterns. It was the **Islamic architecture** that gave birth to jalis. After eleventh century when muslims came to India some of the most beautiful monuments were constructed with excellent jali patterns which decorated the surface beauty of the monuments. For example the tomb of **Salim Chisti** in **Fatehpur Sikri**.

Jalis are a part of a architectural decoration. The formulation of patterns in the jalis are mathematically calculated considering the different angles, degrees and symmetry. The basic geometric forms seen in the construction of a jali pattern are square, circle and a triangle. A subdivision of any of these can give us other geometric patterns like a pentagon, a hexagon, a octagon and so on as well as a rhombus, tetractys etc.

Animal motifs and foliage patterns abound, but more numerous still are repetitions of abstract forms - circles, crescents, rectangles, and arrangement of stripes and lines.

Circle : It is not only the perfect expression of justice equality in all direction in a finite domain - but also the most beautiful parent of all the polygons, both containing an underlying theme.

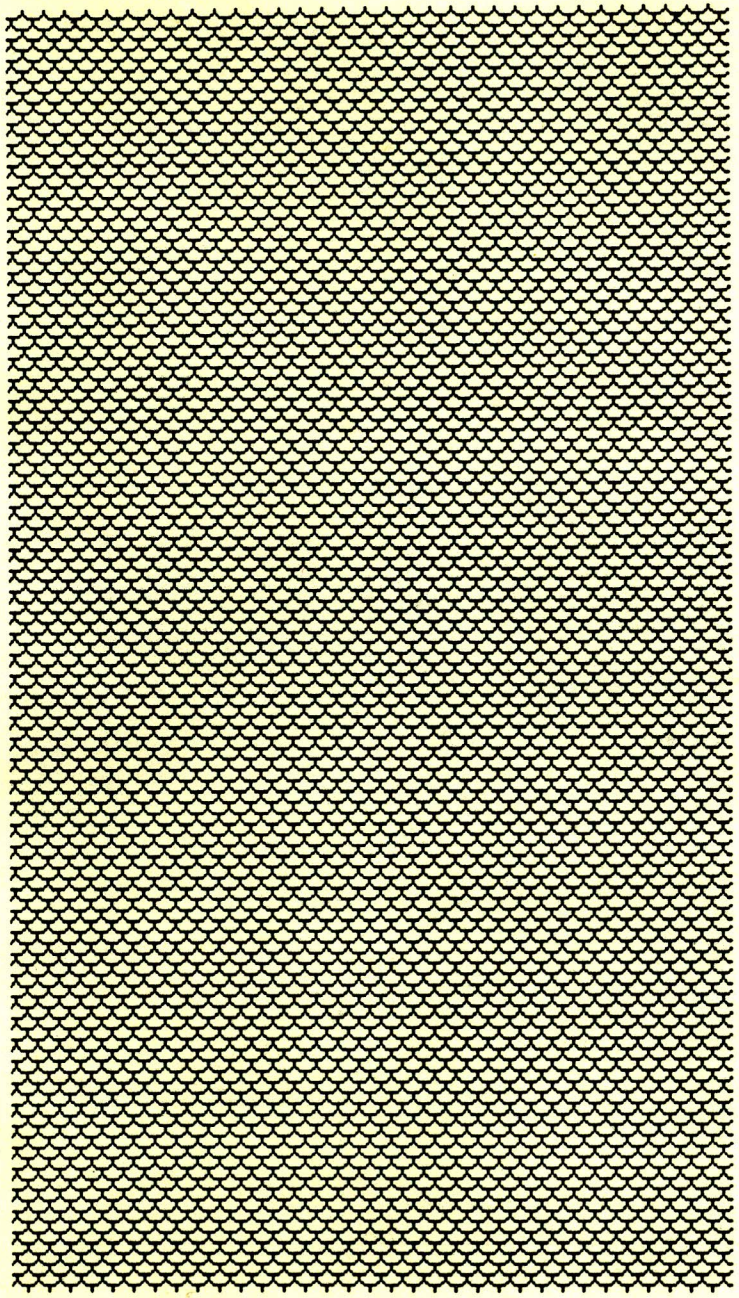


Outside the concept of time, the circle has always been regarded as a symbol of eternity, without beginning and end; just "being".

Point : The symbol of unity and source also known as the center. The center is the illusive controlling point of all forms.
From the basic circle and the hexagonal arrangement of the group of tangential circle of the same radius surrounding it emerge the three primary shapes: the triangle, the hexagon and the square. These three shapes are explored in the jali patterns in detail to reveal their inherent structure, subdivision, proportion, ratios and inter relatedness.

The variety of ornamental pattern is extraordinary. Material generally used was stone, wood or marble.
All around us are patterns in textile design, tiled floors, wall paper, friezes and carpets. In the natural world too we find repetitive patterns - in the arms of the star fish, in the spiral galaxy, and in the arrangement of heaven on the branches of a tree.

Geometrical forms and how they can be used in a design and it is at the same time the story in terms of finished art of a man's intrigue with geometrical forms and the ways in which they can be exploited to produce unique and multiple patterns and design.

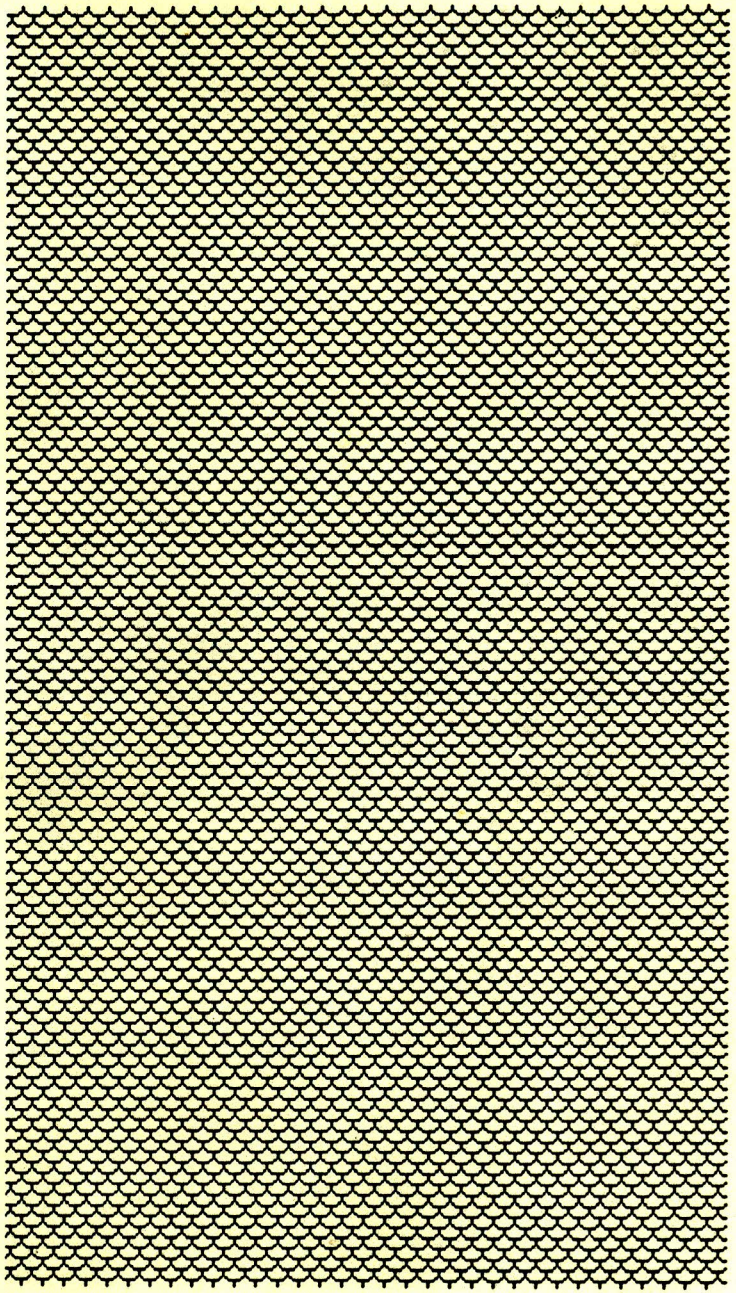


As the forms are set in tight and formal geometrical relationships with one another, we see a full visualization of geometry and its fascinating, innate harmony.
Jalis add to the visual appeal, play of light, design and patterns that are created. Different functions or purposes of the jalis are :

1. Cutting down the heat coming through the window
2. Ventilation (cooling)
3. Segregation of space reducing the volume
4. Add the freshness to the atmosphere.

One can see the early morning sun rays that enter your room. The shadows become the most beautiful design patterns.

Form, patterns and lines are at play in light and shade creating rhythms. The light which enters inside the room is soft and glowing. **Jalis help in to fragment harsh sunlight and filter in a uniform glow and breeze. They add to the dramatic interplay of light and shade in the place interior.**
The **Jharokas** formed in the jalis help the women to peep outside. An interesting phenomena of a jali screen is that, during the day one can view the outside world through the jalis but an outsider cannot see inside world. During night it is viceversa.



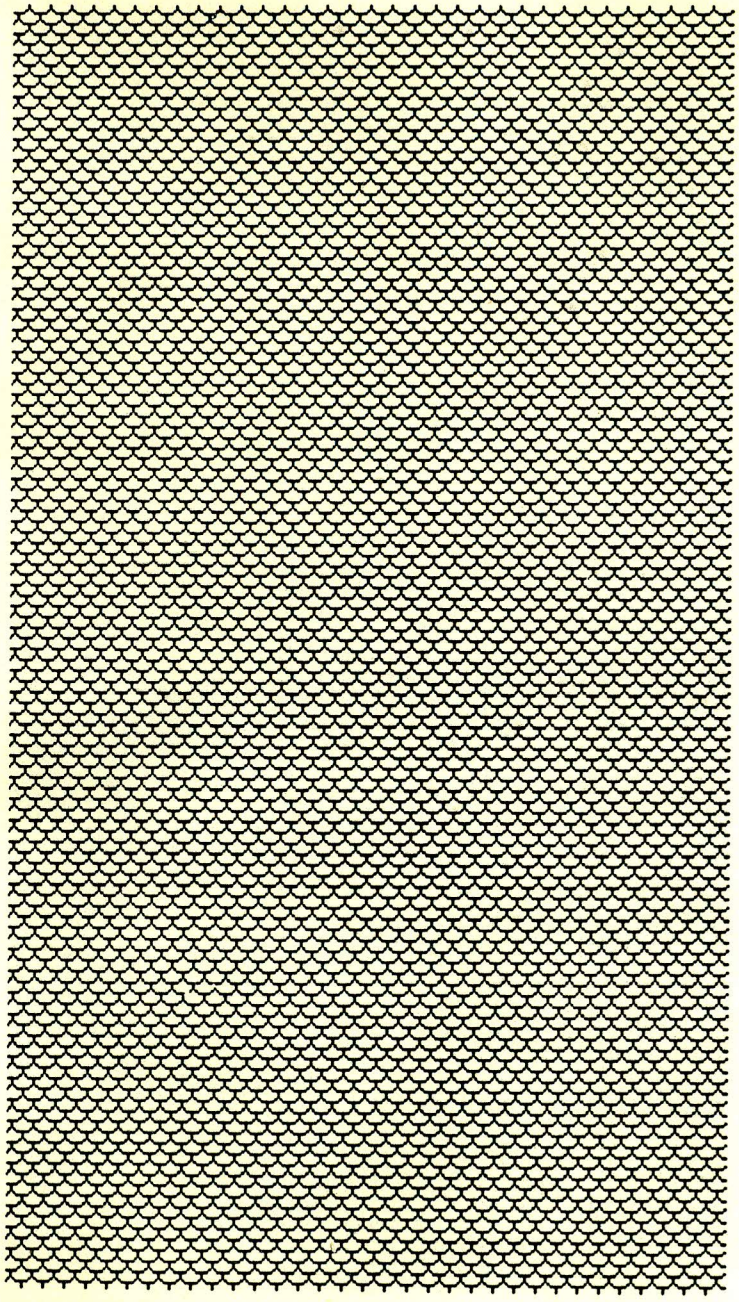
Repetition

Repetition of a pattern is conceptually the simplest though certainly not the least appealing result of his geometrical creations. The harmony of regularity and symmetry holds fast. Repetion of a pattern can be in many ways.

1. repetition at degress like 45, 90, 180 and the inbetweeners too.
2. mirror reflection (mirror rotational symmetry) of the form. When the original form and the mirror reflected form are clubbed together and repeated, they form a new pattern.
3. translational symmetry : Mostly found in three dimensional pattern making, where one face of the object is repeated to form a three dimensional object.

Carefully and precisely executed patterns with its special characteristics, affects the repetitive sequence. The basic themes differ one from another and accordingly so do the sequences played out.

A need to investigate, not the inherent qualities of form, invariable properties of visual configurations, but rather the potentiality of design to arouse certain responses.



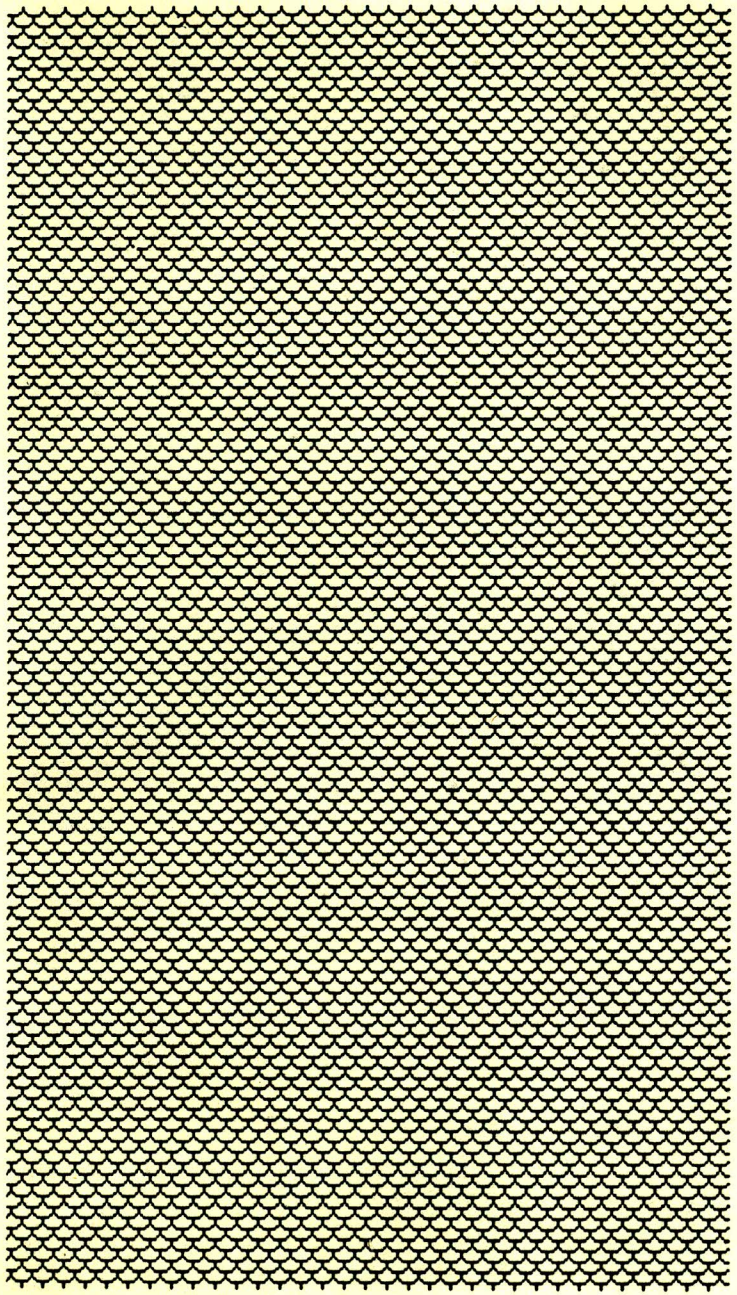
Symmetry :

The term symmetry is the Greek for "Proportionality, Similarity in arrangement for parts." An object is called symmetrical if it can be changed some how to obtain the same object.

Symmetry plays a major role in the formation of a jali pattern. Through symmetry man has tried to perceive and create order, beauty and perfection in the jalis.
Although repetitive designs have arbitrary features - after all, they may consist of clusters of triangles, birds or flowers - their symmetries are fixed. Symmetries describe the ways that the arbitrary motifs can be manipulated.

Knowledge of symmetry group can be great aid to designs. Suppose for example, you manufacture patterns in concrete blocks. What variety of design can you offer your customers?
How many different walls with repeating patterns can you make from the different arrangements of single motifs?

Different types of patterns found in jalis are:
1. symmetrical
2. asymmetrical
3. freehand- a continuous pattern.

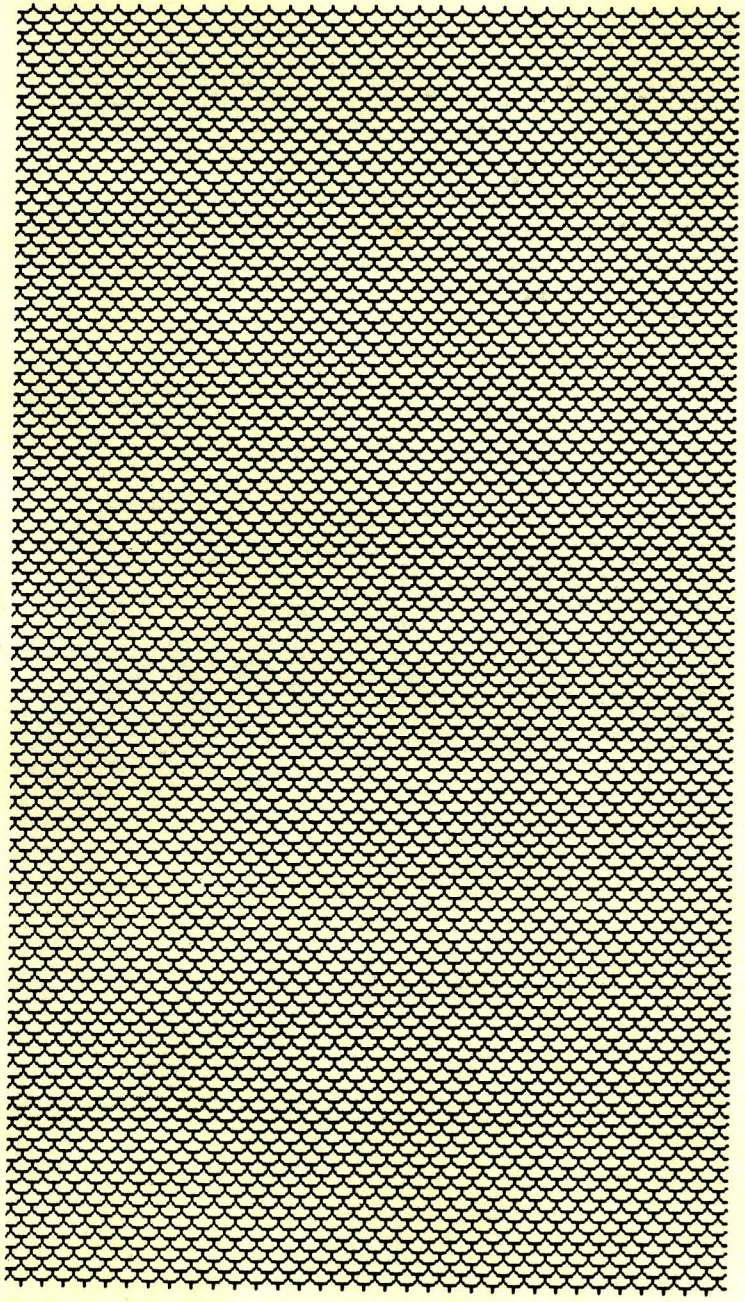


Rep Tiles :

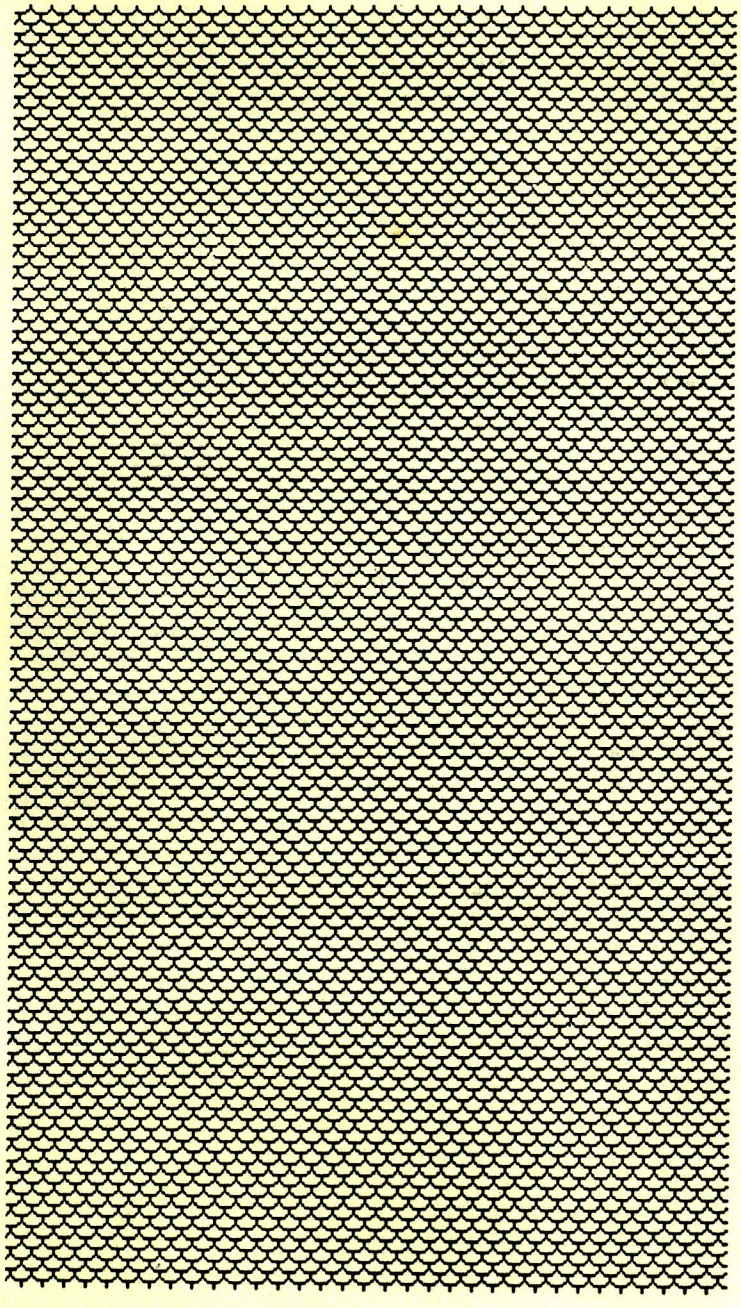
RepTiles is a software package available on Macintosh. Designers can use Rep tiles to develop new complex patterns and tiling. It helps in creation of structured tilings and patterns.

* A fundamental region is the core form which has been duplicated or rotated to make a pattern.
* The package helps in transforming edges - vertices
* Mathematicians can use rep tiles to study symmetry and two dimensional topology.

One has full control over the style, width, colour and fill of all vertices, edges and tiles in the structures periodic tiling of the plane.



Aim



In this project I have tried to **study the formulation of a jali pattern.** A little bit of formal analysis was also necessary. Taking the core form and trying out different transformations to form many more patterns with a proper methodology which can be effectively used in publication design. Also **classify** various patterns found in the jalis for our own reference.
For this project I have selected the structure namely "Gateway of India" and have studied the formulation of the existing jalis.
A need to understand **complexity and pseudo complexity** involved in the making of a Jali pattern was realised which also helped me to understand different variables that go into the making of a Jali pattern.

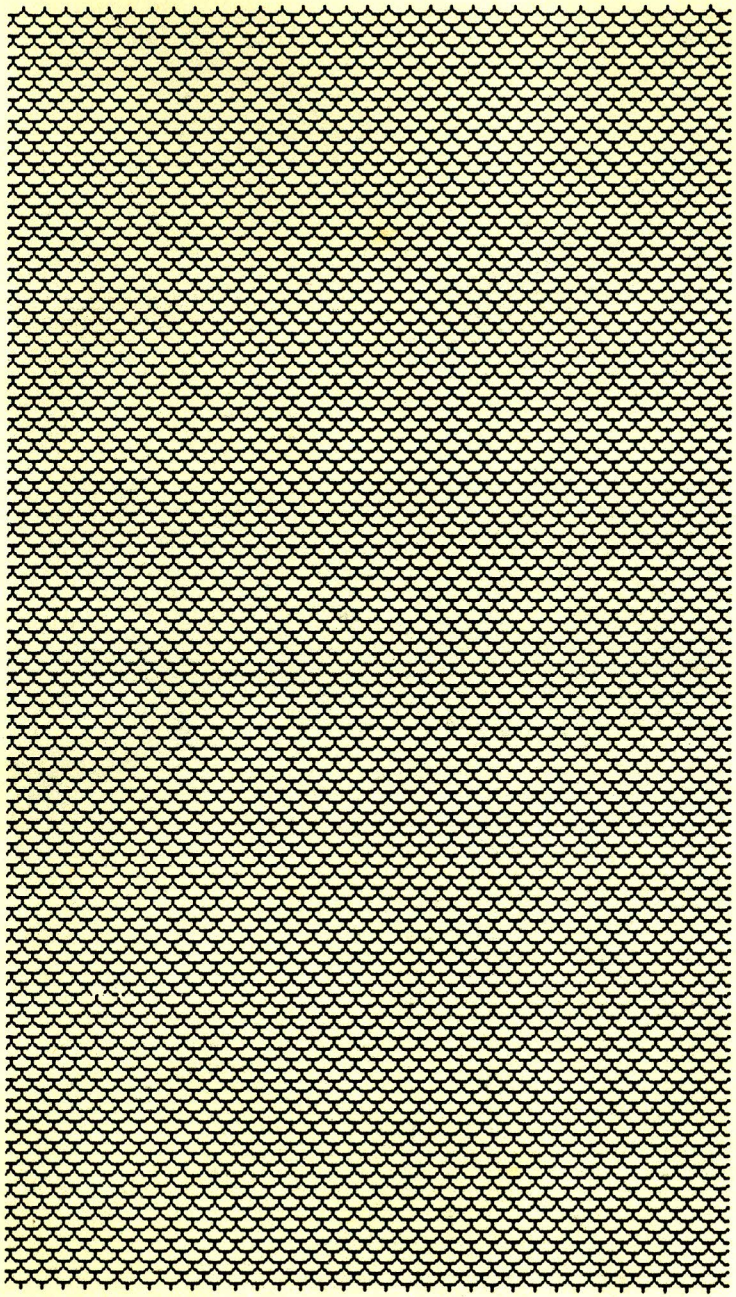
To create patterns two important things are necessary

1. **The origination of the form** - from one form you can create patterns by repeating the forms in various ways.

a. Symmetrical repetition - repeating the form in different angles and at different degrees.
b. Overlapping.
c. Interlocking.
d. Using positive and negative space.

2. **Transforming the form** -

Stretch, rotate, distort, scale, perspective, flip horizontal and vertical. (All these facilities are available on the



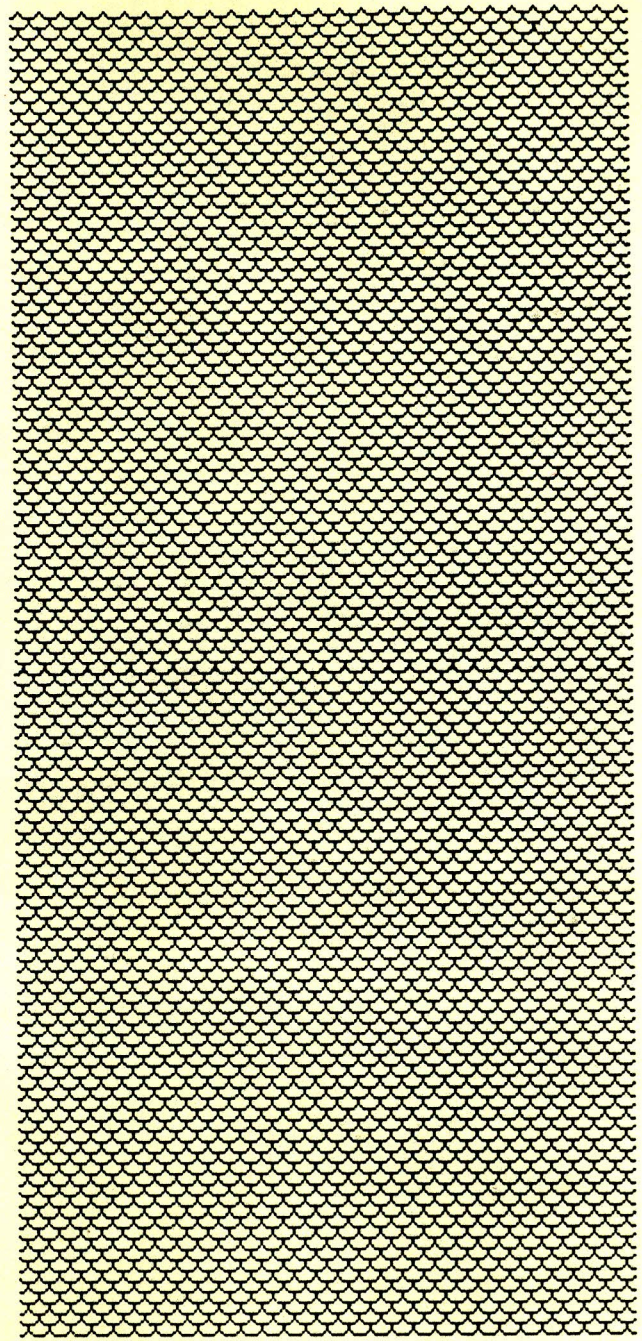
computer.)

While making the segregation of the jali patterns we come across the different ways of using the form

1. One form repeated several times.
   eg. Honeycomb, a hexagon repeated in all directions.
2. Two forms clubbed together to form a pattern. Use of more than two forms and clubbing them together to form a jali pattern which appears to be complex.
3. A negative space helps to create a different form, hence it appears that two forms are used to form a pattern.

Basic geometric forms used in constructing a Jali pattern :

1. circle
2. triangle
3. hexagon
4. Square.
5. Rhombus.
6. Rectangle.

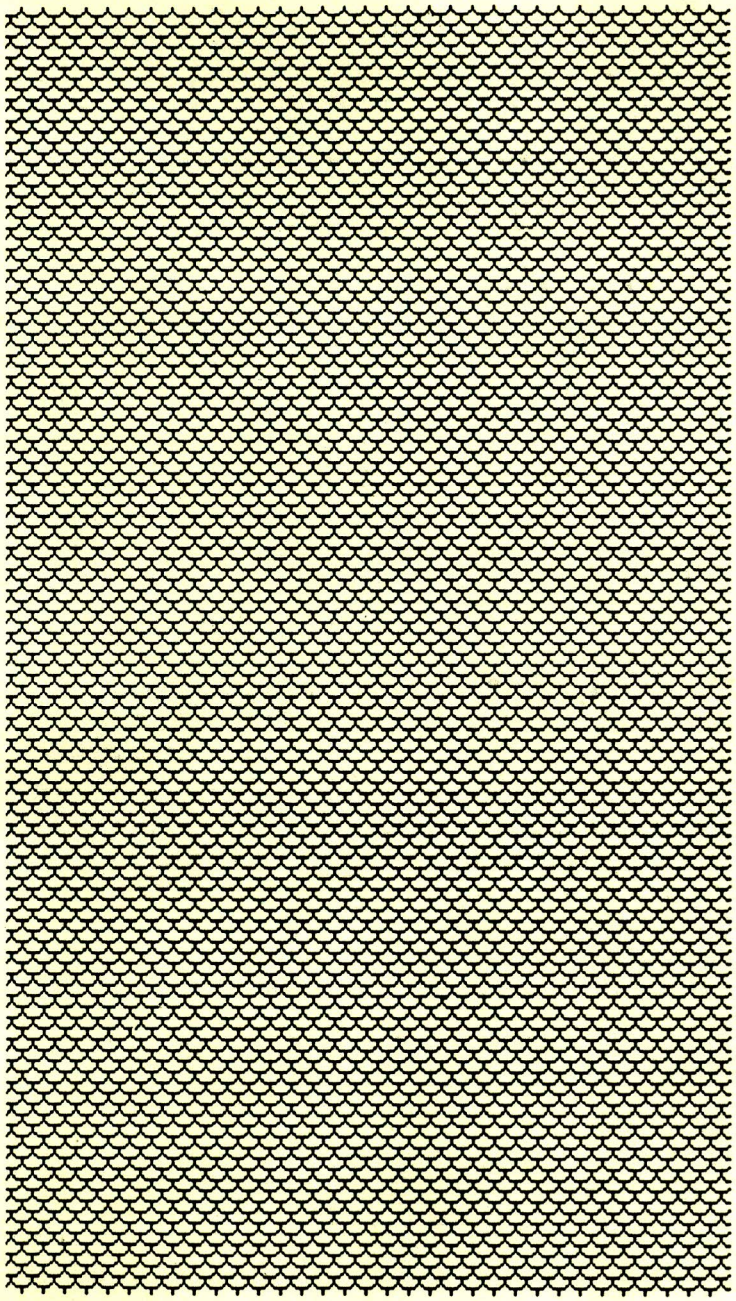


The project involves three stages:

1. Understanding the construction of a Jali pattern.
   It involves :
   - identification of the core form
   - how two or more elements are clubbed together to form a Jali pattern

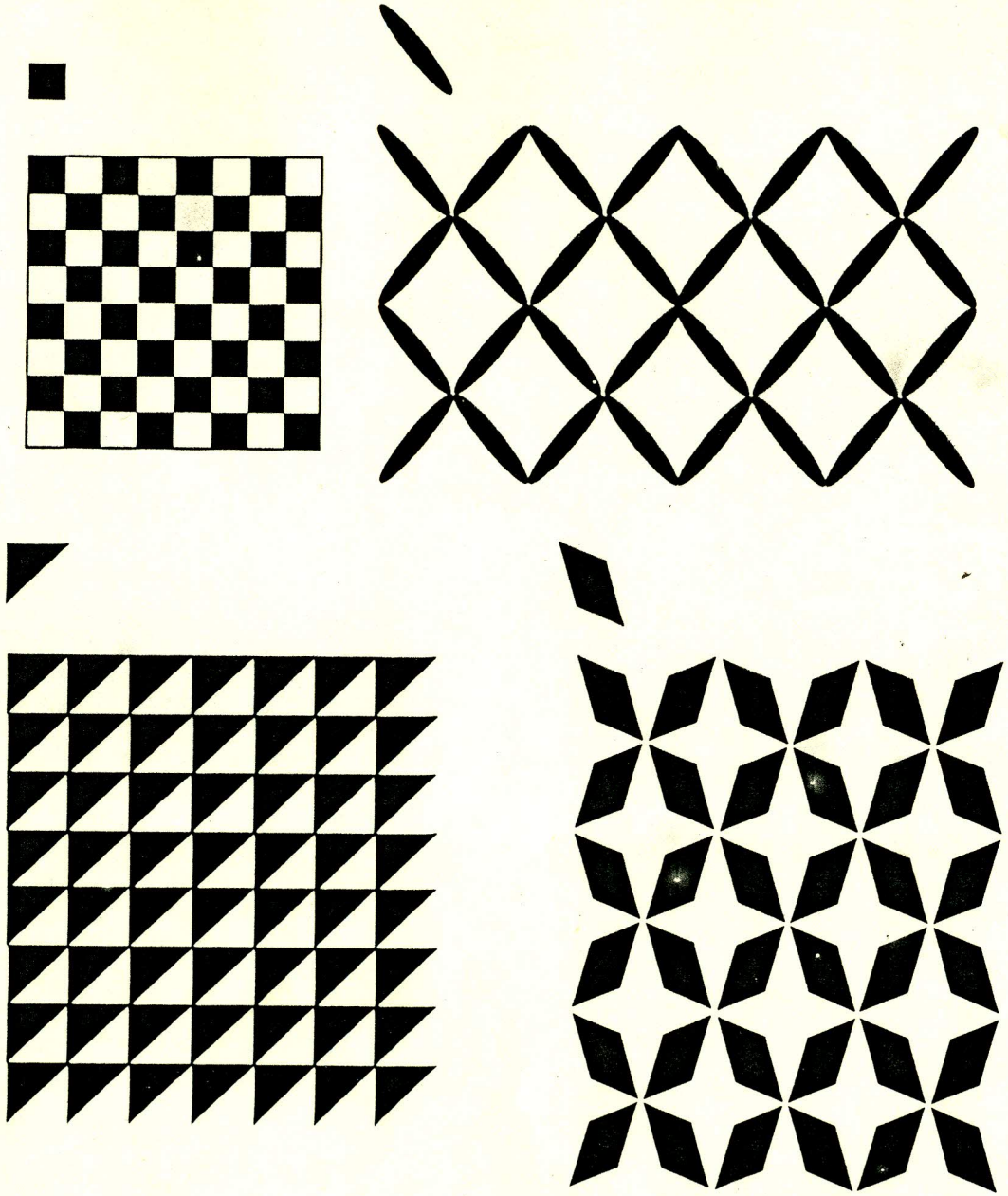
2. Classifying the Jali patterns
   - symmetrical patterns
   - symmetrical and continuous patterns
   - assymmetrical
   - assymmetrical and continuous pattern
   - freehand patterns

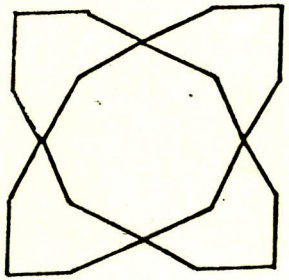
3. Understanding complexity and pseudo complexity involved in pattern making
   - Jalis from "Gateway of India"

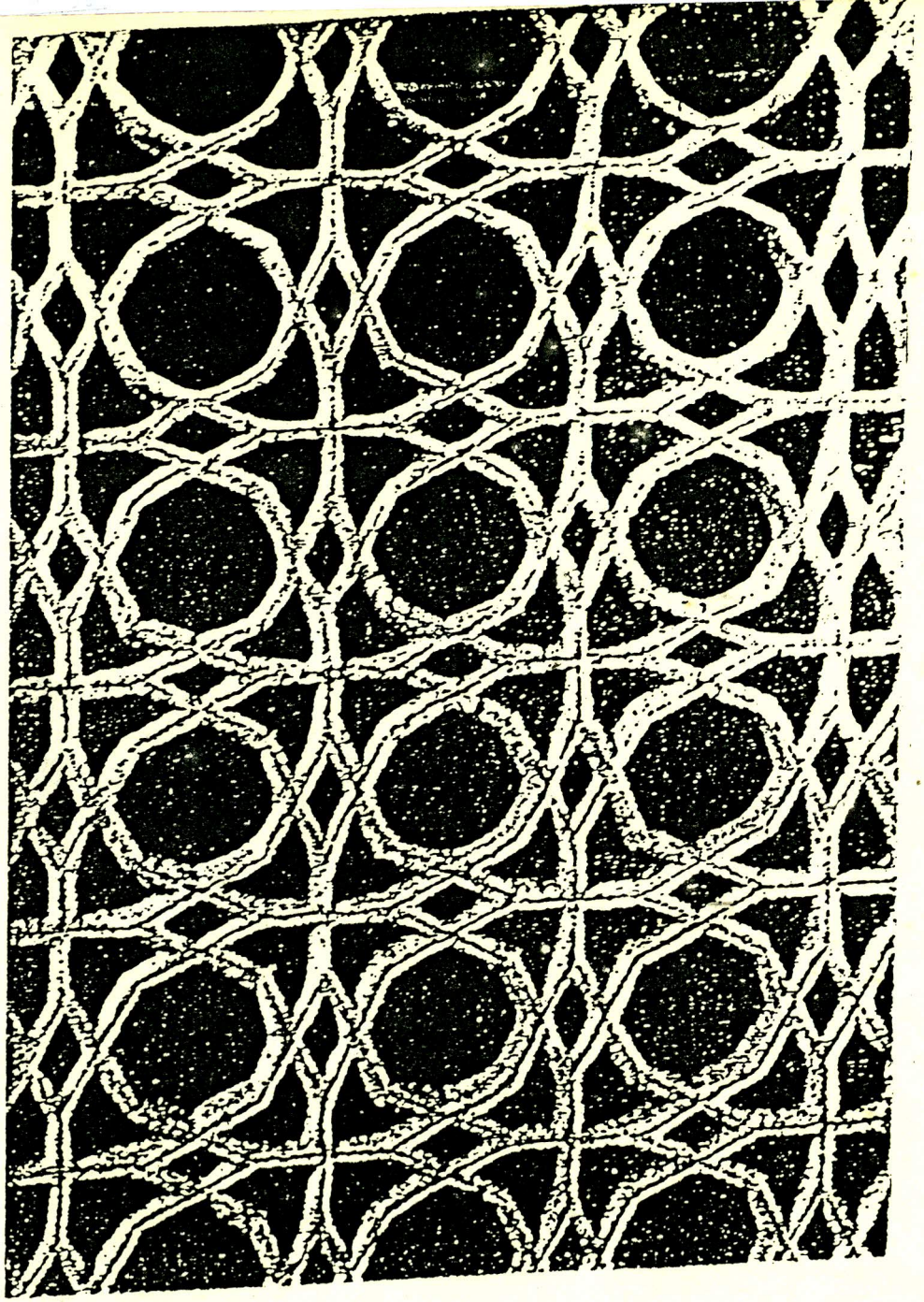


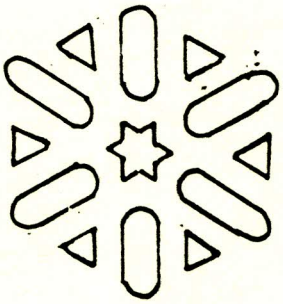
part 1

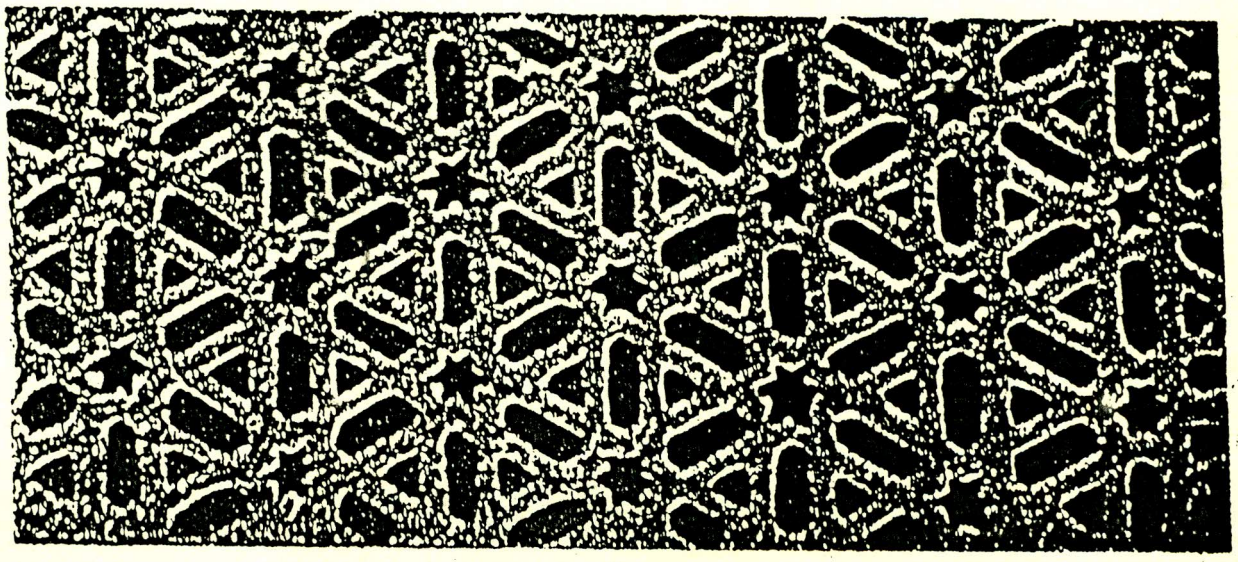
undertanding the core form

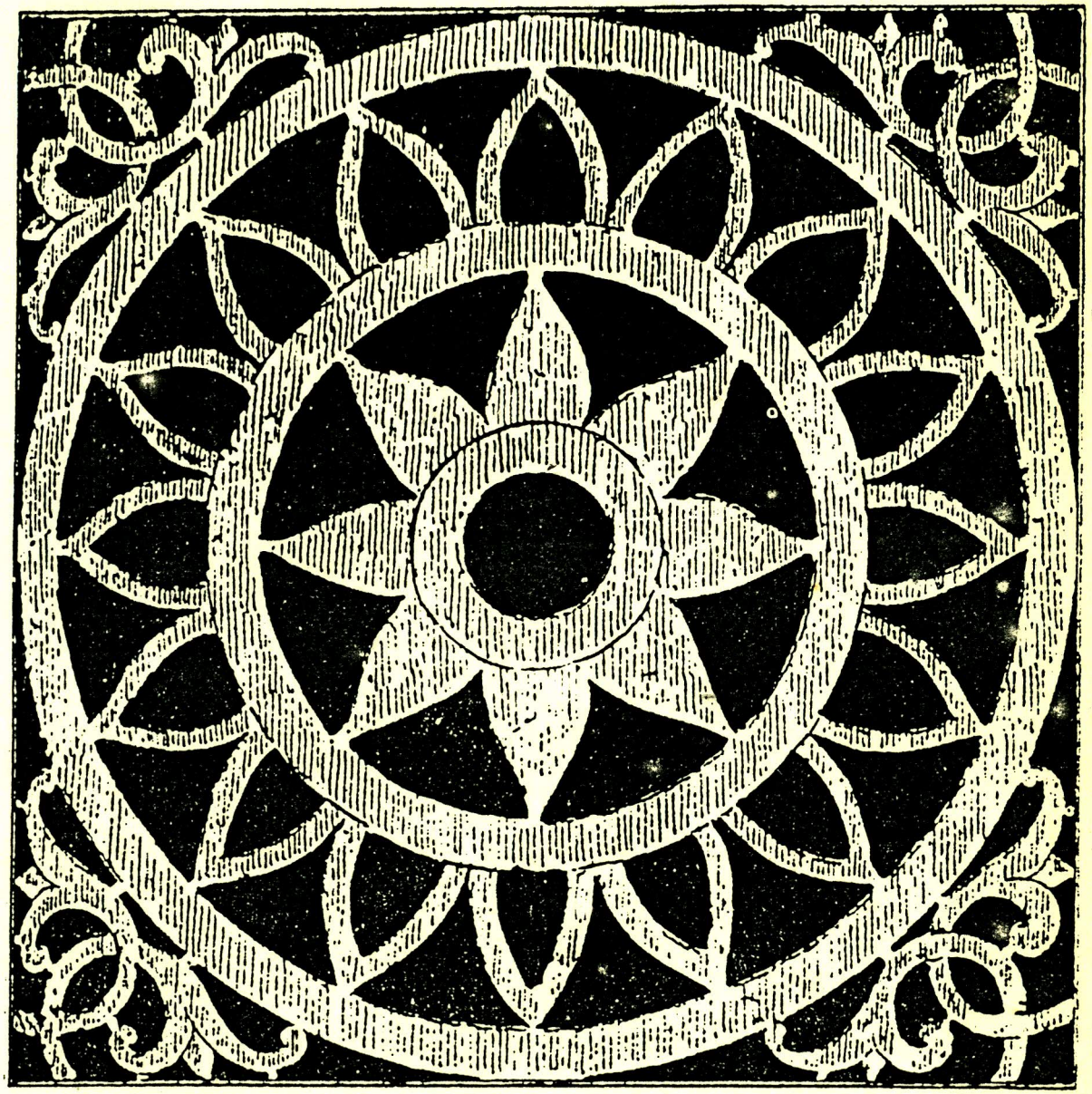


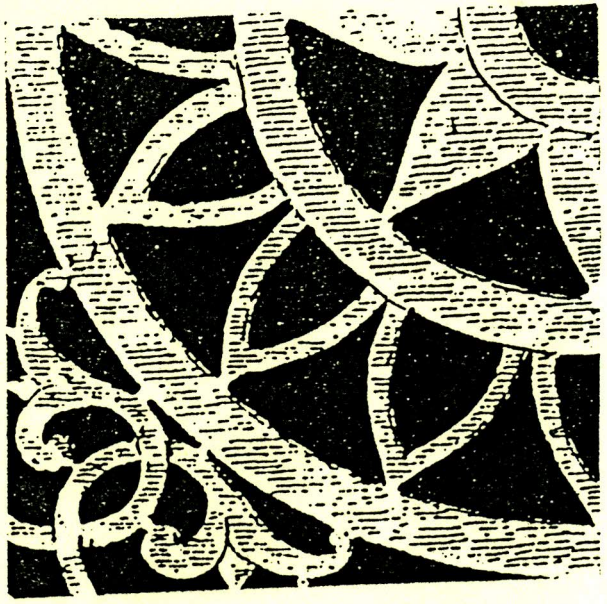


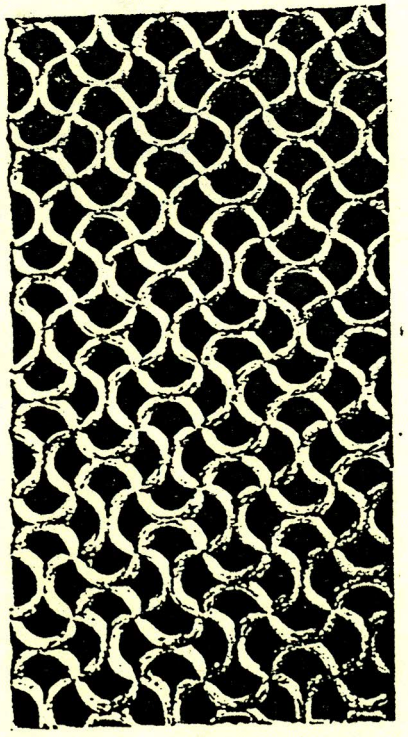


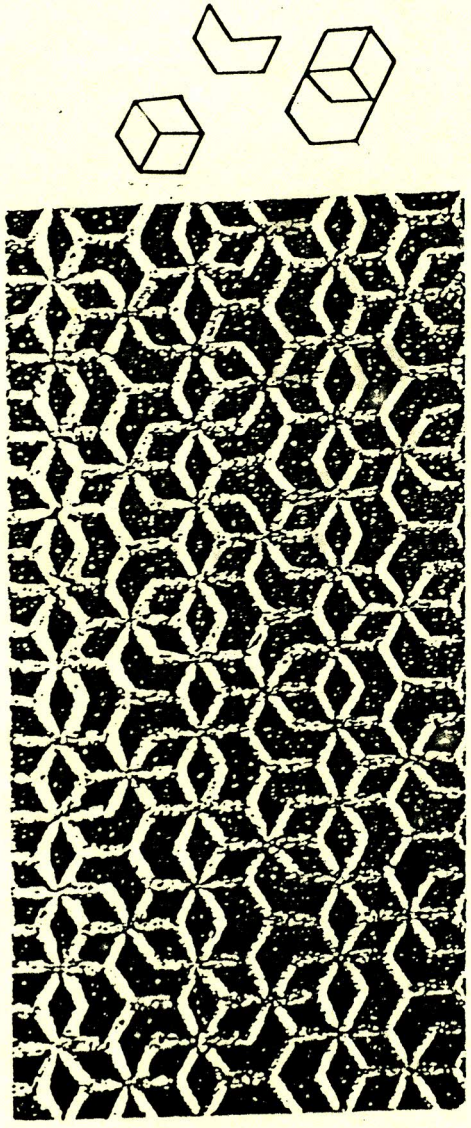


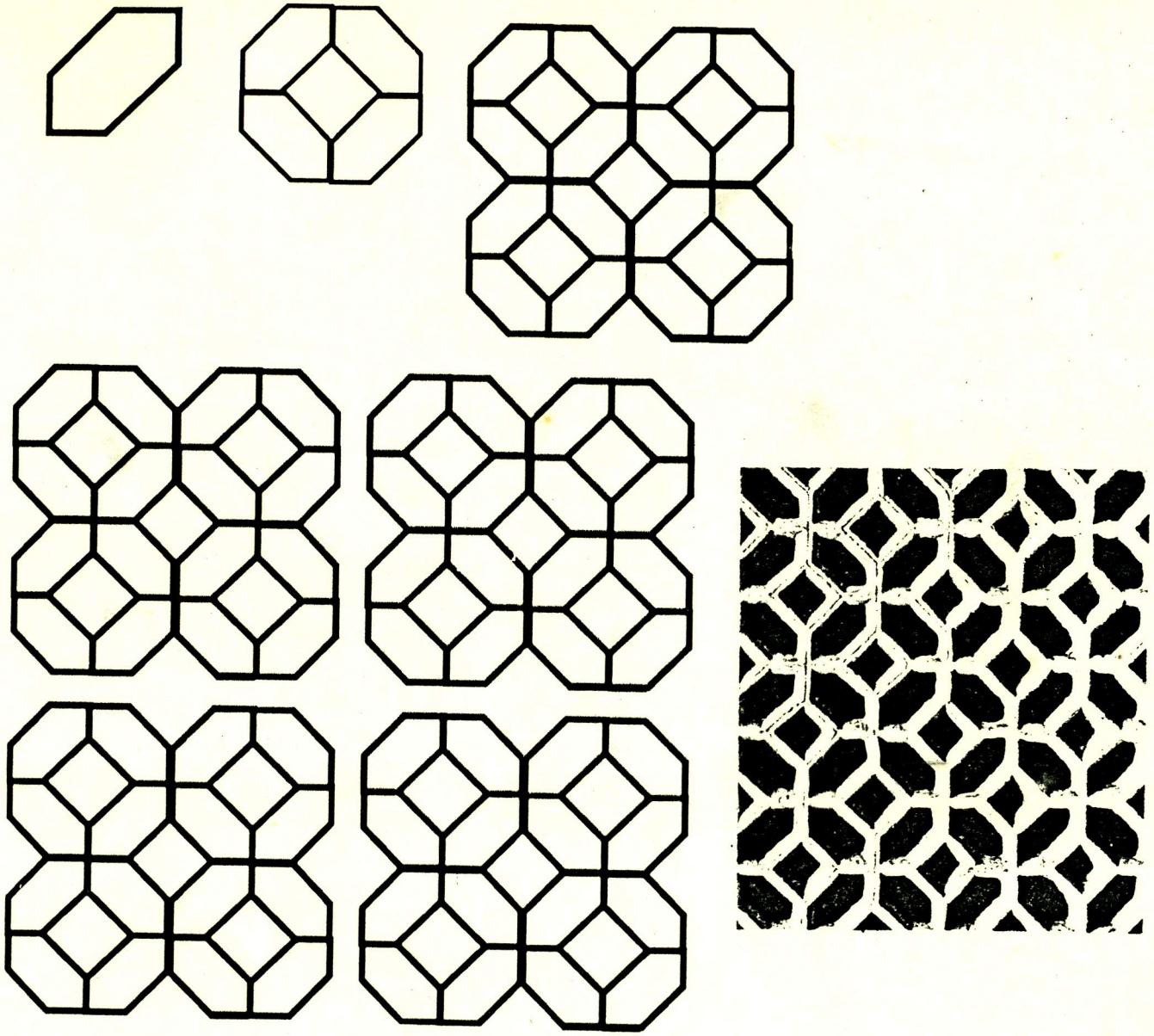


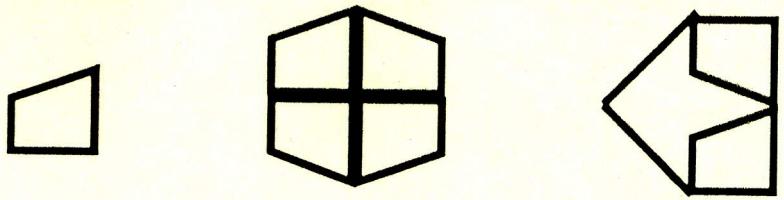


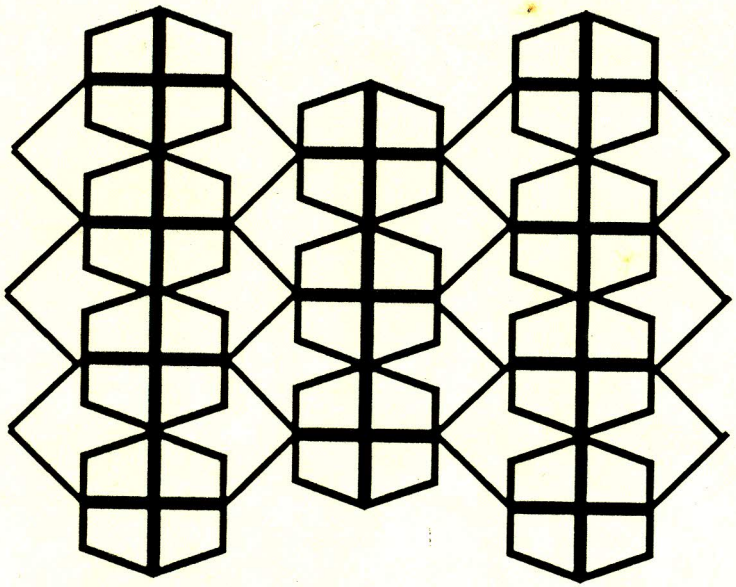


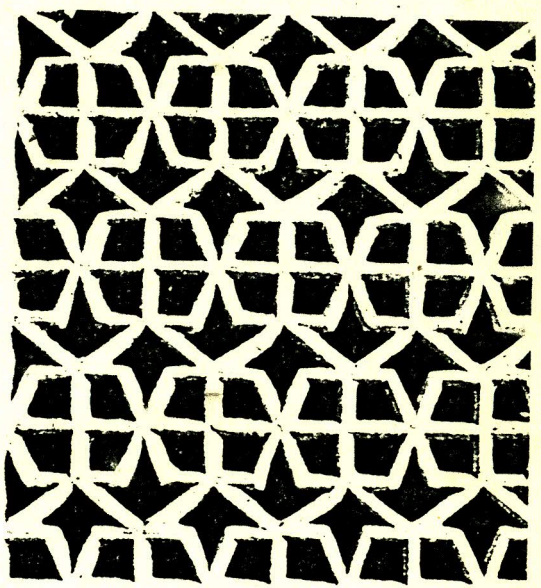


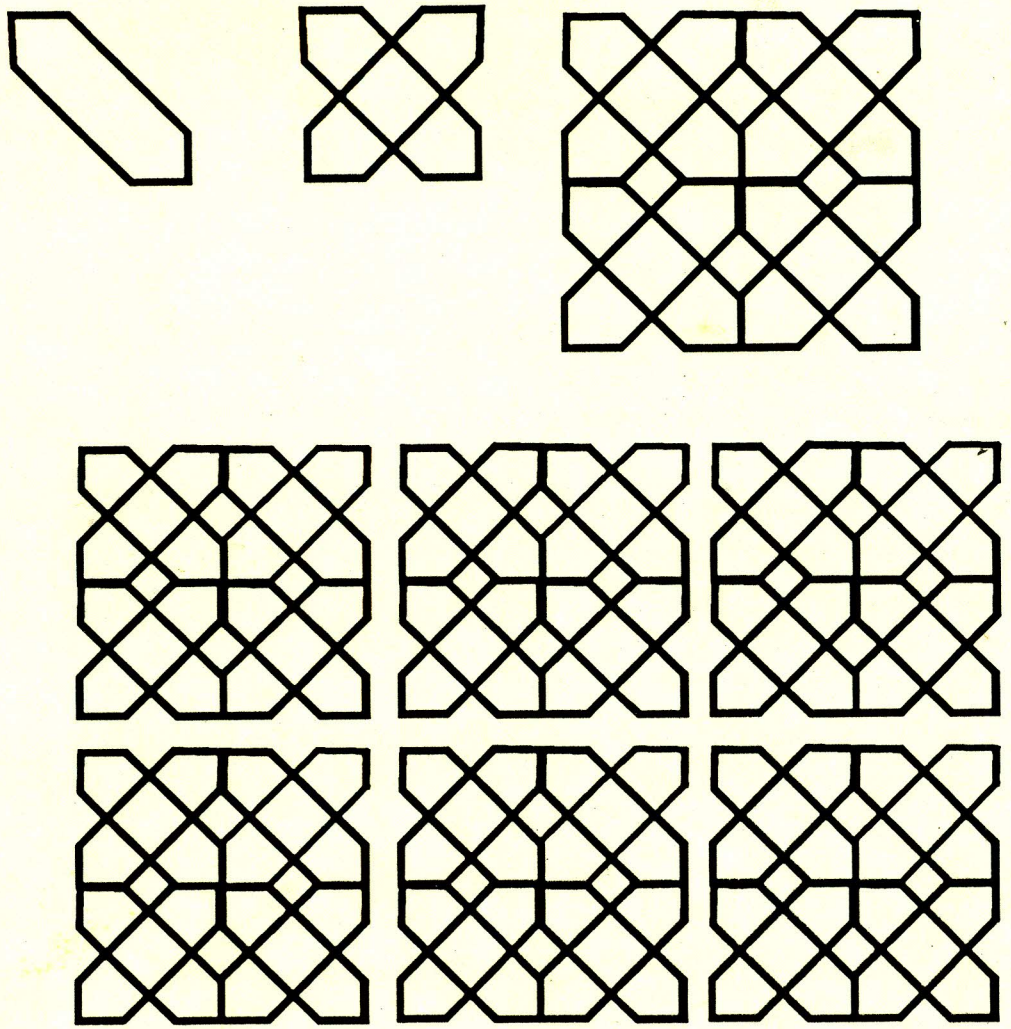


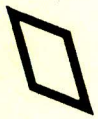




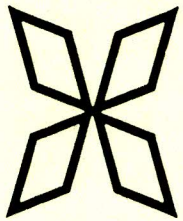


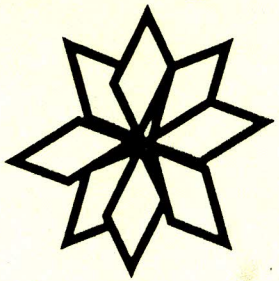




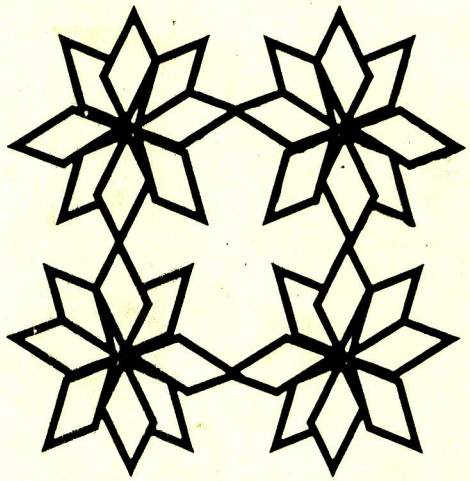


core form

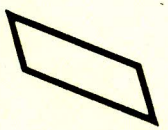




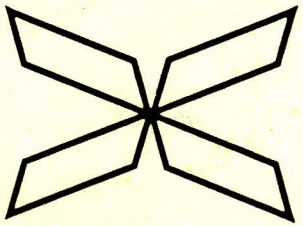
basic form rotated at 90 degree



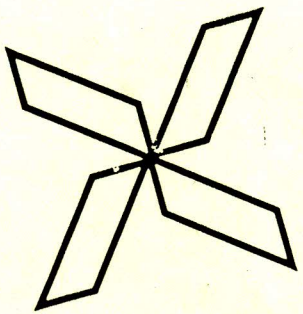
mirror reflection at 90 degree



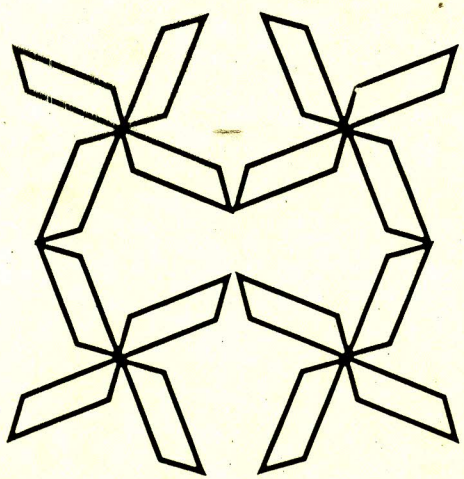
basic form stretched



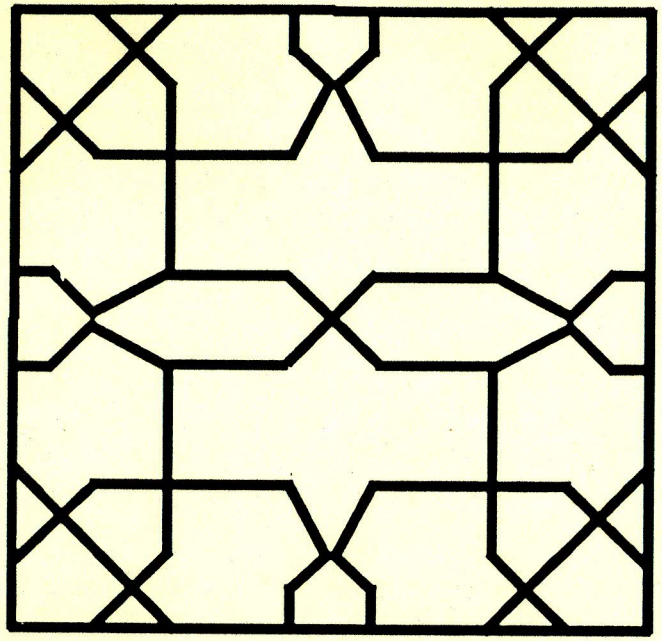
mirror reflection at 90 degree

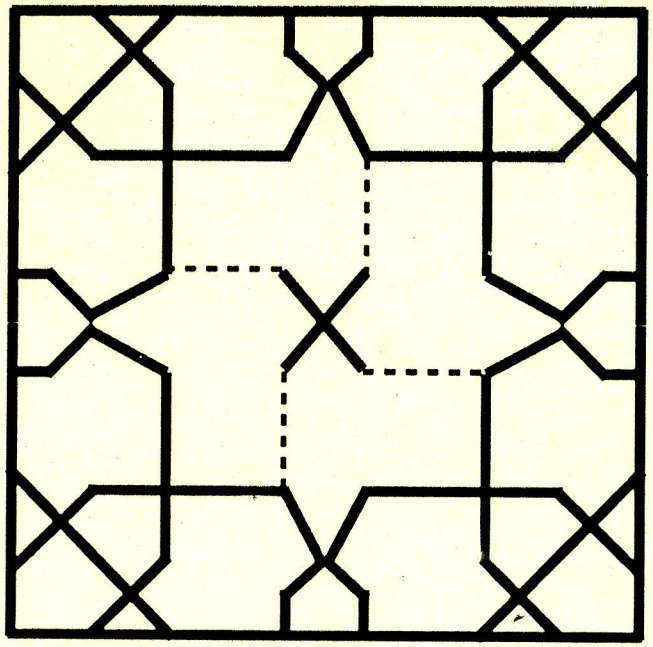


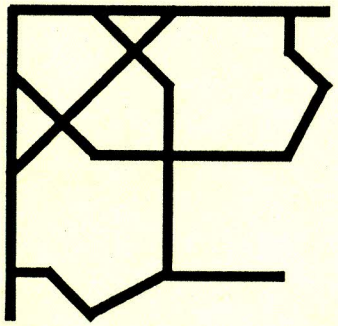
form
rotation at 90 degree

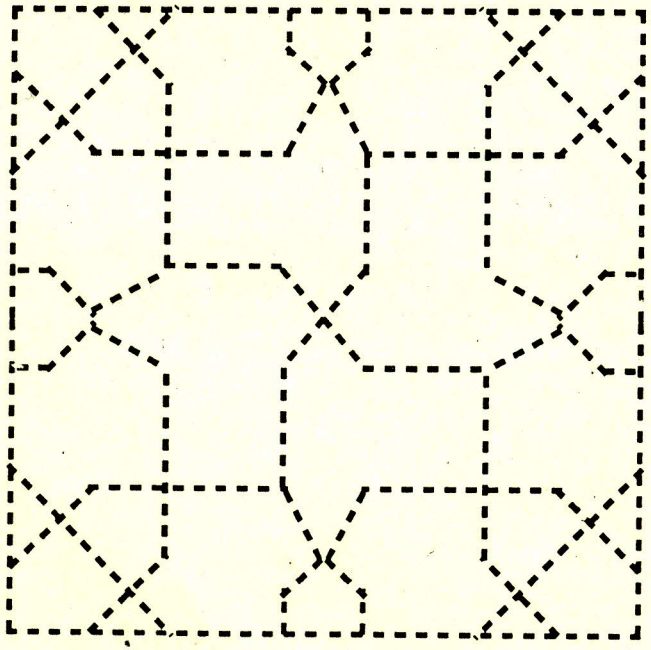


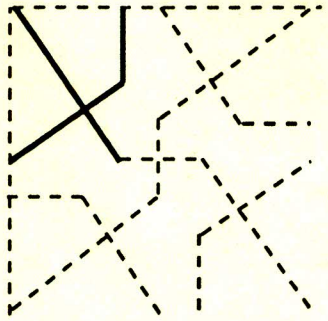
:he whole form mirror reflected at 90 degrees



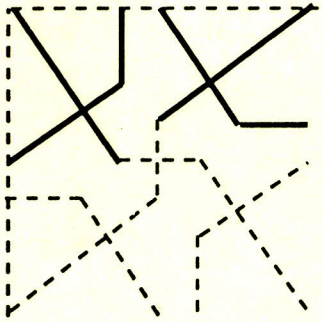




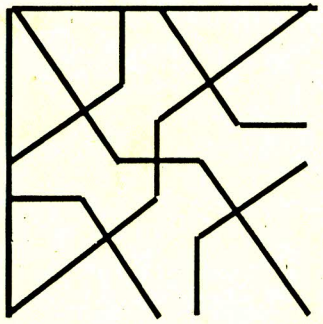




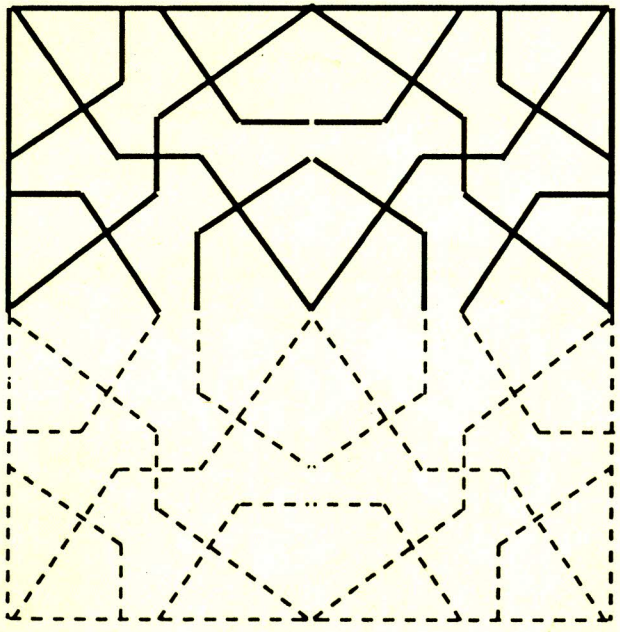
core form

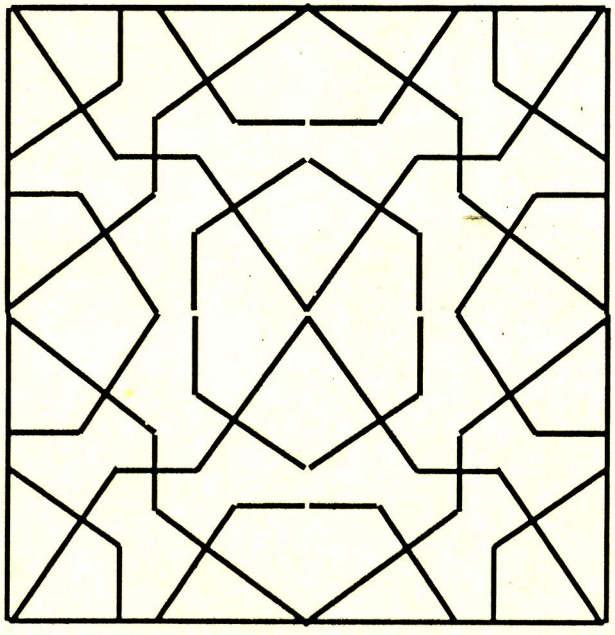


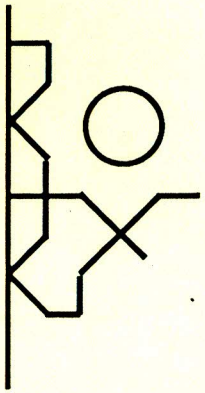
core form rotated at 90 degree, clockwise



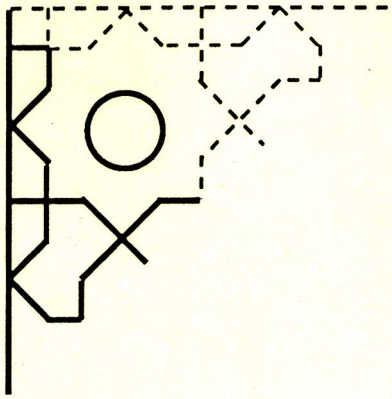
the tile



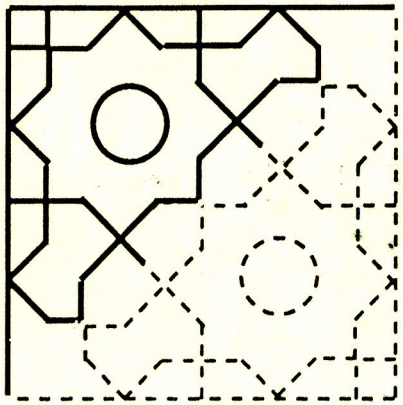


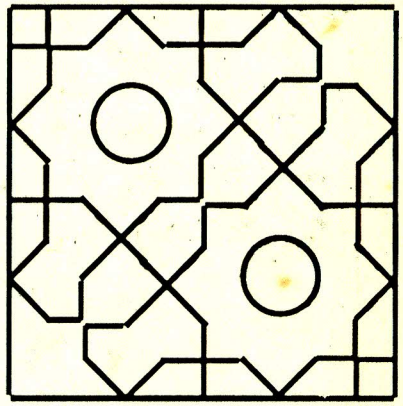


core form

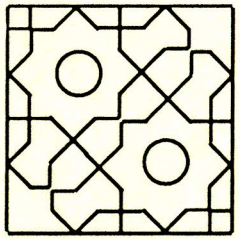


mirror reflection

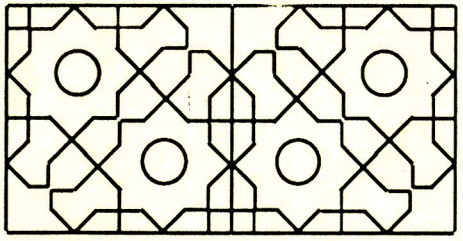




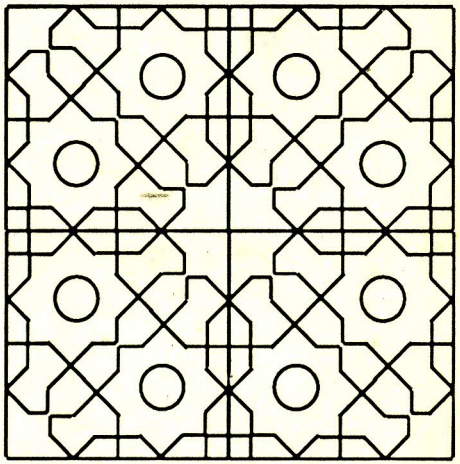
formation of the tile



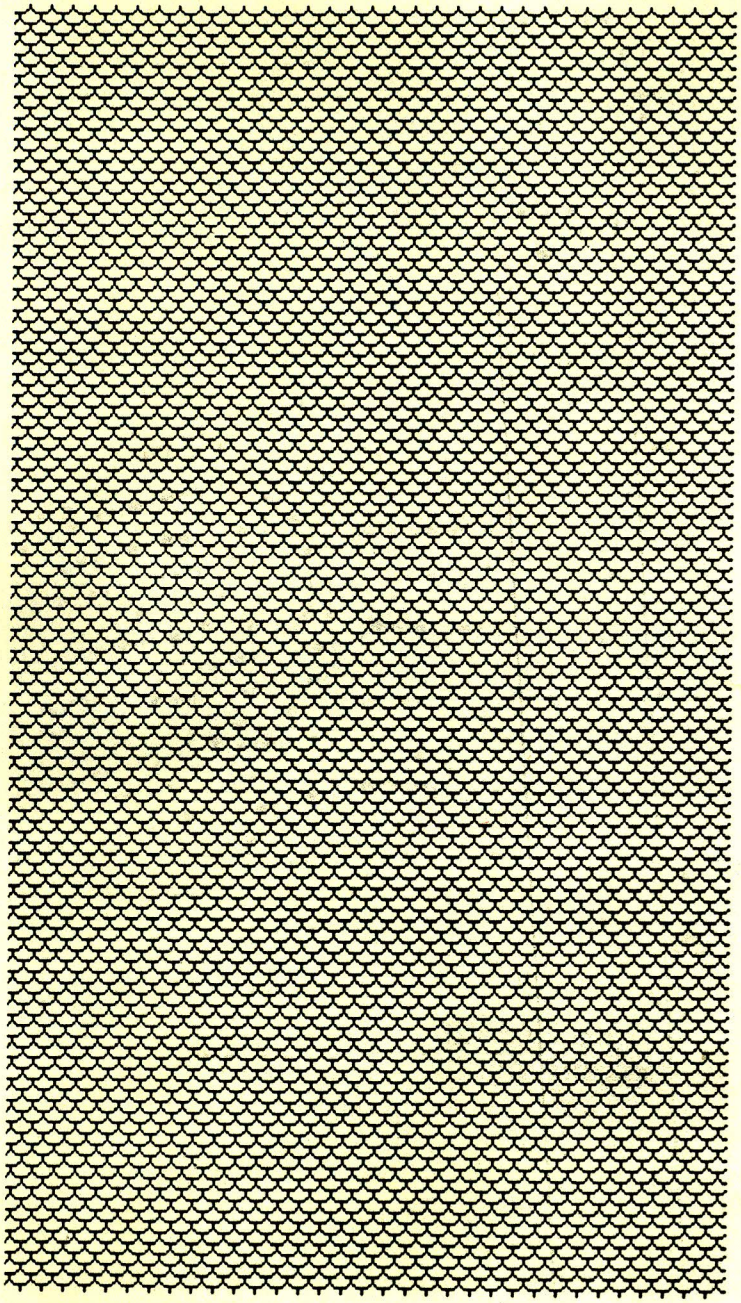
tile



mirror reflection



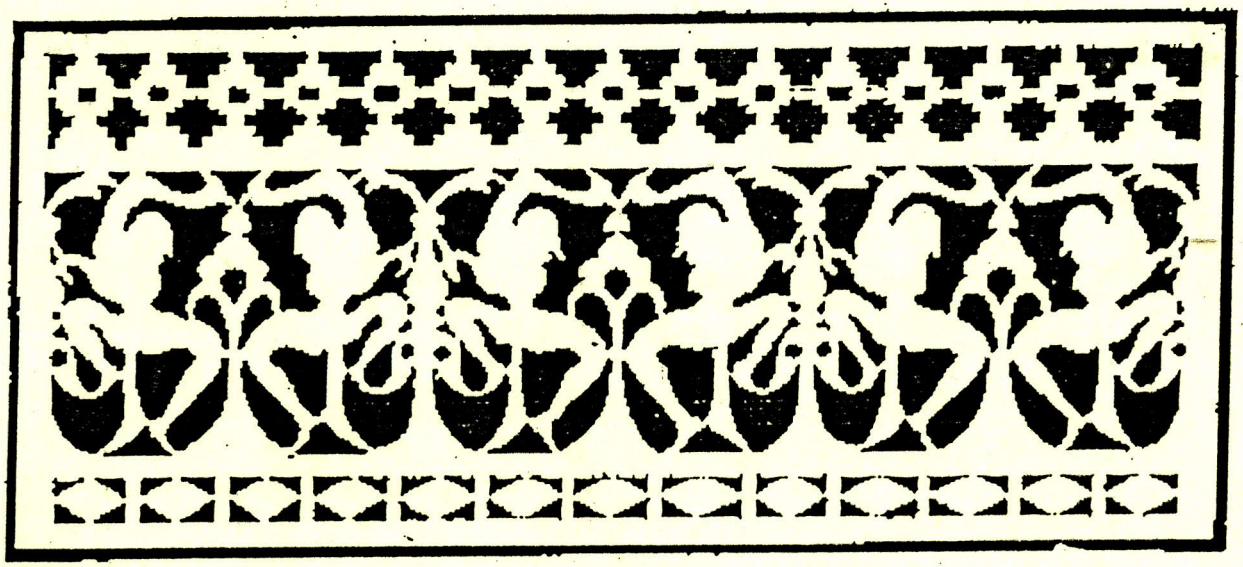
formation of the pattern



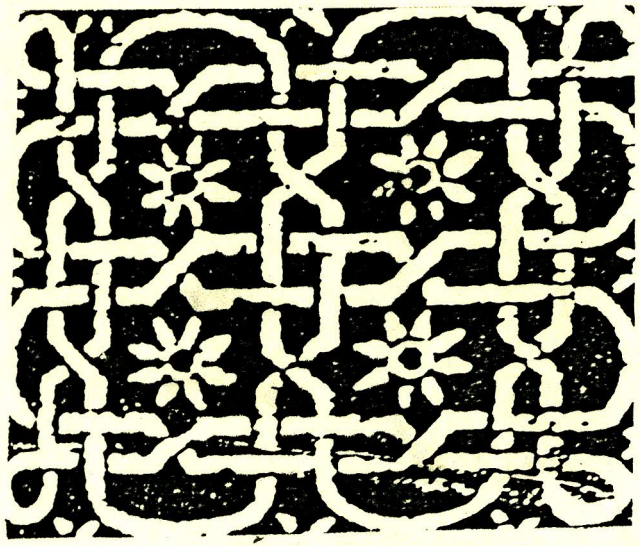
part 2

classifying the Jali patterns

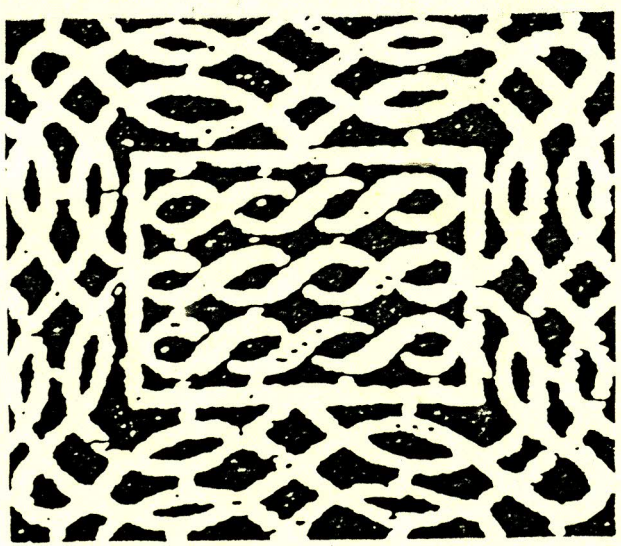
SYMMETRICAL PATTERNS



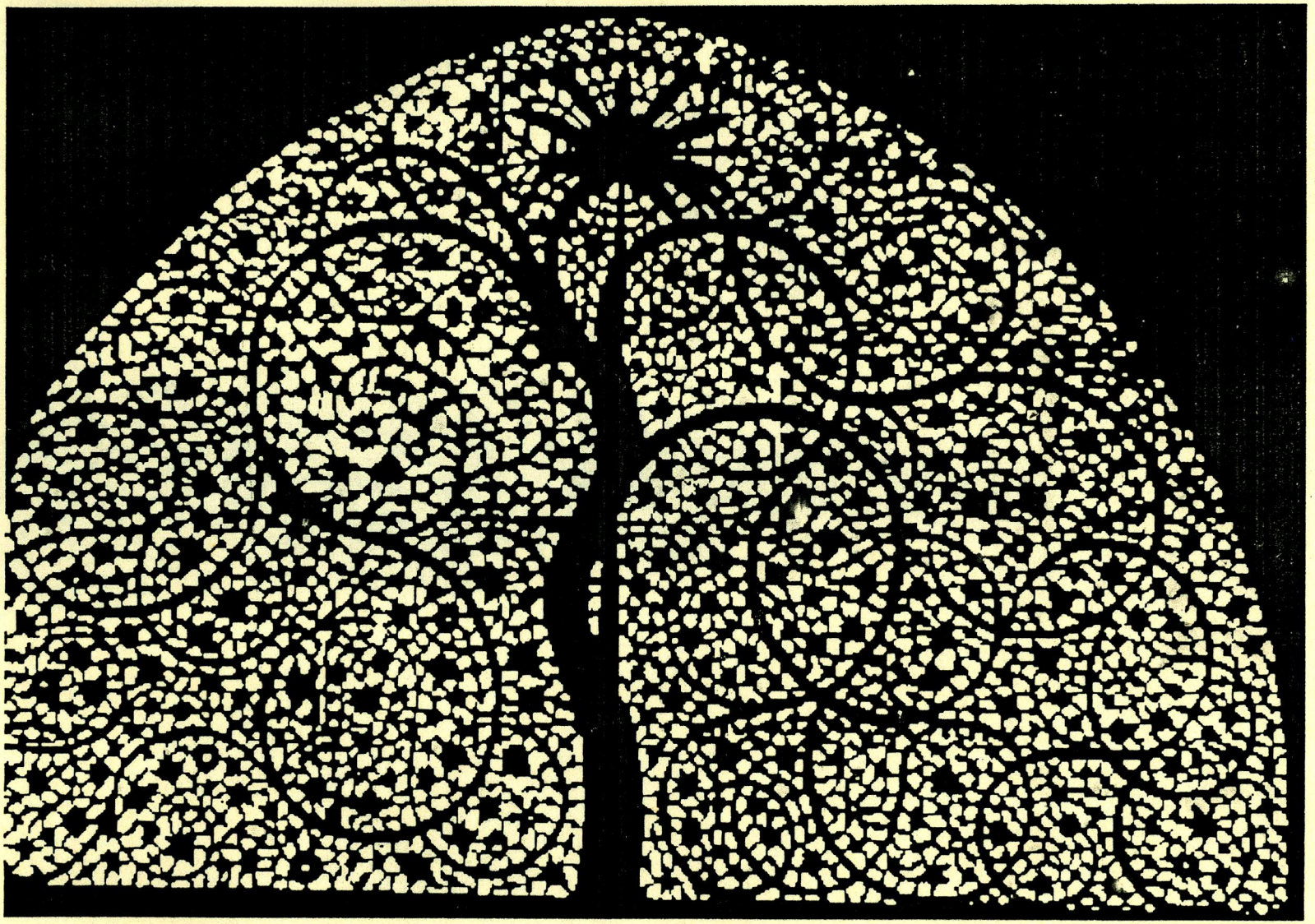
SYMMETRICAL AND
CONTINUOUS PATTERNS

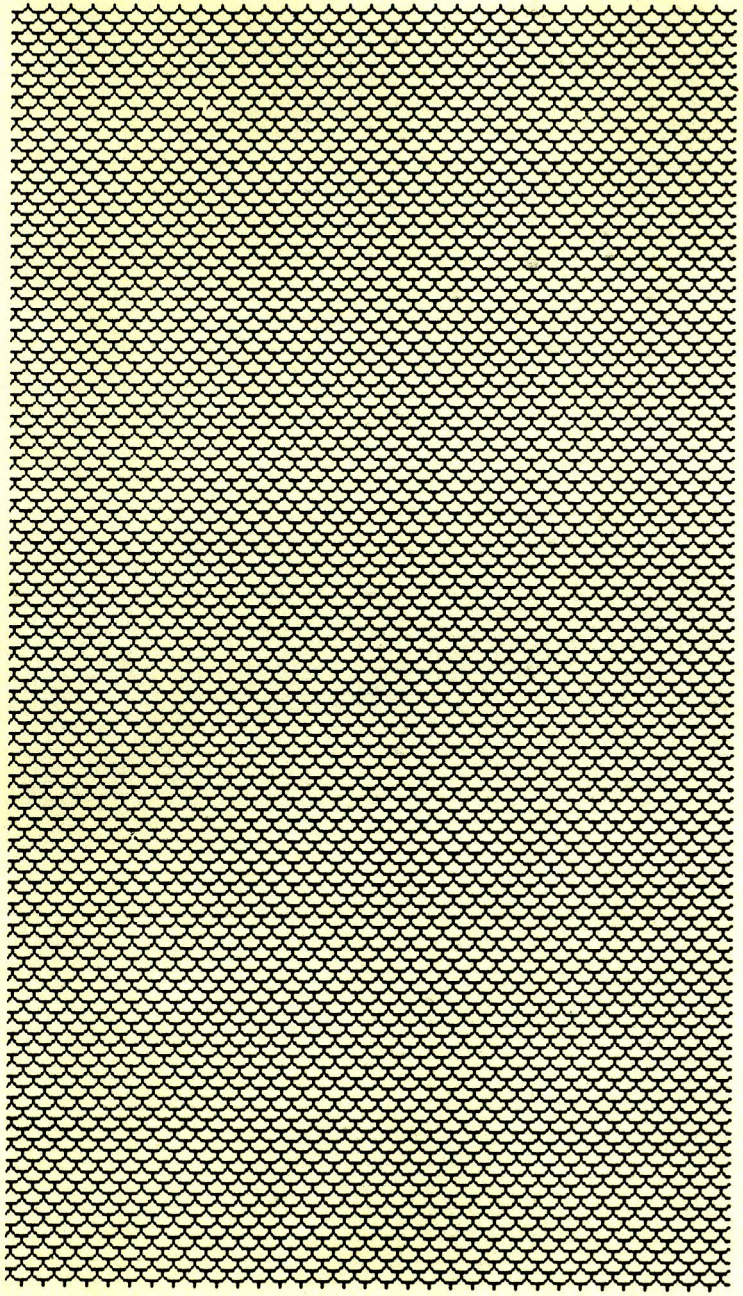


ASSYMMETRICAL AND
CONTINUOUS PATTERNS



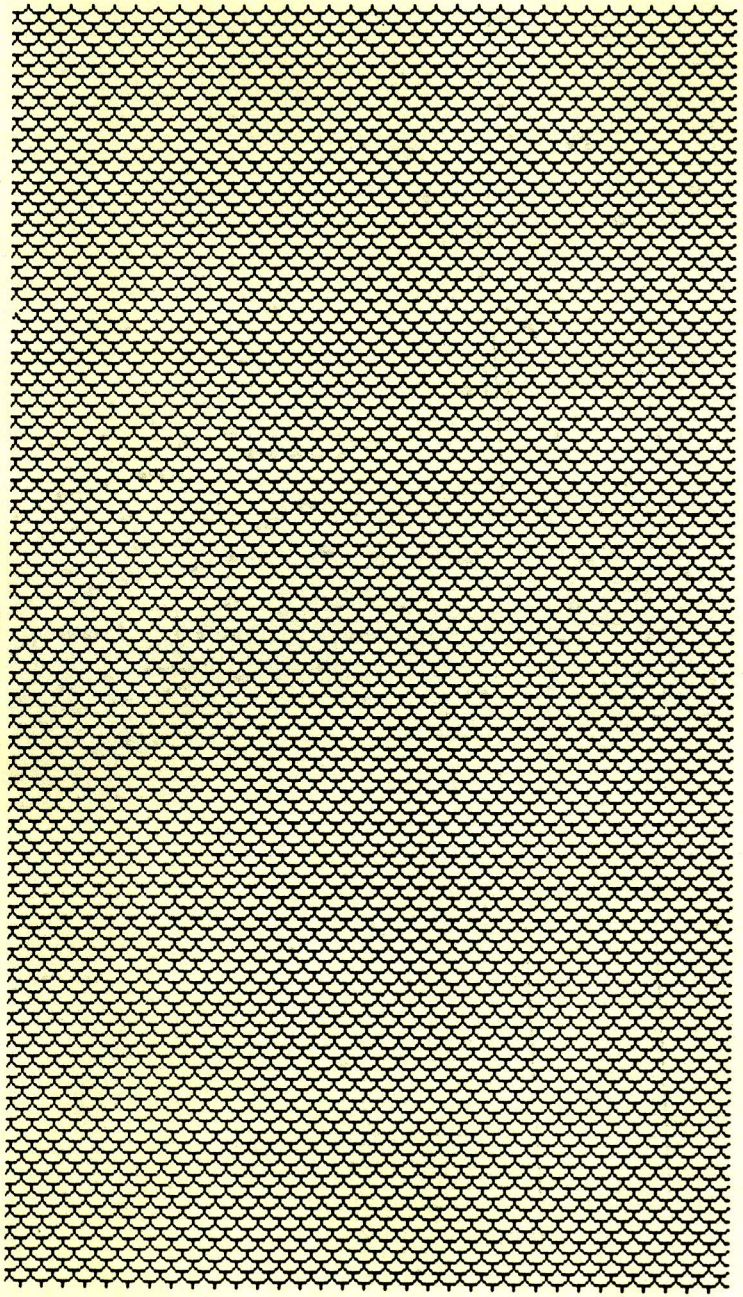
FREEHAND





part 3

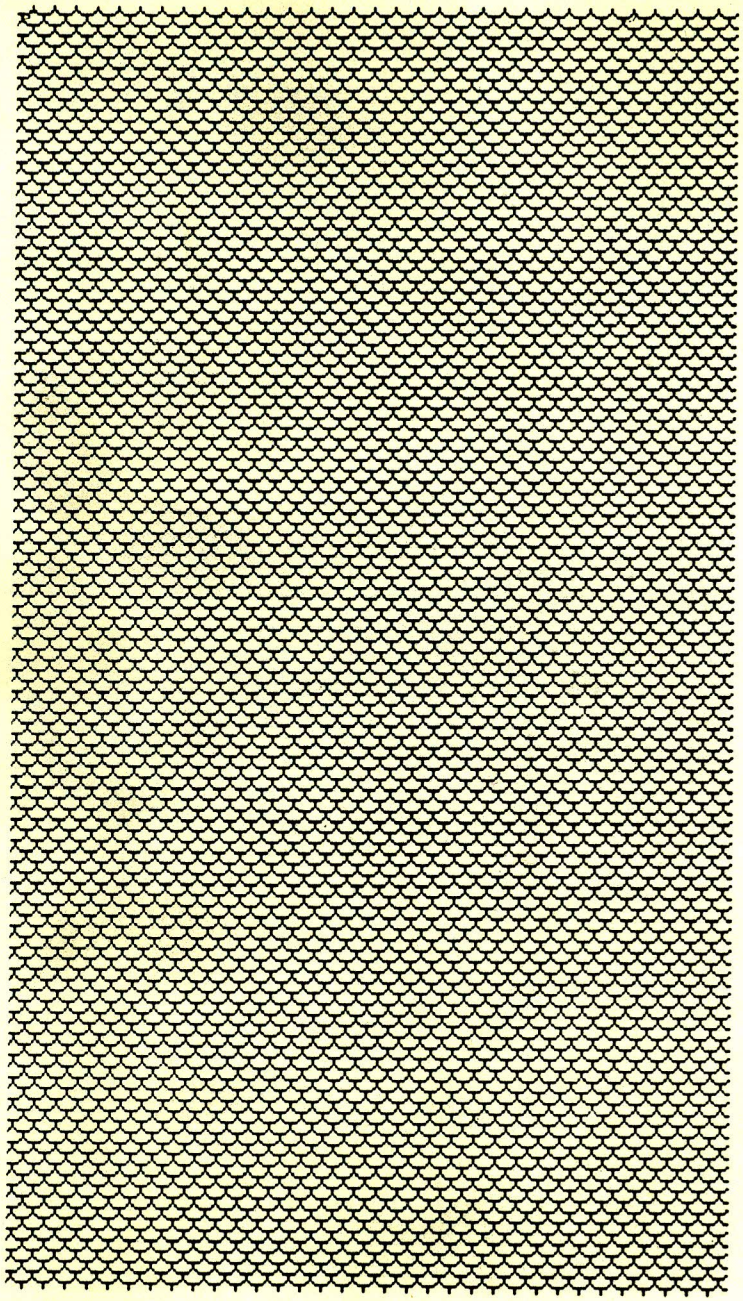
complexity and pseudo complexity



Complexity : When the complexity of the pattern increases there is a corresponding increase in learning difficulty. Here constraints like symmetry could largely compensate for the additional processing burden due to use of larger matrix.

"Attneave" concluded that the perceptual effect of increase in the complexity of the pattern on information is independent of the effects of constraints like symmetry that influence the configuration of the filled cells.

In simple words an image/pattern which we can recall and



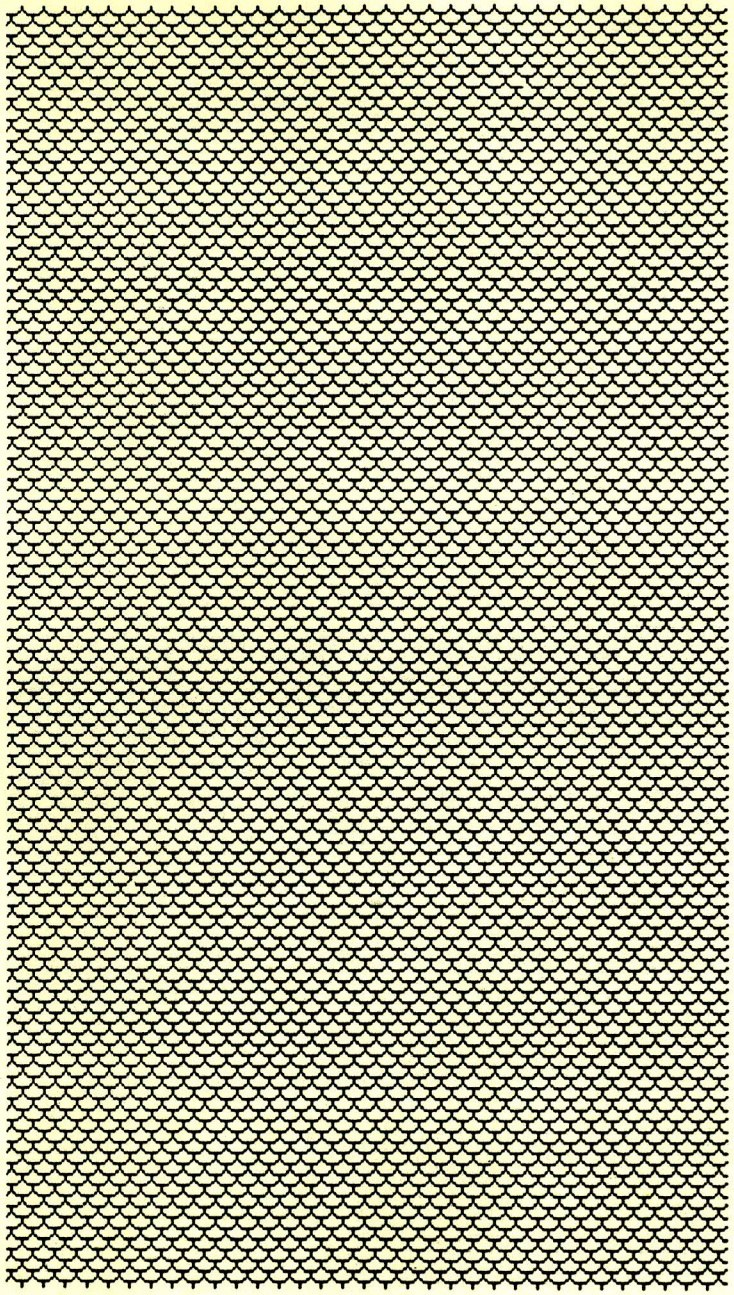
reconstruct is not a complex image or pattern. Recalling and reconstructing factors could be, the various forms, the symmetry and the repetition or the rotational factor.

The factors which leads to the complexity of the pattern are various.

1. **Filling space** : An area which is filled minutely and decoratively but at random by following repetition of the form. In this we may not find the use of symmetry at all. Repetitions are but of common use. Though ofcourse random making of a pattern also follows some specified rules like the size of the form/forms used and the appearance after clubbing them together. These patterns may be termed as assymmetrical patterns which do not follow a particular axis of symmetry but abide the rules of generation of a pattern. They also maintain the decorative and ornamental appearance of the pattern.
Rules help to follow a hierarchy in complex pattern making process.

2. **Reproduction** : A pattern which cannot be reproduced or is difficult to reproduce could be termed as a complex pattern

3. **Use of many forms** : A pattern may have more than two or three number of forms which are used to form a jali. Their arrangement is as such that it becomes difficult to identify them as individual forms. They thus can form a continuous chain pattern

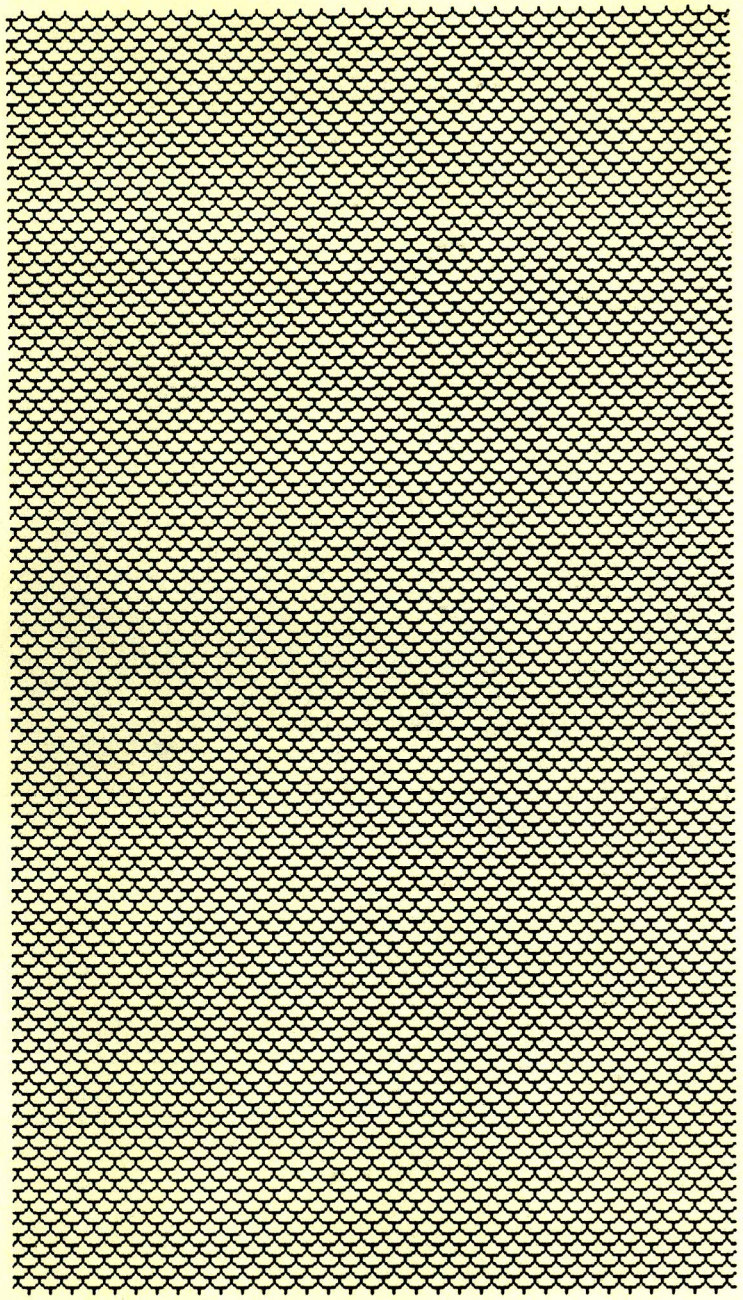


which later appears to be a complex pattern.
When a person is asked to memorize these patterns which are at times geometrical in shape or free hand, he is confused in identifying the reference point to start with and ends up in memorizing bits and pieces of the pattern according to his perception.

4. **Foreground, background** : In some pattern making, by using various line thicknesses, a foreground-background image can be created. Even when the foreground may appear as a reproductive image, the background might appear a complex image to remember and it may not be possible for a person to recall the background. Hence in two dimention the image might appear complex.

Pseudo Complexity :
An image which appears to be complex but can be easily produced could be termed as pseudo complexity.
Factors that lead to pseudo complexity are :

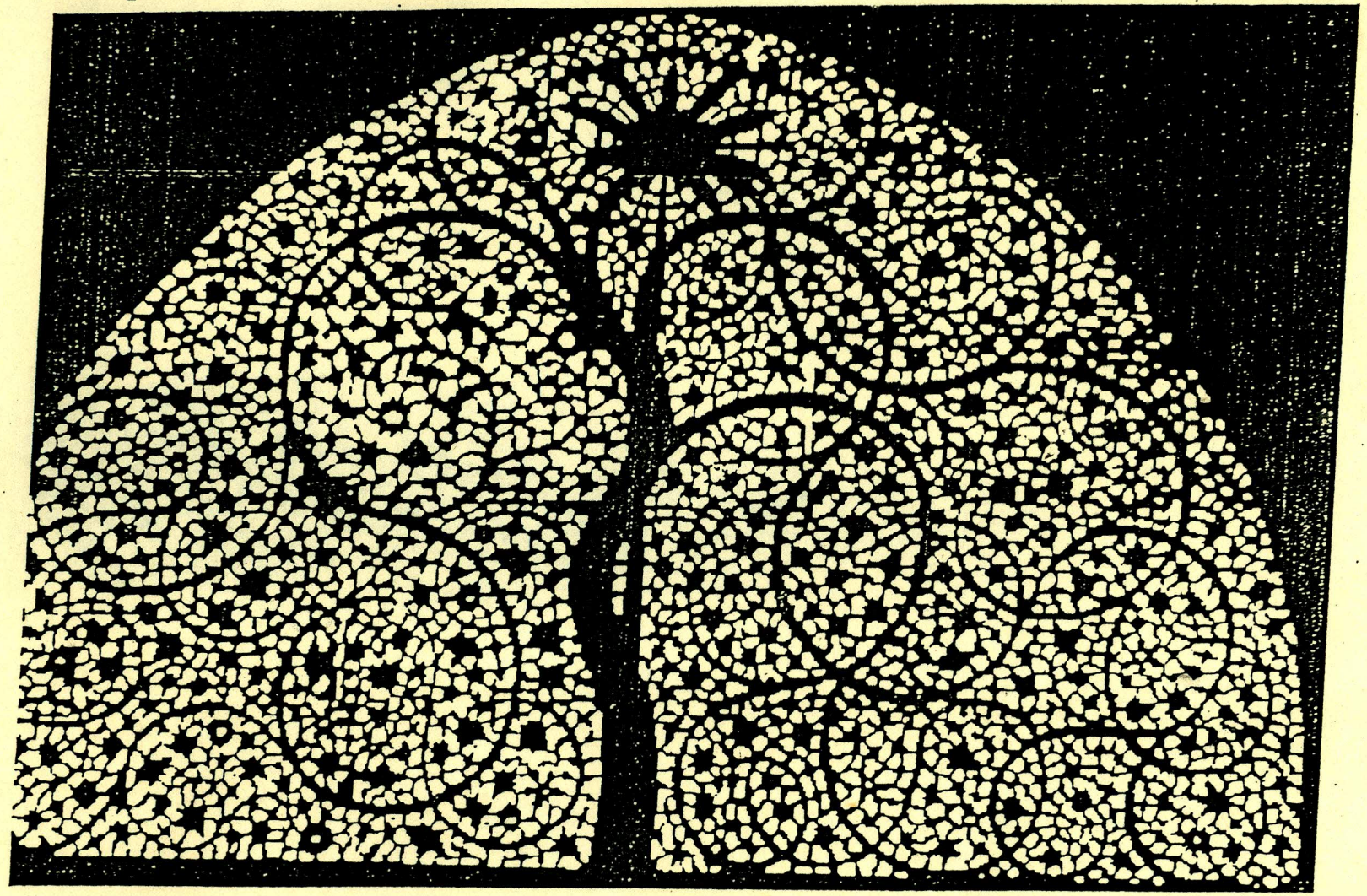
1. **Symmetry** : When a pattern is based on a symmetrical construction of many forms and appears to be complex,
2. **Scaling** : Structure is independent of scale while perception is not. Merely enlarging or reducing a pattern may change the effect dramatically.
3. **Rotation and reflection** : Patterns produced by using rotation and repetition of the core form at various angles.
4. **Varying thicknesses of the lines or the forms** : Increasing the

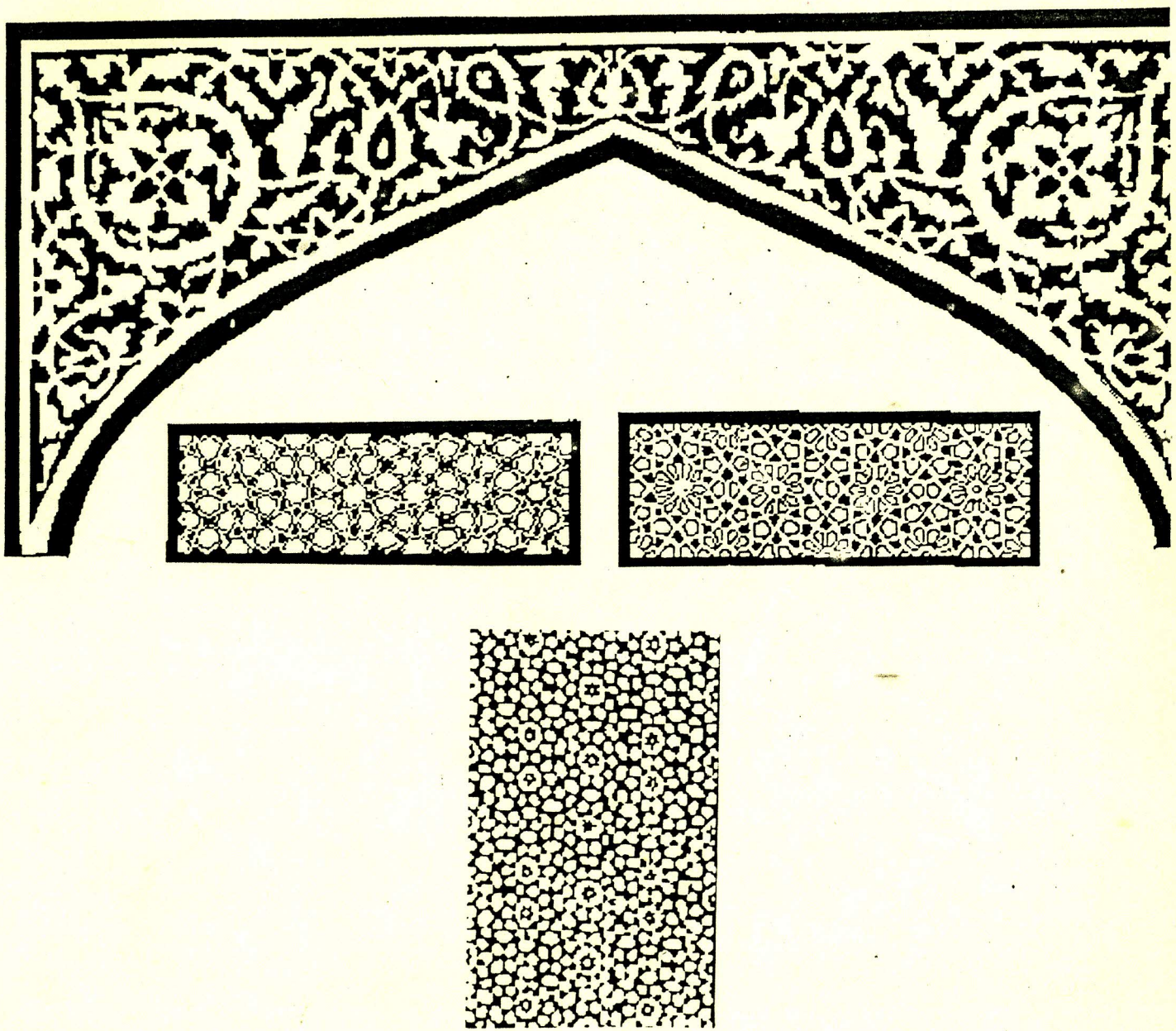


thickness or reducing the thickness/width of the line or form can make an image appear complex.

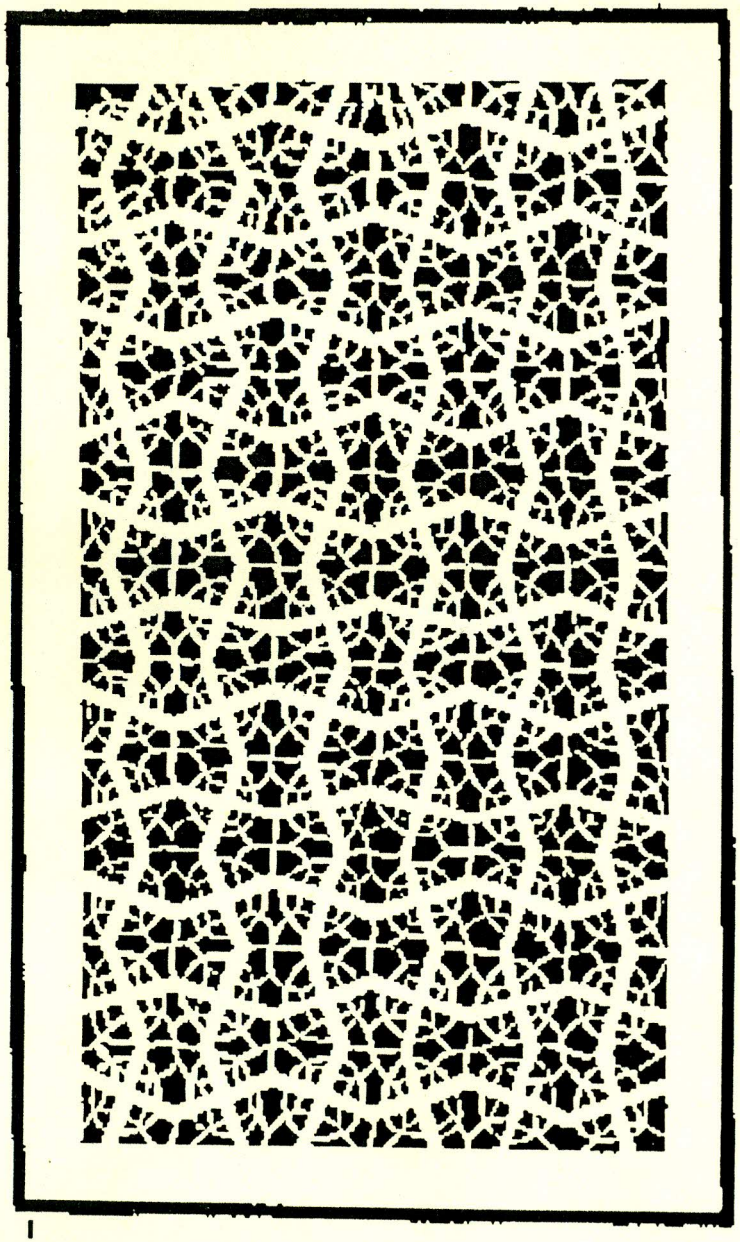
Colour like scale can influence the effect of any order by making the elements more or less conspicuous through contrast or brightness.

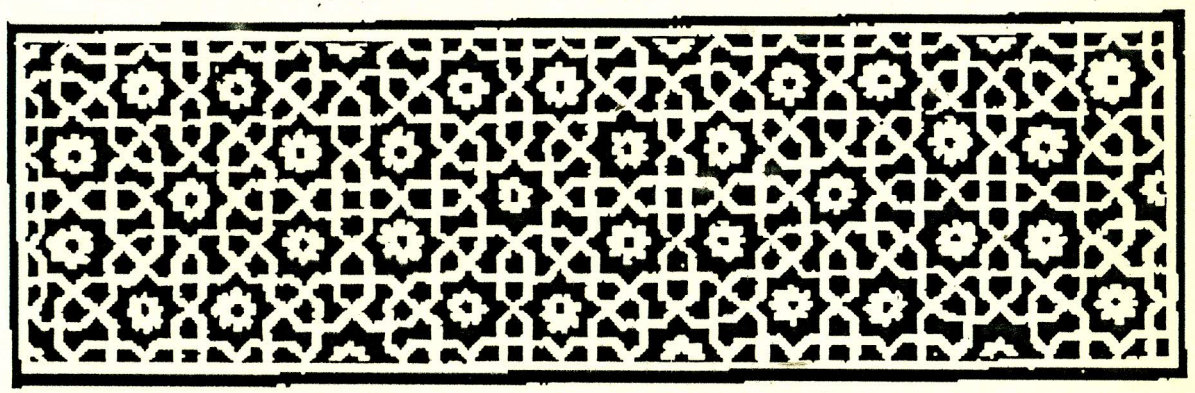
Complex Pattern

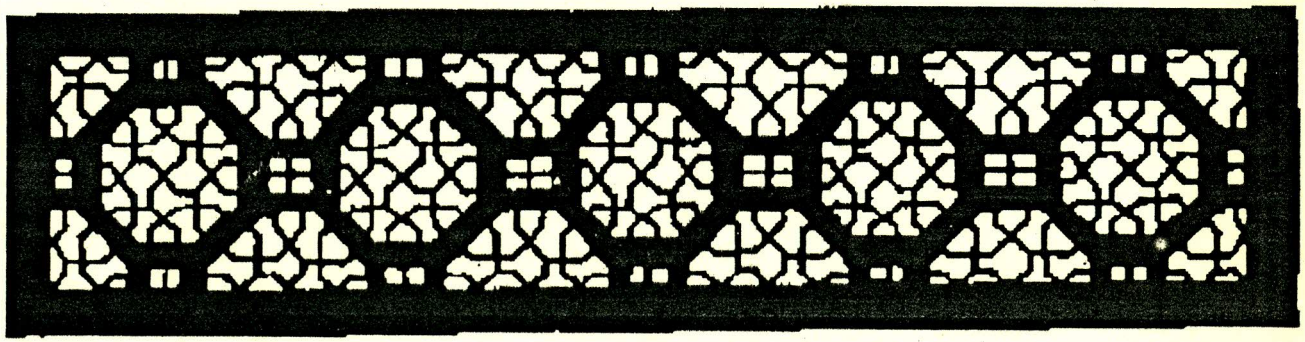


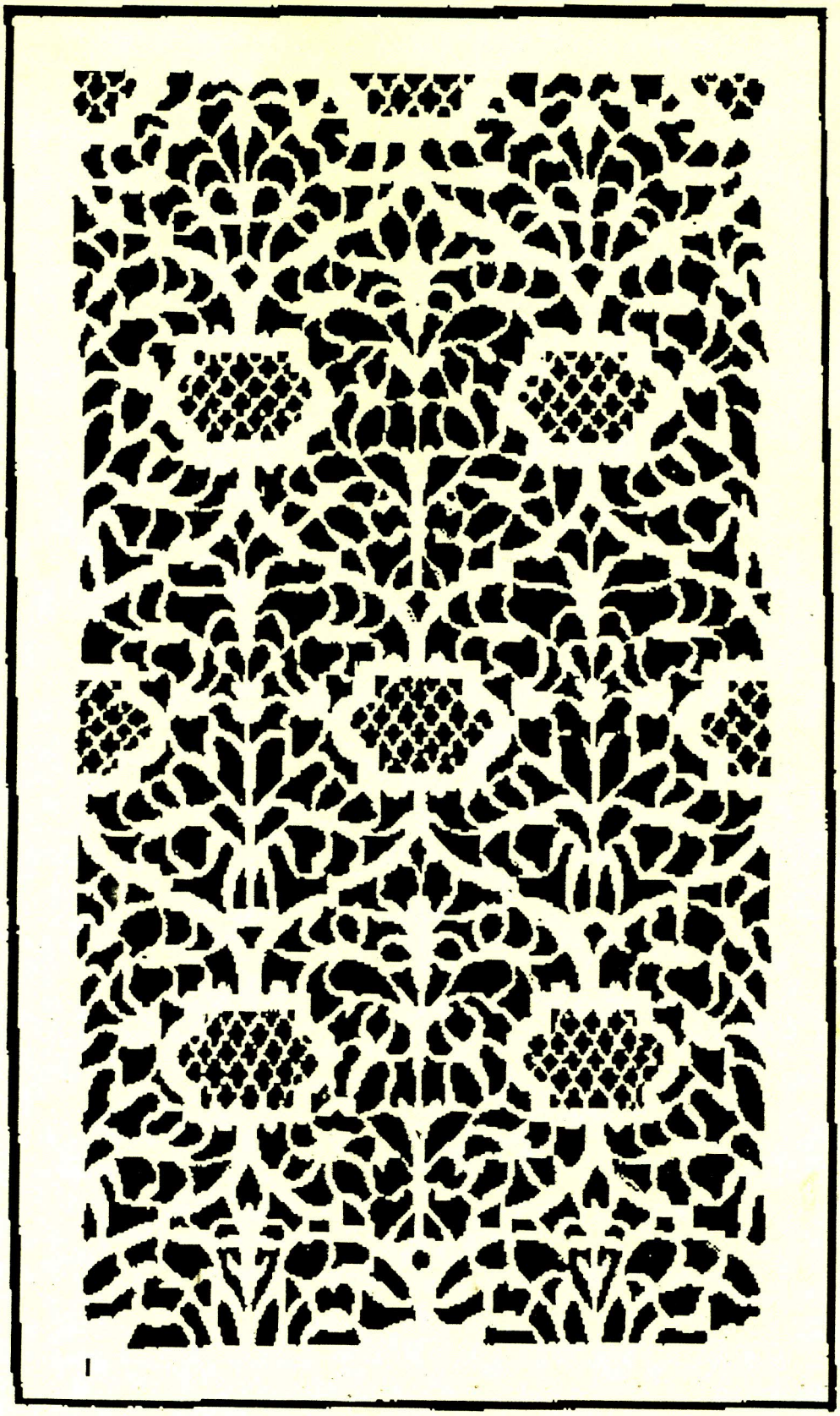


Patterns which appear complex (pseudo complex)









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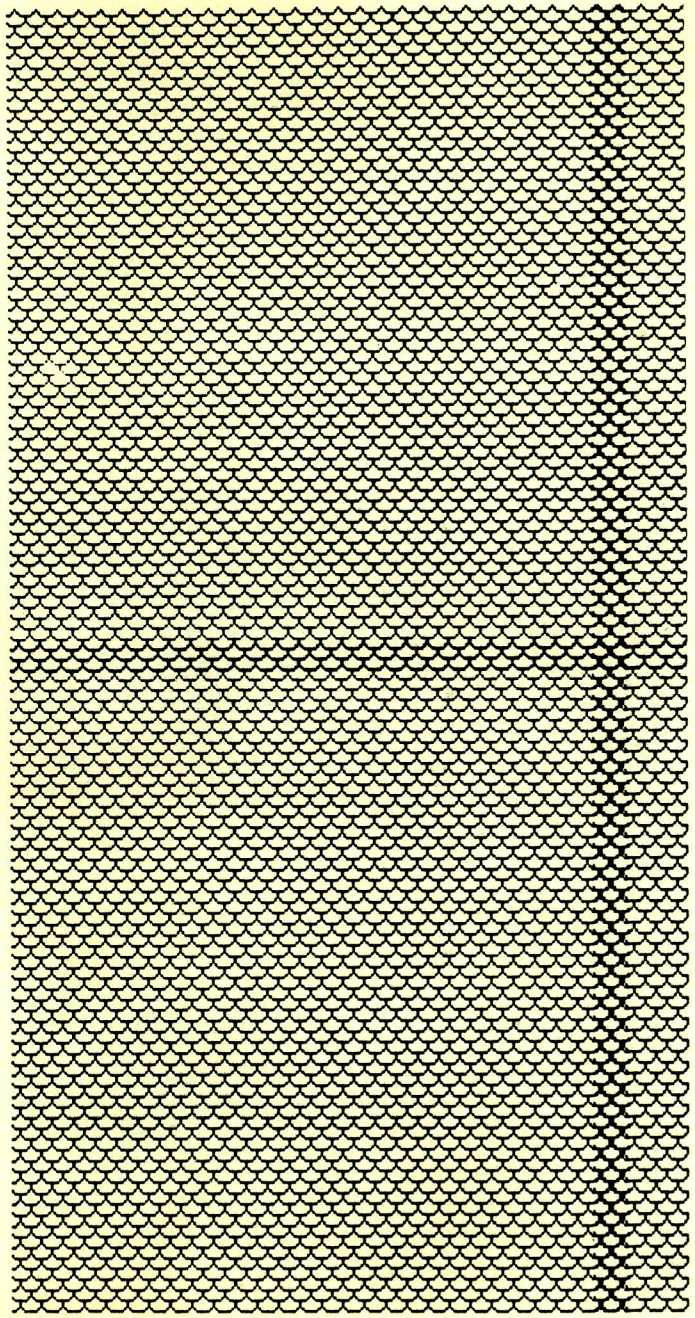
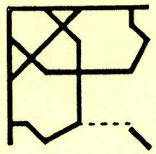
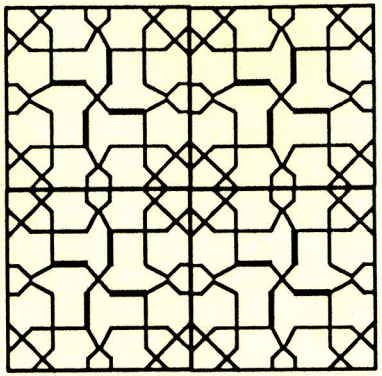
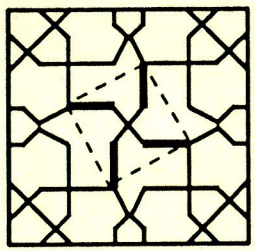


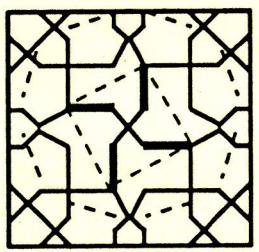
Possibilities of making new Jali patterns by using existing core form of the Jali's, and by making variations, in the reflections and the rotations of the formulation of a Jali pattern. Also by overlapping and interlocking the core form.



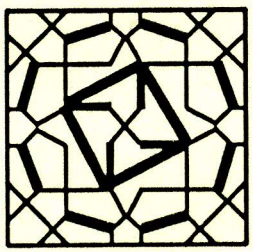


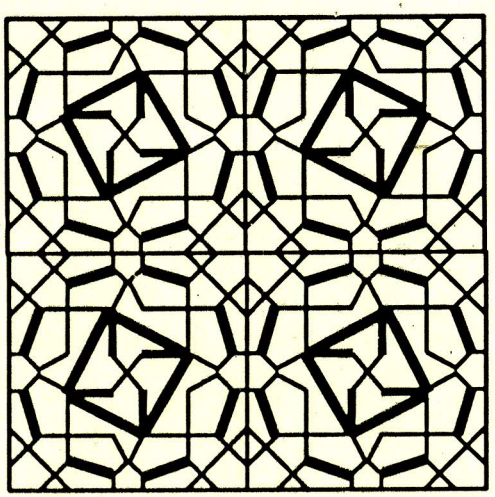
pattern formed by using the core form



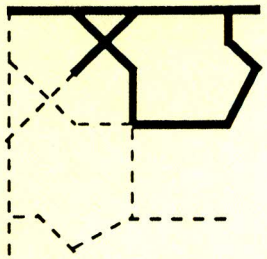


addition of these lines

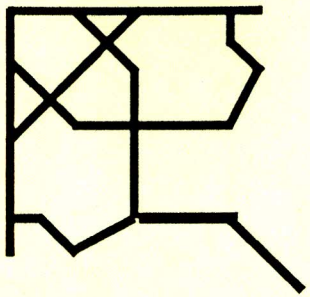




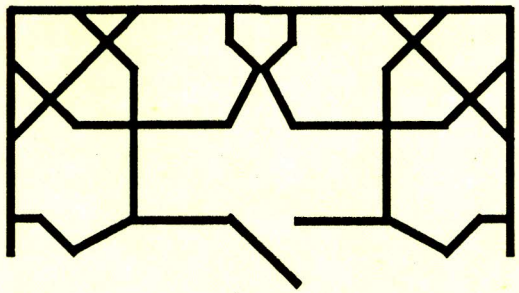
make it appear a different pattern altogether



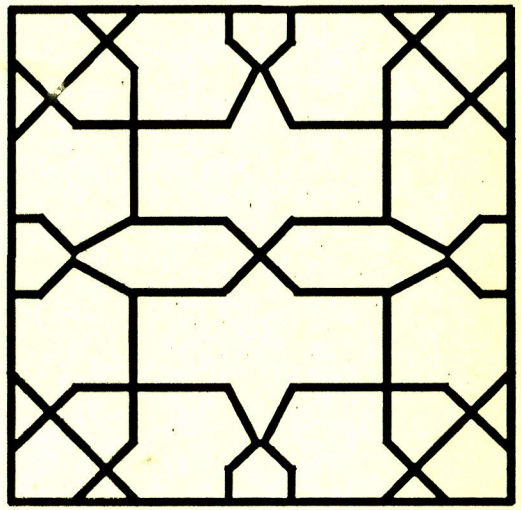
core form



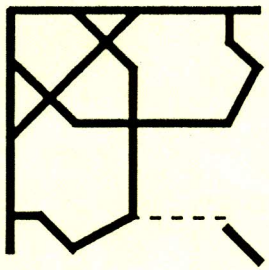
morror reflection
of the
core form
with addition of
two lines

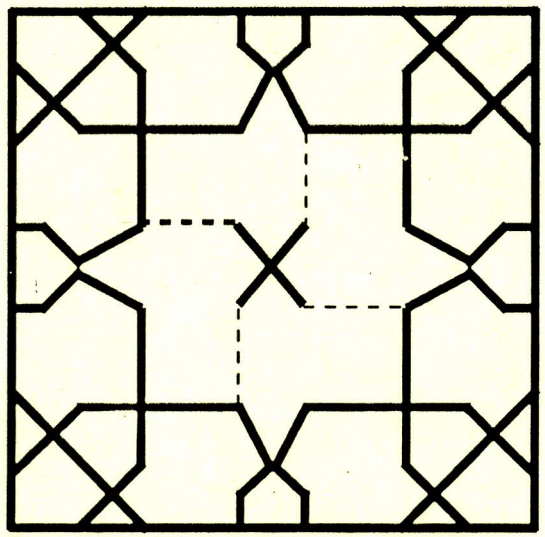


mirror refleciton of the quarter

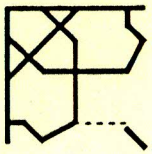


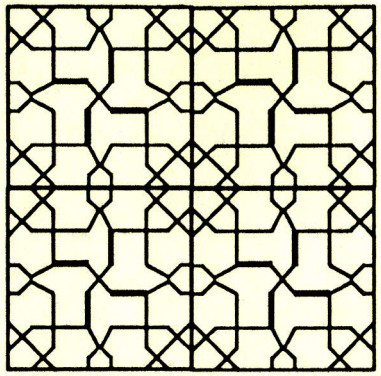
the tile



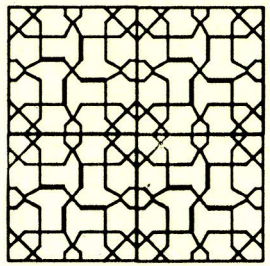


quarter rotated at 90 degrees, clockwise

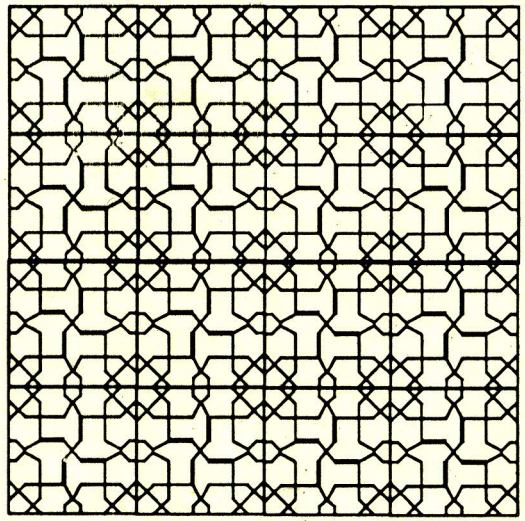




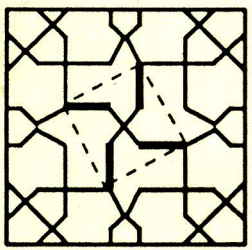
pattern formed by using the core form

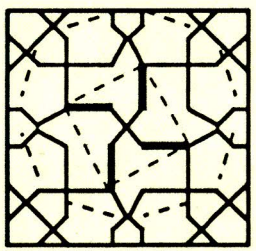


a scaled version

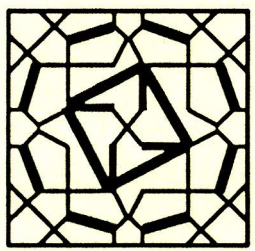


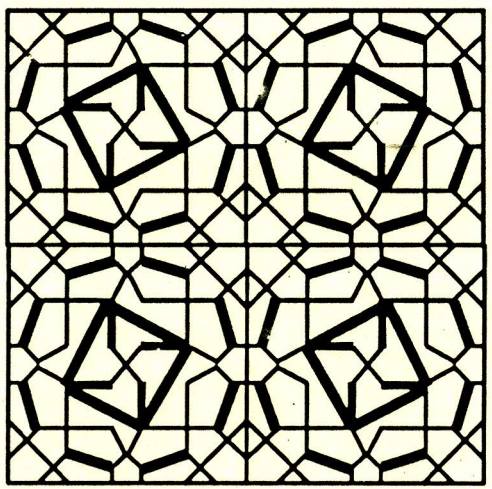
can form a pattern which appears to be complex



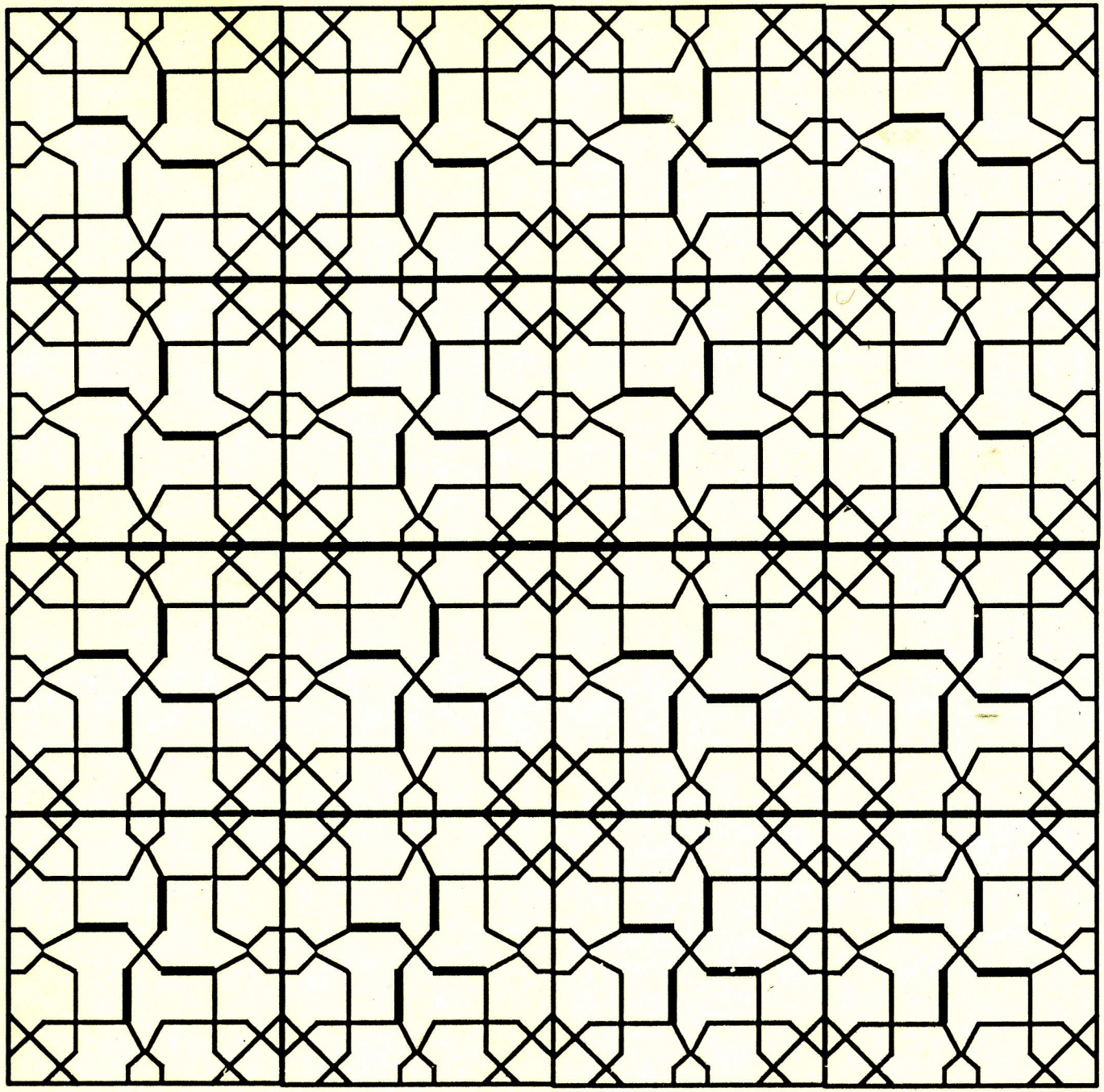


addition of these lines

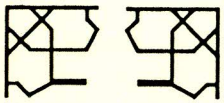




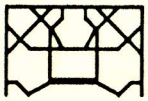
make it appear a different pattern altogether



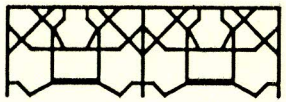
variations of the core form by repeatition and mirror reflection. we can get many more possibilities



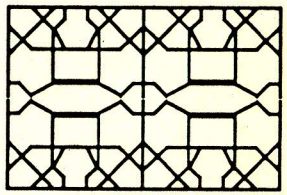
mirror image



overlap at half distance

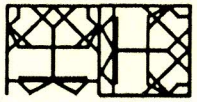


repetition

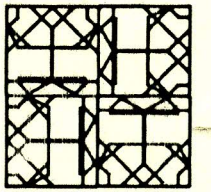


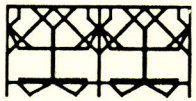
mirror image

overlap

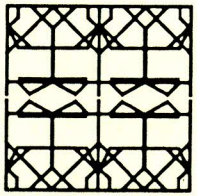


rotated at 90 degrees

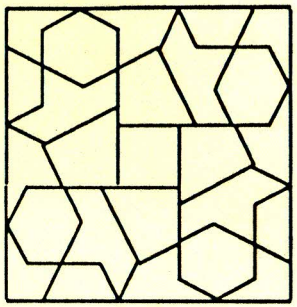


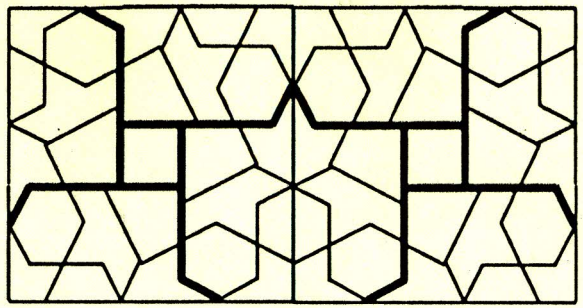


mirror reflection

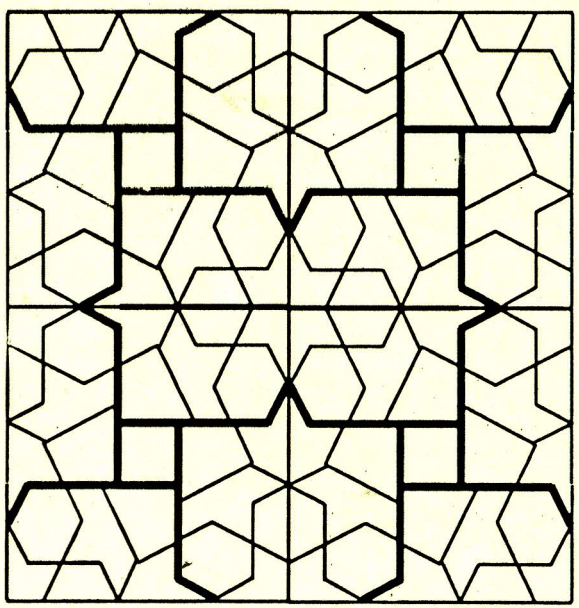


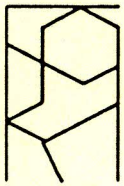
mirror rection

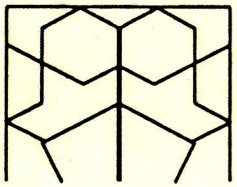


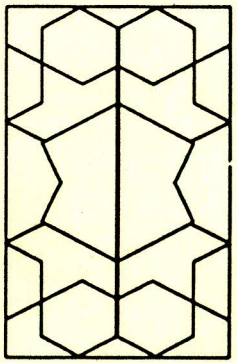


mirror reflection

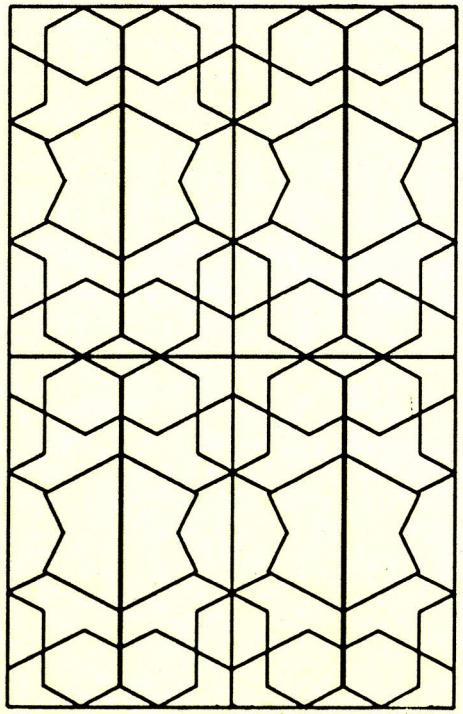






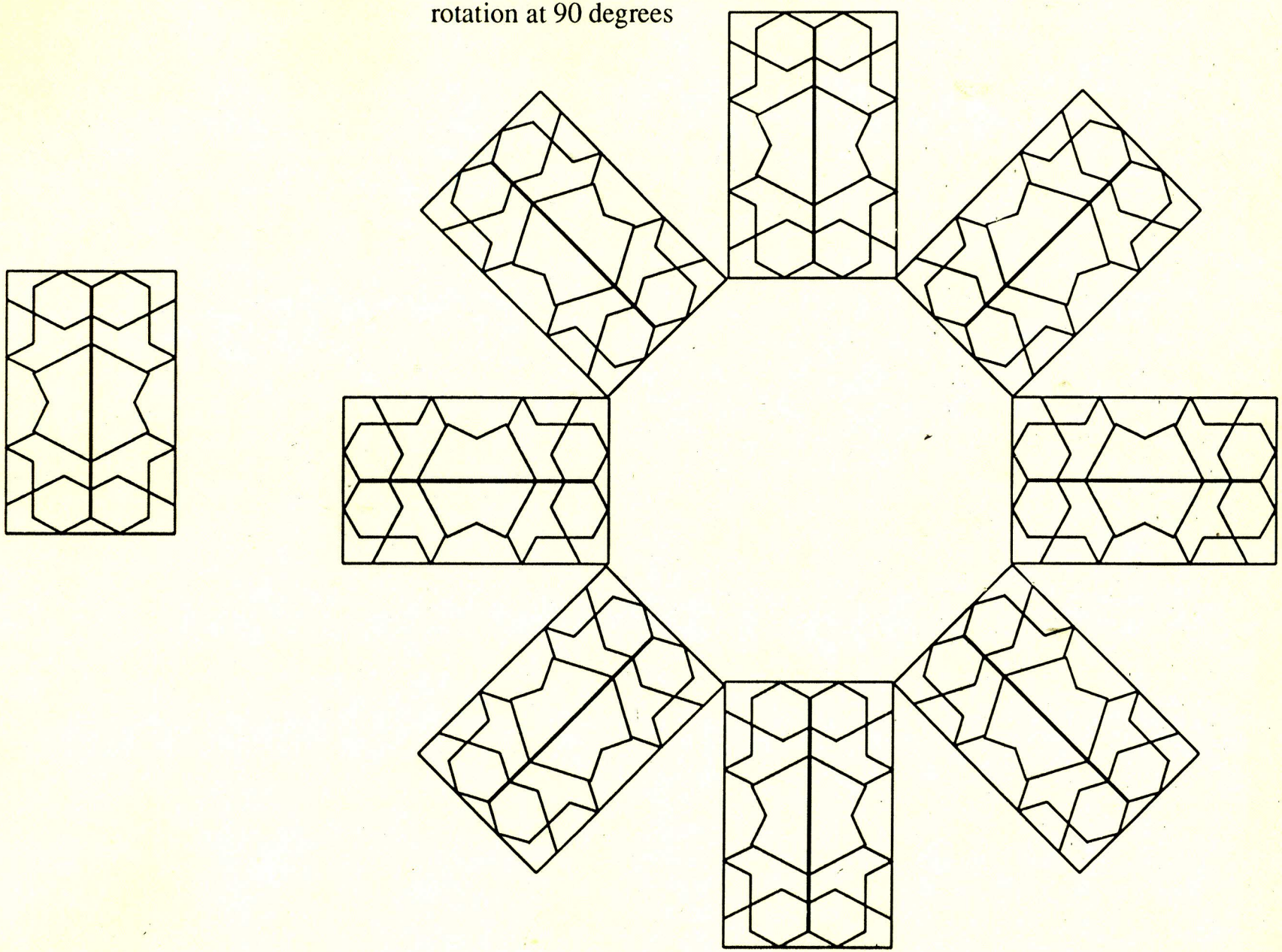


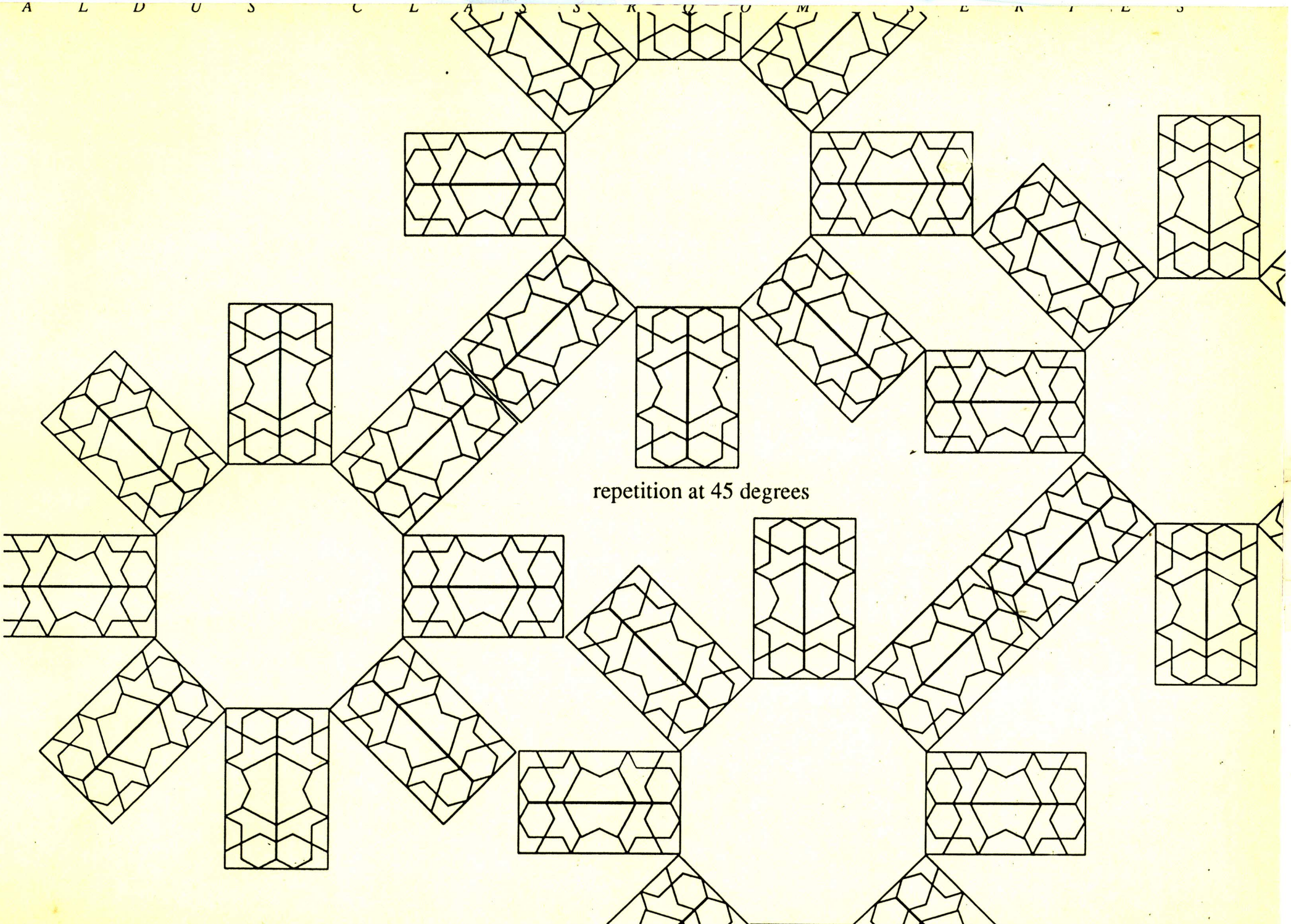
new tile

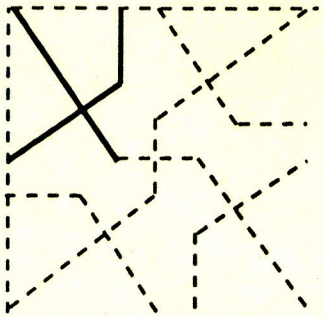


new jali pattern

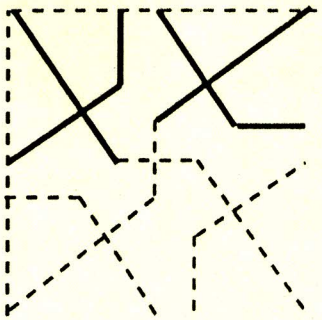
rotation at 90 degrees



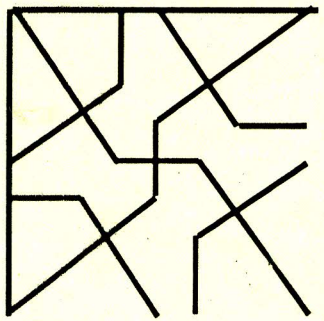

repetition at 45 degrees



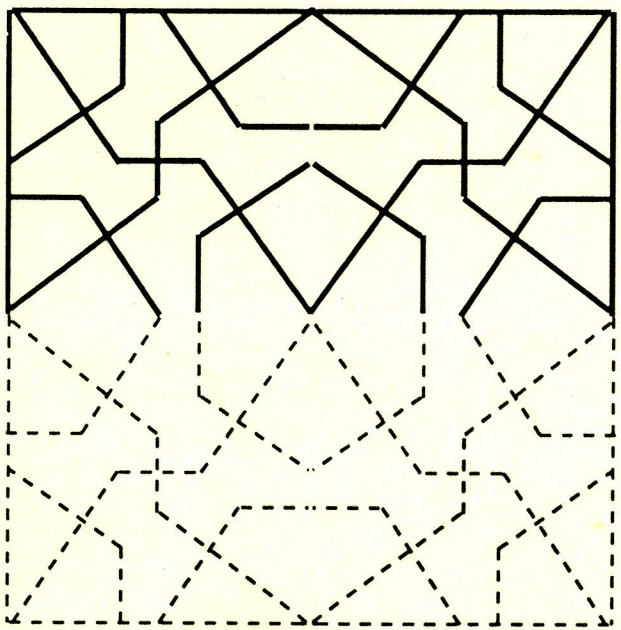
core form



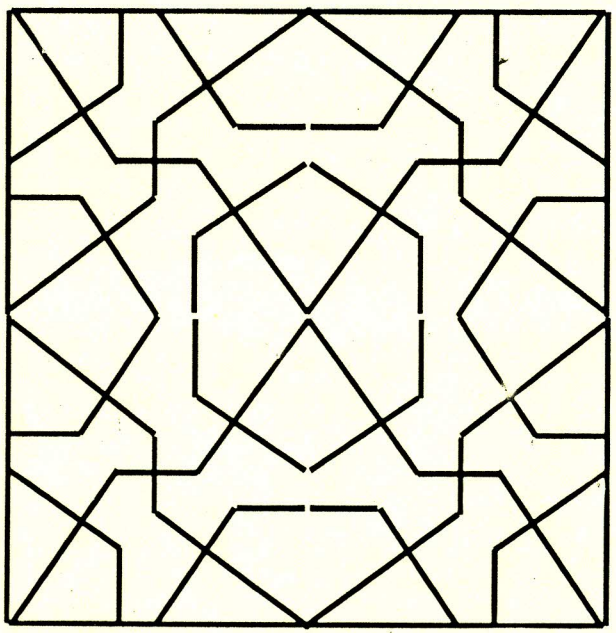
core form rotated at 90 degree, clockwise



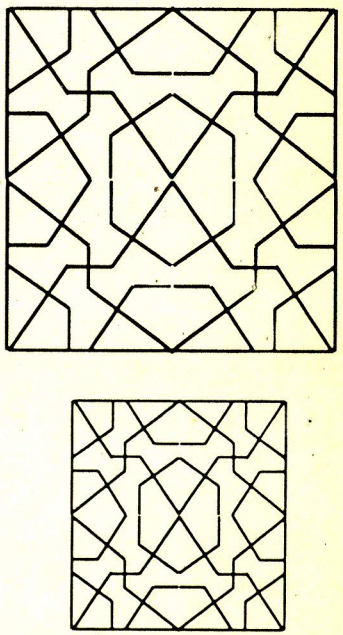
quarter of the tile



mirror reflection and rotation at 90 degree

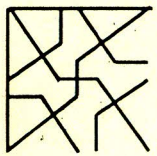


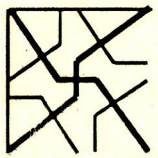
tile



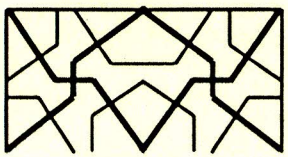
scaled versions

changing the thickness and adding of elements

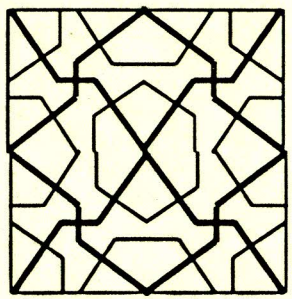




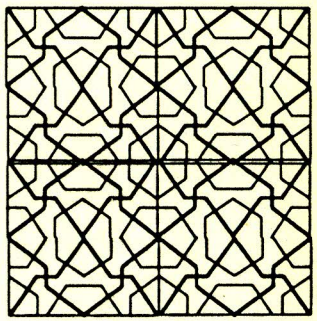
increasing the thickness of the line



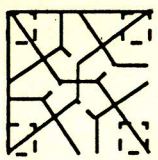
mirror reflction



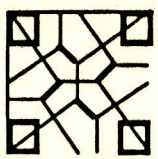
thickness of the line helps in the formation of foreground and background image



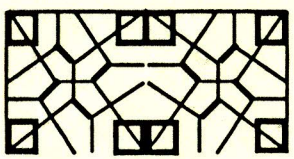
scaled version



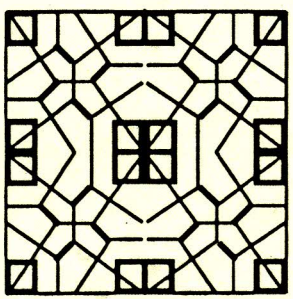
adding of elements



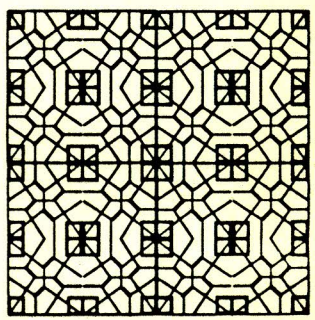
changing the thickness



mirror reflection

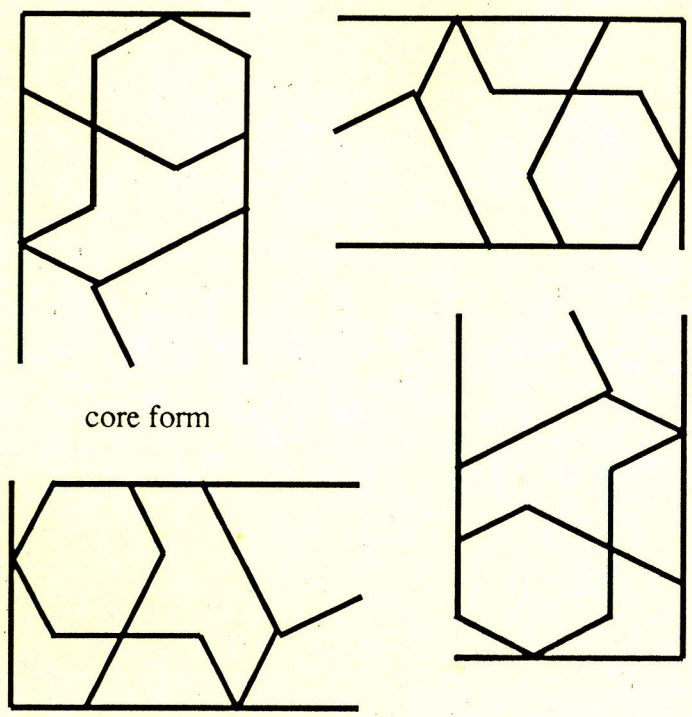


formation of a new pattern



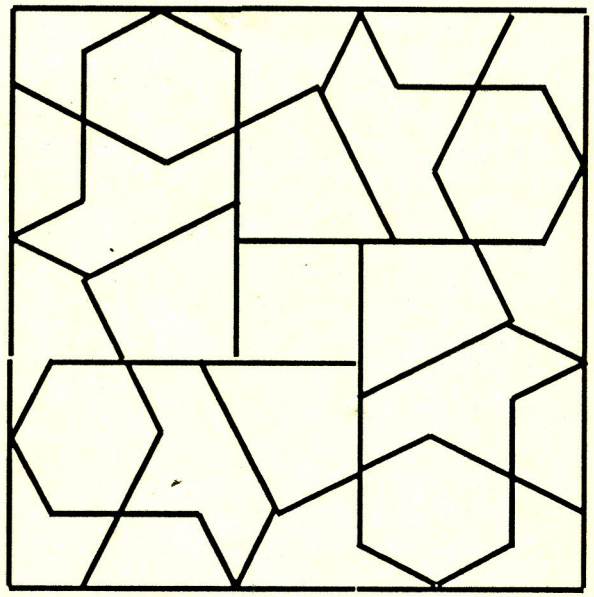
scaled version

these patterns appear to be pseudo complex patterns

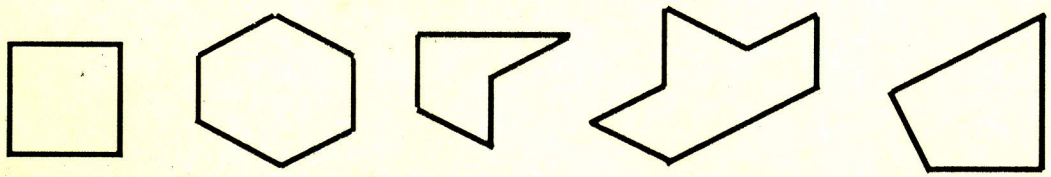


core form

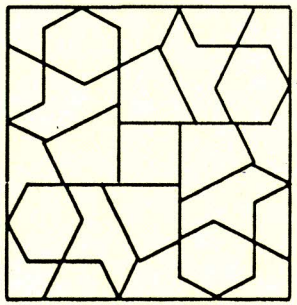
rotations at 90 degree, clockwise



tile



forms which make the core form



scaled tile might appear complex

This project will help as a basis in creation of more JAli patterns with proper methodology

The application of the created patterns into concrete blocks will be another part of the study where one has to understand the functionality aspect of a Jali pattern.