Symmetry and Pattern: The Art of Oriental Carpets

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Symmetry & Pattern
The Art of Oriental Carpets

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The Textile Museum
The beauty of Oriental carpets is achieved by various means including choice of colors and designs, as well as by the manipulation of designs to form pleasing patterns. Patterns in Oriental carpets are never quite what you expect — a surprise here, a flourish there, a change of color, the flip or rotation of a design where you might not predict it. The more you look, the more variations you will find.

The study of symmetry offers an approach to analyzing patterns in Oriental carpets. Through symmetry analysis we may identify areas of pattern that exhibit expected repetitions, and areas that vary from that expectation.

What is a pattern? A pattern, whether in nature or art, is an arrangement of parts that consists of an organized system based upon repetition.

What is symmetry? Symmetry is a fundamental organizing principle. The analysis of symmetry allows for understanding the organization of a pattern, and for determining both invariance and change. Surprisingly, symmetry cannot exist without asymmetry.

What is asymmetry? Asymmetry is both the absence of symmetry, and the fundamental basis for symmetry. Symmetry analysis may result in the identification of a fundamental region that is the smallest element required to explain repetition that forms a pattern.

Although a design may be symmetrical or asymmetrical, the fundamental region that is repeated to form a pattern is asymmetrical. While possibilities for the composition of a design are limitless, the possibilities for manipulating a design to form a pattern are limited by symmetry.

In all patterns there are four basic symmetry operations that may be performed upon a fundamental region. Mathematicians call these the rigid motions because they suggest movements without distortion of size or shape around a point, along or across a line, or to cover a plane. These may be combined to form seven border patterns and seventeen field patterns.
THE FOUR BASIC SYMMETRIES
OR RIGID MOTIONS

Here the letter F (and the blank space around it) serves as a fundamental region to demonstrate symmetrical relationships. There are four basic symmetries used to make border patterns and field patterns.

In rug-weaving, the repetition of a design to form a pattern is accomplished by counting and repeating sequences of knots. In Oriental carpets, by varying relationships within border patterns and field patterns where symmetry is expected, weavers have transformed repetitive patterns into great works of art.

Carol Bier, Curator
Eastern Hemisphere Collections

Advisory Panel
Diane E. Proctor, The Calvert School, Baltimore
David Williamson Shaffer, The Media Laboratory, Massachusetts Institute of Technology
Amira El-Zein, Georgetown University
Tom Cook, Northwestern University

Cover: Pile carpet, Central Asia, Bukhara, 1963.52.6
Gift of Mr and Mrs. Frank Michaelian
SEVEN BORDER PATTERNS

translations

vertical reflections

horizontal reflections

reflections + reflections

glide reflections

rotations

rotations + reflections
SEVENTEEN FIELD PATTERNS

translations
reflectations

reflections + rotations (2)
rotations (2) + glide reflections

rotations (3)
reflections + rotations (3)
reflections + reflections

reflections + reflections

rotations (2) + reflections + reflections

rotations (4)

rotations (3) + reflections

rotations (6)
reflections + glide reflections

reflections + rotations (4)

rotations (2)

rotations (4) + reflections

reflections + rotations (6)

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NATIONAL ENDOWMENT FOR THE ARTS

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GLOSSARY

asymmetry absence of symmetry
axis visible or implied line of symmetry
border pattern linear pattern
field pattern pattern that covers a plane
fundamental region smallest asymmetrical unit required to explain a pattern
glide reflection rigid motion reflected along a line
grid visible or implied series of points or intersections of axes
pattern arrangement of parts that consists of an organized system based upon repetition
reflection rigid motion across a line (axis)
rigid motion mathematical transformation whereby size and shape remain the same while placement and orientation may change
rotation rigid motion around a point
symmetry fundamental organizing principle in nature and art
symmetry-breaking absence of expected symmetry
symmetry operation translation, reflection, glide reflection, and rotation
tessellation pattern formed by a single shape that when repeated covers the plane with no gaps and no overlaps
translation rigid motion along a line

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