

## Key Math Concepts for Your Design

### **1. Golden Ratio**

The golden ratio is a special number often found in nature, art, and architecture. It's represented by the Greek letter Phi and is approximately equal to 1.618. You get the golden ratio when you divide a line into two parts so that the ratio of the whole line to the longer part is the same as the ratio of the longer part to the shorter one.

This ratio appears in the spiral of seashells, the branching of trees, and even in famous artworks like the Parthenon and Leonardo da Vinci's 'Vitruvian Man'. Designers use the golden ratio to create balance and harmony. Mathematically, if side A is 1 and side B is approximately 0.618, then  $A + B$  divided by A equals A divided by B, and both equal around 1.618.

Example: If one part of your design is 10 cm, the other part should be about 6.18 cm to reflect the golden ratio.

### **2. Fractals**

Fractals are complex patterns made by repeating a simple shape at different sizes. The smaller versions look like the bigger version this is called self-similarity. Fractals can go on infinitely in theory, but even a few levels of repetition create rich, detailed structures.

Fractals appear in natural objects like ferns, Romanesco broccoli, clouds, and river networks. You can also find them in traditional African village layouts and textiles. Mathematically, fractals often use geometric sequences and rules of iteration (repeating a process step-by-step).

Example: If a pattern starts with a triangle and then adds smaller triangles on each side, again and again, it creates the Sierpinski Triangle a famous fractal shape.

### **3. Tessellations**

A tessellation is a pattern made of shapes that fit together perfectly without leaving gaps or overlapping. These patterns can go on forever and are often used in tiling, art, and cultural decoration.



Mathematically, tessellations use polygons (shapes with straight sides) that can repeat to cover a surface. Regular tessellations use one shape only (like squares or equilateral triangles), while semi-regular ones combine different shapes.

In Islamic mosaics, tessellations use stars, hexagons, and decagons to create complex symmetrical patterns. Tessellations are also used in science to model crystals and molecules.

Example: A beehive's hexagonal honeycomb is a natural tessellation that uses space efficiently.

#### **4. Symmetry**

Symmetry is when one part of an object or design is a mirror image of another. It gives balance and harmony to shapes and patterns. There are three main types of symmetry in geometry:

- **Reflectional symmetry:** One side reflects the other, like in a butterfly or a face.
- **Rotational symmetry:** A shape looks the same after being rotated around a point. A regular star with five arms has rotational symmetry of order 5.
- **Translational symmetry:** A pattern repeats as you move it along a straight path for example, tiles on a floor or bricks in a wall.

Many cultural designs, including mandalas, origami patterns, and Islamic art, use combinations of these symmetries to create visual beauty and mathematical structure.