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An introduction to Daisy Wheel and Vesica Piscis Compass Geometry

The compass is a hands on computer that can be used to generate angles and proportions relevant to the design, erection or repair of timber framed buildings. To be precise, the medieval compass used by carpenters and masons was what we would now call dividers, a compass with a pin on either arm for scribing into timber or stone. The dividers were used in combination with a straight edge, like a ruler without dimensions, and a scribe or awl for scoring a line along its edge. Using the compass, straight edge and scribe it is possible to draw circles, either individually or in multiples and to scribe straight lines between the precise points where curved or straight lines intersect.

If a circle is drawn by compass its radius will also give six equidistant points around the circumference. And if six further circles are drawn from these points, a daisy wheel is produced within the central circle, diagram **1**. This is the true geometry of the daisy wheel, its geometrical reason for existence, and a revelation of the beauty, symmetry and intricacy of geometrical relationships. It can also be seen, in diagram **2** left, that the central daisy wheel can be drawn independently and that a cut circle, diagram **2** right, represents the tips of the daisy wheel petals where their arcs pass across the circumference of the central circle. The daisy wheel and cut circle therefore both indicate the six equidistant points around the central circle's circumference, the daisy wheel being the long hand and cut circle the short hand method of locating these points.Daisy wheels and cut circles are often found scribed into framing timbers.

The six points yield some interesting geometrical properties. For example, if all six points are connected a hexagon is formed, diagram **3**, and if three alternate points are joined an equilateral triangle results, diagram **4**. If all six points are joined in two reversed equilateral triangles the Star of David is produced, diagram **5**.

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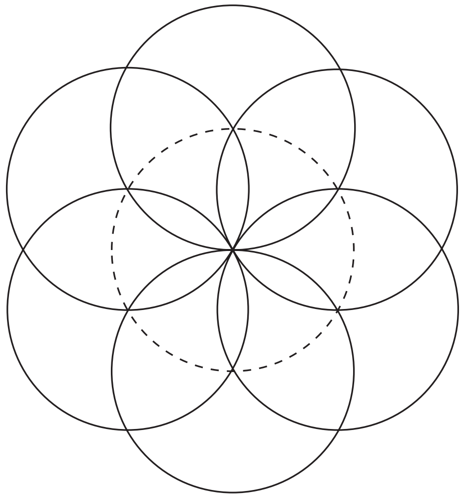

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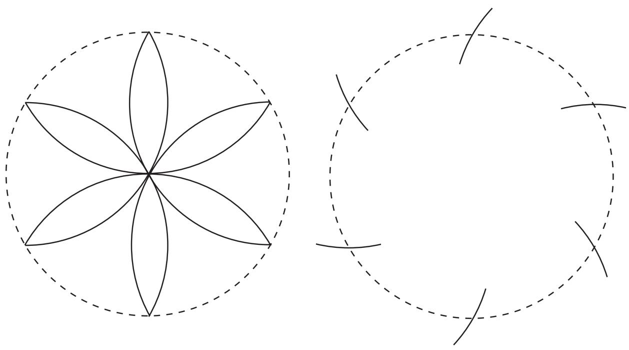

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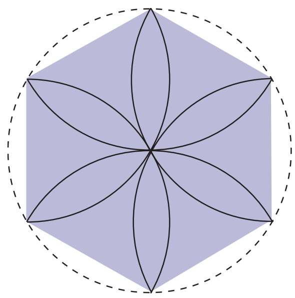

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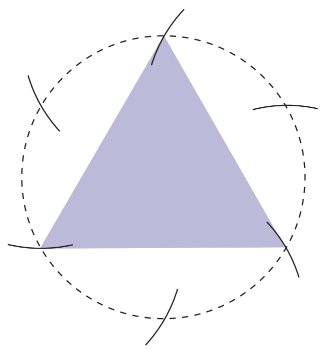

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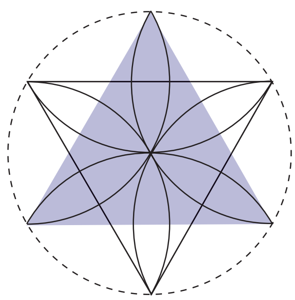

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Connection of four points generates a rectangle, diagram **6**. This rectangle has no historic name, so, because it is often found in medieval buildings and to distinguish it from other rectangles of specific proportion, such as the golden rectangle, it is referred to here as the ***medieval rectangle***.

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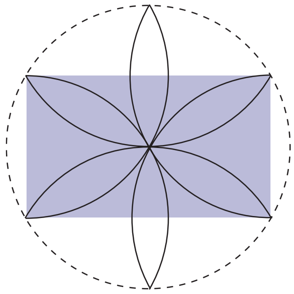

The short side of the medieval rectangle is equal to the circle's radius (it is one of the six equal divisions around the circumference) and its diagonal is equal to the circle's diameter. The rectangle's exterior ratio is approximately 1 : 1.75, the latter a difficult number to multiply or remember, but the true harmonic is the memorable geometrical ratio of 1 : 2 between the rectangle's short side (radius) and diagonal (diameter). No amount of measuring external length or breadth will reveal this intimate internal geometrical harmony, diagram **7**.

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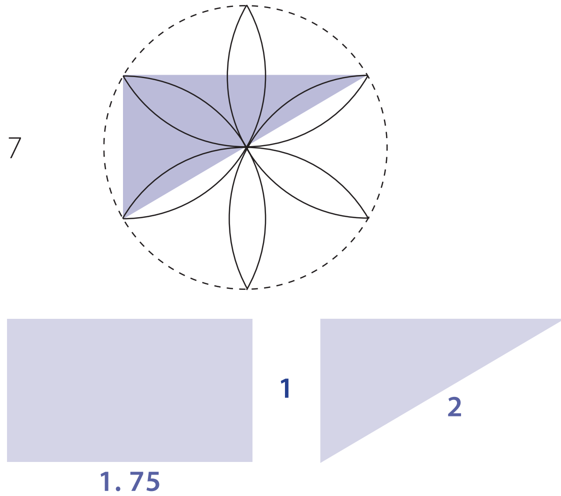

All of the above constructions, springing as they do from shared positions, share intimate relationships. For example, the long sides of the medieval rectangle are equal to the sides of the equilateral triangle and those of the Star of David. If the rectangle and star are superimposed, the long sides of the rectangle are intersected by the lines of the star. When these intersections are connected, the medieval rectangle is subdivided into three smaller rectangles, diagram **8**. The smaller rectangles are identical *in proportion* to the parent rectangle and are therefore also medieval rectangles. This tripartite configuration is found as a window design in both stone and timber building traditions. It can also be seen that the combination of the Star of David and the medieval rectangle generate a ring of six small equilateral triangles with a hexagon at their centre.

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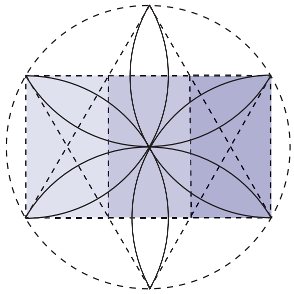

The six points can also be used to generate angles. If all six points are connected a hexagon results and the six angles within the hexagon's rim are all equal at 120°. Connecting every second point gives an equilateral triangle and the three angles within the triangle are all equal at 60°, diagram **9**.

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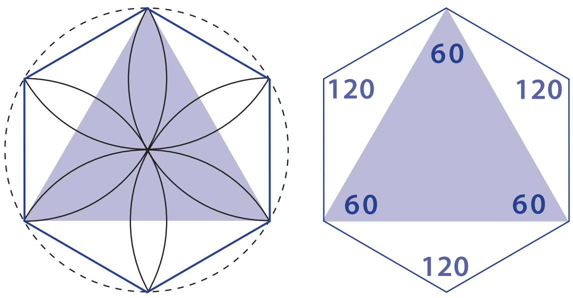

The four corners of the medieval rectangle are all equal at 90° but, if the rectangle is cut by a diagonal, two equal triangles of 30°, 60°, 90° are produced, diagram **10**. The 30°, 60°, 90° triangle makes a perfect carpenter's or mason's set square.

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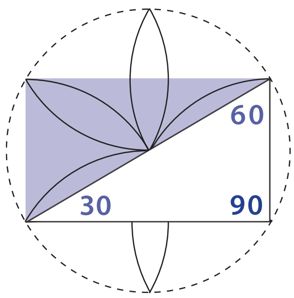

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If the full daisy wheel construction of six circles around a central circle is drawn and every intersection of the circles is connected to the central circle's axis the radials give twelve equal 30° angles, diagram **11**. And if just the central daisy wheel (or cut cirlce) is drawn, connecting each petal tip (or cut) the wheel's axis will give six equal 60° angles, diagram **12**.

If two daisy wheels are drawn through each other's centres on a centre line AB, their intersections can be bisected to form the perpendicular CD. It is interesting to note that the intersections of the circles pass through two of the six equidistant points (of each circle) and the line AB passes through others. The four angles at the centre of the construction are all equal at 90°. Further right angles can be drawn through the points E and F and their mirror image points on the left (not indicated by letters), diagram **13**. Bisecting the vesica formed by the overlap of two circles or wheels gives a perfect right angle because the circles intersect at two precision locations that are perpendicular to the centre line.

A shorthand right angle can be drawn using circles alone, with the perpendicular CD drawn between the intersection of the two circles, diagram **14**. A shorter version can be achieved by drawing two circles or, even shorter, by the drawing just the sectors of the circles likely to intersect (shown in solid line). Where arcs intersect, draw the perpendicular CD.

It can be seen from drawings 13 and 14 that the overlap of the daisy wheels (or circles) generates two vesicas, the larger contained between the circumferences of the two wheels (or circles) and the smaller identical in size to each daisy wheel's six radial petals. This means that they are always harmonically related. It can also be seen that a vesica can easily be drawn to any known dimension by drawing from either end of a line of specified length, say AB. This line is always the smaller of the vesica's two axes.

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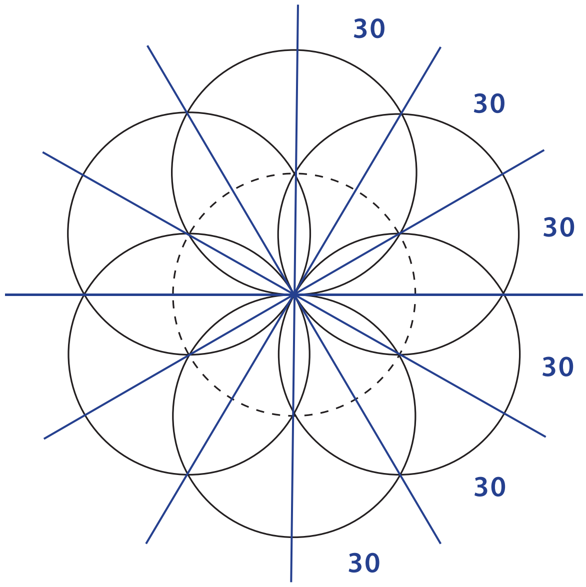

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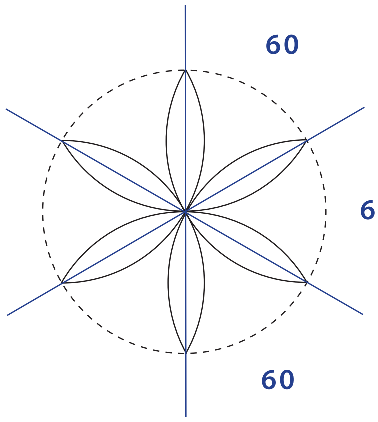

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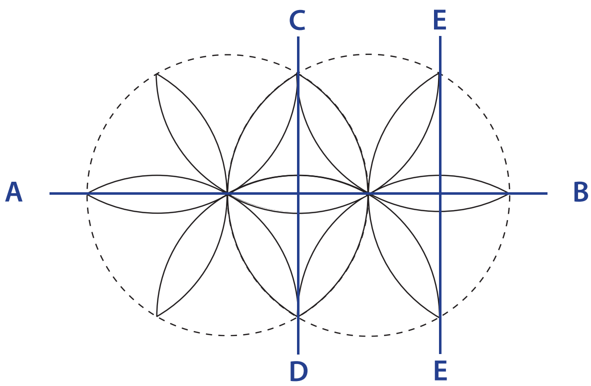

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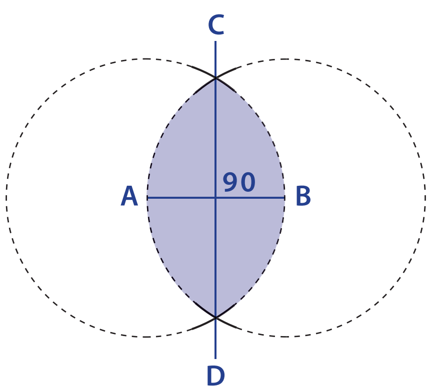

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The daisy wheel has three alignments, each drawn through a pair of petals that combine to span the diameter of the wheel. The three alignments project at 60˚ intervals around the wheel's circumference, each pointing in two directions but here, for simplicity, they are shown facing in a single direction only. The daisy wheel and, in consequence, the three alignments can be drawn with either a vertical emphasis, diagram **15**, or a horizontal emphasis, diagram **16**. This means that the rectangle drawn between four of the wheel's six points is also either verical or horizontal. The orientation of the rectangle has design implications and it is clear that while the vertical rectangle is suitable for the proportions of a door, the horizontal is suitable for a window (especially if the Star of David is constructed and the rectangle is cut into three smaller, equal rectangles, or a tri-partite window with two mullions). Finding the orientation of a vertical daisy wheel from a horizontal one (and vice versa) is simple. Two of the daisy wheel's petal arcs are extended until they intersect. A line is then drawn between the intersection and the wheel's axis. Where the line cuts the wheel's circumference it marks the point from which the opposite wheel can be drawn, diagram **17**.

A square can be constructed within the daisy wheel using the same method described for diagram 17. Once the new alignment is drawn the wheel has two alignments that cross at right angles at the wheel's axis. It follows logically that where the alignments cut the wheel's circumference they are equidistant from each other and, as such, constitute the four corners of a square, diagram **18**. It can be seen that the arcs of the two daisy wheel petals and their extension form another vesica piscis, half in and half out of the wheel.

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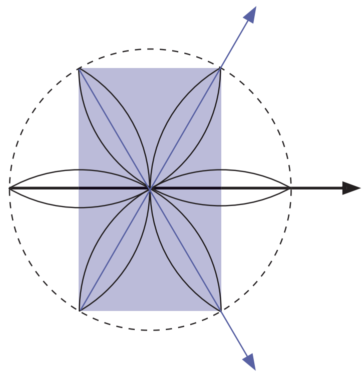

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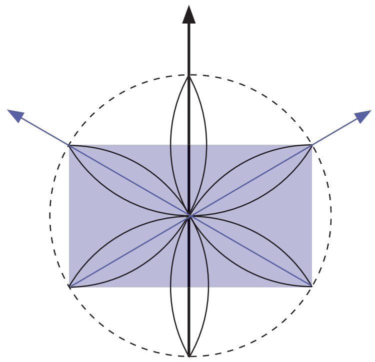

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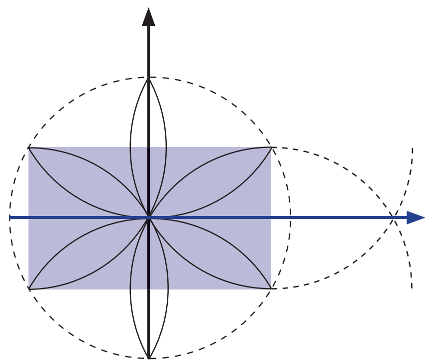

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