

ERIC BROUG

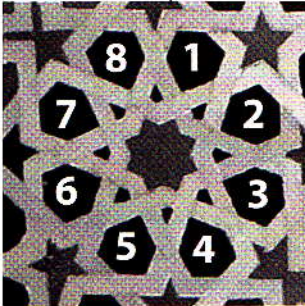
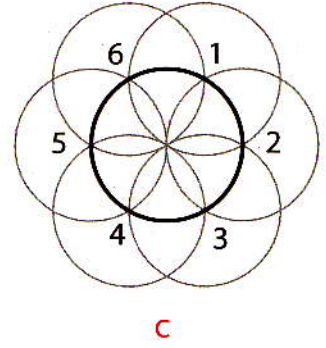
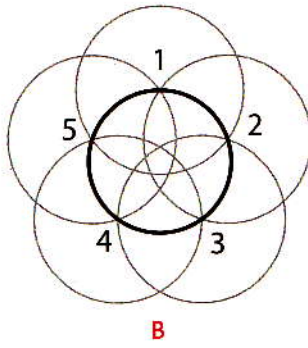
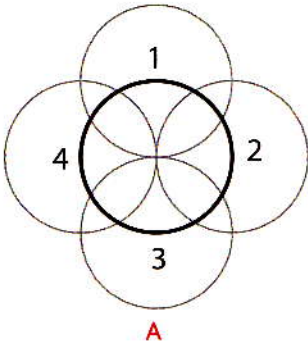
Islamic
GEOMETRIC
PATTERNS

with over 290 illustrations

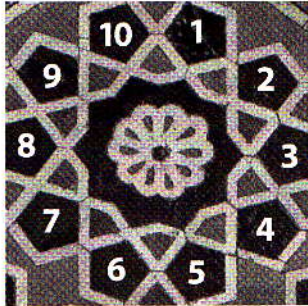


Thames & Hudson

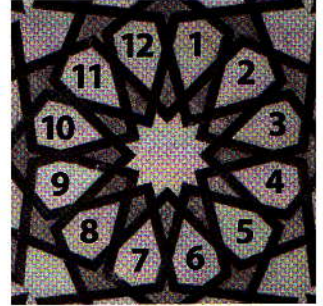
CHAPTER 1: The Basics



The Alhambra, Granada, Spain



Muradiye Mosque, Bursa, Turkey



The Great Mosque of Damascus, Syria

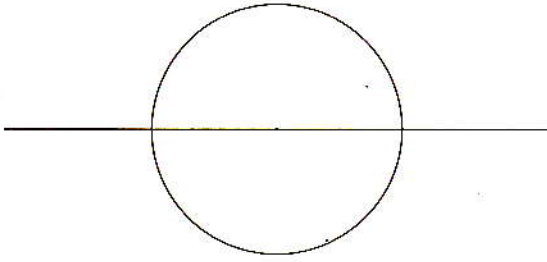
The starting point for every geometric pattern is a perfect circle. A designer adds secondary circles of various sizes, interlacing them and connecting the intersections with straight lines to create intricate designs. The way the circles and lines intersect one another determines the basic shape and 'family' of the pattern.

It is important to decide how many secondary circles will be drawn around the primary circle before you start, as this will indicate which family or group it belongs to. There are a limited number of options, and most of the geometric patterns found in Islamic art and architecture fall into the three families illustrated above in which four (A), five (B) or six (C) interlacing secondary circles are constructed around the primary circle.

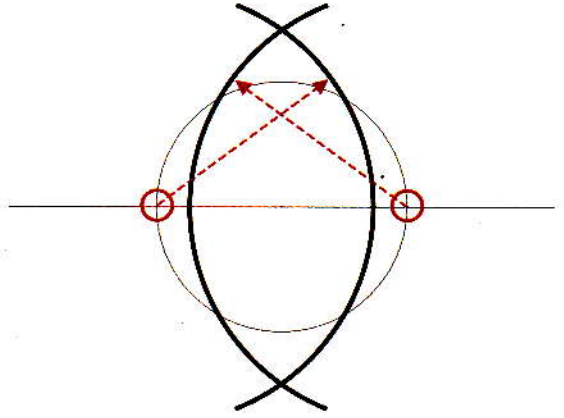
Hundreds of different geometric patterns can be created from these three groups, which include designs with multiples of four, five and six secondary forms. It should be easy to work out which family a pattern belongs to by identifying the motif and counting the number of identical forms around its star-shaped centre. The examples in the photographs above show patterns with eight, ten and twelve identical forms around a star which belong to families A, B and C respectively.

Patterns in groups A, B and C fit into a square, pentagon and hexagon respectively. The step-by-step diagrams on the following pages show you how to construct these shapes using straightedge-and-compass. However, all of the patterns demonstrated in Chapter 2 belong to groups A or C as pentagons (B) can only be tiled in combination with other shapes.

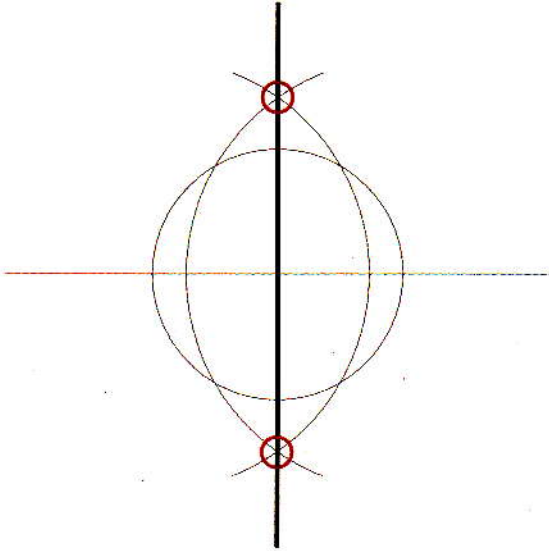
Squares



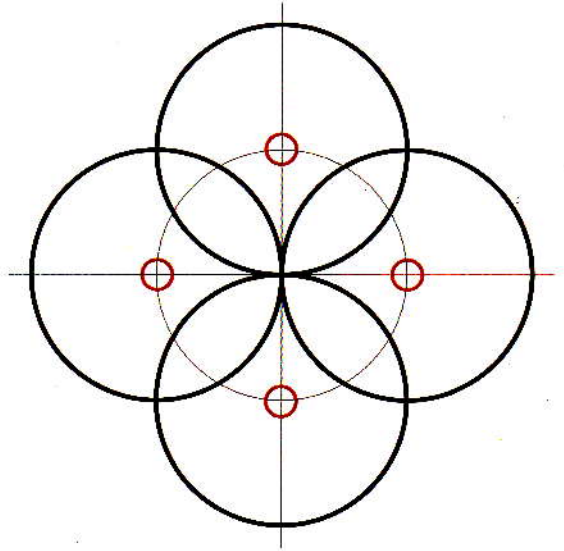
- 1 Mark out a horizontal line. Place the compass point on the line and draw a circle.



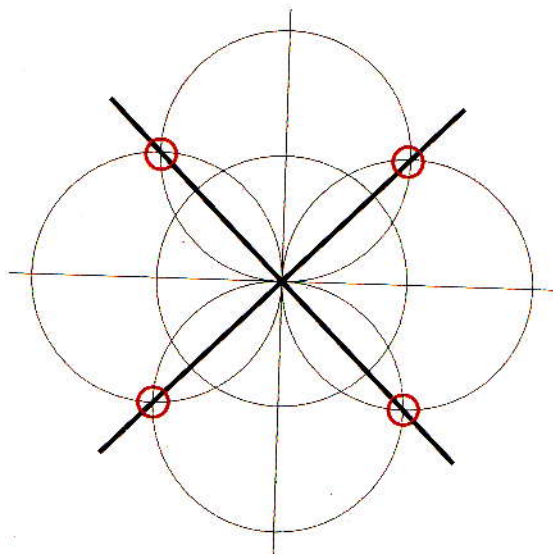
- 2 Placing the compass point on each of the ringed intersections, draw two arcs of equal size. It doesn't matter what their radius is, as long as they meet above and below the circle.



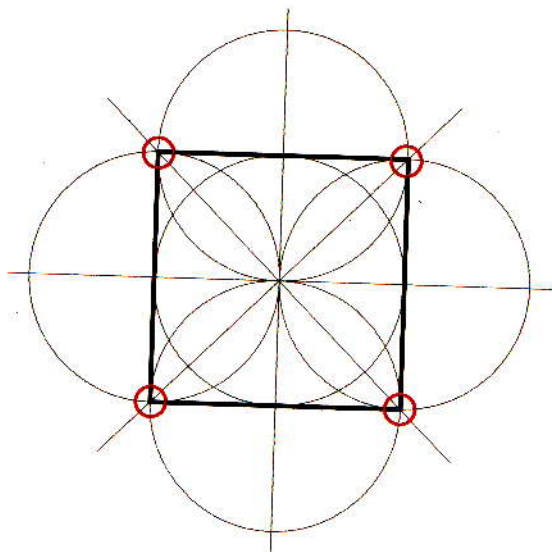
- 3 Draw a line connecting the two points where the arcs meet.



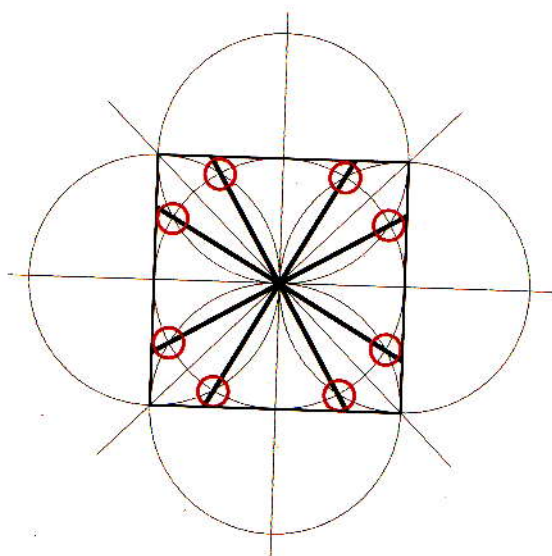
- 4 Place the compass point on each of the ringed intersections and draw four secondary circles of equal size. The secondary circles should touch at the centre point of the primary circle, where the intersecting horizontal and vertical lines meet.



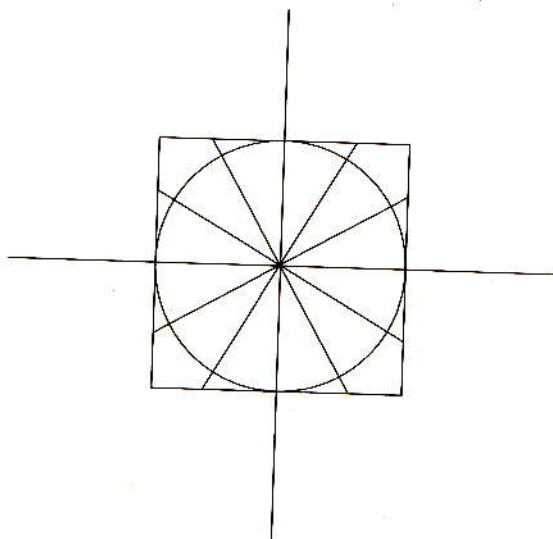
- 5 Connect the four circled intersections with two diagonal lines.



- 6 Draw a square by connecting the highlighted intersections as shown. In this book the majority of square units in step 1 are divided into eight equal parts.
- Follow steps 7 and 8 to divide the square into twelve equal parts
 - Follow steps 9, 10 and 11 to divide the square into sixteen equal parts

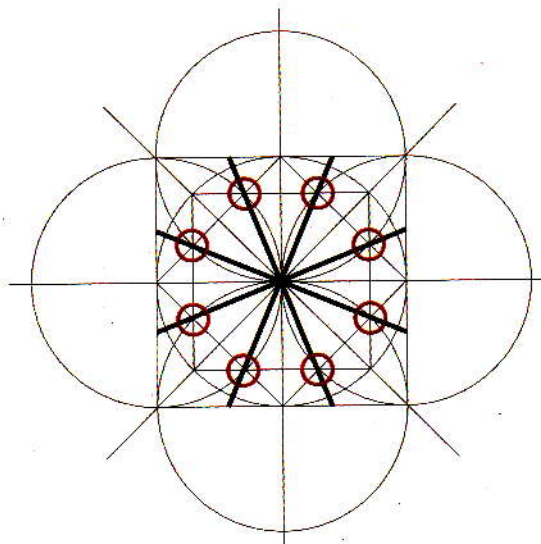
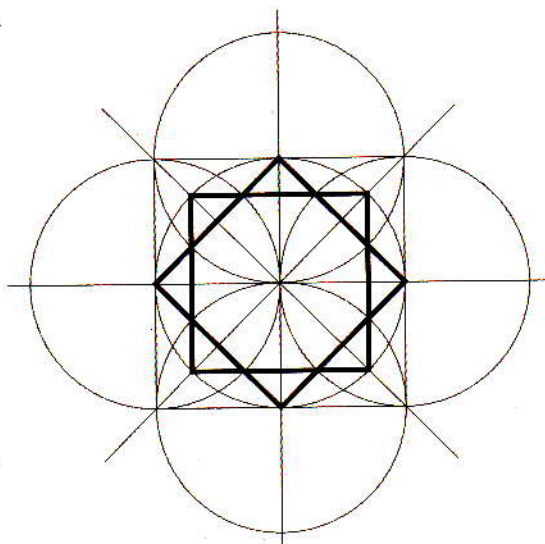


- 7 Connect the ringed intersections with four diagonal lines.



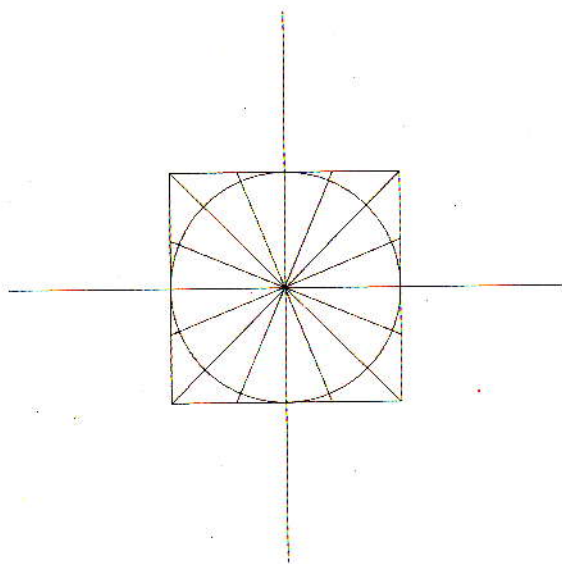
- 8 Without the construction lines the twelve equal parts are clear. The patterns on pages 71 and 88 are based on this square unit.

Squares



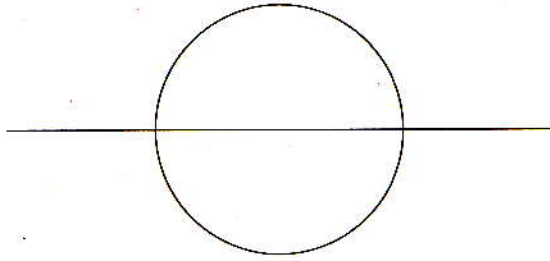
9 In the primary circle draw the two squares highlighted in bold, using the horizontal and vertical lines as markers.

10 Connect the ringed intersections with four diagonal lines.

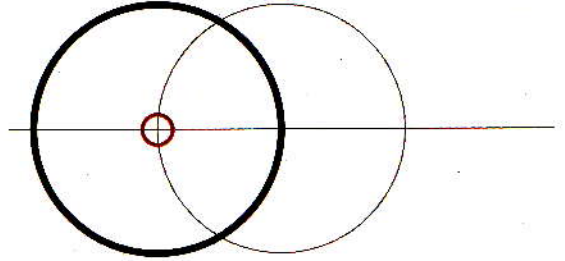


11 The pattern on page 66 is the only example in Chapter 2 to be based on this square, which is divided into sixteen equal parts.

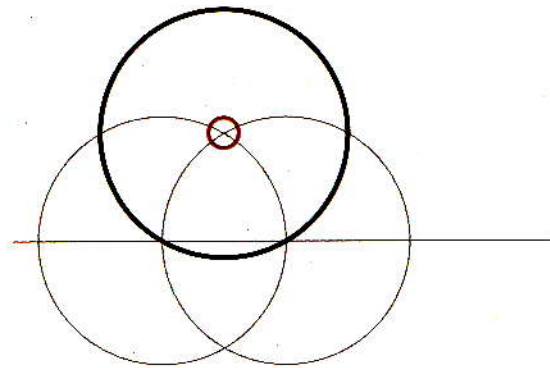
Hexagons



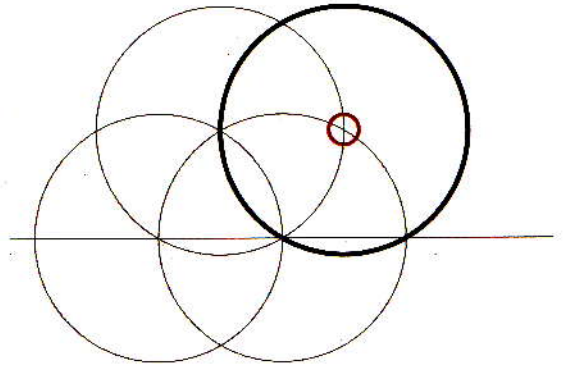
1 Start with a horizontal line and a circle.



2 Place the compass point on the marked intersection and draw a secondary circle of equal size.

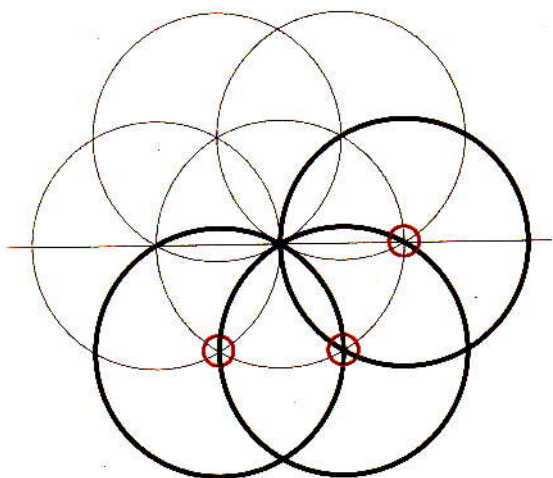


3 Place the compass point on the ringed intersection and draw a third circle.

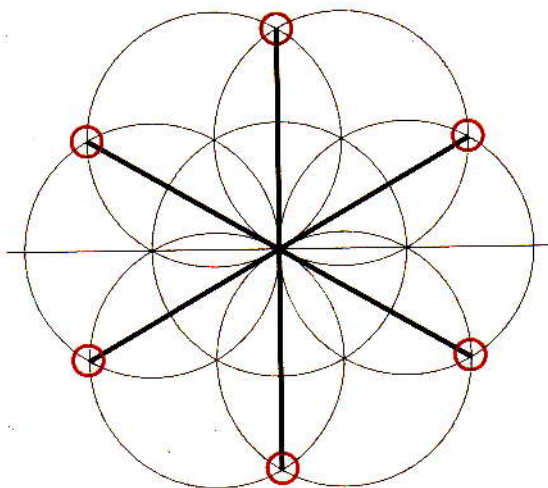


4 Draw a fourth circle, as shown.

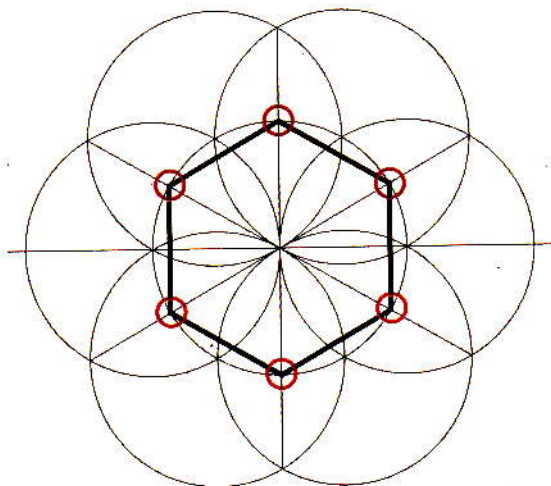
Hexagons



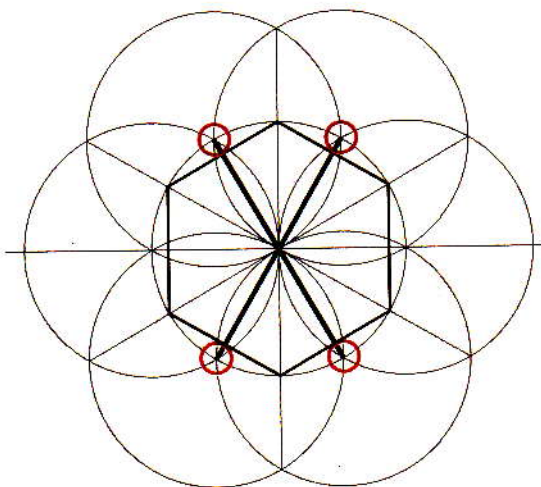
- 5** Draw another three circles, following the same procedure. You should end up with six secondary circles around the primary circle.



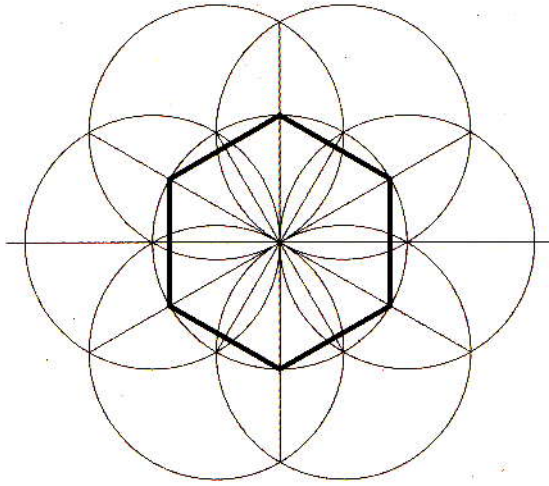
- 6** Connect the ringed intersections with three lines.



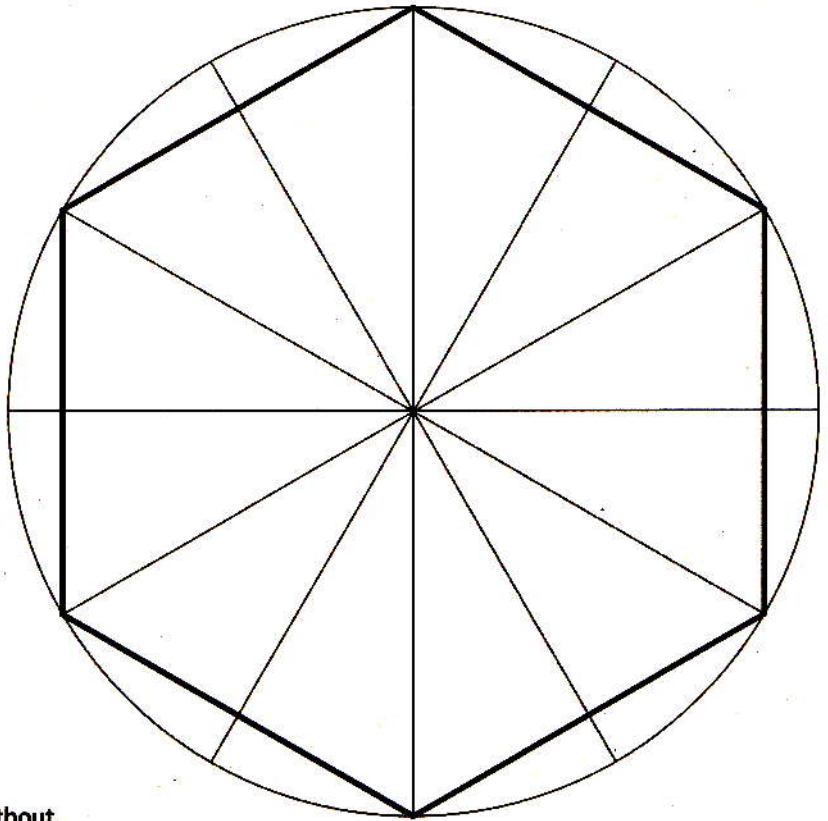
- 7** Connect the circled intersections to construct a hexagon.



- 8** Divide the hexagon into twelve equal parts by adding two lines, as shown. The original horizontal line in step 1 represents the first line. This is the starting point for most of the hexagonal patterns in this book.



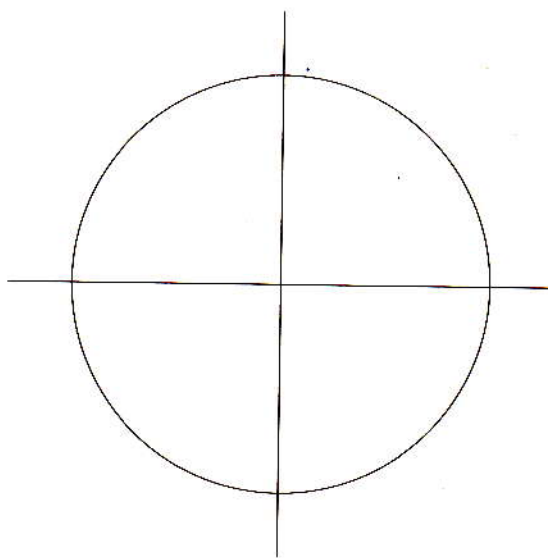
- 9 A hexagon divided into twelve equal parts, with the construction lines of the secondary circles still in place.



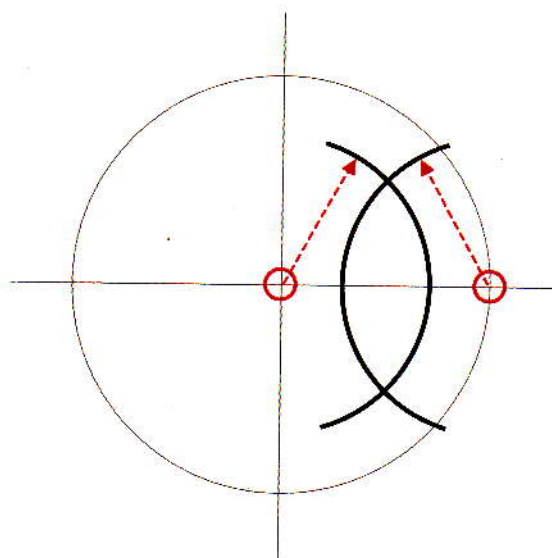
- 10 The same hexagon without the construction lines.

Pentagons

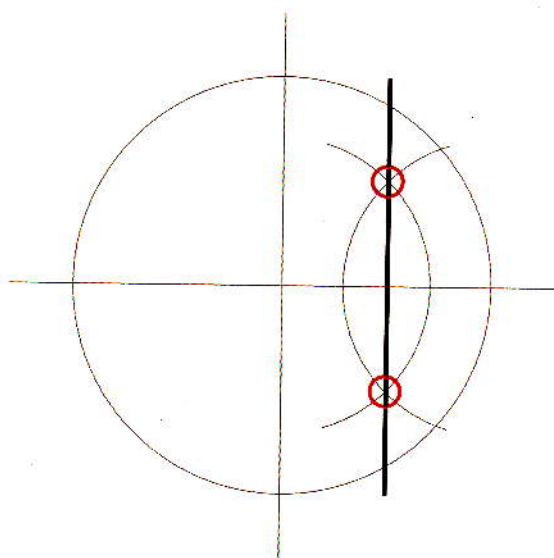
Over the centuries various methods have been devised to construct a pentagon within a circle. Knowing how to draw this shape with straightedge-and-compass is a useful basic geometric skill, although pentagons are rarely seen in Islamic geometric patterns – partly because constructing large-scale compositions from a pentagonal recurring motif is such a complicated process. The problem lies in the angle: it is impossible to tessellate pentagons of equal sides around a 360-degree point without combining them with other forms or shapes, because each angle is 108 degrees. Squares and hexagons are much more straightforward: a surface can be covered with a repeated square or hexagonal unit much more easily, with all the components fitting together perfectly.



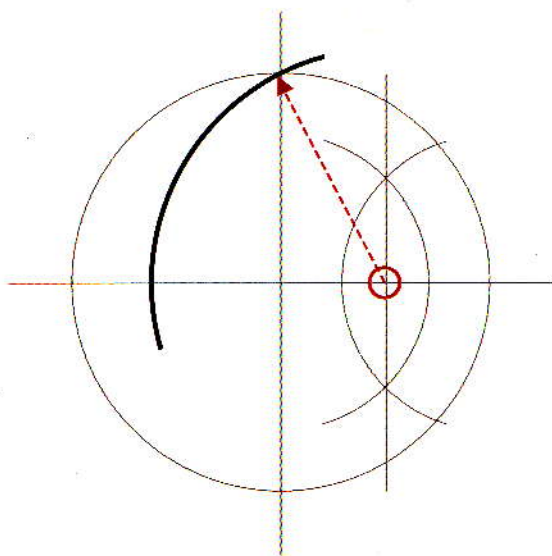
- 1 Follow steps 1 to 3 on page 10 to construct a circle with intersecting horizontal and vertical lines.



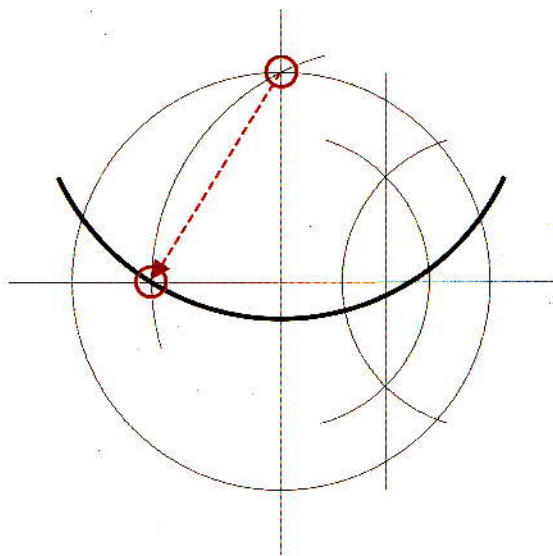
- 2 Draw two intersecting arcs of equal size by placing the compass point on the marked intersections. The radius of the arcs is unimportant.



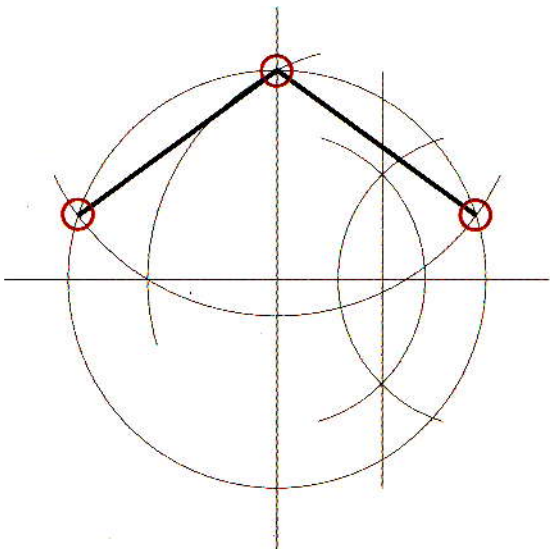
- 3 Draw a line that connects both points where the arcs meet.



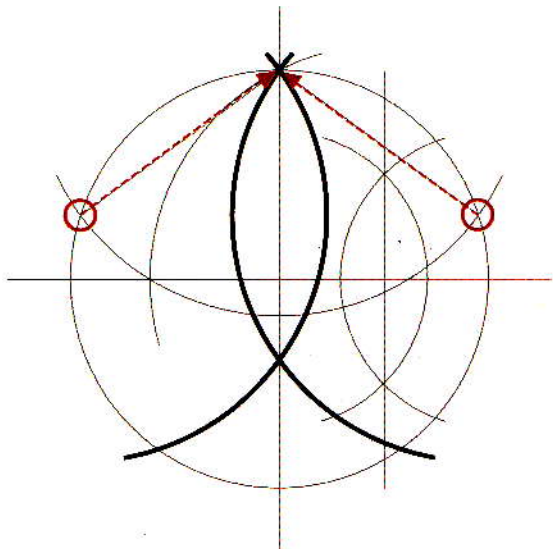
- 4 Place the compass point on the circled intersection. Draw an arc that cuts through the top of the primary circle – where the circumference of the primary circle and the vertical line intersect – and the horizontal line.



- 5 Draw another arc, placing the compass point on the ringed intersection at the top of the circle. Make sure this fourth arc cuts through the horizontal line at the marked intersection.

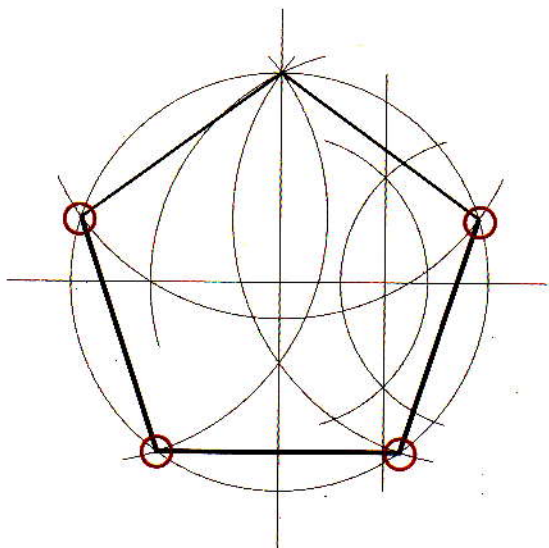


- 6 Connect the ringed intersections with two lines, which form the 'roof' of the pentagon. All of the lines that make up this pentagon are of equal length.

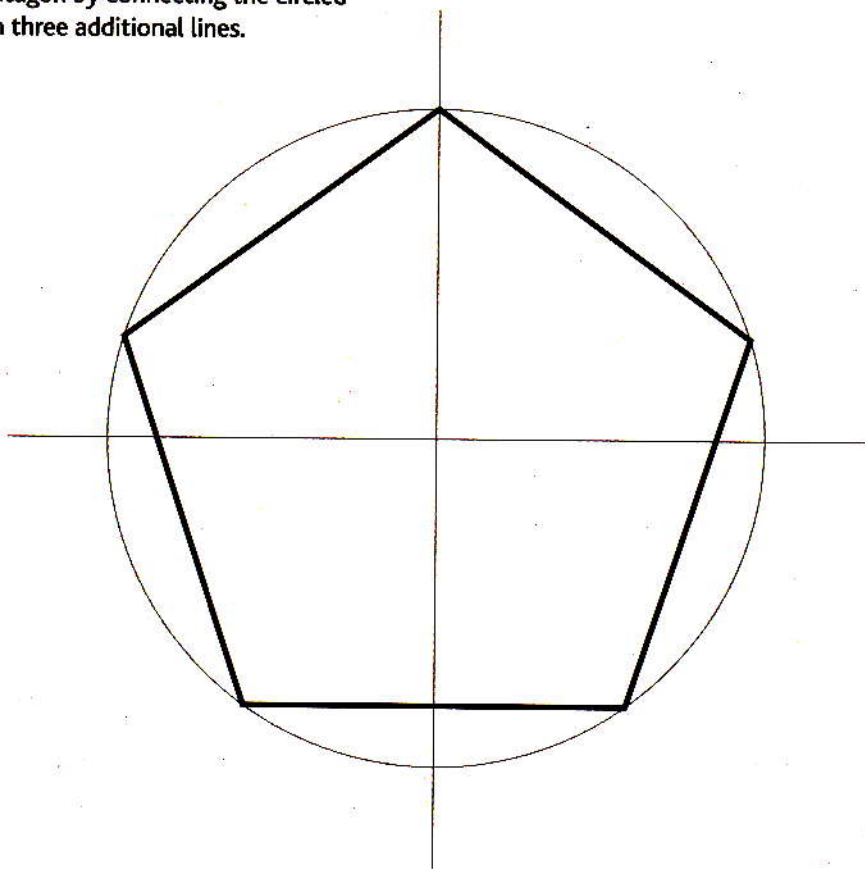


- 7 Place the compass point on the ringed intersections to create another pair of arcs which cut through the apex of the roof. Make sure that these two arcs are long enough to cut through the lower circumference of the circle.

Pentagons



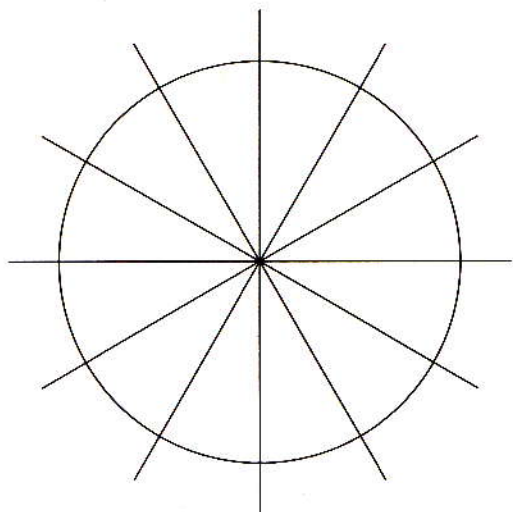
- 8 Complete the pentagon by connecting the circled intersections with three additional lines.



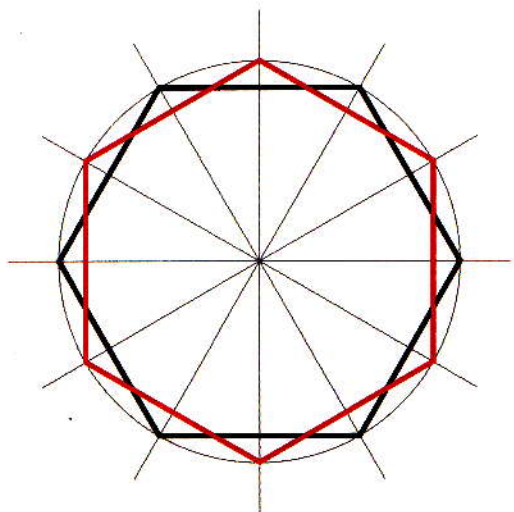
- 9 The final result, without the construction lines.

Combinations

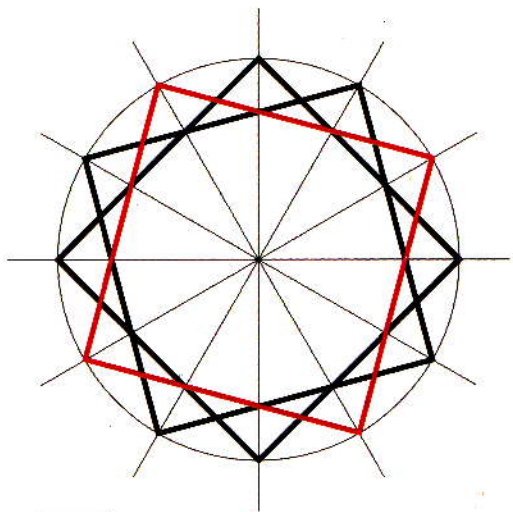
There are various ways to look at geometric patterns. This book takes a step-by-step approach, showing how traditional designers built up their patterns. However, geometric patterns can also be constructed mathematically, as this section illustrates.



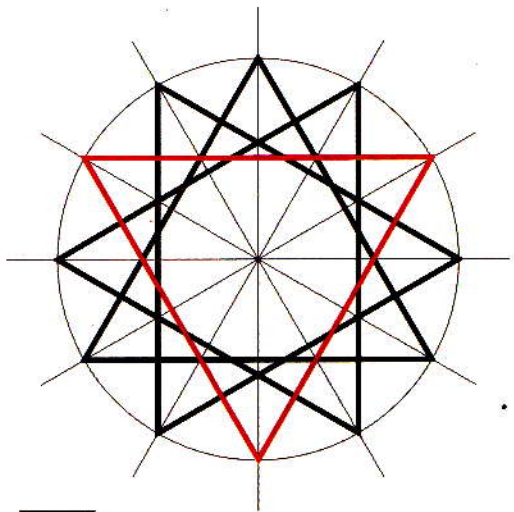
A circle with twelve equal parts is the starting point for a traditional star pattern. You can proceed in one of three ways, based on two hexagons, three squares or four triangles in a circle, but your choice will determine the ultimate shape of the star pattern.



x 2 Two hexagons in a circle
($2 \times 6 = 12$)



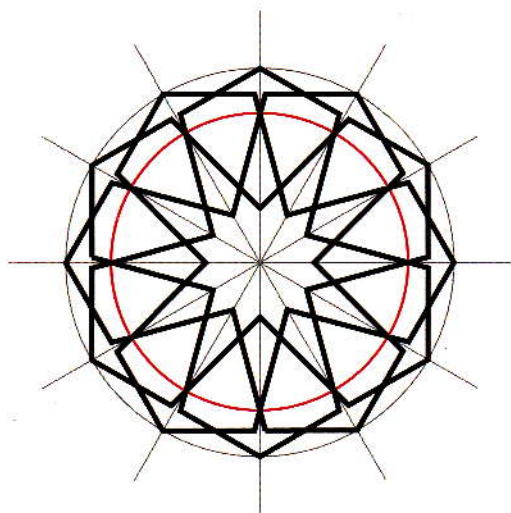
x 3 Three squares in a circle
($3 \times 4 = 12$)



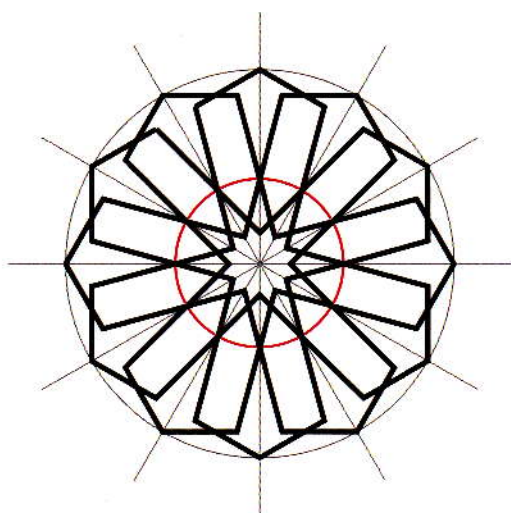
x 4 Four triangles in a circle
($4 \times 3 = 12$)

Combinations

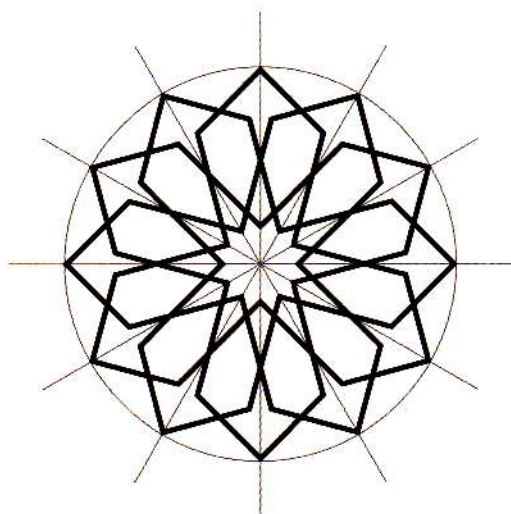
Combinations of two hexagons, three squares or four triangles form the basis of many geometric patterns, including the star patterns below. The size of the central star and the surrounding shapes must be well balanced.



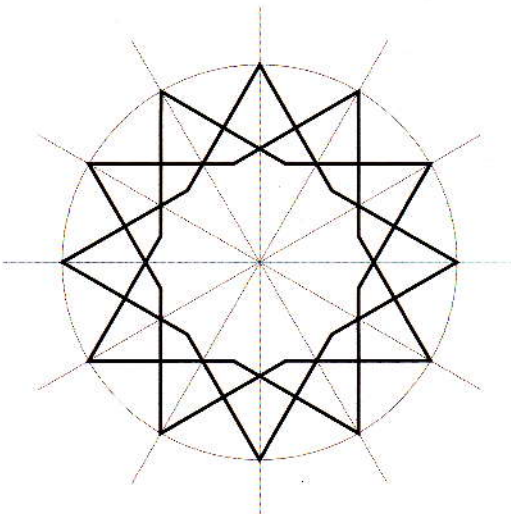
x2 **Good** A traditional star pattern based on two hexagons within a circle. The red circle shows where the lines intersect to create the star pattern. Compare this hexagonal pattern with the one on the right.



x2 **Bad** This star pattern is also based on two hexagons within a circle. However, the red circle is much smaller here than in the previous pattern, and the outer shapes look excessively large, creating an imbalance.

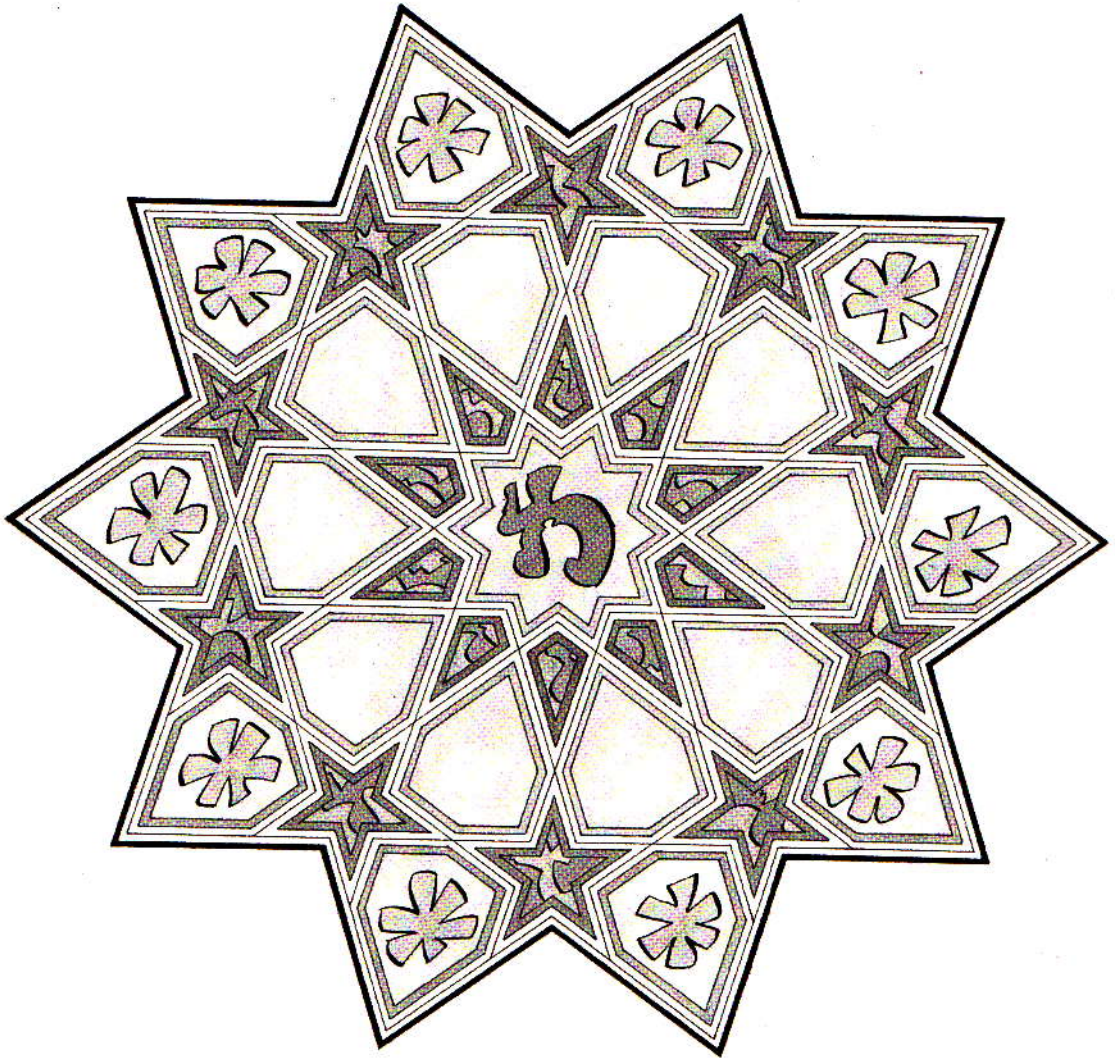


x3 A traditional star pattern based on three squares within a circle.



x4 A traditional star pattern based on four triangles in a circle.

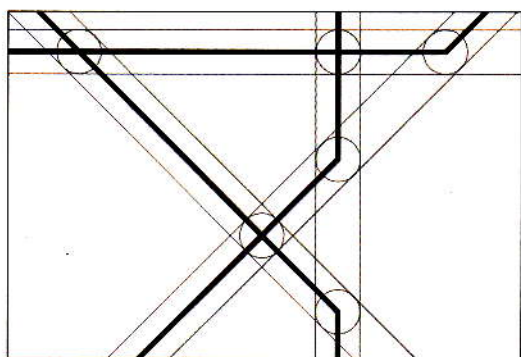
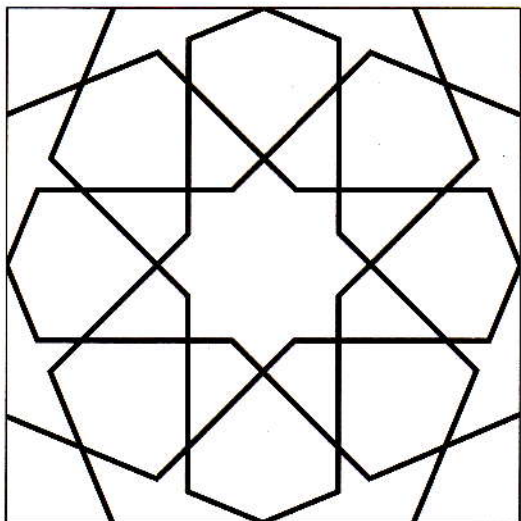
Design Tips



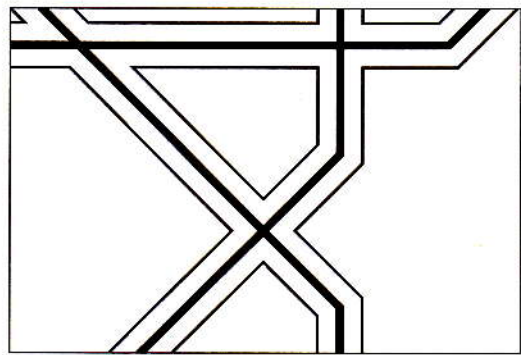
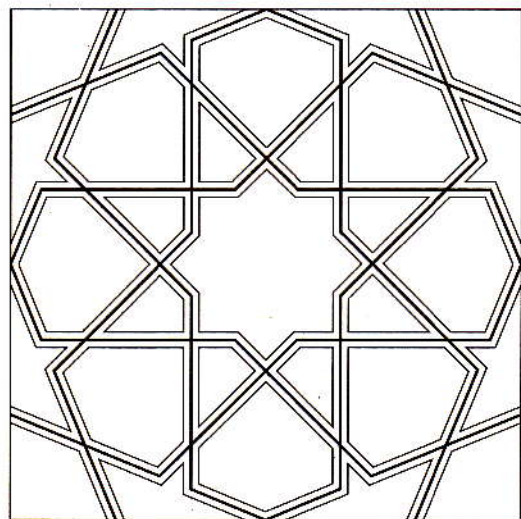
Harmony and balance are important elements of Islamic geometric art. A pattern that is made up entirely of straight lines is incomplete; it needs an extra something to set off the different elements and shapes. This is why designers lavish a great deal of attention on decoration in almost all traditional geometric compositions. It is possible to bring

out the symmetry and richness of a line pattern by applying vegetal motifs such as flowers and leaves, for example, or colour. The geometric patterns in this book are only the first step; the following pages are designed to enable you to take the next step of transforming a line drawing into an elaborate geometric composition.

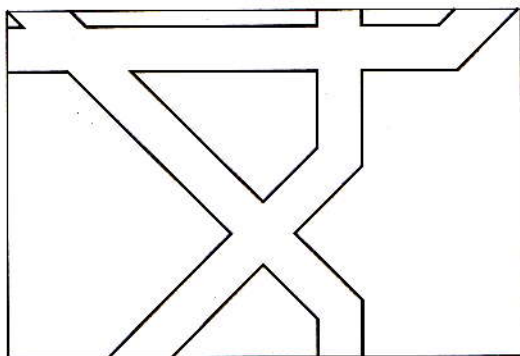
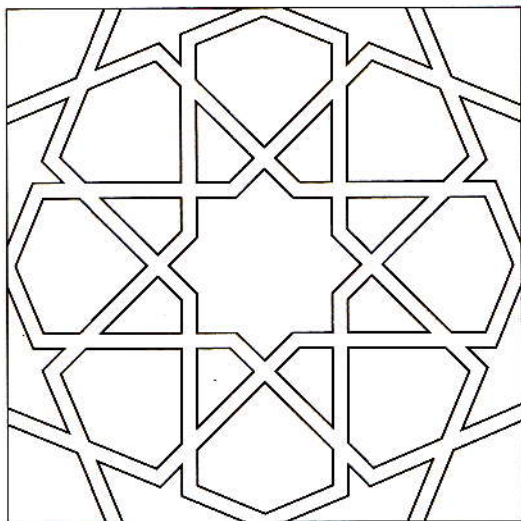
Design Tips



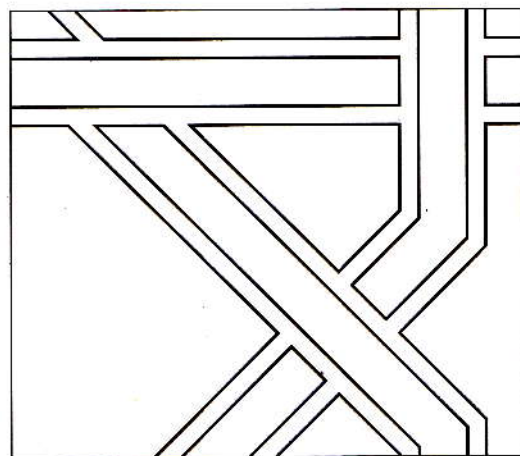
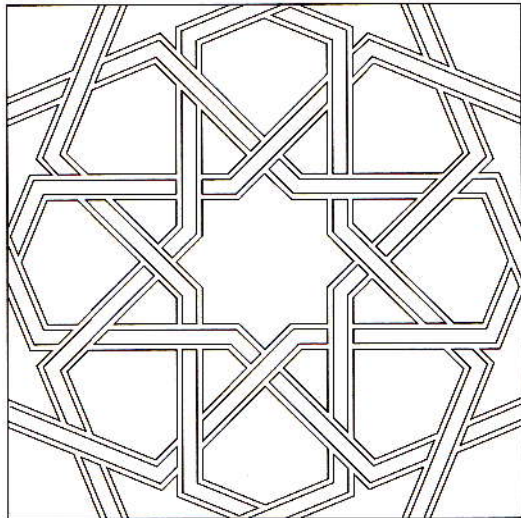
Encasing the structure of a pattern in double lines enriches the design. There are two ways of doing this: either use a ruler to mark up a new line either side of and at an equal distance from the original structure; or use a compass to construct small circles of equal size at each intersection in the original structure and connect them as shown in the detail above.



The combination of inner and outer lines creates an intricate pattern which can be further embellished with colour and motifs; clarifying the different shapes gives the pattern balance. The original line pattern, marked above in bold, can be highlighted with changes in colour or line weight to emphasize different elements of the composition.



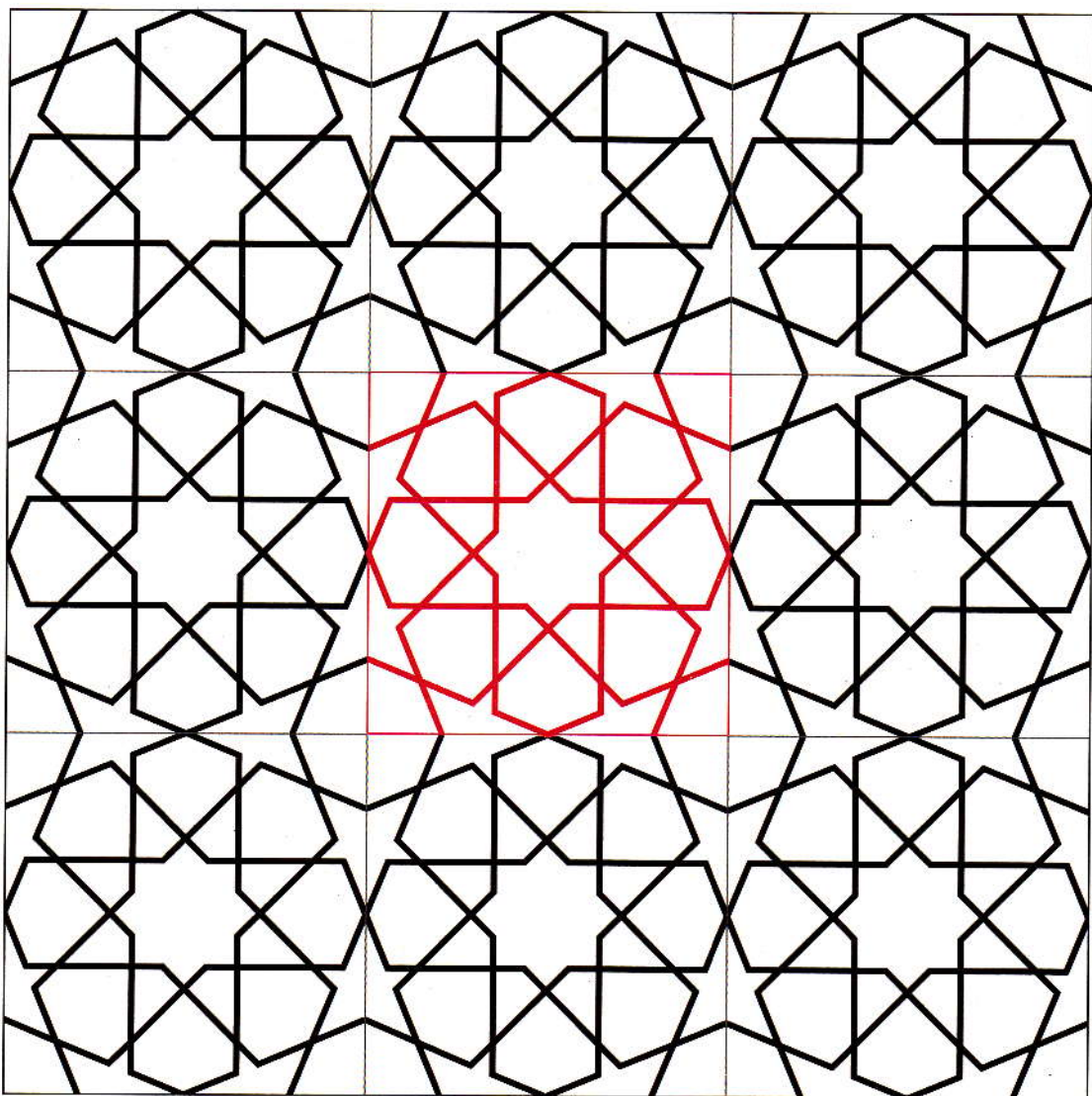
Draw all the lines initially in pencil as you will need to erase some of the construction marks. The diagrams above show the design opposite stripped of the original structural lines, highlighting individual forms that can be elaborately decorated with patterns and colour. In this composition the (decorated) shapes and the (blank) spaces in between are in harmony. It is important not to draw the lines too far apart from one another – otherwise you will find that the individual shapes appear overly small.



To turn the design into an interlace pattern, first add another set of double lines in pencil. Then work out how you want the different bands to interlace. In most geometric patterns, the bands tend to go over and under one another in an alternating sequence. Whichever way you choose, the sequence should be logical: if one band goes over another band and then under the next, and so on, this sequence should be applied throughout the entire design. Ink over the double lines to produce the interlace effect and rub out the pencil marks.

The Great Mosque of Kairouan

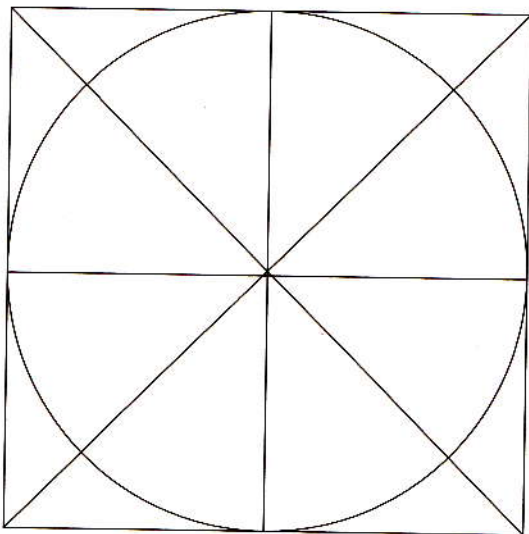
Kairouan, Tunisia (AD 670 / AH 50)



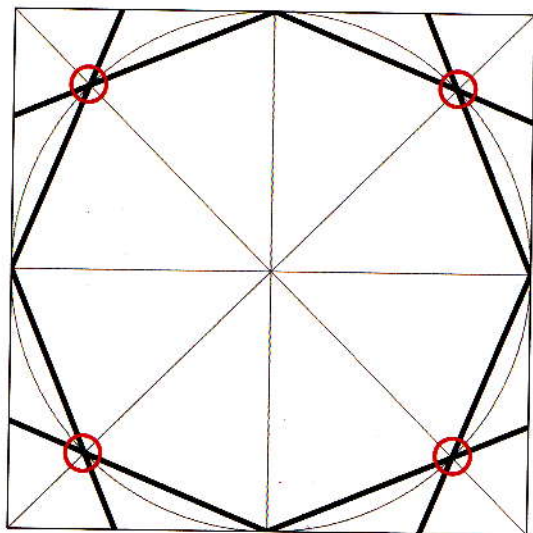
Kairouan was founded in around AD 670 when the Arab conqueror Uqba ibn Nafi established a military post there and ordered a mosque to be built. Located on the site of a ruined Roman or Byzantine town, Kairouan – which takes its name from the Arabic for ‘camp’ (*Qayrawan*) – is slightly elevated above the surrounding plain and was well placed against enemy

attacks or floods. The Great Mosque is the centrepiece of Kairouan, which is the fourth holy city of Islam after Mecca, Medina and Jerusalem. The original red-brick mosque was rebuilt on several occasions but the present form dates from around AD 836, making it one of the oldest mosques in the world.

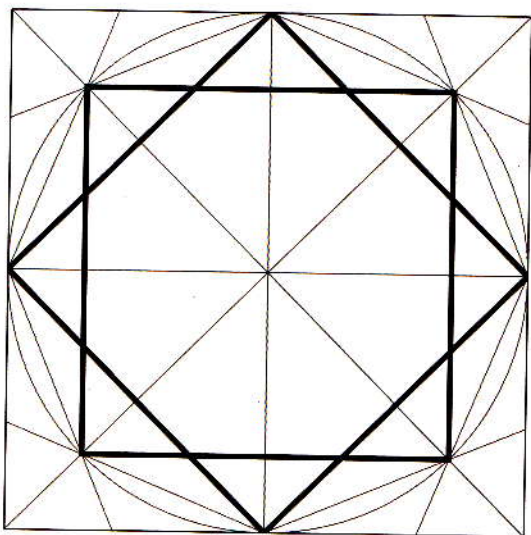
CD: SAMPLE PATTERNS (5)



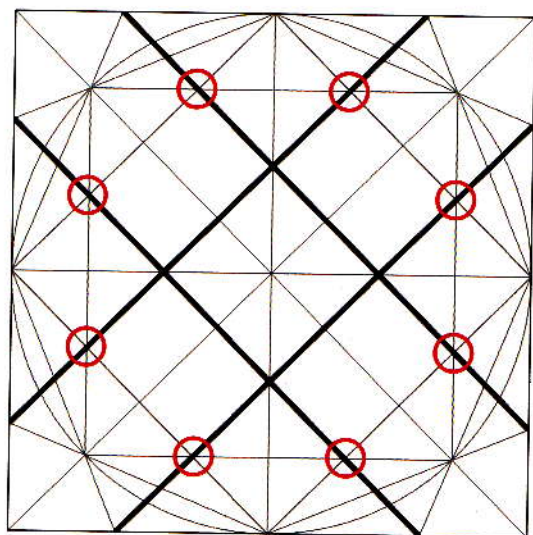
- 1 In pencil draw a circle in a square with four intersecting lines (> 10–11).
CD: BASIC TEMPLATES (1 & 2)



- 2 Draw eight lines that run through the ringed intersections to the edge of the box. An octagon is created within the circle.

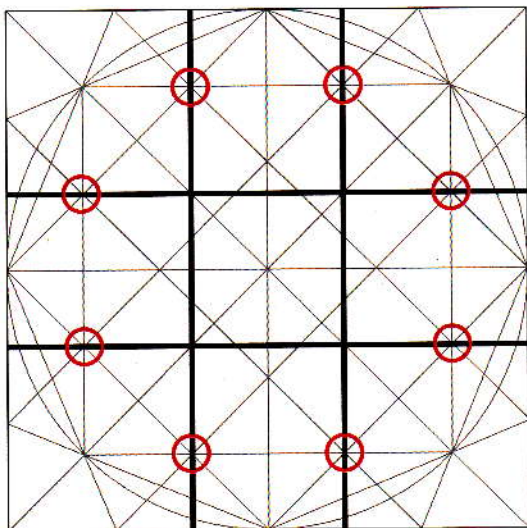


- 3 Now draw two interlocking squares within the circle.

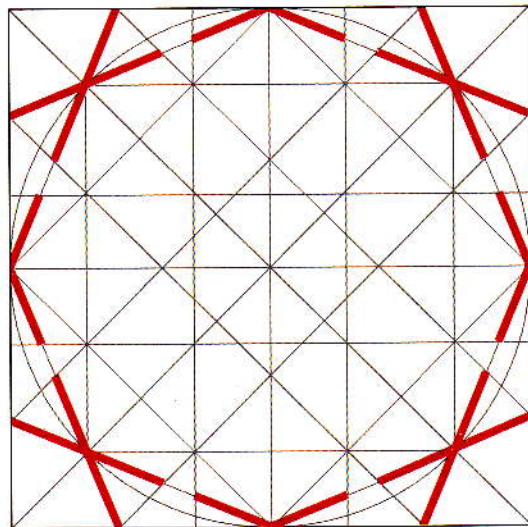


- 4 Use the highlighted intersections as guides to draw two sets of parallel diagonal lines.

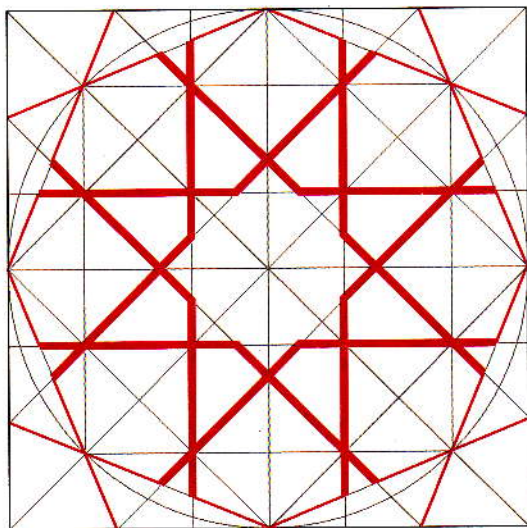
The Great Mosque of Kairouan



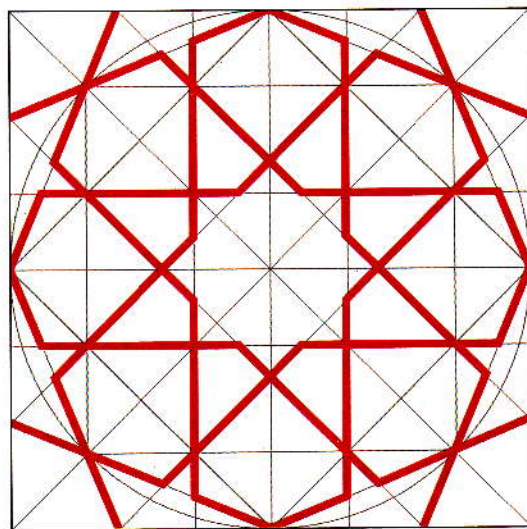
- 5 Using the same intersections as guides, draw another two pairs of parallel lines, this time running vertically and horizontally.



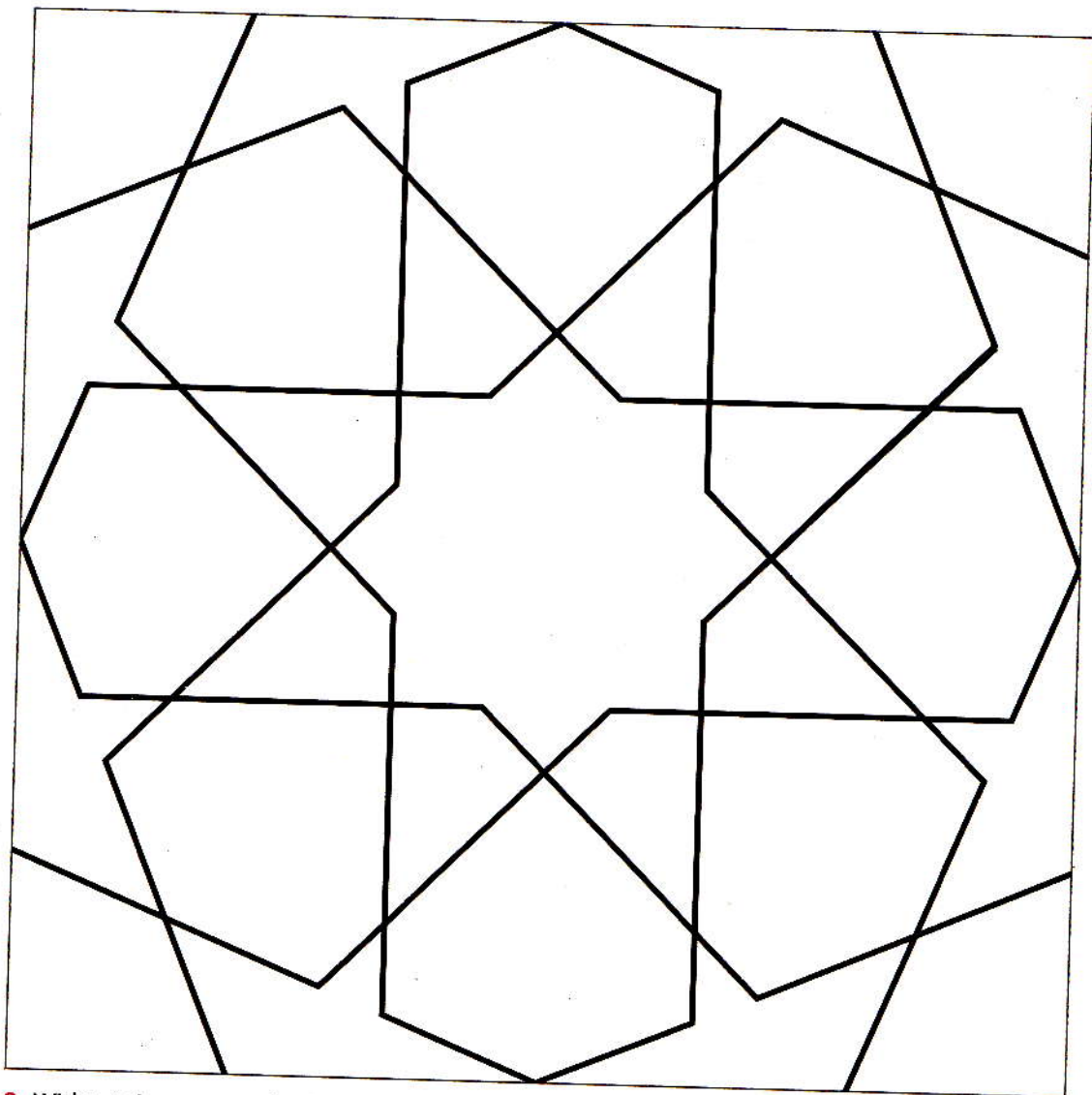
- 6 Use a pen to highlight the bold red lines, paying close attention to where the lines should begin and end.



- 7 Now ink over these lines to create a star pattern.



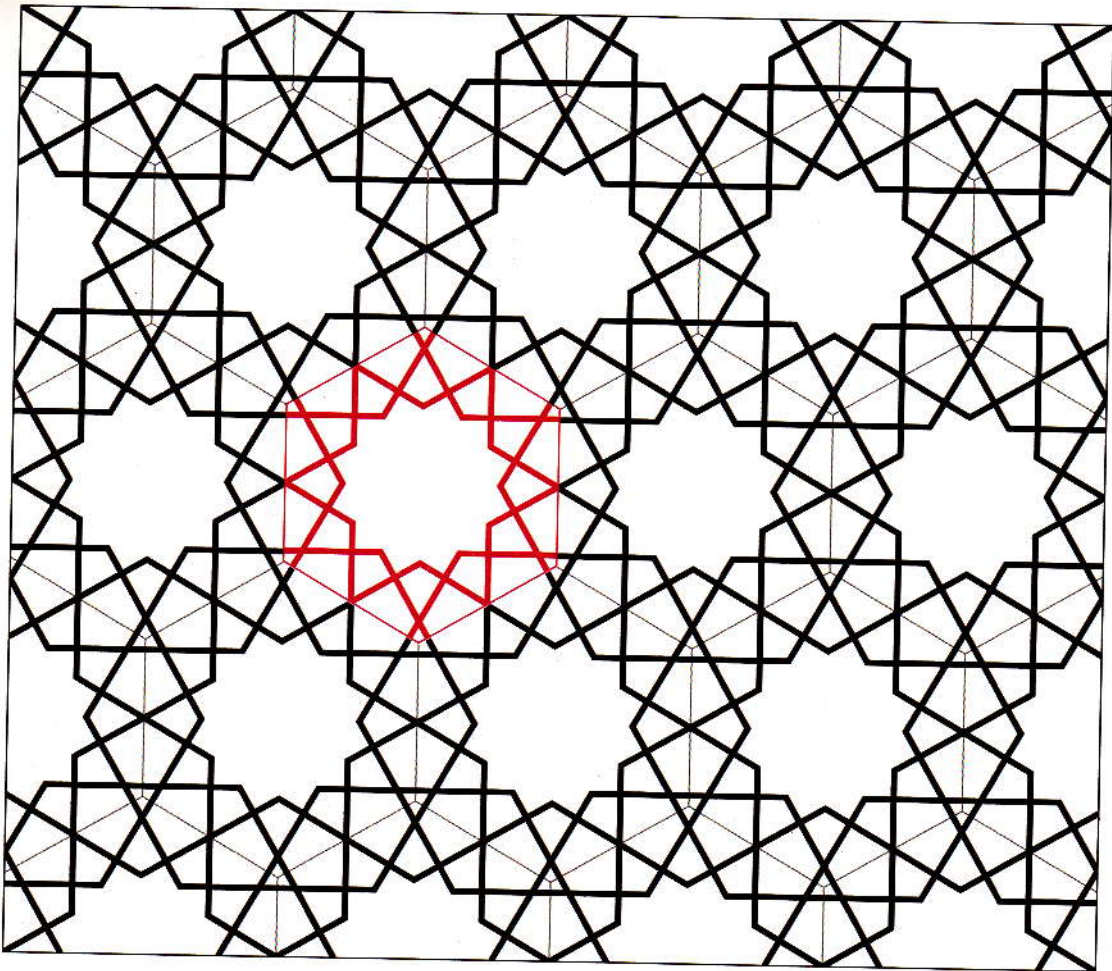
- 8 The finished pattern is in red, with the construction lines in grey.



9 Without the construction lines.

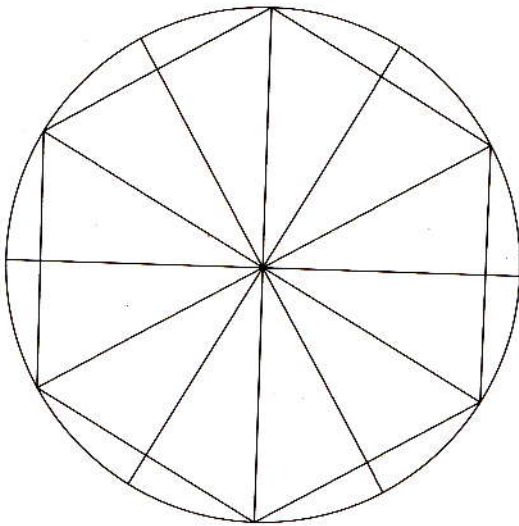
The Great Mosque of Herat

Herat, Afghanistan (AD 1200 / AH 596)

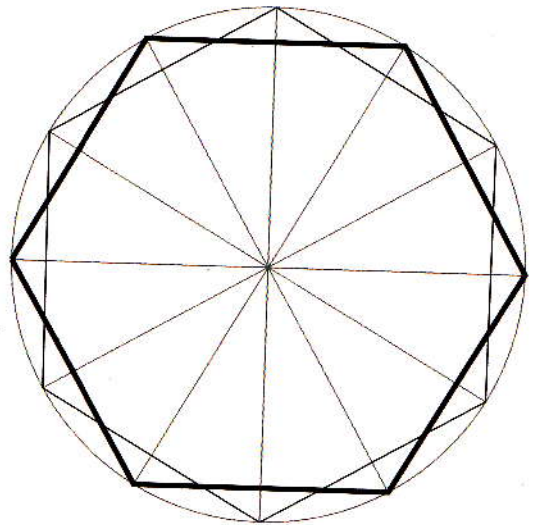


Herat is dominated by a citadel, originally built under the rule of Alexander the Great in 330 BC, and was renowned for producing fine metalwares and textiles throughout the Islamic period. The Great Mosque of Herat was the city's first Friday mosque and is decorated with glazed tiles with floral motifs. The present structure was begun by the 12th-century

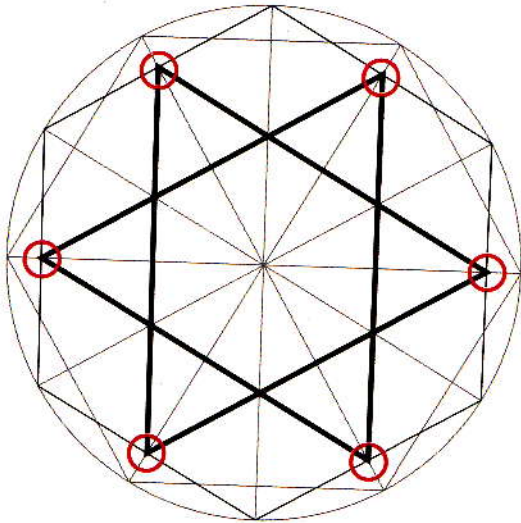
Ghurid ruler Ghiyath al-Din Muhammad ibn Sam, but over the centuries the building has been partially destroyed, rebuilt and renovated on so many occasions that few of the original features have survived. Remains of the Ghurid mosque include the south-east portal which is flanked by two columns that are covered with geometric carvings.



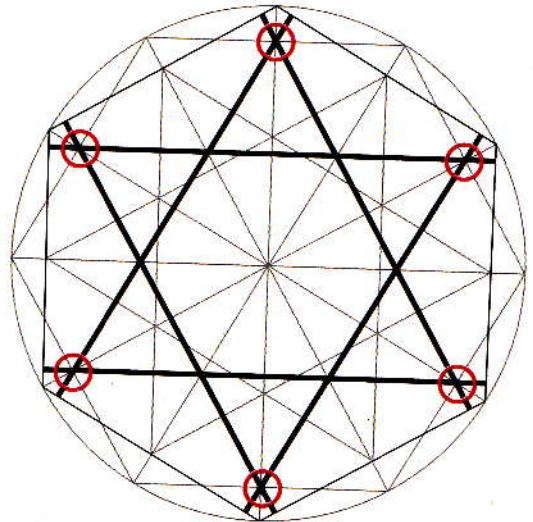
- 1 In pencil draw a hexagon in a circle with six intersecting lines (> 13–15).
 CD: BASIC TEMPLATES (3 & 4)



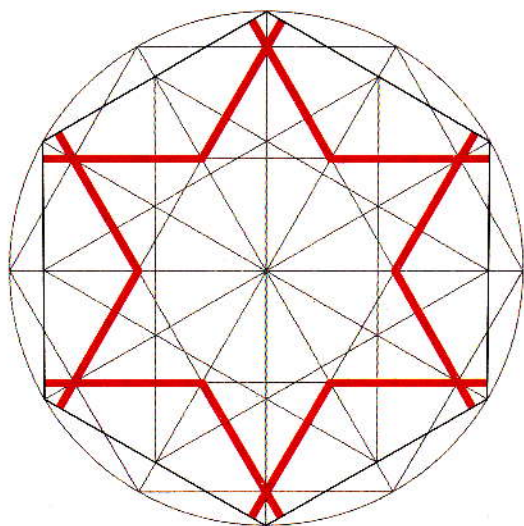
- 2 Three lines connect the corners of the first hexagon; use the other three lines, which extend beyond the first hexagon, as guides and draw a second hexagon that fits into the circle.



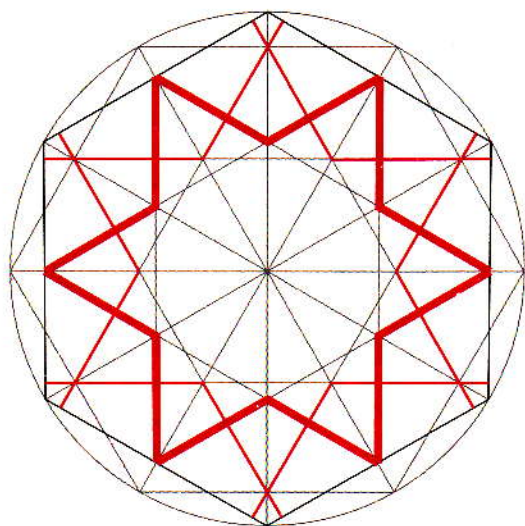
- 3 Connect the circled intersections to create two triangles in the first hexagon. The triangles should touch the edges of the hexagon, but not the circle.



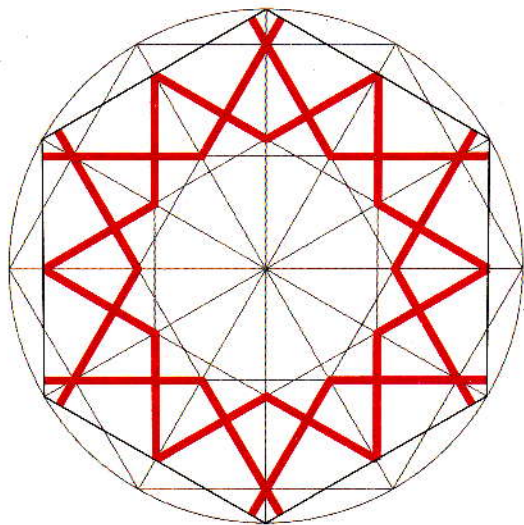
- 4 Connect the ringed intersections on the sides of the second hexagon to create another two triangles. The lines extend to the edge of the first hexagon.



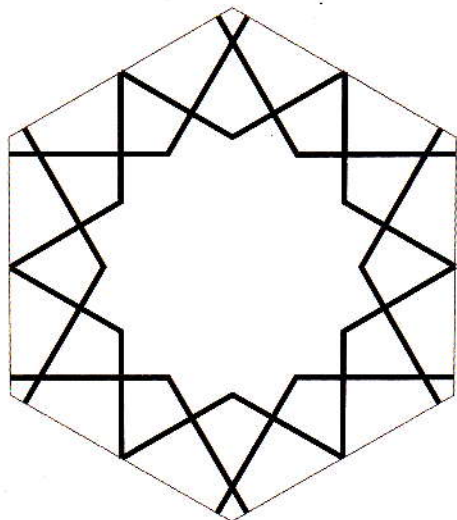
5 In pen, ink over the bold red lines to highlight the outline of the shape in step 4 – a star with overlapping lines.



6 Now ink over the outline of the star in step 3 which fits neatly into the first hexagon.



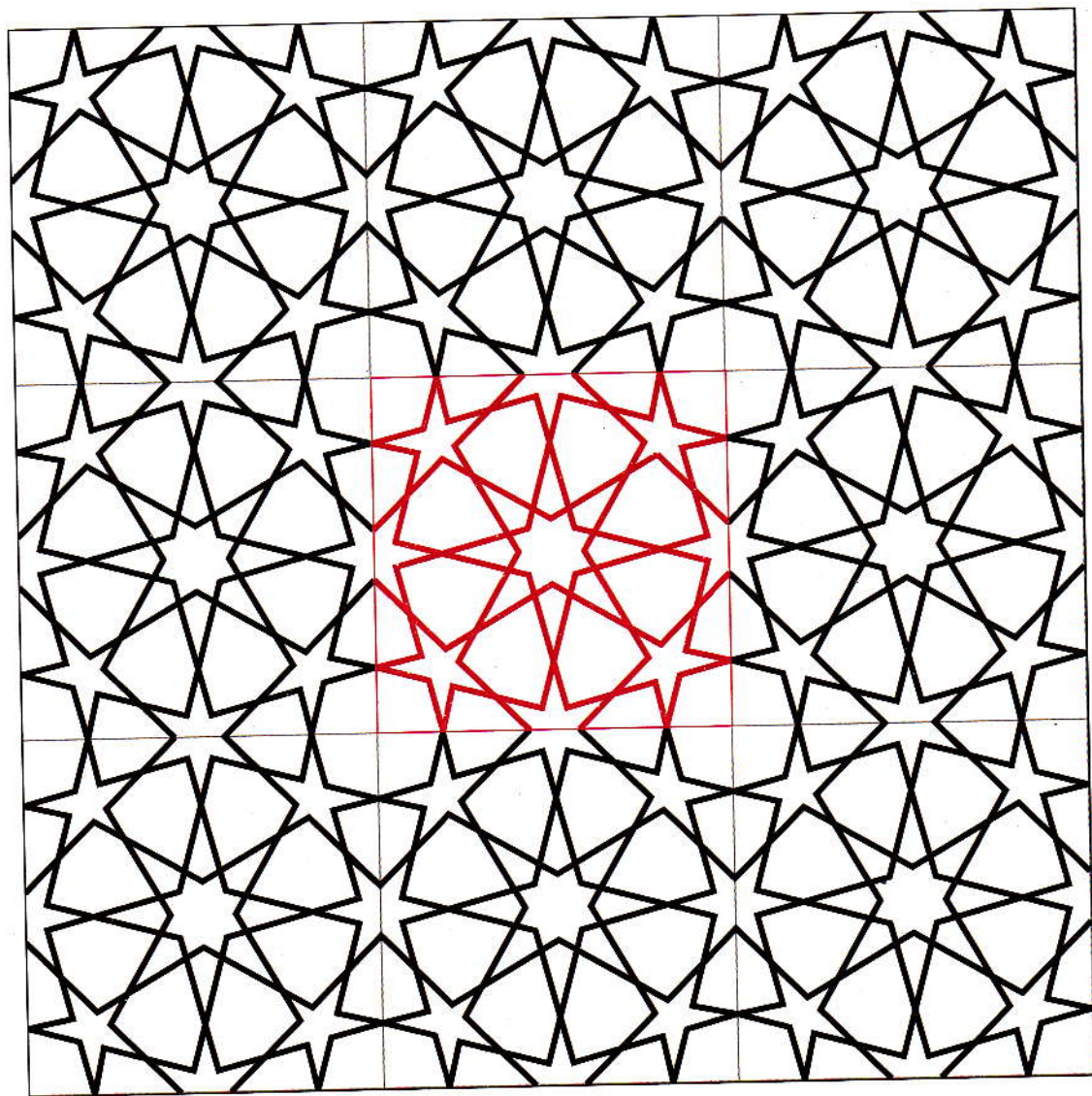
7 The pattern with the construction lines.



8 The pattern without the construction lines.

The Mosque of al-Salih Tala'i

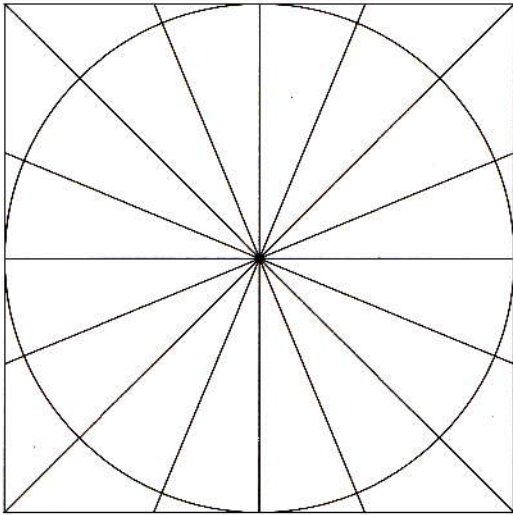
Cairo, Egypt (AD 1160 / AH 555)



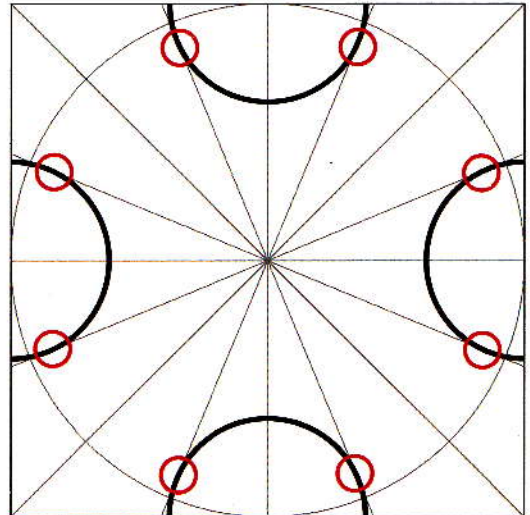
The Mosque of al-Salih Tala'i was built by the Fatimid vizier Ibn Ruzzik. It was originally conceived as a shrine – the final resting place for the head of the martyr Husayn, Muhammad's grandson, and as such a Shiite place of pilgrimage – but the relic was never housed there. The original main entrance to the mosque, removed for preservation, bears geometrically adorned bronze plates (dating

from AD 1303) and is thought to be the earliest example of this technique in Islamic Egypt. The mosque also accommodates Cairo's earliest *malqaf* (wind-catcher), a chimney-like construction that captures the wind and circulates it through the mosque for ventilation.

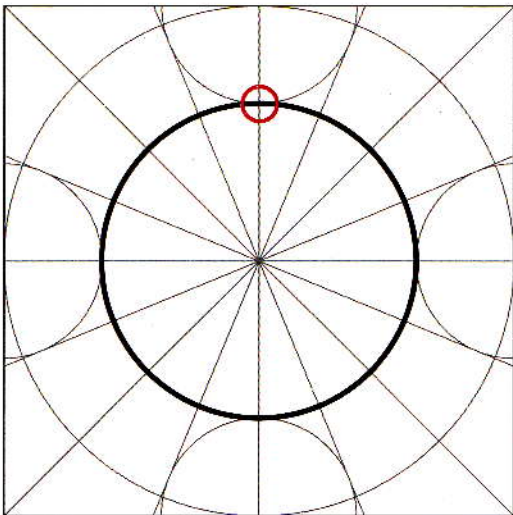
**CD: SAMPLE PATTERNS (3);
DESKTOP WALLPAPERS (4)**



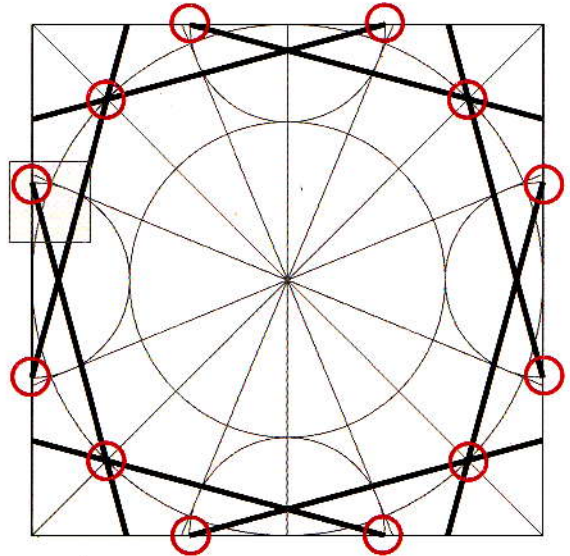
- 1 In pencil draw a circle in a square with eight intersecting lines (> 10–12).
CD: BASIC TEMPLATES (1 & 2)



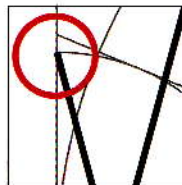
- 2 Placing the compass point on each of the four intersections of the square and the circle, draw four arcs that fit precisely between the highlighted lines.



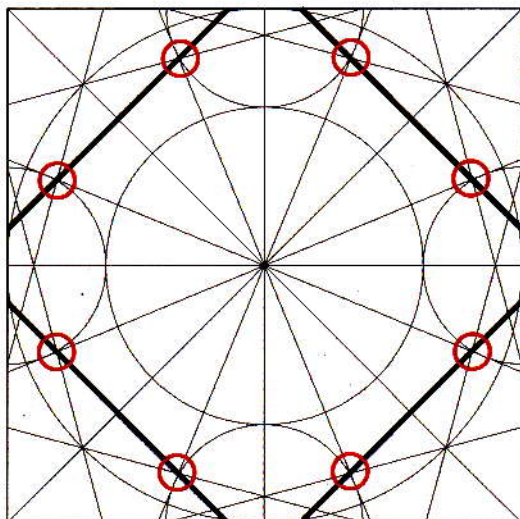
- 3 Draw a circle that just touches all four arcs.



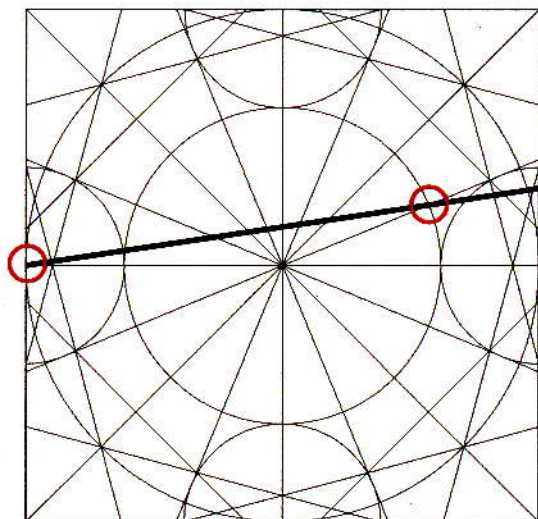
- 4 Note the eight intersections of the arcs and the square (see detail) and draw a line from each to the edge of the box. The lines cross over at four points on the circumference of the largest circle.



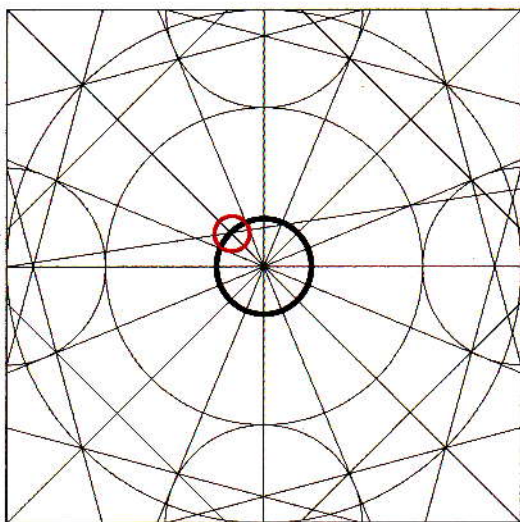
The Mosque of al-Salih Tala'i



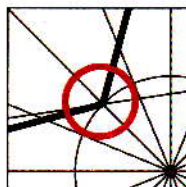
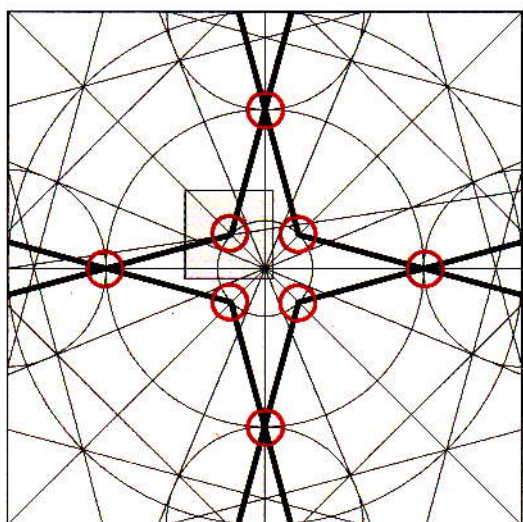
5 Draw four lines that run through the ringed intersections.



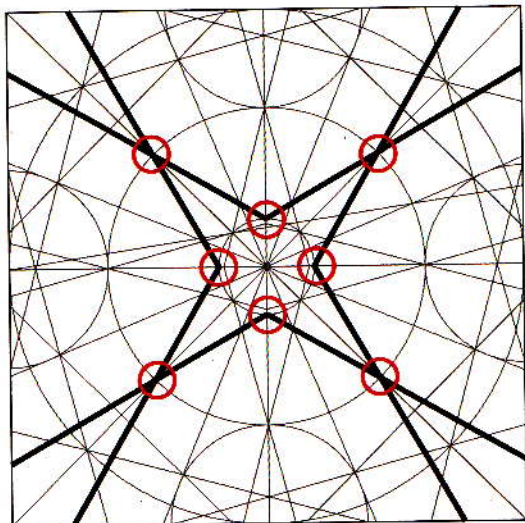
6 Connect the ringed intersections.



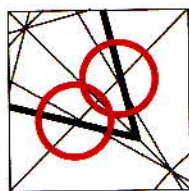
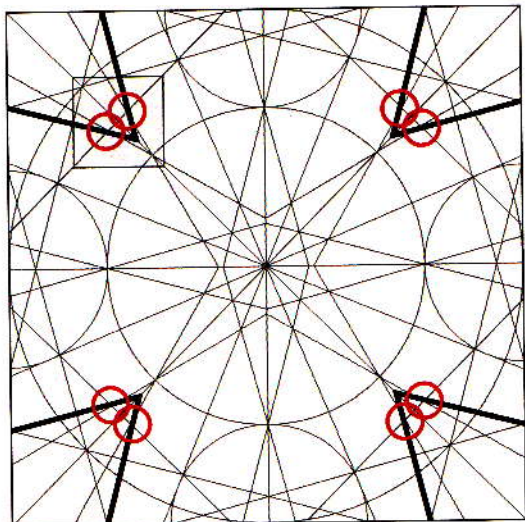
7 Note the intersection circled in red. Adjust the compass so that the point is at the centre of the square and the pencil tip is on the intersection, and draw a circle.



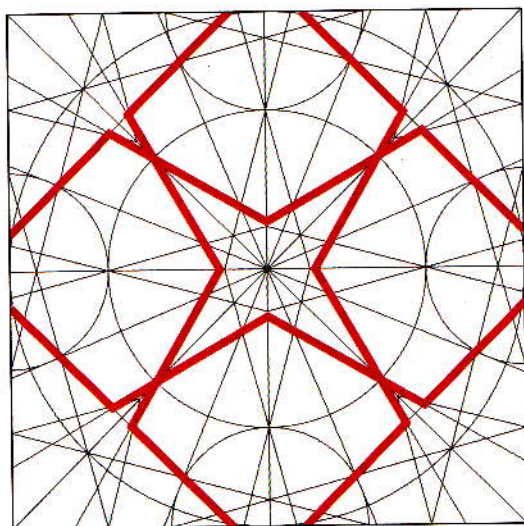
8 In complex patterns such as this, you may find it useful to make a near-invisible mark at the ringed intersections (see detail) before you draw the lines.



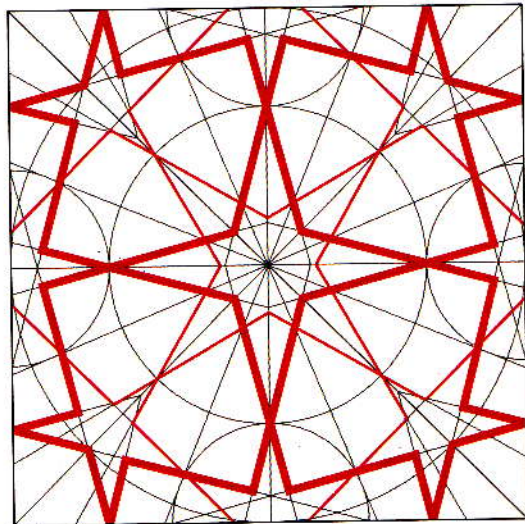
9 Draw another eight lines as shown.



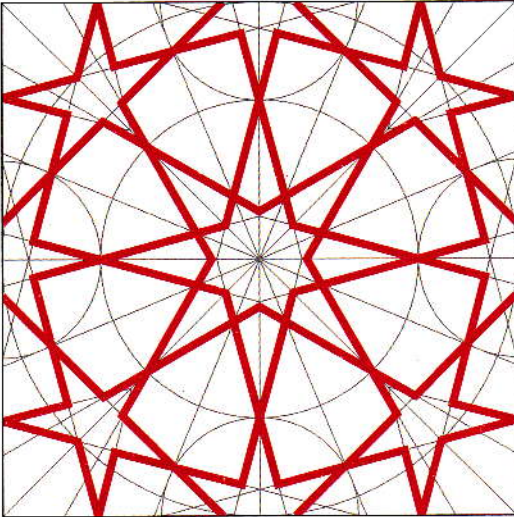
10 Draw four pairs of lines, using the circled points as markers (see detail).



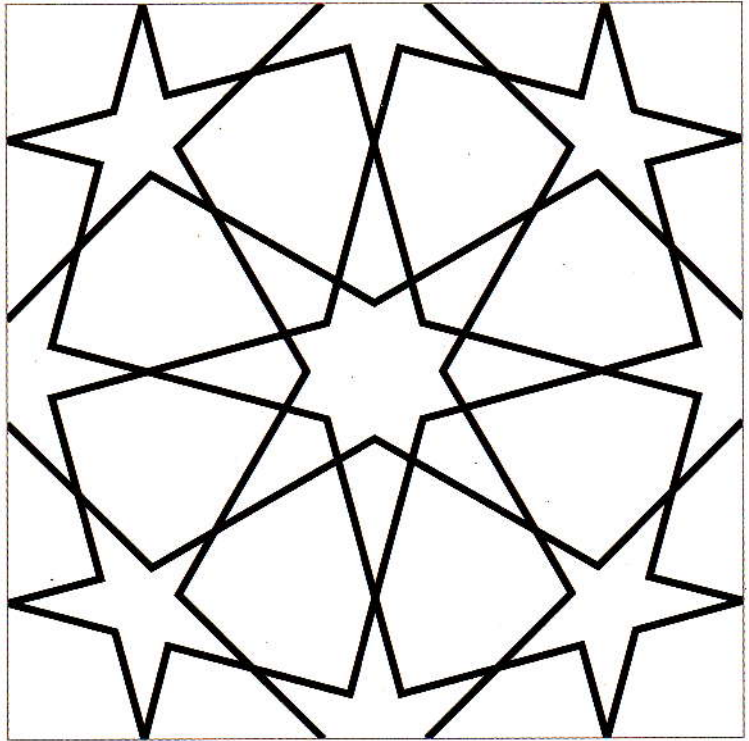
11 Ink over the bold red lines in pen.



12 Ink over the bold red lines.



13 The pattern with the construction lines.



14 The pattern without the construction lines.