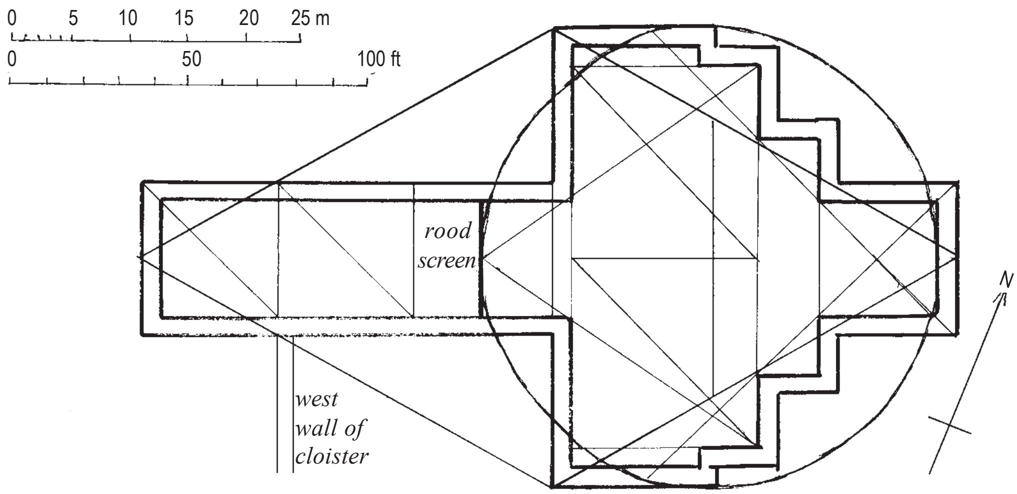
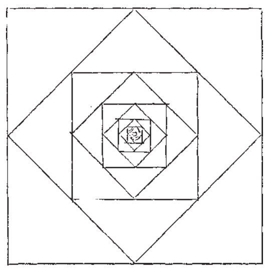
LIONEL GREEN tells how

THE MASTER MASON COMES TO MERTON

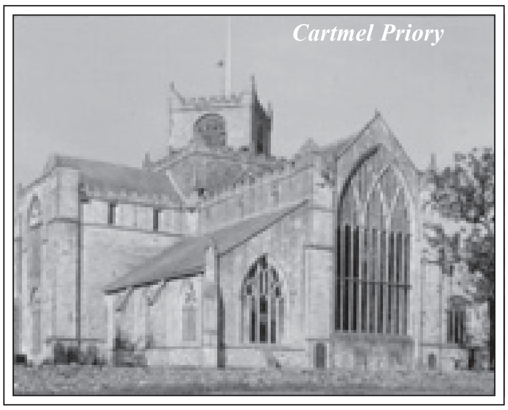
Euclid's *Elements of Geometry* was introduced into England about 1120 by Adelard of Bath in a translation from the Arabic version. But it was not necessary for the mason to understand the theoretical basis of any design. He was able to manipulate basic figures such as the square, circle and triangle to produce lines and points from which any structure could evolve. Each mason learned what was traditional in his lodge.



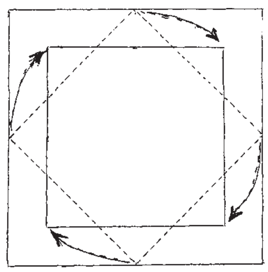
The use of the square involved building *ad quadratum* (from *quadrare* = to make square or fit), and of the triangle, *ad triangulum*. Many buildings were based on a combination of the three figures. This is a plan of the priory church at Merton at an early stage, showing possible use of squares, circle and triangles in a design which shows that it was planned as a single construction, and not added to with afterthoughts. Most of the layout is developed within the circle, but even the rood screen in the nave had been planned from the start.



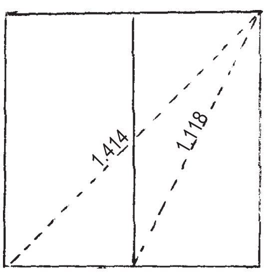
Much can be expressed with the use of the square. By rotating a series of squares by 45°, smaller squares can be formed within a bigger square, the area being halved each time. From the figure it can be seen that window tracery and the plan view of pillar profiles can be determined. Even pinnacles can be drawn from the progression of the small squares.



The square tower of the Augustinian priory of Cartmel, Cumbria, developed a fault about 1400. This was probably due to the insufficiency of the corner piers. To reduce stresses, the tower was rebuilt with a rotation of 45° in order to transfer these from the corners to the central walls, which had the support of the roofs and walls of the transepts and choir. The upper portion fits well and succeeds in reducing its mass, and time has proved that the remedy worked.

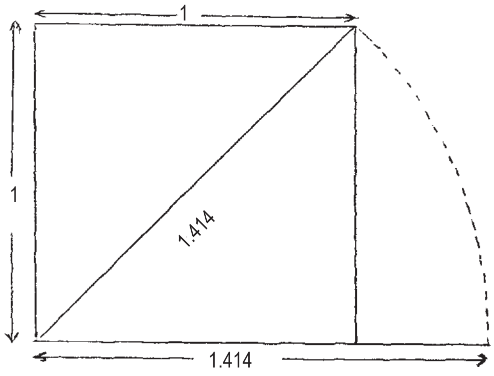


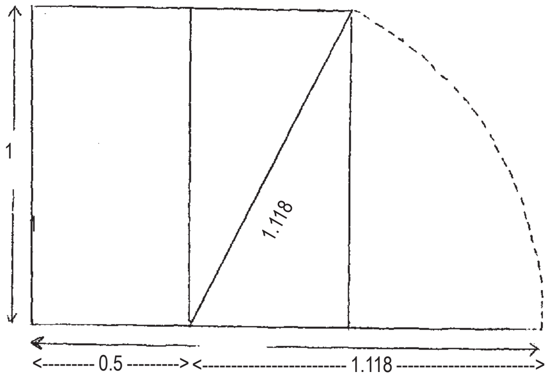
If a square cloister is required to be built, the same method can provide an inner square or garth, with a proportionate cloister walk around its edge. The first drawn (dotted) inner square is rotated through 45° to bring its sides parallel to the outer square. It can be seen that the sum of the areas of the four displaced corners of the original square equals the area of the inner square, and hence that the area of the walkway equals the area of the garth.



The square can be used to produce other designs. The ratio of the sides of a square is 1:1, but the rectangle made by halving the square produces a ratio of 1:2. If the length of one side of the square is 1, the length of the diagonal is the square root of 2, which is (approx.) 1.414. The length of the diagonal of the rectangle which is half of the square is the square root of $1^2 + 0.5^2$, which equals (approx.) 1.118. Adding the half side (0.5) gives a length of (approx.) 1.618. The ratio 1: 1.618 is known as the Golden Section or Ratio, a ratio of 'perfection', and is often used in geometry, architecture and art. It can be produced without mathematical calculations, by using a mason's square and a pair of compasses.

There is evidence of the use of the square root of 2 ($\sqrt{2}$) at Merton. The side of the cloister next to the church would appear to have been 24 metres (78' 9"). Assuming that the cloister was square, the diagonal would have been 24 x $\sqrt{2}$ = 33.9m (111' 3"). This is closely related to the internal length of the nave at Merton. A similar relationship of the cloister to the nave occurred at the cathedrals and abbeys at Canterbury, Durham, Norwich, Tewkesbury, Westminster, Winchester and Worcester.[1]





1. E Fernie *The Architecture of Norman England* Oxford University Press p.289