The use of the Golden Triangle in Somerset building design.

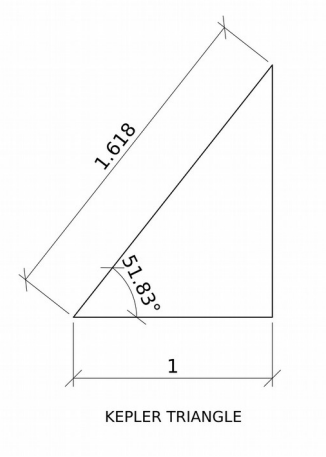
This document considers the possible use of the Golden Triangle in the construction of Somerset's vernacular houses.

Golden Triangle

The Golden Rectangle is well known and has been suggested as the basis for many historic buildings. With its side ratios of 1.618 to 1, its appearance was considered pleasing to the eye.

The Golden Triangle (or Kepler triangle) is less well known, but is based on the same ratios. This triangle has an angle of 51.83°.

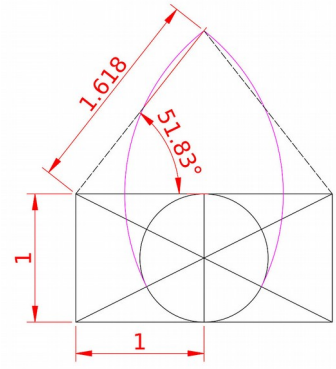
Johannes Kepler
1571 - 1630



The Golden Triangle was recorded by Johannes Kepler in his book, "The Harmony of the World", in 1619. This date suggests the geometry may have been available to the constructors of the buildings we now survey and record.

There are many surveyed building with a roof angle of around 52°. A roof with a 12 to 15ft run / rise would give a pitch of 51.34° so identifying a "Golden Triangle" roof based on purely the pitch would be near impossible.

The Geometry



The way around the problem of identifying a "Golden Triangle" building comes from a geometrical development of the triangle.

Start by drawing the two squares to form a rectangle, add the central circle and diagonally cross the corners of the rectangle. The ridge point is now plotted by swinging an arc, around the top corner of the rectangle, from where the diagonal crosses the circle.

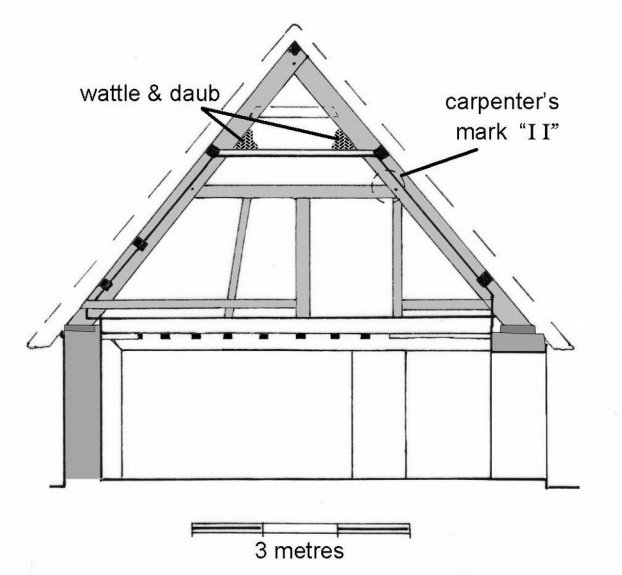
Clearly the resulting geometry already looks house shaped.

The beauty of this geometry is it can be laid out completely, with only a length of string.

Anchorage House, Thorney, Somerset.

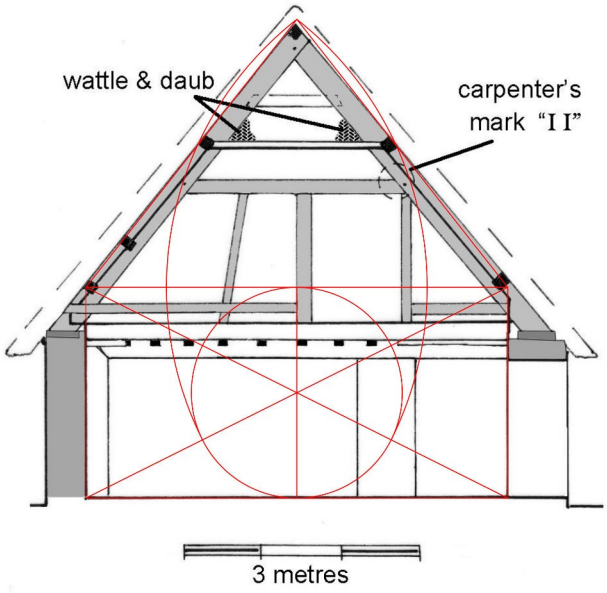
This house was surveyed, by the Somerset Vernacular Building Research Group, in 2017. The survey just happened to be on my desk when the geometry was being considered. The roof pitch had been recorded at 51° so it was clearly a target for research. The house was originally of cob, this remains in the rear wall, and has a suggested C17 date.

The Anchorage, Thorney.



Anchorage House Section

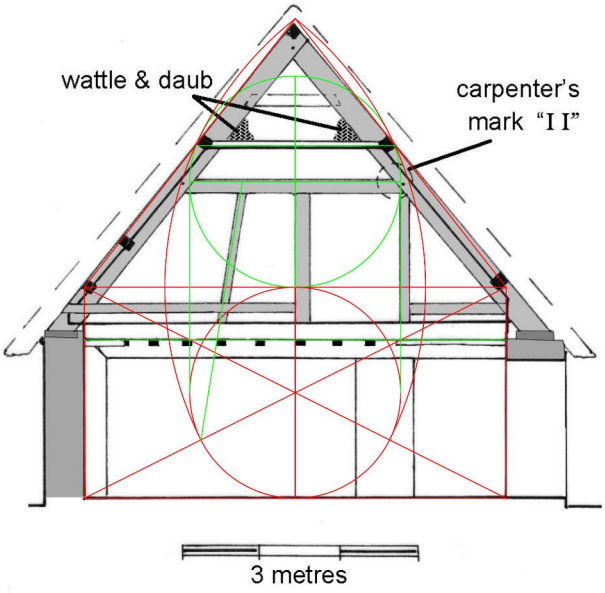
Method



The building section was extracted from the pdf survey report and imported into a cad program. A 3m line was drawn and the section was stretched until the scale bar was the length of the 3m line. All stretching operations maintain the proportions of the original. We are now able to work on the section at full scale.

The geometry was also imported and stretched to the internal building width.

We have to allow for the limitations of surveying, drawing and the age of the building, and later modifications. Bearing this in mind the geometry clearly suggests the ridge position.



If the building is being designed using geometry it might be reasonable to expect additional lines to identify more features.

Copying the circle to above and taking its centre line gives us the top of collar.

A vertical tangent between the right hand side of these circles gives us the right stud.

Where these tangents cross the diagonal lines gives underside of first floor beam.

Where the upper circle crosses the arc, gives the underside of wattle and daub panel.

The sloping stud is given by taking the mid point on the upper circle radius to the start of the left arc.

Note on internal referencing

We know that jointed cruck buildings were referenced to the internal face of the posts as scratched layout marks have previously been recorded on other buildings.

Jointed Cruck scratched layout marks.

Risks and uncertainties when applying the theory

There is a risk that any geometry could have the number of lines and intersections expanded to such an extent that any building could be shown to fit the model. To avoid this the basic geometry must be kept simple.

It can however be used in different ways to suit the type of building being constructed. An example of this might be the way the above geometry aligns to the inner face of the wall. Jointed cruck and cob wall construction are both common in Somerset. Setting out the cross frame from the inner face of a jointed cruck is logical as the outer face of the cruck is lost in the wall, so it is reasonable to expect the geometry to align at this point. At Anchorage, if any such cruck joints were present they were hidden from view so this detail could not be confirmed.

To confirm the validity of this geometry model it is essential to find it used repeatedly in as many buildings as possible. Clearly this process will take some time, therefore this document will periodically be updated. There follows a number of houses, taken from our archive, where the geometry looks convincing. In some cases, such as the Treasurer’s house Martock, the drawings were very small and could not be scaled with any high degree of accuracy. Where possible they will be resurveyed and our results updated. They are only included because initial results are tantalising.

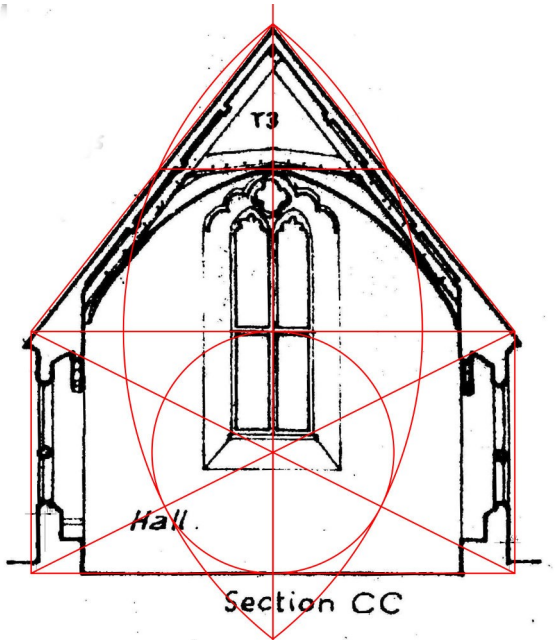
Later changes to the building make it difficult to align the geometry correctly.

- Cob walls are frequently replaced by stone, and the latter are usually narrower. Normally this reduction in width occurs on the outside face, but this is not always the case.
- Raising / lowering floor levels, and adding flagstone floors

The Treasurers House, Martock

A National trust property, open to the public. The building dates to 1293, with the hall roof being C15. The survey drawings are of small scale, so the main hall will be resurveyed at some point. It is included at this time as it fits the geometry with an outer wall alignment. We know the flagstone floor is not original, being replaced in recent memory, there may have been a level change at this time. The roof pitch was not recorded.

The Treasurer's House, Martock

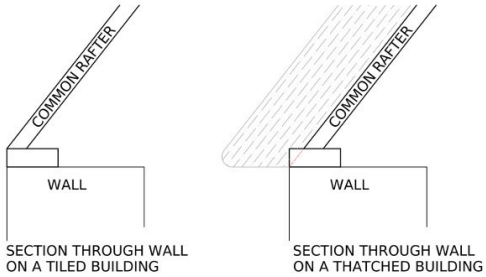


Not the best section for alignment on the walls, the width of these will be resurveyed. There is an interesting alignment with the window transom, and the roof pitch is a good match. The underside of the collar also seem to be identified. The referencing to the underside of the collar seems unusual, but it is common in many of the sections.

Different roof coverings

Dealing with different roof coverings initially caused some concern. The apex of the geometry aligns with the apex of the common rafters. The hypotenuse of the triangle is therefore on top of common rafter. Where this meets the outer walls we have a sharp corner, this is fine for a tiled roof but causes issues with a thatched roof.

Rafters land inboard

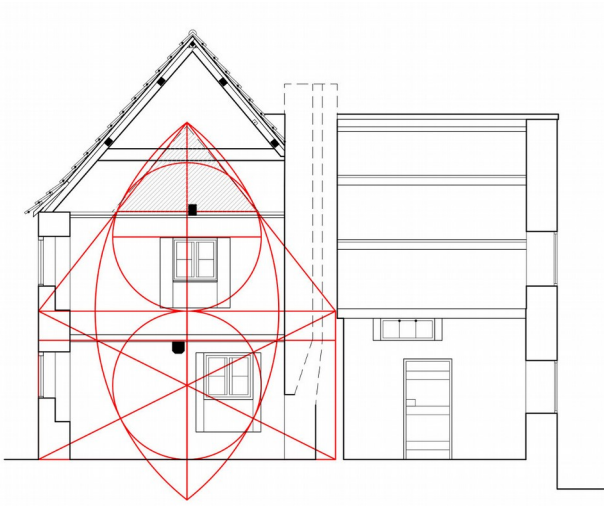


On a thatched roof the rafters land about 75mm inboard of the wall face. This allows some thatch to hit the top plate and stops the thatch being easily lifted by wind or birds. Now this rafter to top plate joint does not give the sharp corner the geometry requires. However if we reference the top of wall to rafter it does work. The geometry references the underside of the top plate, or top of wall, not the top of top plate that we might expect from current roof layouts. This only applies when the outer face of the wall is aligned, not the inner.

Woodlands Farmhouse, Shepton Mallet

Surveyed by SVBRG in 2013, this house is given a suggested C17 date. The house is now two storey but a plaster “shadow line” of the original roof still exists in the loft so it is possible to interpret the original ridge height.

Woodlands, old roof line



The geometry picks out the roof pitch, outside of front wall and chimney. It suggests top of original wall was at the height (see notes above) of the present first floor windows. Top of current first floor window is where the geometry suggests for underside of the collar. We also have a suggestion for the underside of floor beams.

Summary

As previously stated these are early observations made to test the theory that, there are houses in Somerset that were designed using a development of the Kepler golden triangle.

Initial results are favourable but there is much work to do before we can confirm the theory is correct.

If anyone has other examples of this geometry in use I would be interested to hear of them.

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