Archaic Measurements Used In Historic Building Design

By David Taylor, Somerset Vernacular Building Research Group

The “Somerset Vernacular Buildings Research Group” surveys and records historic domestic buildings. Our surveys include a scale plan of the building, notes on wall thicknesses and suggested dates for the different phases of building.

It has long been known that changes in wall thickness are a good indicator that the building had differing phases of construction, however no one could tell me why this was the case. There is little written about how wall thickness’s were determined by the original builders. Suggestions that it might be based on daisy wheels or other geometrical forms have been extensively tested, without any success. They get over complicated very quickly.

The actual solution to the wall thickness problem is a very simple and obvious one. The wall thickness is always a simple multiple of the units used to set out the building. It is likely that for timber buildings, with thinner walls, this will be a division of the units.

Method of analysis

The analysis uses CAD and drawings are scaled to full size using the scale bar for reference. This allows the drawing to be measured directly. These measurements can then be entered into a computer program that suggests possible units to consider and how accurate the match is. I keep the original names of measurements as I find them.

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Tollerance =     50 mm

Distance of  5875.0 mm =
        Units =  Long Reed / 6           mm= 533.4      Conversion=  11.014     Error=  7.0 mm   1 %
        Units =  Biblical Long Cubit     mm= 533.4      Conversion=  11.014     Error=  7.0 mm   1 %
        Units =  Long Reed / 12          mm= 266.7      Conversion=  22.028     Error=  7.0 mm   2 %
        Units =  Rod / 12                mm= 419.1      Conversion=  14.018     Error=  8.0 mm   1 %
        Units =  Reed / 8                mm= 419.0      Conversion=  14.021     Error=  9.0 mm   2 %
        Units =  Reed / 12               mm= 279.33     Conversion=  21.032     Error=  9.0 mm   3 %
        Units =  Reed / 16               mm= 209.5      Conversion=  28.043     Error=  9.0 mm   4 %
        Units =  Moxon 10ft Rod/12       mm= 254.0      Conversion=  23.13      Error=  33.0 mm  12 %
        Units =  Golden cubit            mm= 739.77     Conversion=  7.942      Error=  43.0 mm  -5 %
        Units =  Perch                   mm= 2960       Conversion=  1.985      Error=  44.0 mm  -1 %
        Units =  Roman Gradus            mm= 740        Conversion=  7.939      Error=  45.0 mm  -6 %
        Units =  Roman Palmipes          mm= 370        Conversion=  15.878     Error=  45.0 mm  -12 %
        Units =  Roman foot, Pes         mm= 296        Conversion=  19.848     Error=  45.0 mm  -15 %


        METRIC TO HISTORIC DIMENSION CHECKER
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A grid, using the appropriate units is then applied to the drawing. I do not think for a minute that the carpenters laid out a grid when designing the building. They would have used simple measurements with a measuring stick. The grid allows me to easily see alignments with the measurements and the building. It is possible to identify areas of later construction or modification. It also helps to bring order and make sense of complicated layouts.

There are many issues that can make applying grids difficult.

- Later works in different units of measurement, although grids can be used to identify different phases of work.

- Poor or inaccurate survey drawings, or inaccurate scale bars.

Simply applying a grid to a building or landscape is rather dangerous as you get lots of false positive results. A building plan can show alignments with a number of different sizes of grid. To identify the correct units some basic rules need to be followed.

Rules for using grids correctly

1. As well as short distances matching the grid, there must be alignment with the grid over long distances so any error in the unit of measurement is magnified. Ideally a number of long measurements should be examined to ensure random alignments are not being detected. An example might be the the length and width of the building.
2. The grid must be able to pick up detail over short distances, to confirm the units are correct. Examples might be wall thicknesses or other small structural details.
3. Wall thicknesses are always a simple multiple of the basic units of measurement, however in Somerset early cob walls are often replaced by thinner walls in stone, so some common sense needs to be applied. Generally the internal span stays the same, so floor beams can be reused, with changes being made to the external dimensions. These can often be seen as exposed areas of foundation, wall plate or timbers projecting out of the wall.
4. Only measurements based on known historic units are used. Random distances are not considered. Longer measurements are subdivided by 12, 10 or 8 to give practical units for construction.
5. Any unit of measurement needs to be found in multiple buildings before it can be accepted as being correct.

Units of measurement found in buildings.

The vernacular houses of Somerset are generally jointed crucks with thatched roofs. Initially they would have had cob walls. Frequently these have been replaced in stone. The initial cob builds are usually set out in 740mm units of measurement. Strange as it may initially seem this is a Roman measurement, the Gradus. Obviously any Roman connection has disappeared in history. The carpenter only knows he has a measuring stick that is the same as his fathers, who he was apprenticed to, and his father before him. All his rules of thumb for construction are based on that cob measurement so why change.

The change comes with the dissolution of the monasteries in the late 1530's. We see stone chimneys being built and cob walls being replaced in stone. Presumably newly unemployed masons starting to work on domestic buildings and cheap stone now available. They bring with them their own measurement units, Masons measurements or Reed/10 (Reed/10=335.28 mm). Originally I referred to these as North German Feet, but that was causing confusion so it has been dropped.

A Reed is a biblical measurement, 11ft. (There are other Reed measurements at 10.5 & 10.25 feet but they are not a concern at present). The Reed (11ft, 3352mm) is 2/3 of a Rod (16.5ft, 5029.2mm) which has been found in Anglo Saxon building, with the work of Fernie[1] & Huggins [2]. They suggest

1 E. C. Fernie – Anglo-Saxon Lengths and the evidence of the Buildings.
2 P.J. Huggins – Anglo-Saxon Timber Building Measurements.

the Rod divided by three as a base for measurement of archaeological remains. Their difficulty is there is no fine detail in these remains to take the division further.

In standing Somerset buildings it is possible to see the Reed is divided by 10. Walls tend to be 2 units wide, 670mm.

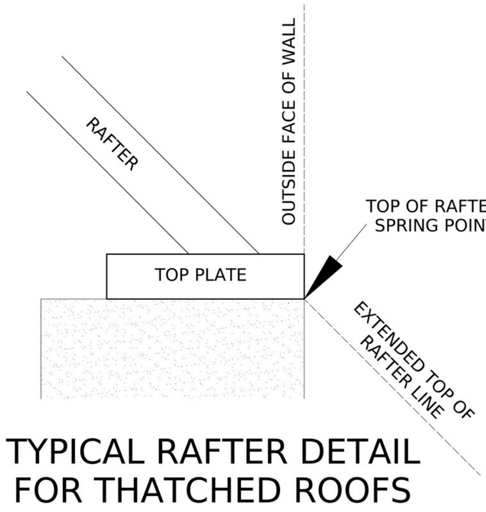
In Oxfordshire there is increasing evidence of the Reed divided by 8 as a unit of measurement.

Rafter Positions

Rafters for thatched roofs, in Somerset, do not land on the outside edge of the top/wall plate, instead they land 3” to 4” inboard of this point, see photo below. This has a number of structural advantages. Any rotational forces on the top plate are minimised. The load on the top plate is spread more evenly, reducing pressure points on the wall below. The outside corner of the top plate provides a “kicker” to allow the initial layers of thatch to be tensioned.

From analysis of construction measurements from houses such as The Mount at Dowlish Wake it is clear that the reference point for building was the top of the wall / under side of wall plate, not the top of the wall plate as we do today. Using this point very much simplifies the layout for construction of the building.

A spring point is used for the accurate setting out of rafters, see below. The spring point is where an imaginary line following the top of the rafter intersects with the outside face of the wall. Clearly using the underside of the wall plate as the reference matches the spring point for the rafters. So when layout lines are set out on a lofting floor they all meet at the same point.



The Mount, Dowlish Wake.

This is a thatched house, originally of cob construction. The section we are looking at, drawing 1, is a jointed cruck and dendrochronology gives us a date of 1591. The building is older than this but earlier timbers failed to date.

The rear wall, left on the drawing, see below, is the original cob, and is 740mm wide. Being a jointed cruck frame the roof is self supporting so walls are frequently found to have been replaced and upgraded in stone. This is what has happened to the front wall, right on the drawing. Cob has been replaced by a thinner stone wall which has left the lower end of the cruck blade exposed, see photo.

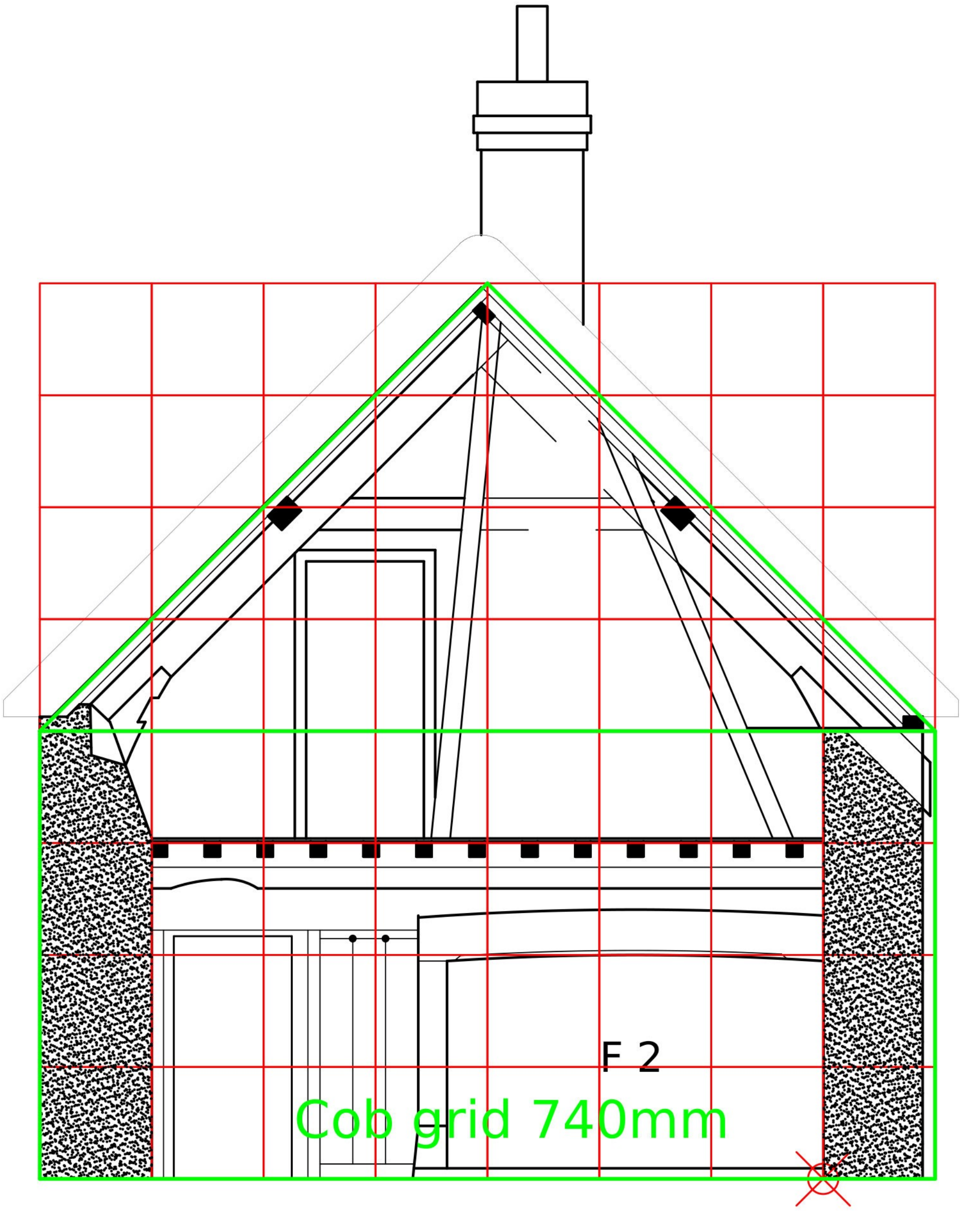
Exposed lower end of cruck blade

The stone wall is laid out in masons units so it is 670mm wide, 70mm thinner than the original Cob wall.

The grid indicates the thickness of the original wall, enclosing the cruck blade end

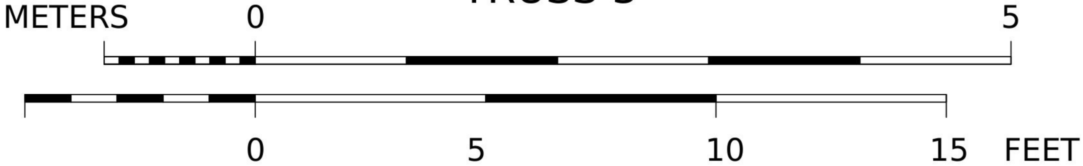
Note how the grid references the top of wall / bottom of top plate, not the top of top plate that is referenced in modern buildings.

The Mount



THE MOUNT - 1591 DENDRO

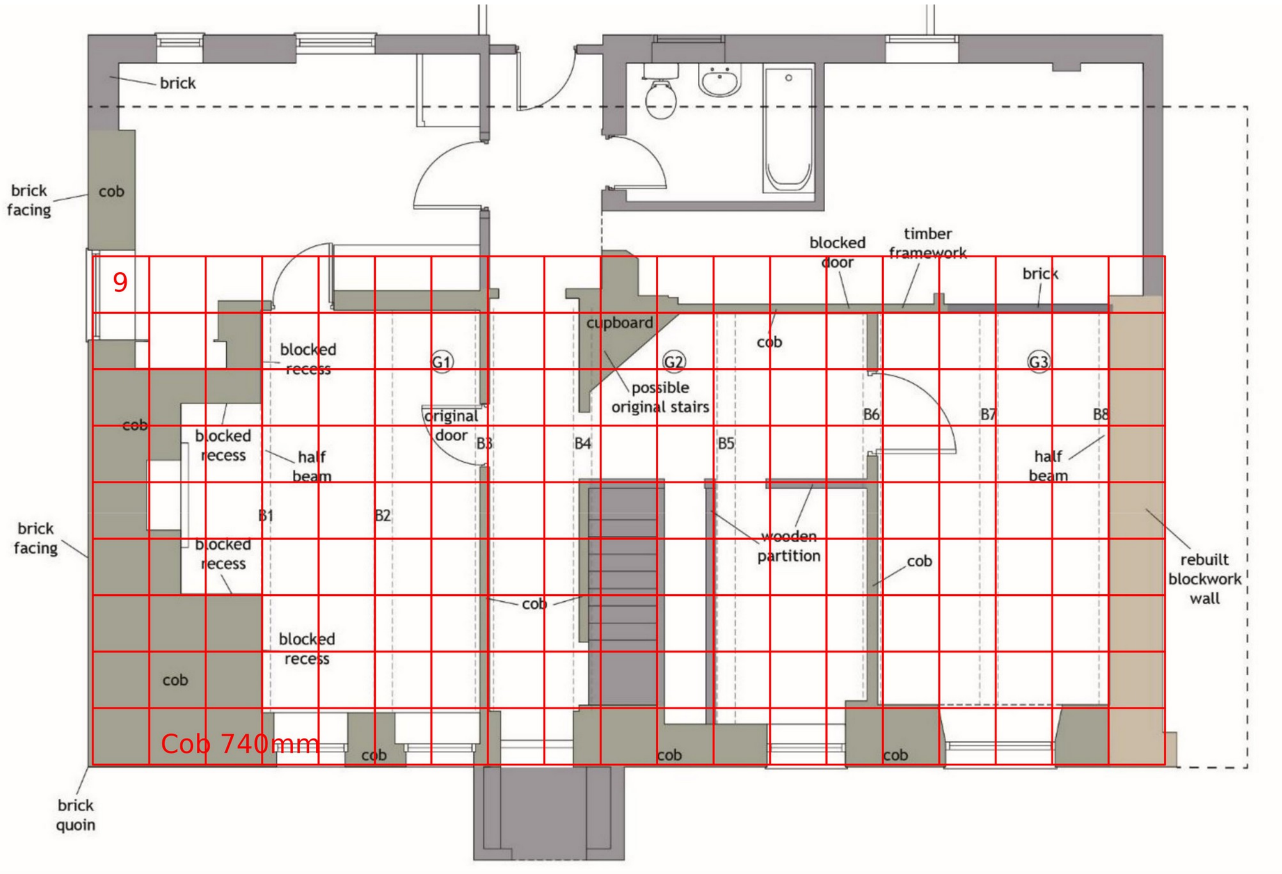
TRUSS 3



10 Load Lane, Westonzoyland

This was a jointed cruck and cob house, dating to late C16 or early C17. It was surveyed by Context One [3] prior to demolition.

As can be seen from drawing 2, the building was laid out in cob measurements (740mm). The original rear wall had been enclosed by a later lean to, and the cob wall removed. Its position was still clearly indicated by the cruck posts. Note how all the beams conform to the grid. Another feature which looks to be a standard detail is the 3x3 of the "Malting kiln" or large oven, bottom left of building. Buildings can be 8 or 9 units, this is a 9 (may be dating significance, more research needed).



3 Photo & base drawing by Context One