A DIMENSIONAL ANALYSIS OF THE “GREAT HALL COMPLEX” AT LONG WITTENHAM, OXFORDSHIRE

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This document looks at the excavation plan, produced by Helena Hamerow and Adam McBride, and applies dimensional analysis techniques developed on standing buildings. The results suggest that the tenoned posts under the gable tie beam of the reconstruction might not be appropriate. The archaeology suggests external gable posts, which if extended to roof height would address the problem of wind loading and racking in the common rafter roof. Whilst this design of gable has been recorded I’m not aware of any instances where its significance has been discussed.

Method of analysis

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.

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, likewise wall thickness’s based on the width of the building.

The actual solution to the wall thickness problem is a very simple and obvious one. The wall thickness is always a multiple, or division, of the units used to set out the building. The interesting thing is the units of measurement used. (To be accepted as a correct unit of measurement it needs to be identified in multiple buildings.) I am finding C16 buildings laid out in “Roman Gradus” (740mm), though the carpenters probably only knew this as the length of their stick, their walls are one unit wide. Others are laid out in “North German Feet[1]” (335mm), derived from Anglo Saxon units, their walls are two units wide. There is no suggestion that this is a remnant from earlier buildings on the site. It is more likely the units of measurement are being passed down by the apprenticeship system.

By applying grids in the correct units to the building plans, it is possible to identify areas of later construction or modification. I don’t suggest the original builders used grids, they used simple measurments, but the grid helps to bring order and make sense of complicated layouts.

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.

1. There must be alignment with associated points 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.

This research is on going and will be the subject of a separate document in due course.

The method has been used on domestic dwellings in Somerset, which are constructed from cob or stone. It has not been tested on timber buildings or archaeological plans. Its use in this instance was an experiment to see if it could be applied more broadly.

The Archaeological plan

The original archaeological plan, by Hammerow & McBride, on which this analysis is based is included at the rear of this document as drawing 1.

The post trench had a vertical inner face and a sloping outer one. This inner face provided a suitable reference to apply a grid.

Naturally the first units of measurement tried were Anglo Saxon, no matches were found. Being a rectangular building Roman units were tried. The “Gradus” (740mm) had some interesting alignments with the doorways, but was eventually rejected based on the earlier rules. The “Cubitum” (444mm) was by far the best fit, see drawing 2.

Clearly we have a 24x12 grid that aligns well with the internal face of the trench, complying with the long measurement rule. The long distances are multiples of each other so could still allow a chance alignment. The trench looks to be one unit wide, complying with the detail requirement. With wall thickness’s we have a problem as there are no complete wall remains. So first impressions are we have a reasonable chance that this building was laid out in Roman Cubitums.

Rule 3 tells us the walls are always a simple multiple or division of the unit of measurement, so lets try working in reverse. One Cubitum (444mm) is clearly too wide for a timber structure so the closest option is ½ a Cubitum, a “Palmus Major” (222mm). In our reconstruction we are cutting 9” top plates so 225mm is very close to the predicted value. Adding a ½ grid top plate, shown shaded, and shuffling the grid very slightly for best alignment gives us drawing 3.

We have a good alignment with all the door posts falling within the top plate. On the long walls the few post pipes visible also fall within the plate. The short walls are not as expected, with post pipes outside the plate, but tightly against it. This could be an indication of a fault with the grid method, or might indicate a variation in the method of building. For the answer we need to look at a standing building.

The Church of St. Andrew Greensted-juxta-Onger Essex

Variously described as our oldest wooden Church, and being the remnants of a stave church from the 9th Century. Dendrochronological dating of the present structure gives a date of 1053, it is considerably later than our building.

It is no longer earth fast, as the bottom plate can clearly be seen. In fact little of the original remains. The roof was lost in the mid C19 when the building was enthusiastically restored by the Victorians. We do however have some good site drawings made by Cecil Hewett[2]

Drawing 4 shows Hewett's detail of the wall construction. There are some features on this drawing that look to be later modifications. The purlin cuts are of Victorian proportions and purlins were not part of the later "common rafter roof" style and so would not be expected in earlier structures.

As expected the front wall has posts under a top plate, being later the jointing detail differs. The end wall has series of vertical timbers running to roof level, in front of the tie beam. The outer cladding of half timbers are omitted for clarity. When the carpenter changes the method of construction we must assume there is a reason for it, after all this is unlikely to be the first house he has built.

If we consider this building as an earth fast post structure then the reason for the change is clear. The front wall with earth fast posts and tie beams provides a rigid structure to resist the outward thrust of a common rafter roof. The gable wall with full height timbers, earth fast and pegged to the tie beam also provides a rigid structure, this time to resist wind load. Simply connecting the gable to the common rafter roof, with the battens or hurdles required to support the thatch would prevent the whole roof racking. Our external post pipes in drawing 3 now make complete sense.

Hall at the Weald & Down museum

In a building with earth fast posts, a detail using earth fast posts to resist the racking must be a sensible solution. On all the existing reconstructions of great halls the gable posts terminated at the tie beam. Carpenters realised this caused problem of racking and solved it with long diagonal braces, a detail we see regularly from around the C19. This method of bracing does not carry on into our oldest standing roofs, where the crown post and collar purlin stop the racking in common rafter roof. It also has a number of issues. If braced above the rafters, the thatch would have to be thicker to accommodate it. If places below the rafters, then any failure of the method of jointing would result in the timber falling onto the occupants.

Similar buildings

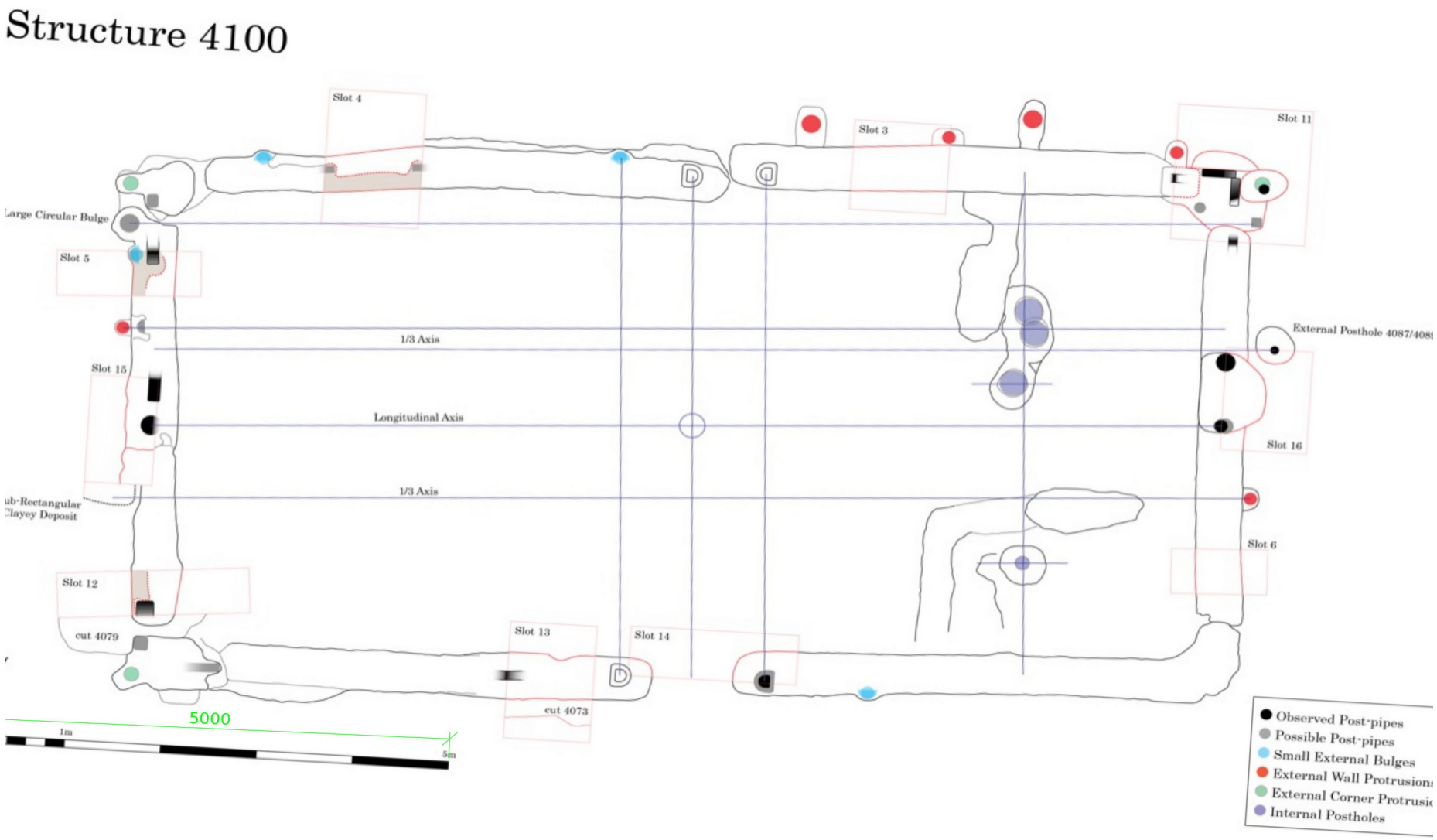
The great hall building, C12, at Cowdery's Down makes a good comparison with Wittenham C7, see drawing 5 for both halls with the same grid and scale.

The Cowdery Hall is exactly twice the internal length of Wittenham. The width is greater, but set out in the same units of measurement. At the gable ends they both have posts outside the proposed tie beam, which matches the standing Greensted Church (dendro 1053). This suggests all the reconstructions to date have the wrong gable detail. Both have the posts on the long walls set under the wall plate. Considering how well the dimensions match on the two plans it is unlikely that they were not laid out using the same Roman units of measurement.

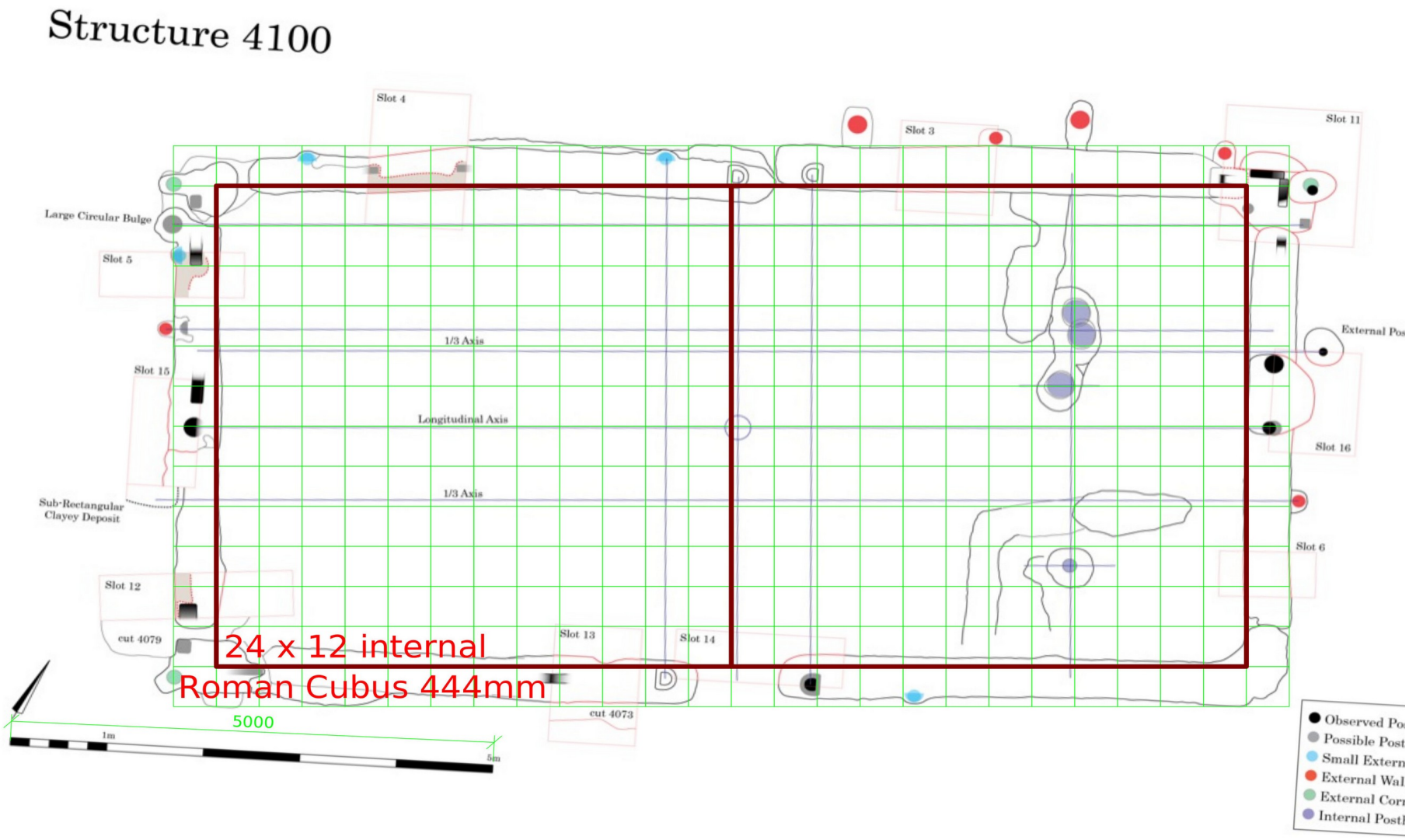
Conclusion

Whilst some of the grid techniques may be rather tenuous at present when used for archaeological analysis, the technique does work well on standing buildings. We have two buildings with similar layouts and suggested units of measurement. With details in both matching a standing building. This suggests previous assumptions about the gable construction may, in some cases, not be correct. Potentially we have an earlier type of box frame common rafter roof construction. With earth fast posts the wind loads are handled by rigid gables. Once earth fast posts fall from fashion the Crown Post roof becomes the preferred method of construction to avoid racking.

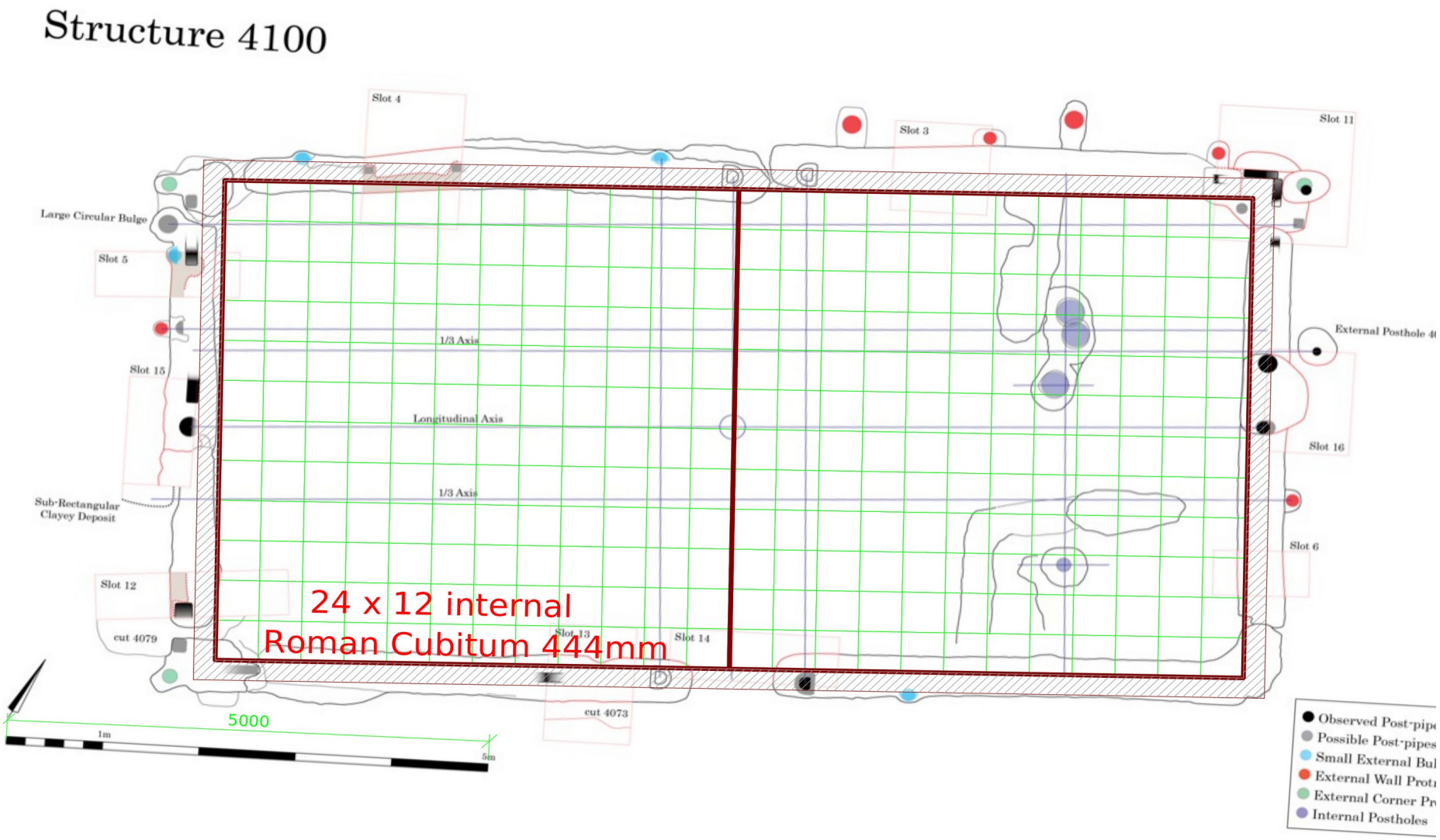
It also suggests Roman units of measurement continued in use long after the Romans left. This is inline with results from cob & jointed cruck buildings in Somerset where Roman units of measure have been found in buildings as late as C15. It is unlikely that those using these measures knew of their history. The use appears to be tied to the carpentry trade as masons generally use units of measure derived from the Pole (16.5ft) or more likely the Reed (11ft, or 2/3 of a Pole).



Drawing 1: Original archaeology, Hamerow & McBride



Drawing 2: Initial Roman Cubitum grid



Drawing 3: Grid with suggested top plate / wall

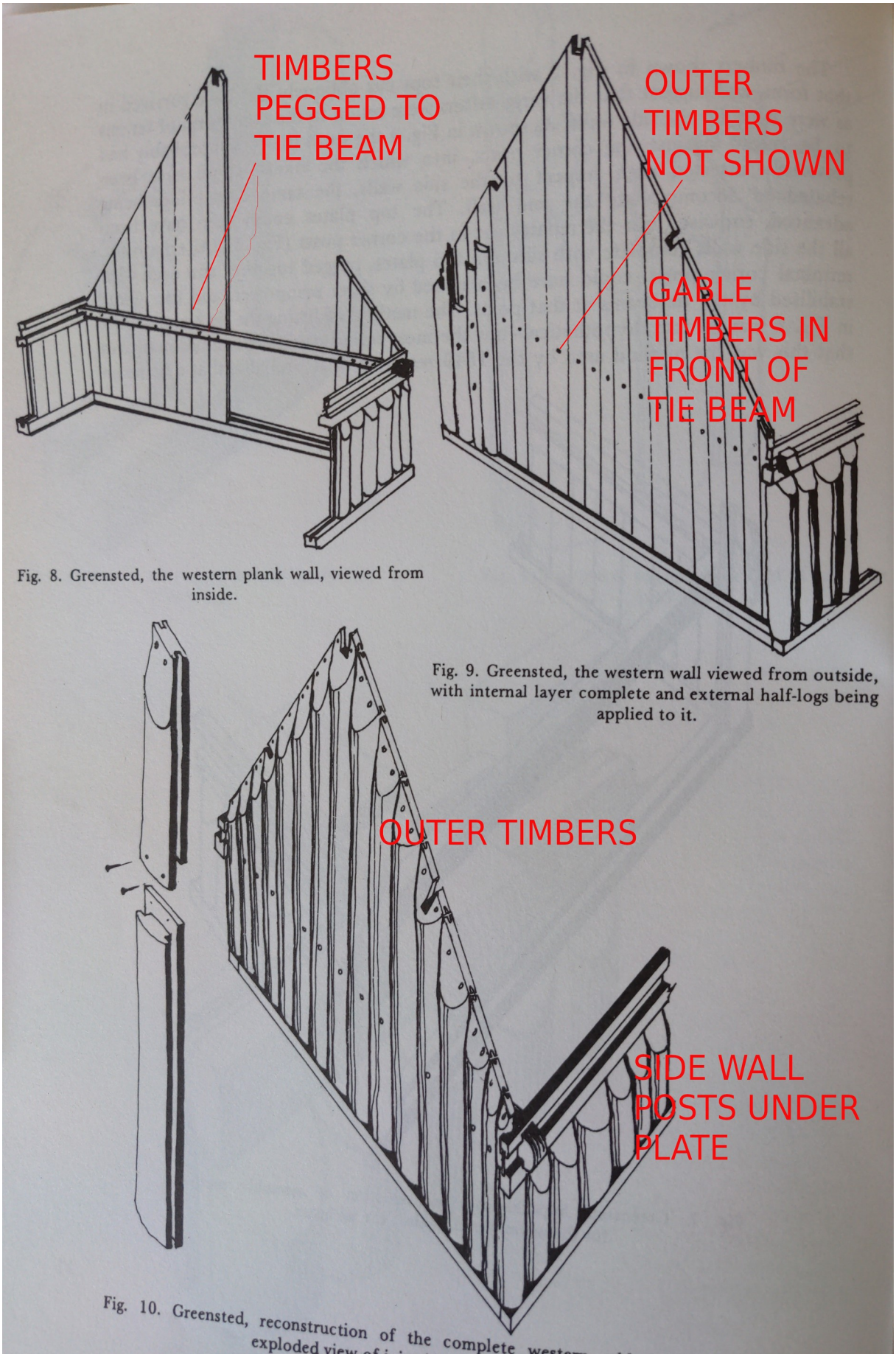
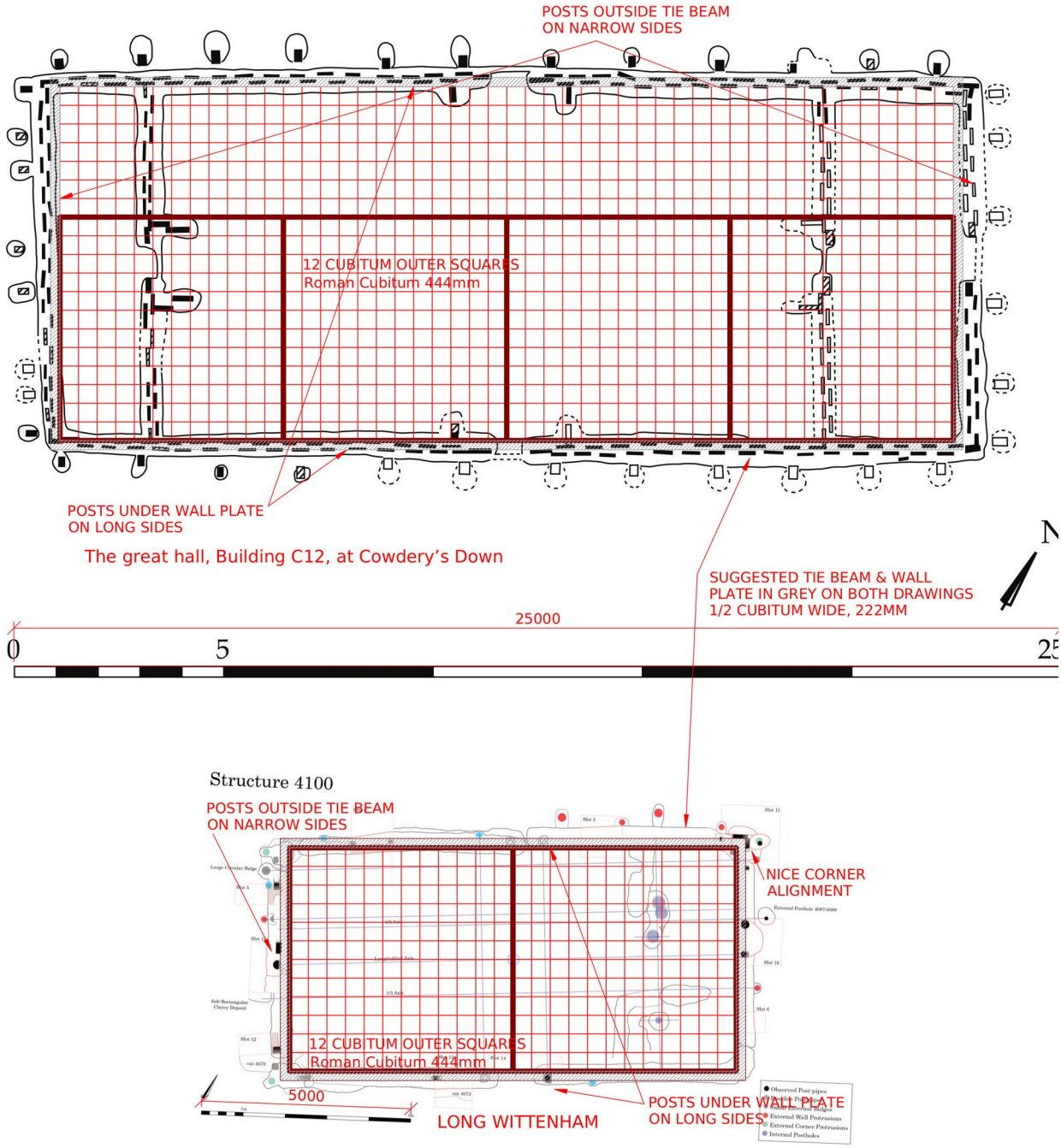


Fig. 8. Greensted, the western plank wall, viewed from inside.

Fig. 9. Greensted, the western wall viewed from outside, with internal layer complete and external half-logs being applied to it.

Fig. 10. Greensted, reconstruction of the complete western exploded view of

Drawing 4: Greensted Church, by Cecil Hewett



Drawing 5 Wittenham and Cowdery with the same grid

1 There are many different names for the same measurements, I try to stick to the same names and include either a conversion to millimetres or feet for clarity. The North German Foot (335.28mm) is 1/15th of a Rod (16.5ft), or more importantly 1/10th of a Reed (11ft). These are both derived from Anglo Saxon units of measurement.

2 English Historic Carpentry by Cecil A. Hewett.