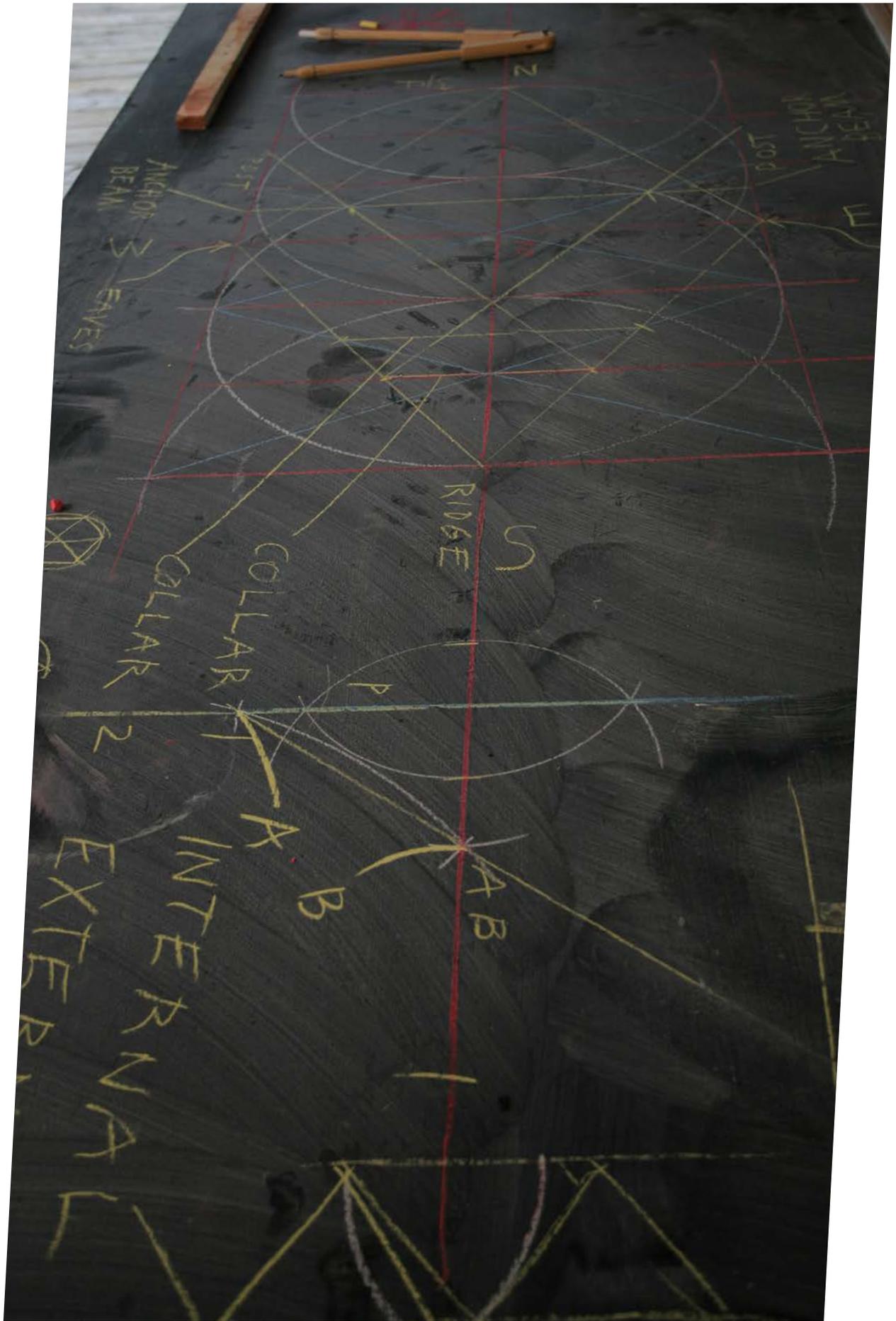


THE DUTCH HOUSE
at Bucksteep Manor
A Geometrical Design and
C18th Hand Tool Workshop

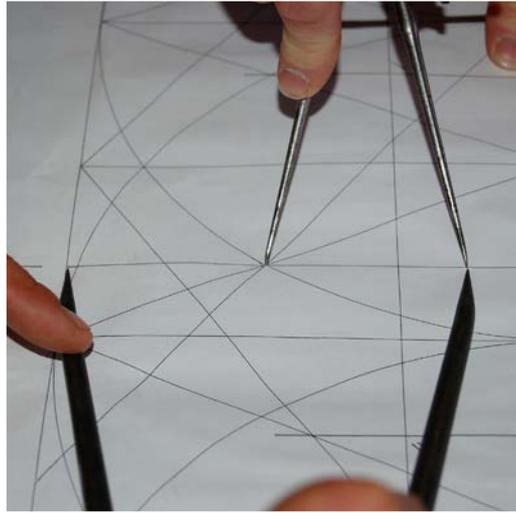


Laurie SMITH
THE GEOMETRICAL DESIGN WORKS



The Dutch House at Bucksteep Manor

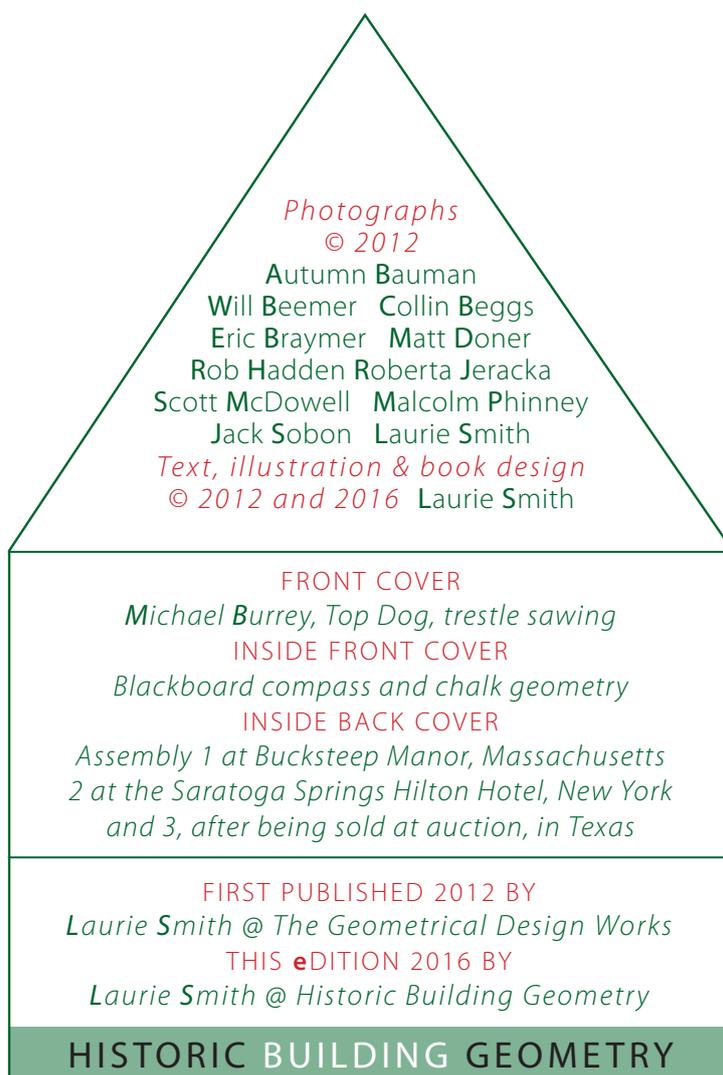
A Geometrical Design and 18th Century Hand Tool Workshop



TIMBER
FRAMERS
GUILD
SPECIAL
EDITION

HISTORIC
BUILDING
GEOMETRY

Laurie
SMITH



Photographs
© 2012

Autumn Bauman
Will Beemer Collin Beggs
Eric Braymer Matt Doner
Rob Hadden Roberta Jeracka
Scott McDowell Malcolm Phinney
Jack Sobon Laurie Smith

Text, illustration & book design
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FRONT COVER

Michael Burrey, Top Dog, trestle sawing

INSIDE FRONT COVER

Blackboard compass and chalk geometry

INSIDE BACK COVER

*Assembly 1 at Bucksteep Manor, Massachusetts
2 at the Saratoga Springs Hilton Hotel, New York
and 3, after being sold at auction, in Texas*

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HISTORIC BUILDING GEOMETRY

The Dutch House at Bucksteep Manor

Foreword

The construction of the Gardener's Shelter at Cressing Temple in the UK county of Essex in 2008 by an international team of carpenters included several Americans from the USA Timber Framers Guild. In 2009 the Guild announced a similar project in the USA and offered me the opportunity of co-running a course at Bucksteep Manor in Massachusetts, with Guild founder, architect, author and frame carpenter Jack Sobon. The course would bring together geometrical design methods and the use of 18th century hand tool techniques for the major timbers.

Prior to the course Jack Sobon and I corresponded by email. Jack sent drawings of timber-framed English, German and Dutch settler buildings from Massachusetts on the eastern side of the USA and I analysed as many of these historic examples as possible in the short time available, trying to absorb their aesthetic differences and searching for evidence of geometrical design. Bucksteep Manor in Massachusetts was chosen as the venue and Jack, who lived nearby, favoured building a frame based on the Dutch Settler houses in the area. The course was planned for the week prior to the Timber Framers Guild Eastern Conference in Saratoga Springs Hilton Hotel and the frame would be auctioned there after display in the Hilton's exhibition hall. There were two design constraints: to plan a frame capable of being manually converted and constructed within a week and, when erected at Saratoga Springs, to avoid collision with the Hilton's 20 feet high ceiling mounted lighting.

The text follows the project through research and concept to construction.

INDEX

- | | | | |
|----|---|----|---|
| 1 | Transatlantic Communications 1
<i>Settler Buildings in Massachusetts and New York States ~ Cohoes, NY</i> | 21 | On Course
<i>In the Wedding Reception Marquee</i> |
| 2 | <i>Dutch settler anchorbeam sections</i> | 24 | <i>Geometry 1 STEPPING OUT</i> |
| 3 | <i>North Hillsdale, NY</i> | 25 | <i>T Augers and Drilling Machines</i> |
| 5 | <i>The Dutch House, Hudson, NY</i> | 27 | <i>Geometry 2 ARCH BRACES</i> |
| 7 | <i>The Dutch House, Buskirk, NY</i> | 29 | <i>Geometry 3 CORBELS</i> |
| 9 | Transatlantic Communications 2
<i>Corbels</i> | 31 | <i>Geometry 4 THE ADZE</i> |
| 11 | Transatlantic Communications 3
<i>Two Circle Geometry</i> | 32 | <i>Peg Making</i> |
| 12 | <i>The Geometrical Development</i> | 33 | <i>Logos</i> |
| 20 | Transatlantic Communications 4
<i>Bucksteep Manor</i> | 34 | <i>Meanwhile, inside the Marquee</i> |
| | | 35 | <i>And outside the Marquee</i> |
| | | 37 | Dark Evenings : Day's Eye
<i>The Dutch House Team KEY</i> |
| | | 39 | Triple Assembly |

Transatlantic communications 1

I met Will Beemer, then Chair of the USA Timber Framers Guild, at the UK Carpenters' Fellowship Frame 2008 Conference where, over our pints of beer, he had offered the chance of running a geometrical design and hand tools course in the USA, working with Guild founder, architect, author and timber-frame carpenter, Jack Sobon. I knew Jack by reputation and had read his books so it took about a nanosecond to say yes. Will was thinking of a small geometrically designed frame, echoing the Gardener's Shelter that I designed for the walled Elizabethan garden at Cressing Temple in Essex, UK combined with Jack's knowledge of early settler timber frames in Massachusetts and his practical skills in the use of hand tools. This sounded like an exciting idea but, like all ideas, would take considerable time and energy to bring to fruition.

An initial difficulty was that Jack and I had never met and were on opposite sides of the Atlantic. I was told, though I'm not sure whether I believed it or not, that Jack did not use a computer and, as someone who does not have a television I was with him in spirit. But I do use a computer for geometrical analysis and it is the optimum means of communication. Just as I was getting slightly apprehensive about how we could get the project rolling I received two emails, first one from Will saying Jack had acquired a computer and then a second from Jack himself! If he had never used a computer he soon made up for it. Flight after flight of measured floor plans, sections, photographs and scans winged their way across the pond with examples of early timber-framed houses and barns, built by English, German and Dutch settlers in Massachusetts and neighbouring New York State. We were under way.

It was easy enough to single out specific sections or plans from Jack's information and to run basic searches for evidence of geometrical design systems but some of the characteristics of the buildings were unfamiliar. In particular there was a significant difference in concept between English frames with tie beams and principal rafter trusses spaced at bay intervals and the Dutch system of anchorbeams jointed to posts with corbels and posts, spanning the building in a much tighter, repetitive rhythm.

Settler buildings in Massachusetts and New York states

Downloading Jack's emails gradually opened up a view of the settler barns and houses. For some there were drawings, others were merely lists of statistics and there were a few photographs. This was where my learning curve began. Some of the houses or barns had known construction dates while others remained elusive. I accepted them in the order of their arrival and soon had a growing list of settler house names from either Massachusetts or New York states: Cohoes NY, North Hillsdale NY, Buskirk NY, Stuyvesant NY (which I recognised as the name of an expensive cigarette from my youth), Alford MA, the Bronck House, Jan Breese House, the German Barn at Alcove NY, the English Barn at Egremont, the Mason House, Adams, the Coffin House, Fairbanks House and the Lawyer Barn NY. A note on my list stated that Cohoes was probably the earliest and I had two dates, the Fairbanks House 1637 and the Coffin House 1654. Lets re-run my introduction to these barns and houses to see what could be discovered ~

Cohoes, NY

Cohoes, NY arrived as statistics. It had a floor plan of 18 feet 9 inches x 18 feet 7 inches, 4 x 6 inch posts and three anchorbeam dimensions, 6 x 8¼, 6 x 9¼ and 6½ x 11½ inches, four bays and a 44° roof pitch. Even without drawings or photographs it was clear that the floor, with just 2 inches difference between its sides, was intended to be square and that the roof pitch at 44° was virtually the diagonal of a square at 45°. I could also visualise the three anchorbeams of a 4 bay house were in the three internal bents, leaving a gable wall at either end. These were simple proportions and it was no surprise that Cohoes was listed as probably the oldest example. Geometrically, the four bays came easily from dividing the square floor in half with each half halved again. The posts had a specific compass geometry and the three anchor beams all came so close that they could easily have diverged slightly from precise geometries during hewing or sawing. All are easy to mark up 'on the job geometries' shown opposite in figures 1, 2, 3 and 4 with the blue tone showing the given timber dimensions.

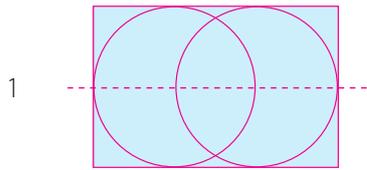
Dutch settler anchorbeam sections

During our email conversations, Jack and I discussed timber sections. Jack observed ~

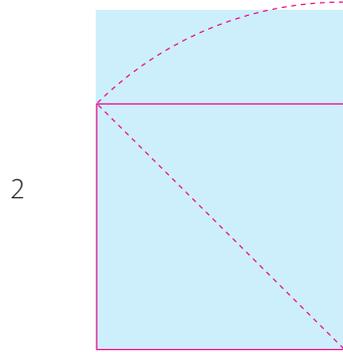
*One thing I've always noticed is that the cross section of anchorbeams in Dutch houses and barns approaches the vesica piscis proportion or sometimes 1 : 2. In my college statics course I learned using calculus that the **strongest** shaped beam to get out of a given diameter is a 1 : 2. Funny how those builders of old knew that.*

Figure 4 shows the vesica piscis beam section and figure 5 shows its simple extension into 1 : 2 double square proportions. It can also be drawn as a three circle sequence, figure 6. Linking four of the daisy wheel's petals, figure 7, generates the $\sqrt{3}$ rectangle and extending the rectangle to the wheel's circumference gives another double square. The rectangles in figures 4 and 7 are identical.

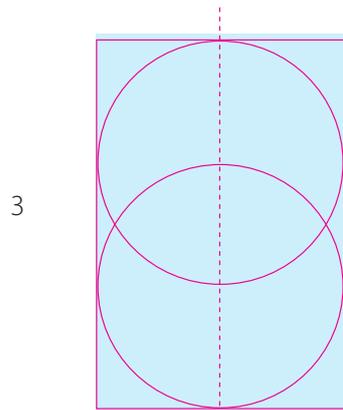
I emailed Jack with some information on beam sections from page 433 of my copy of *The Encyclopaedia of Architecture* by Joseph Gwilt, a 1364 page facsimile of *The Classic 1867 Edition*. To precis Gwilt, the **stiffest** beam that can be cut out of a round tree is a $\sqrt{3}$ rectangle, a good proportion for beams that have to sustain a considerable load. My take on these sections is, as the drawings clearly show, they were all compass-based proportions and as such, had inherent strength.



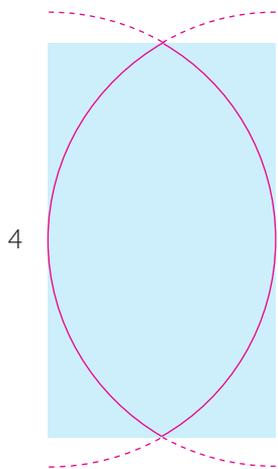
1
POST 6 x 4
two-circle geometry



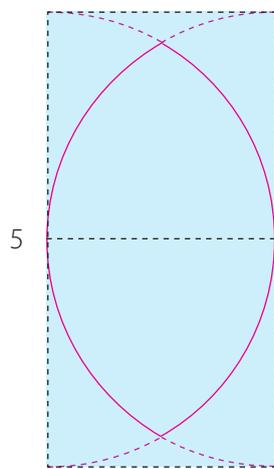
2
ANCHORBEAM 6 x 8¼
root 2 rectangle



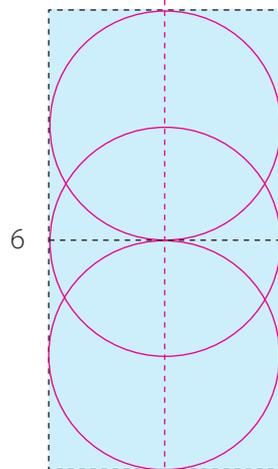
3
ANCHORBEAM 6 x 9¼
two-circle geometry



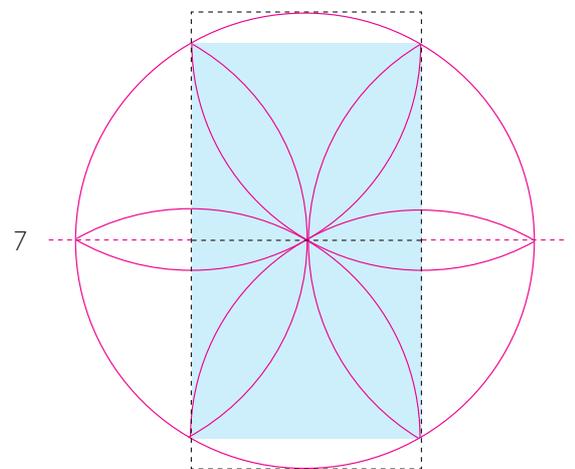
4
ANCHORBEAM 6½ x 11½
vesica arcs from centres of sides



5
ANCHORBEAM
1:2 double square



6
ANCHORBEAM
3 circle geometry



7
ANCHORBEAM
daisy wheel $\sqrt{3}$ rectangle

North Hillsdale, NY

North Hillsdale came with drawings: a gable elevation, including an outshot to one side with a catslide roof that was slightly out of sync with the roof pitch of the house and a side elevation of the framing, figure 8. The major dimensions, given for the house, were height to ridge 20 feet 9¾ inches and length of house 24 feet, height to upper face of collar 15 feet, height to eaves, upper face of wall plate 12 feet, outshot height to eaves 6 feet 10 inches, figure 8. No dimensions were given for the building's width or anchorbeam depth but putting a ruler to the drawing gave a gable end width of + – 20 feet and an anchorbeam depth of + – 1 foot 1½ inches.

The sectional drawing revealed the principle of the anchorbeam, massive enough to resist deflection when loaded with furniture and people and therefore able to support the posts in a rigid vertical position. The dimensions for North Hillsdale's anchorbeams were 5¾ by 10½ inches, a compass defined $\sqrt{3}$ rectangle, on the left, and 6¾ by 13½ inches, a related double square, on the right in figure 9. This was my first view of a Dutch settler frame and, compared with Welsh historic frames with tie beams, principal rafters and heavy purlins, I found the fragility of the roof disconcerting although in East Anglia, just across the North Sea from Holland, roof structures are often similarly light.

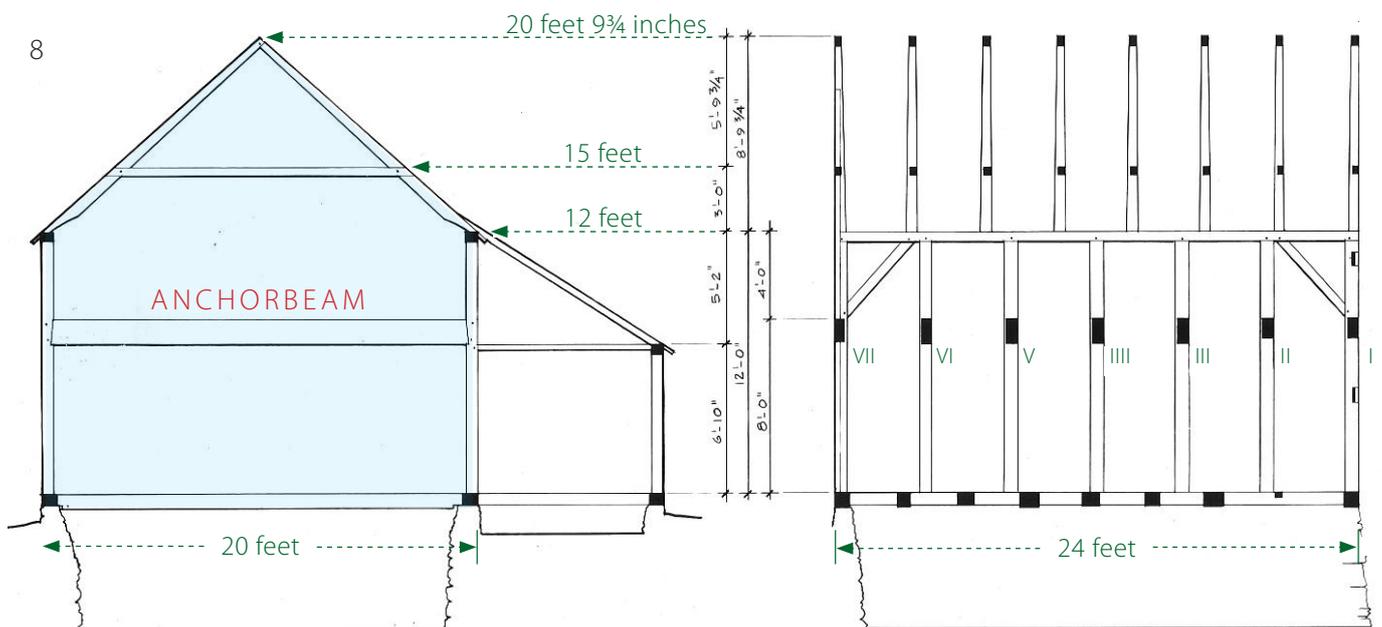
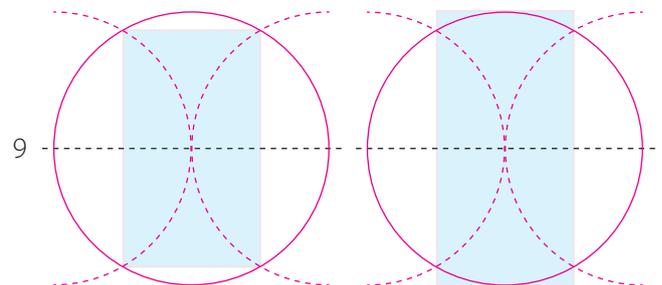
Finding the geometrical basis of this frame took many attempts but I slowly uncovered a gable geometry that was new to me and this was exciting!

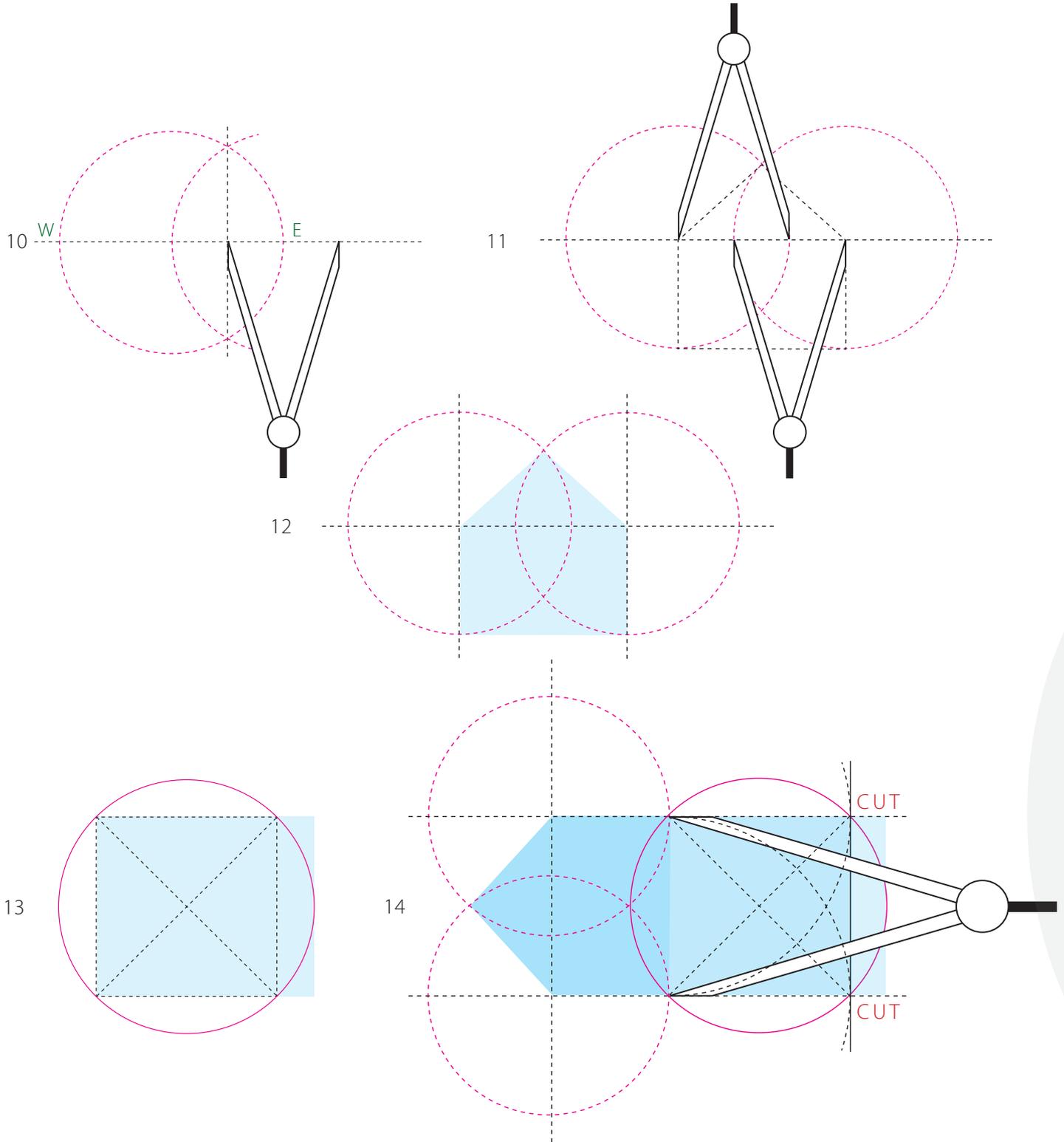
SECTION

Draw a circle on a horizontal centre line to give east and west poles and then an arc of a second circle from the east pole to cut the first circle's circumference. Where the full circle and arc intersect they form a vesica piscis and a vertical perpendicular can be drawn through the intersections, figure 10.

Draw a second full circle, identical in radius to the first, so that it passes through the point where the perpendicular cuts the centre line, figure 11.

The final stage connects each circle's axis to the top vesica intersection and drops vertical radii down to the circumferences to form the gable section, figure 12. The section is shown in blue tone and repeated at a larger scale as an overlay on the gable section in figure 8 to confirm its fit.





FLOOR

The floor dimensions 20 by 24 feet are found in a classic compass / square geometry where the circle passes through all four of the square's corners. The floor equals the square plus an extension on one side as far as the circle's circumference, figure 13. This is a simple and elegant way to find a floor proportion and it also has the potential to expand as far as the opposite side of the circle to give a longer rectangle.

Figure 14 shows how the square can be developed from the gable section's base, shown in medium blue tone. Two arcs of base width are

swung to cut the two circle's centrelines and these cuts are connected to form the square, in medium blue tone. Diagonals are drawn in the square and a circle is drawn from where they intersect. The circle passes through the corner angles of the square which is extended to the circle's circumference, in pale blue tone.

A revelatory finding from the analysis is that the wall heights equal the radius of the circles and that, therefore, so do the post lengths. With the posts at 12 feet in length a design drawing would most likely be at 1:12 scale.

The Dutch House, Hudson, NY

The Dutch House at Hudson, New York came as front and end elevations, floor plan and a vertical cutaway section through the house that revealed a cellar that was not evident in the other drawings, figure 15. There were no dimensions. Externally, the house seemed small and neat but the cellar beneath the main ground floor room (first floor if you are an American reader) and a further two floors rising into the roofspace made this a four floored house.

My first geometrical step was to check the proportions of the floor plan which proved to be a double square, a commonly used European proportion at the time the settlers were sailing across the Atlantic. They probably brought it with them, along with their saws, axes and chisels. Looking at the floor it was obvious that the double square met on the centre line of the house, running down the middle of the entrance hall and stair well which occupied half the width but a quarter of the area of the hall. Each square therefore has five spatial divisions between its beams, making ten spatial divisions for the whole double square floor.

THE FLOOR

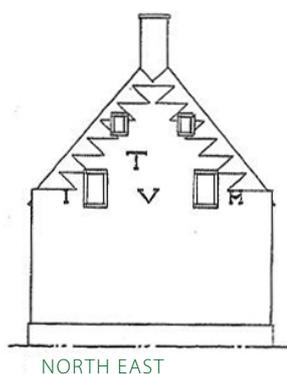
There is a specific geometry for dividing a square into five equal sectors. The square is first divided in half and then each half is halved to

give four equal divisions. A diagonal is drawn in each of the divisions and then the square's full diagonal in the opposite direction. The diagonals of the four sectors cut the square's full diagonal at four points which are spaced at five intervals the line. Parallels to the square's side divide the square into five sectors, figure 16, and the construction is repeated for the second square, figure 17.

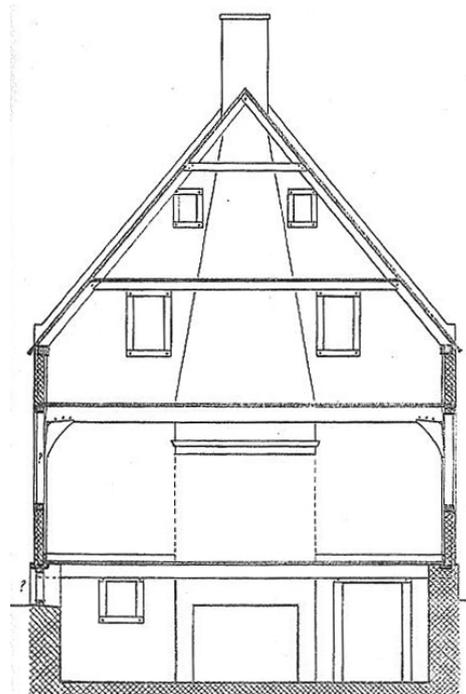
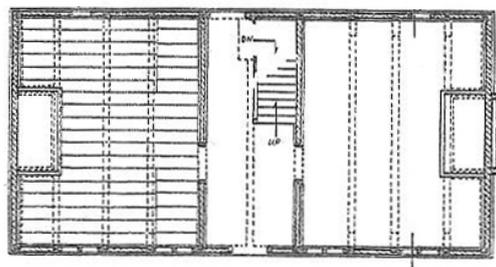
Looking at the floor plan again it can be seen that the great fireplaces at each end are a third of the building's width. The geometry is identical to that just described: the double square is divided in half along its length, diagonals are drawn in each half and then the full floor diagonal in the opposite direction. The half diagonals cut the full diagonal in two places at thirds along the line and parallels to the long walls, drawn through these points, divide the floor into thirds, figure 18. The whole floor is subdivided using the same geometrical system but in two directions, across the width for joists and along the length for fireplaces.

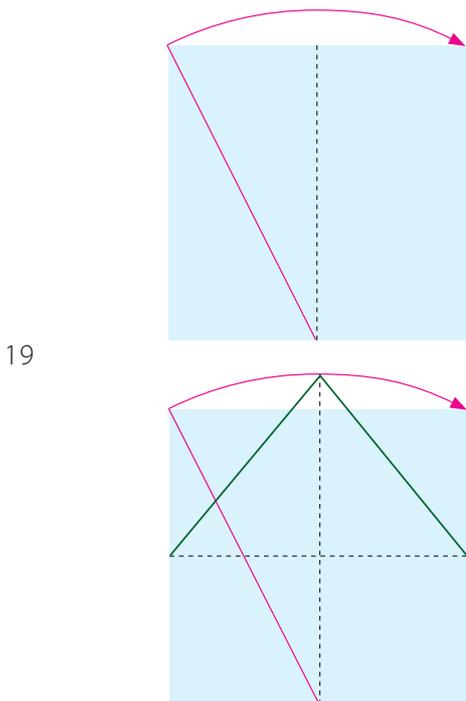
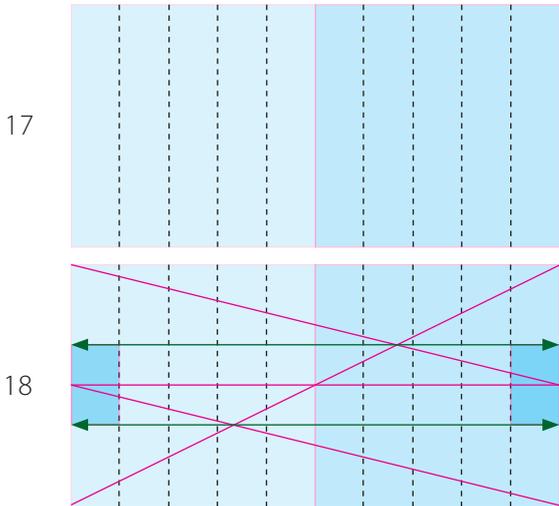
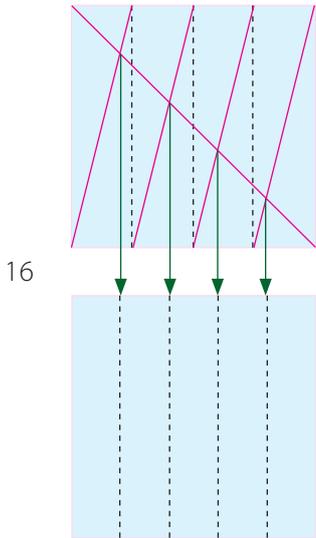
THE SECTION

The section followed the plan by using square geometry. Standing a square on the ground sills fell short of the roof ridge but a compass arc, drawn from the base of the square's vertical centre line, and passing through the square's top corners, gave the ridge height. Angles drawn from either end of the square's



15

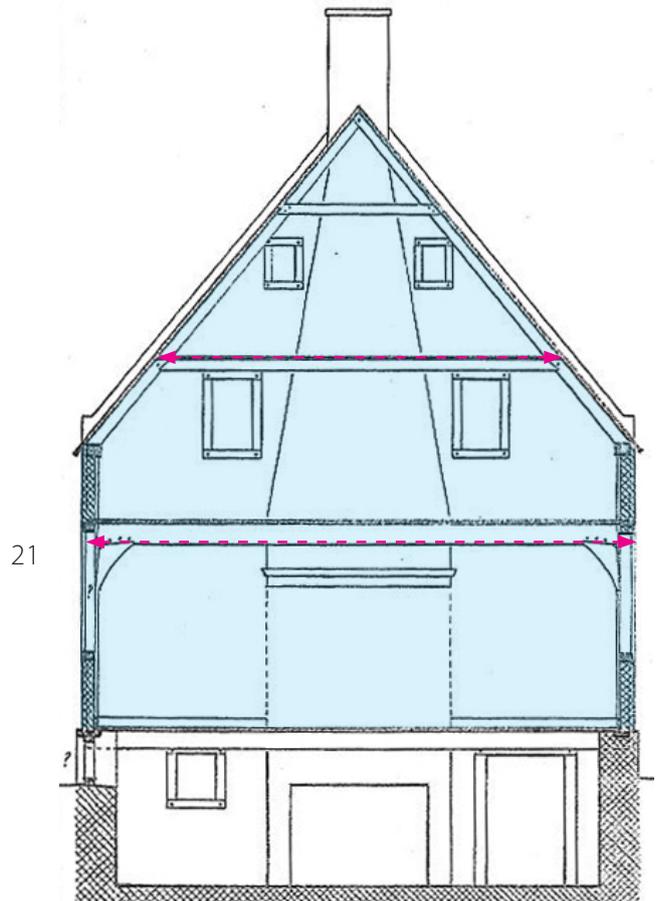
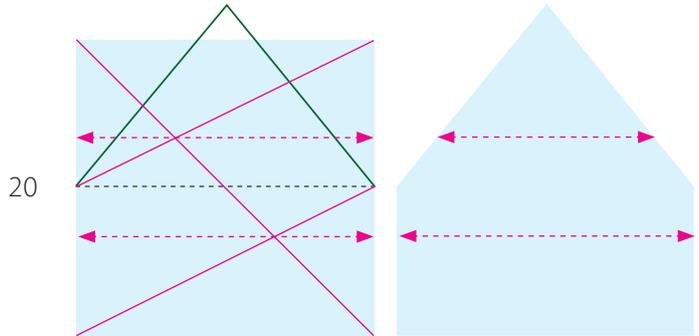




horizontal centre line to the ridge gave the roof pitch, figure 19. In the final development of the section the square is subdivided into three horizontal bands using the same diagonal geometry described in figures 16 and 18, the dividing lines indicating the levels of the anchorbeam and the large, lower collar, figure 20. Figure 21 shows the geometrical section superimposed over the drawn section.

THE FACADE

It is worth mentioning that the facade is half the floor's double square high from ground to the eaves and, although the drawings are very small in scale, the front door appears to be double square and the windows a square and a quarter in height.



The Dutch House, Buskirk, NY

The Buskirk drawings depicted an impressive house with a central classical portico flanked by two pairs of windows and a ground to eaves pilaster completing the facade at either side, a floor plan with a wide entrance hall and stair well and a gable elevation with side pilasters from ground to eaves and windows on two floors. There were two anchor beam dimensions, 7 by 10½ inches and 8 by 11 inches.

The anchor beams both gave approximately geometrical proportions, the former and smaller being slightly over a square extended to the circumference of a circle passing through its corners, the latter and larger slightly under a $\sqrt{2}$ rectangle, figure 22. Both geometries are easy to mark out with a carpenter's square and dividers on the end of the felled timber.

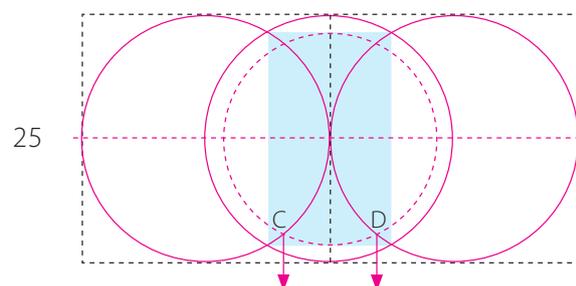
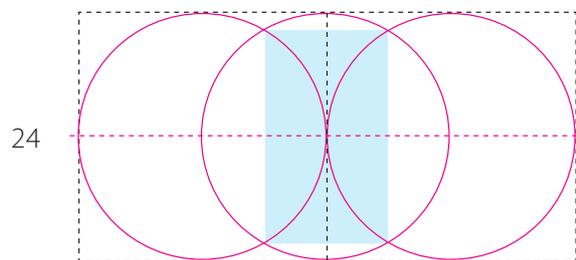
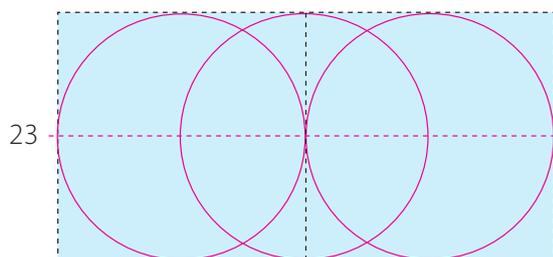
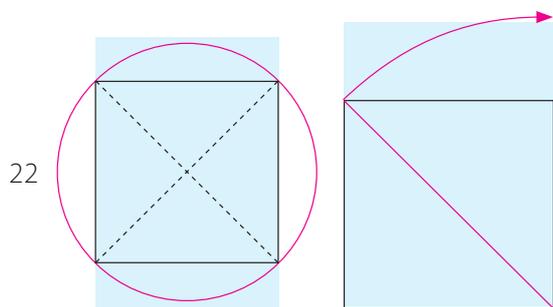
THE FLOOR

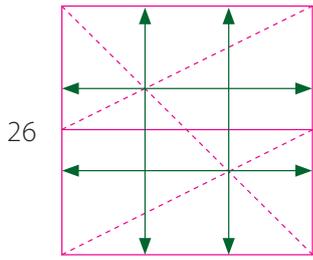
Drawing a three circle sequence along a centre line and then tangents to the circles generates a double square, figure 23, the floor proportion of both the Hudson and Buskirk Dutch houses. Where the floor plan of the Hudson house gave extensive details of the sill beams and joists, the Buskirk drawing recorded the walls and stud positions within them. Analysis of the Buskirk floor gave an unexpected result with a double square proportion fitting the *internal* face of the outer walls. However, stretching the double square to fit the long walls causes the proportion to overshoot the gable walls.

The three circles intersect at four points, two above and two below the centre line. Figure 24 shows a blue tone filling the space between the intersections and this tone defines the width of the entrance hall and stair well. The geometry can be developed further. A fourth circle, shown in dashed line and drawn from the tone's centre, kisses the top and bottom edges of the tone on its vertical centre line. Where this circle cuts the outer circles at C and D it marks the width of the classical portico at the front of the house, figure 25.

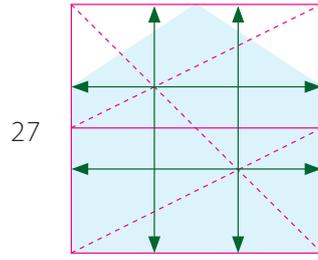
THE GABLE ELEVATION

Where the floor is a double square, the gable is a single square. The geometry evolves as follows. The square is divided in half horizontally and diagonals are drawn first in each half and then the full diagonal in the opposite direction. The diagonals intersect at two points that divide the main diagonal into three sectors. Two horizontal and two vertical lines can be drawn through these points to proportionally divide the square, figure 26. Figure 27 shows how the top line defines the eaves level and how the eaves are connected to the ridge at the square's top centre. Figure 28 shows the geometry superimposed over the gable drawing. It can be seen that the top horizontal line marks the level of the eaves and the centres of the two small upper windows while the lower horizontal line marks the head of the large lower window and the column height of the classical portico. The vertical lines mark the inner mouldings of the upper windows.

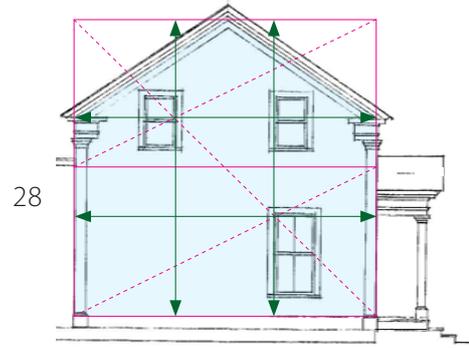




26



27

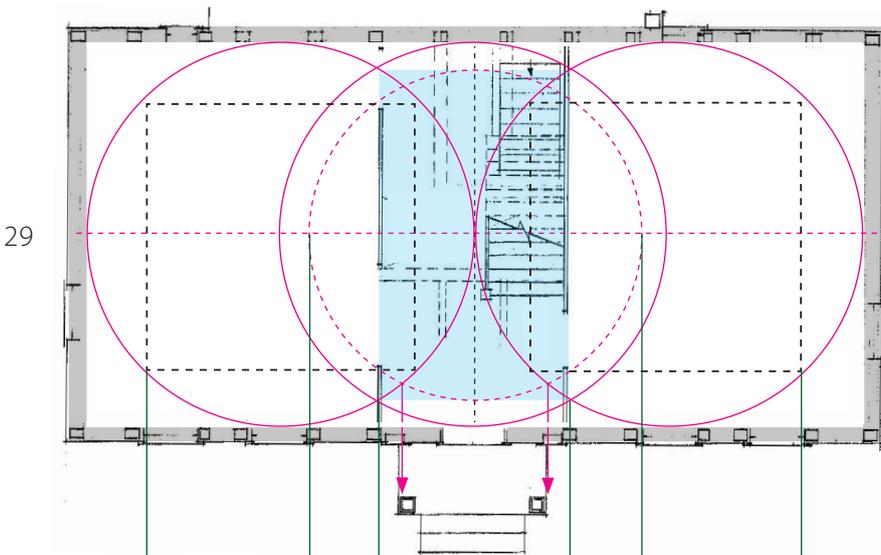


28

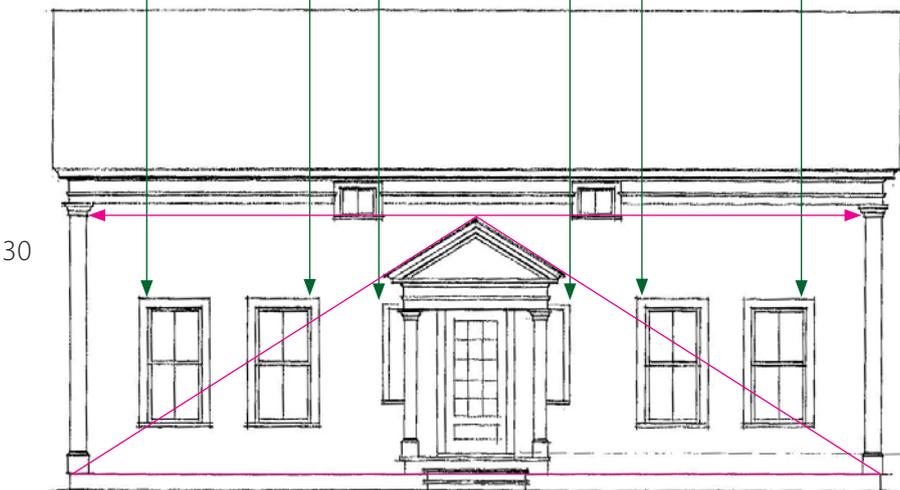
THE FACADE

Many aspects of the facade's proportions are determined by the floor plan, first from the three circle geometry and, secondly, from a square drawn, in dashed black lines, within each of the two outer circles, figure 29. The circles and squares provide a number of intersections from which vertical lines, shown as arrowed green lines, can be dropped into the facade elevation to define the edges of the tall ground floor windows, the narrow entrance windows flanking the portico, the two small eaves level windows and the width of the por-

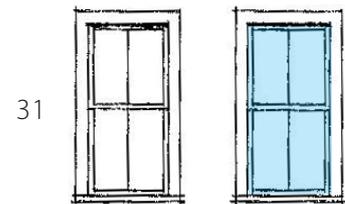
tico pediment. The facade's final resolution is shown in magenta line. A horizontal stretched between the base of the column capitals at either side of the facade also provides the base line for the two small eaves windows and a great triangle spanning the full width of the house at sill level meets the centre of the stretched horizontal line to give the portico's precision roof pitch, figure 30. The large vertical facade windows are double squares, figure 31, the front door is a double square, figure 32, both replicating the floor geometry.



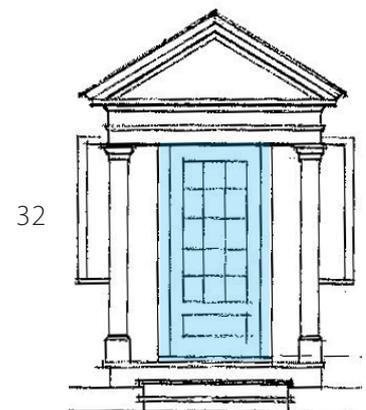
29



30



31



32

Transatlantic communications 2

As Jack emailed drawings of settler buildings across the pond I was acutely aware that we were hurtling towards the project start date and that I knew too little about American settler buildings. I would have preferred to analyse the drawings more slowly and carefully over greater lengths of time but, as this was not possible, I had to send back my initial responses, thoughts that I would never normally reveal until I had had time to verify them. I'm not sure that Jack was convinced by some of the findings and neither was I so those on the previous pages, Cohoes, North Hillsdale and the Dutch houses at Hudson and Buskirk, are houses that I have re-analysed at leisure since the project. But the benefit of the exchanges was that we established a dialogue and began to pull the two strands of the project together.

Once Bucksteep Manor in Massachusetts was chosen as the project venue, Jack, who lived close by, felt that we should use the local Dutch settler influence for the project building and this became the focus of our attention. Practicalities began to arise, the first being the TFG's funding for the project, the amount of timber this would buy and, therefore, the scale of the frame. The frame's size would also be conditioned by what it was feasible to accomplish with hand tools in a week. Jack emailed ~

I would propose that we frame a squarish Dutch house with anchorbeams as low as practical (Finish 6'-6" clearance under) with a second floor having collars also as low as practical. With a steep roof pitch, this would make the overall height about 19 feet. I will need to check if this will clear the ceiling of the exhibition hall.

We also knew that after a test assembly at Bucksteep, the frame would be taken apart, transported to Saratoga Springs, scene of the Timber Framers Guild's Eastern Conference at the Hilton Hotel, and re-assembled in the Hilton's Exhibition Hall, on display prior to being auctioned on the Saturday. The exhibition hall lighting, suspended from the ceiling, was 20 feet above the floor. Our frame had to be safely assembled below the lights, hence the frame height of 19 feet. Another email came ~

I attach a rough sketch of the idea. You can adjust the proportions as necessary. It is certainly

not as glamorous as a medieval English structure but it is appropriate for this region. It is especially significant because this year is the 400th anniversary of Henry Hudson's voyage up the Hudson River and the beginning of New Netherland.

We discussed the details of the settler houses, particularly the heavy anchorbeams and the corbels that made the junctions between the beams and outer wall posts absolutely rigid.

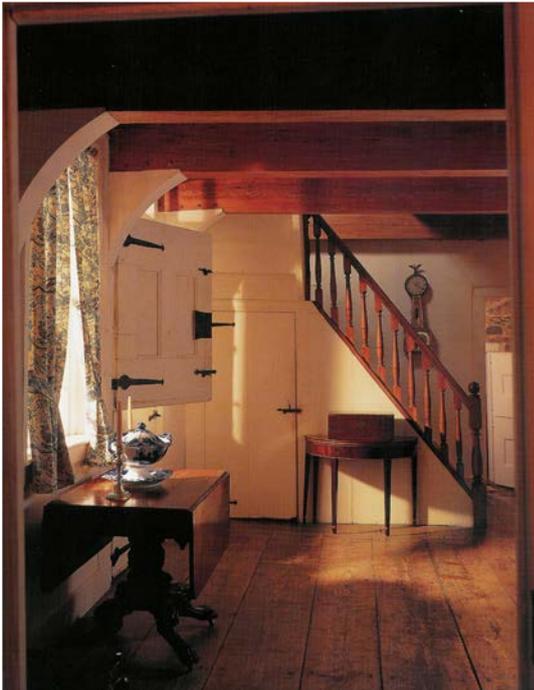
Corbels

By the way, the corbels come from the Dutch corbeel, karbeel, korbeel, a brace that functions much like a masonry corbel. The end wall braces would be normal type.

Corbels were new to me and the word is not part of English framing vocabulary but there are similar forms in English historic carpentry where a jettied floor projects beyond the floor beneath and is supported by brackets, their function being to transmit the weight of the upper floor down to the lower floor wall and, eventually, to the ground. Photograph 33 shows an English jetty on the gable wing of The Little Hall in Lavenham, Suffolk where, as befits a high status house, the jetty is supported by a bracket beneath every second joist. Figure 34 is from an American book titled *The Hudson Valley Dutch and Their Houses*. It shows the corbel in its simplest form, tenoned into both anchorbeam and post but not framed tight into the angle between these timbers. Figure 35, from an unknown book, shows the interior of the Bronck House with corbels painted to match the walls and other paintwork in the room. The corbels are clearly the same width as the anchorbeam they support and are housed into them. The anchorbeams are colossal. These corbels fit tight into the angle between each anchorbeam and post.

As an architect Jack had taken photographs and made many drawn records of settler building details during the course of his professional work, sadly sometimes to record demolitions. Figure 36 shows the structure of a corbel still pegged to its post and, finally, dismantled. A drawing of a corbel from the Jan Breese House in New York State, figure 37, shows the housing of the corbel into the lower face of the beam and gives the corbel's dimensions of 1 foot 8 inches by 1 foot 5 inches or 20 x 17.

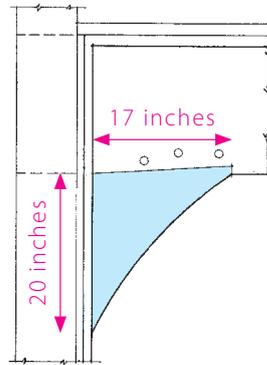
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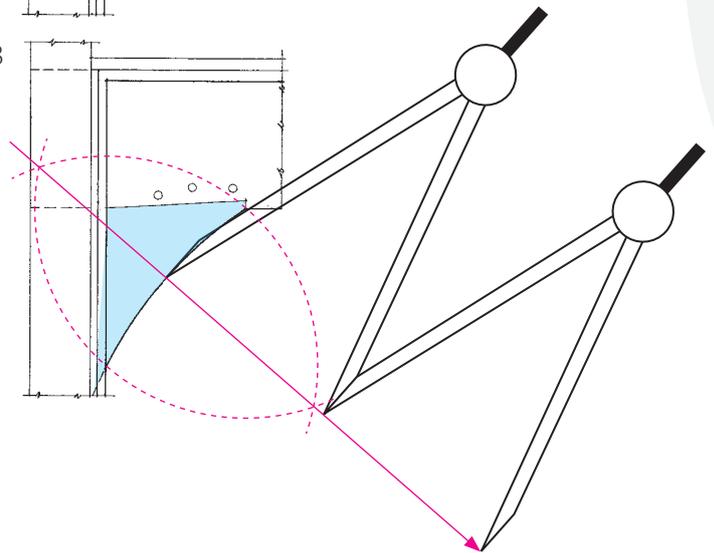
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37



38



Using the drawing from the Jan Breese House I was able to find the axis of the corbel's arc. If compass arcs are drawn from either end of the corbel's curved underside they intersect at two points. A line drawn through the intersections leads in the direction of the axis. Using the same radius as the arcs, the axis is exactly two radii along the line, figure 38.

Transatlantic communications 3

With time growing short Jack and I turned our attention away from the early settler houses and focussed more on the practicalities of running the course. It was also time for me to commence the geometrical design that we would be using but there were still a few questions. One was, were the sills to be included within the geometrical outline and what would their depth be? Jack's reply resolved this ~

I hear from Sue Warden that the height in the exhibition hall to the bottom of the lights is 20 feet. So if we keep it to 19 feet we should be fine. Figure on a sill height of 7" and two inch thick blocks on the floor of the hall (necessary if we needed to get a fork lift's forks under the frame to move it). Thus the frame height from top of sill to peak should be less than 18' - 3".

Reading the email I thought that allowing a whole foot for clearance was a bit on the cautious side but the beauty of geometrical design is that, even when the scale is changed, it retains identical proportions. So, I added a foot to gain space within the frame in the knowledge that we could always shrink it again if necessary! So 19 feet 3 inches to the peak.

We discussed possible methods of converting the geometrical design into timber at full scale. At Crossing Temple in the UK, the previous year, we had used daisy wheel geometry set out full scale on the ground using two rods of 7 feet 6 inches in length (the wheel's radius) to triangulate the cardinal geometrical points. The points were then marked by small larch squares with cross lines intersecting at the cardinal point, nailed to the ground, and the geometry was plumbed up to the timbers in a lay up. Jack was uncertain about this and favoured a scale drawing and stepping out with dividers ~

I'm not sure of the process of setting out on the actual ground using square boards. If we build the floor frame first and set it out level and square, can't we work off that? I had envisioned you creating a geometric draft on paper or a planed board to some scale (like one inch equals a foot), then setting the compasses to a length on that draft and stepping it out on the actual timber the appropriate number of times (12) to get the full size.

I had once designed a small, mobile, golden rectangle frame that had to fit the flat bed of the truck that would carry it around, a similar method to working off the floor frame. But there was also the issue of how tuition would take place. The geometrical instruction had to come first so that the course participants understood the evolution of the design and how to translate it into a frame. Another email confirmed this ~

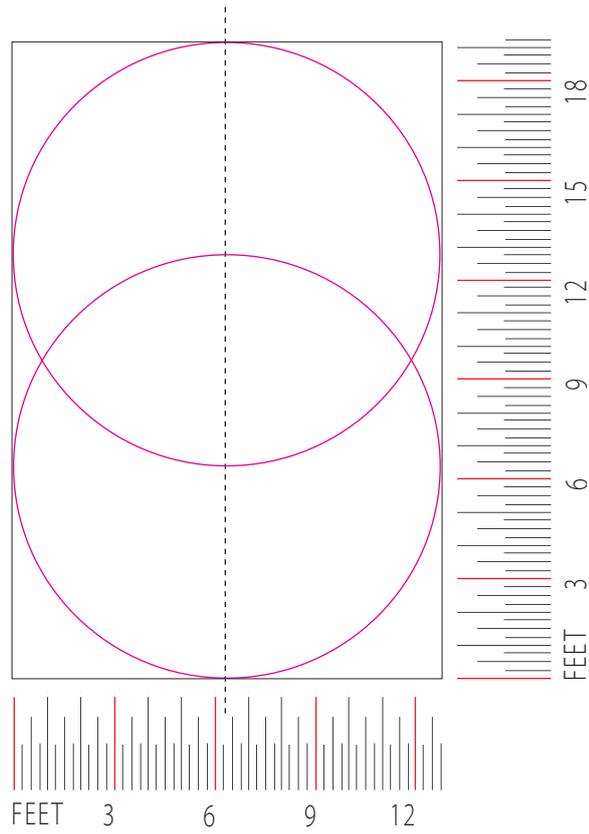
One advantage of the Dutch house design is that there are multiple bents (five in the project design), multiple rafter couples (also five), and of course two longitudinal walls. As each bent is scribed, a handful will take it off to cut the joints, allowing the next group to scribe. There will be additional setups with people hewing, making pins on a shaving horse, and people shaping corbels. We should also note that some of the course participants, I counted at least seven, would qualify as advanced timber framers. Some could teach their own workshops on specific topics like hewing, scribing, etc. I'm betting that most are in it for the geometry portion.

Reading the last sentence it was clearly time to pick up the compasses. I had the height limitations and Jack's suggested sill height. Jack had also assessed the timber budget and decided the general scale of frame that we could afford to undertake, a fairly small footprint around 12 feet square on two floors, five bents, the internal three with corbels and the gable bents with straight braces, all beneath a steeply pitched roof. Following the style of the settler houses there would also be two braces on each side wall, springing from the sill at each gable post and passing the next post on their way up to the wall plate.

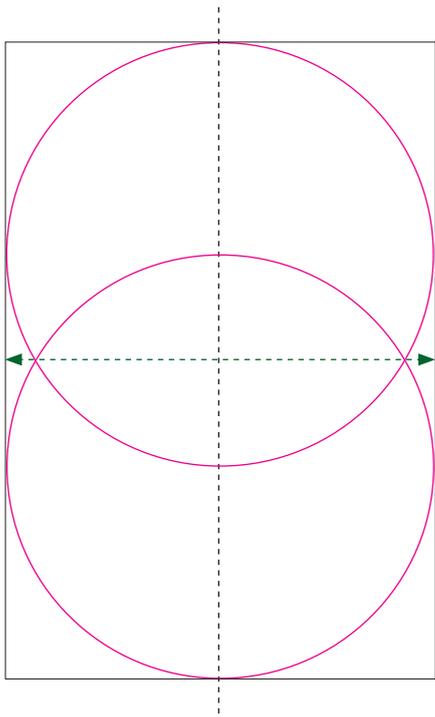
Two Circle geometry

After a number of trials, I decided to use two circle geometry: two circles drawn on a vertical centre line so that each circle passes through its neighbour's axis. This simple configuration gives a pleasing 2 x 3 proportion (a diameter in width by a diameter and a half in height) for a rectangular perimeter drawn around the two circles. Measured using a scale ruler, 19 feet 3 inches in height gave 12 feet 9 inches in width, the closest geometry to the dimensions we needed for the footprint, figure 39.

39



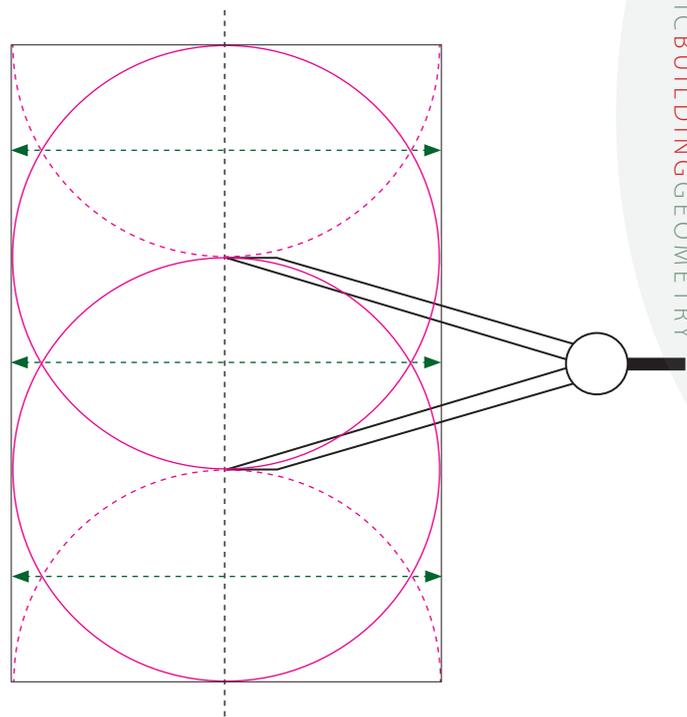
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The geometrical development

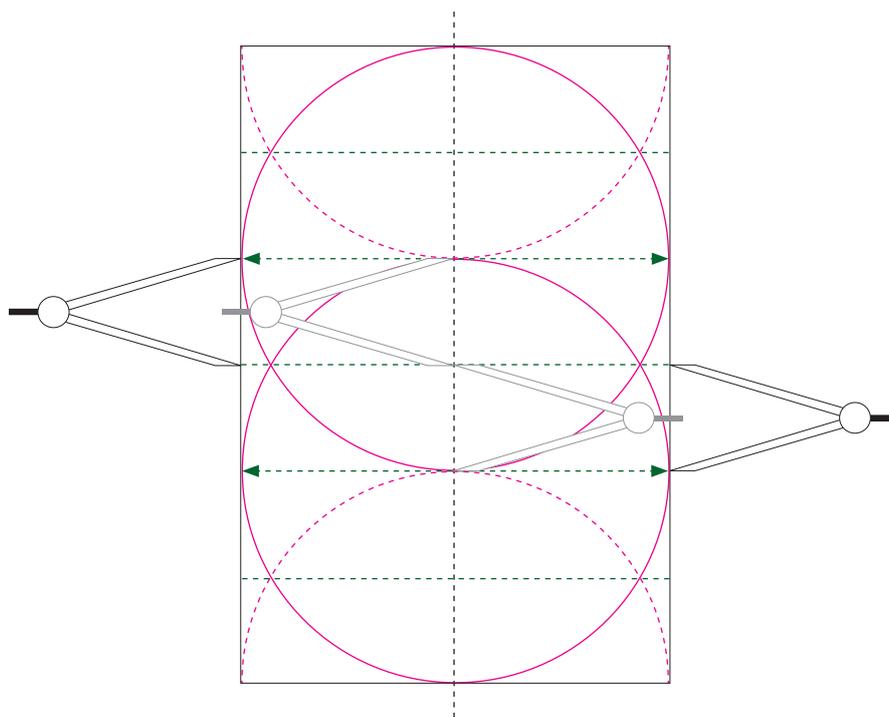
The development of the baseline geometry is described as if drawn manually. Each new line drawn between, or through, points of intersection builds towards a more complex, though still simple, geometrical grid. In figure 40, the two half circles overlap to form a vesica piscis and a line is drawn through its intersections.

41

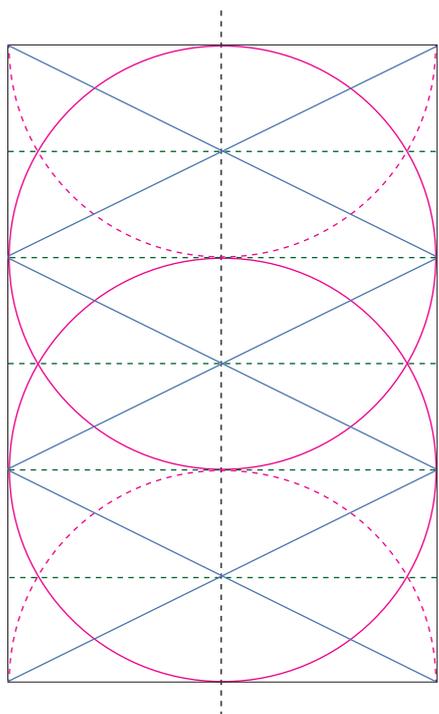


In figure 41, two half circles are drawn at either end of the centre line (where it is cut by each circle) so that both circles contain two horizontal vesicas. However, because the circles overlap, the original, central vesica is shared by both circles. Lines are drawn through the intersections of the upper and lower vesicas so that all three vesicas are bisected by a parallel horizontal.

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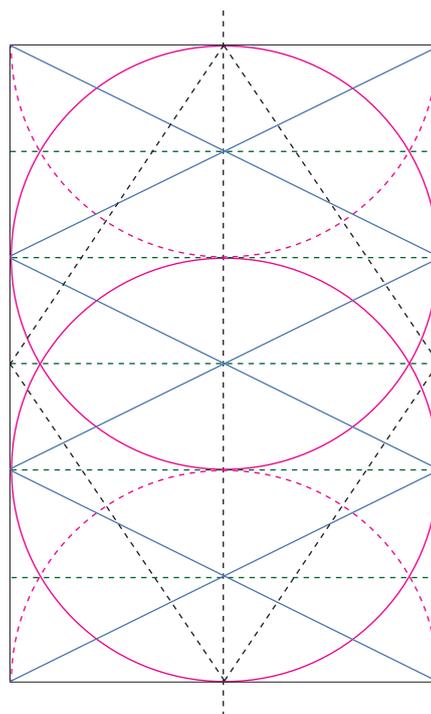
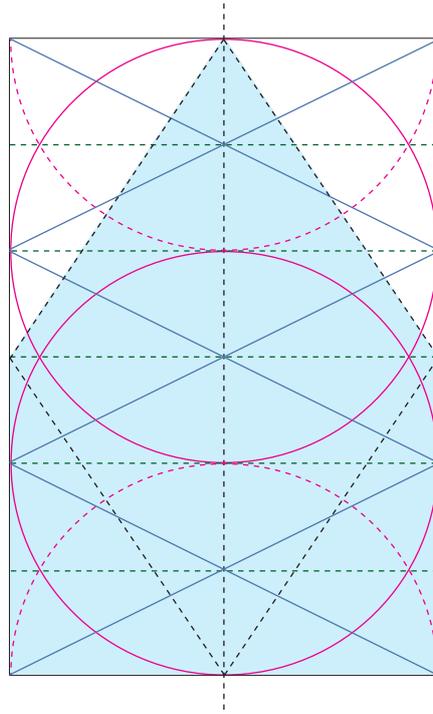


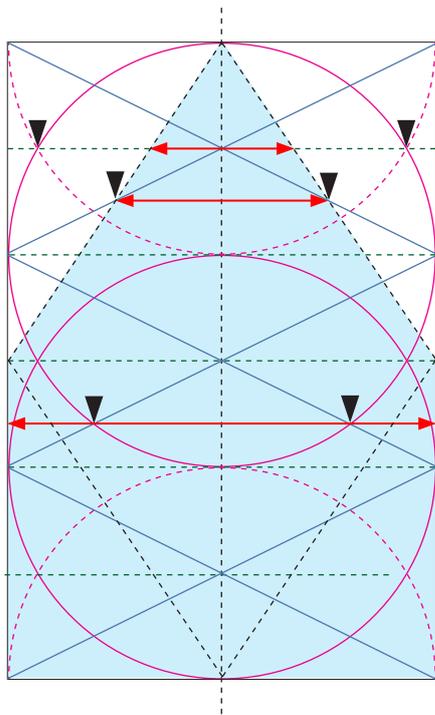
Figure 42 shows how two further horizontal parallels are drawn at the levels of the original circle's circumferences. Dimensions on the vertical centre line can be transferred to the geometry's boundary using dividers. The resulting configuration has six equal horizontal bands, four in each original circle though two are shared within the central vesica overlap.

In figure 43, diagonals are drawn across the horizontal parallels and, simultaneously, the three vesicas. In figure 44 a large diamond is drawn by linking the vertical and horizontal centre lines where they cut the geometry's boundary. The diamond completes the geometrical grid: a graph paper of circular arcs, straight lines and variable spaces, ready for designing.

45



46



COLLAR 1
COLLAR 2

ANCHORBEAM

47

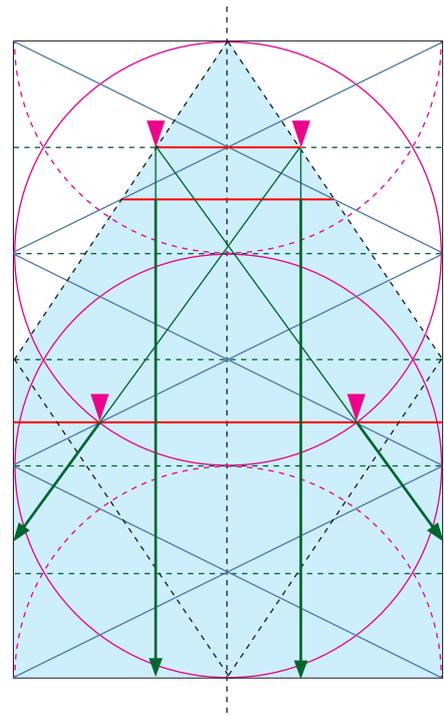
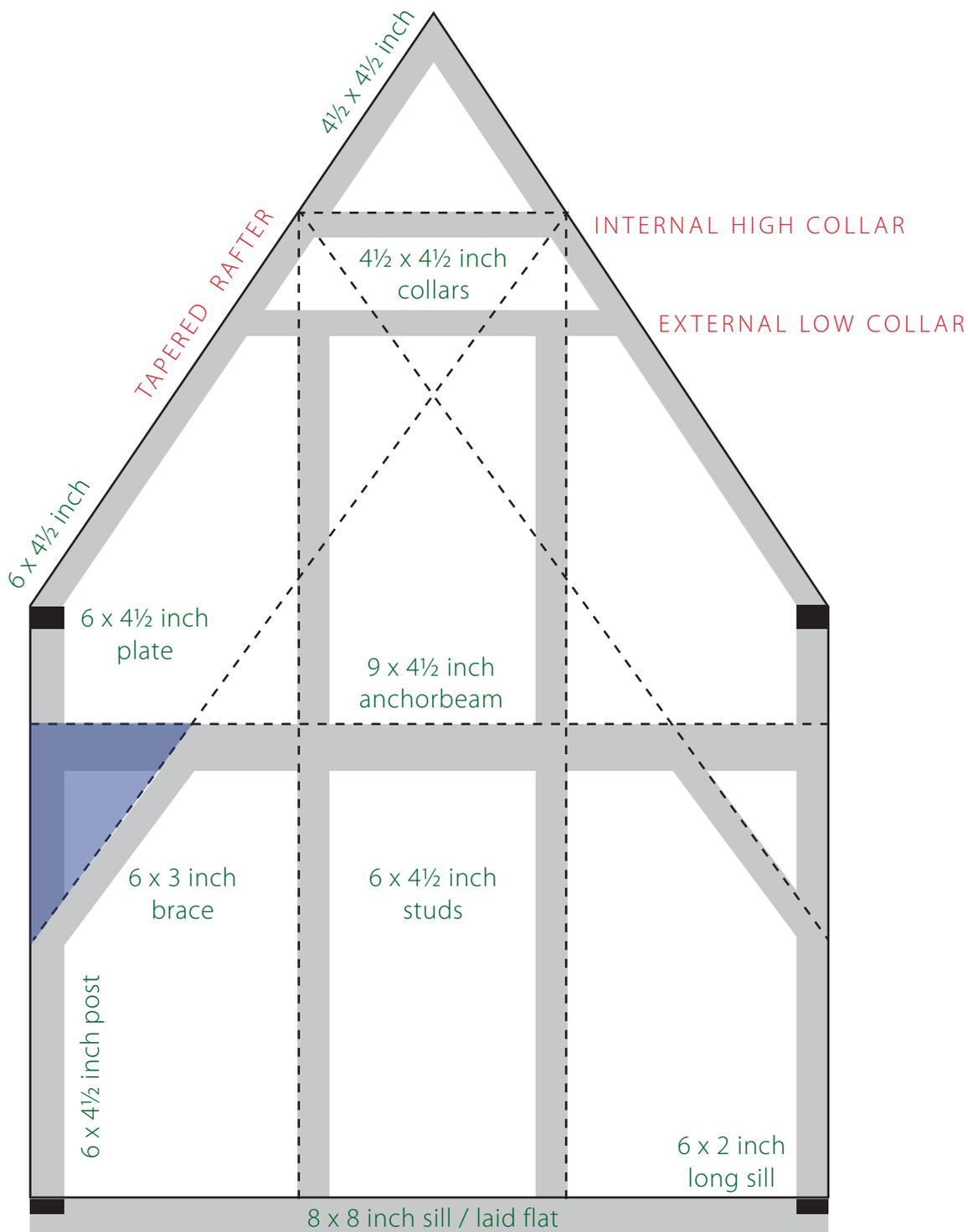


Figure 45 shows how, with the diamond in place, the section of the house can be defined. The angle of change from wall to roof is determined by the horizontal line bisecting the central vesica, at exactly half the height of the house and satisfying Jack's request for a steep roof pitch. Figure 46 shows the choice of anchorbeam and collar levels. Collar 1 is on the line bisecting the top vesica, collar 2 where the top pair of diagonals cut the roof pitch. The anchorbeam level is where the central pair of

diagonals cut the circumference of the upper circle.

Figure 47 shows the vertical studs and angled brace alignments, all four of which descend from the top two magenta arrows where the horizontal vesica bisection cuts the roof pitch. The vertical studs follow their line from collar 2 down to the sill. The angled braces pass down through the two lower magenta arrows and on beneath the anchorbeam, to the outer walls.

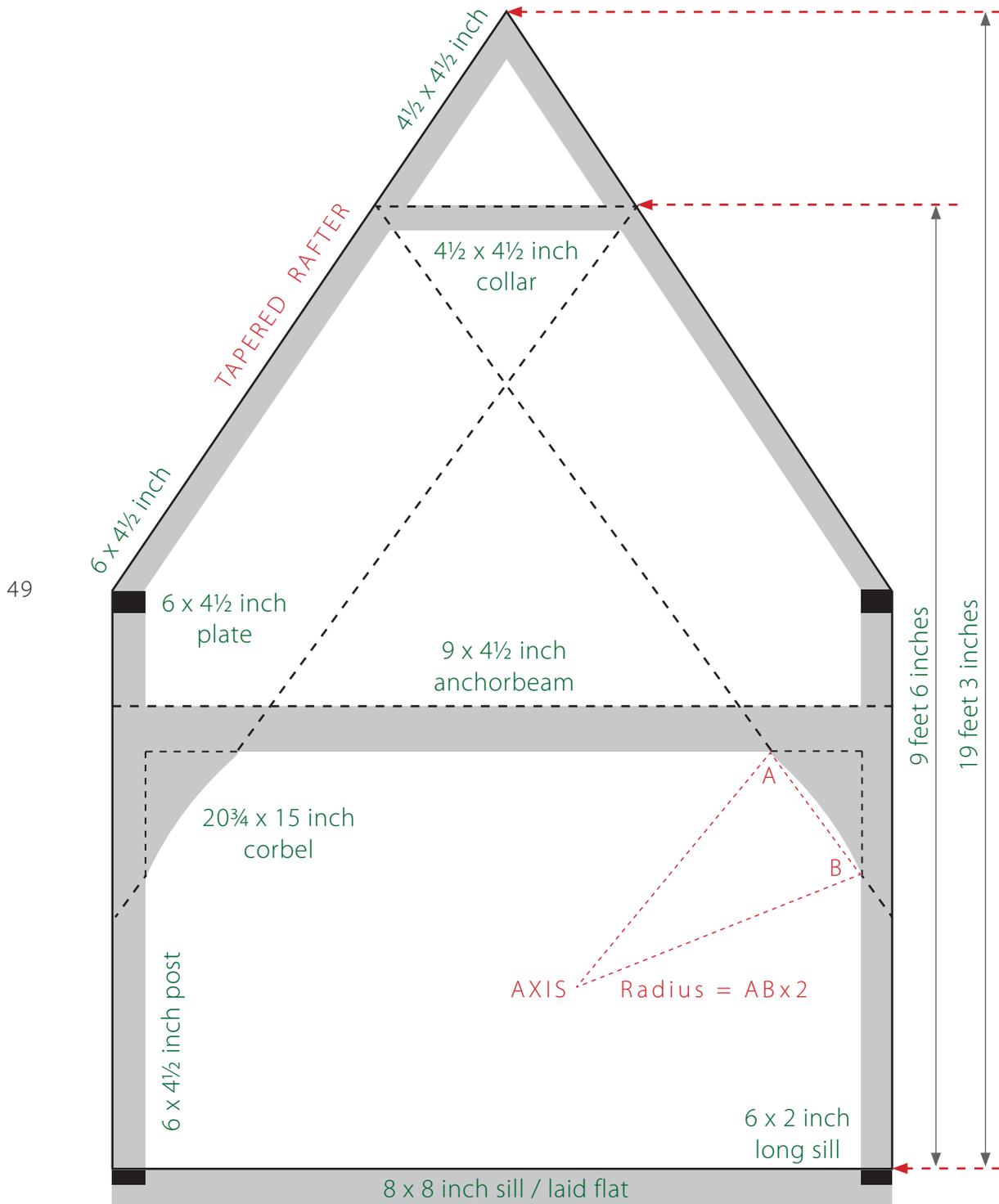
48



EXTERNAL STRAIGHT-BRACED GABLE FRAME

I had received a proposed cutting list from Jack so, with the geometrical grid complete, I could now insert scaled timbers into their positions. Figure 48 shows a gable bent with all but the perimeter and brace line geometry stripped out. It is important to recognise that much of the geometry serves as scaffolding to enable the crucial elements to be constructed and, once this is achieved, a clear drawing

can be made. The drawing shows the two collar levels, raising the possibility of using the lower, stronger triangulation in the gable bents where headroom was not an issue but to use the higher collars on the internal bents where headroom was essential. The blue tone shows the straight brace gable triangulation that would be replicated for the corbels to ensure that all the braces were visually harmonious.

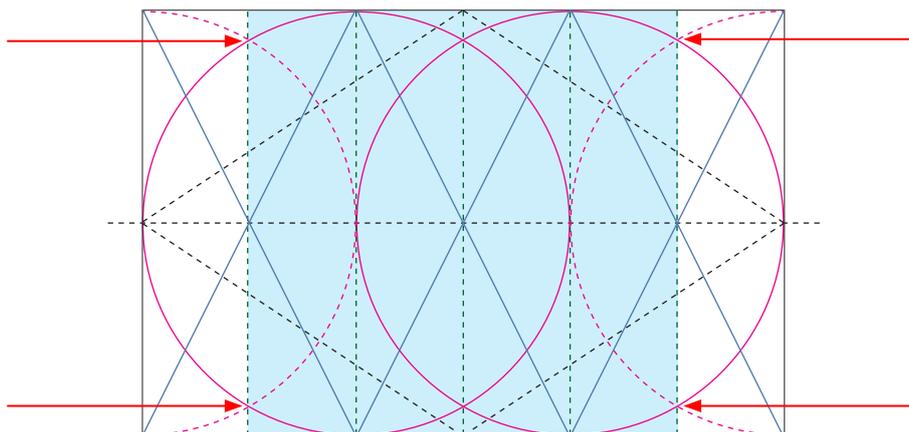


INTERNAL CORBEL-BRACED FRAME

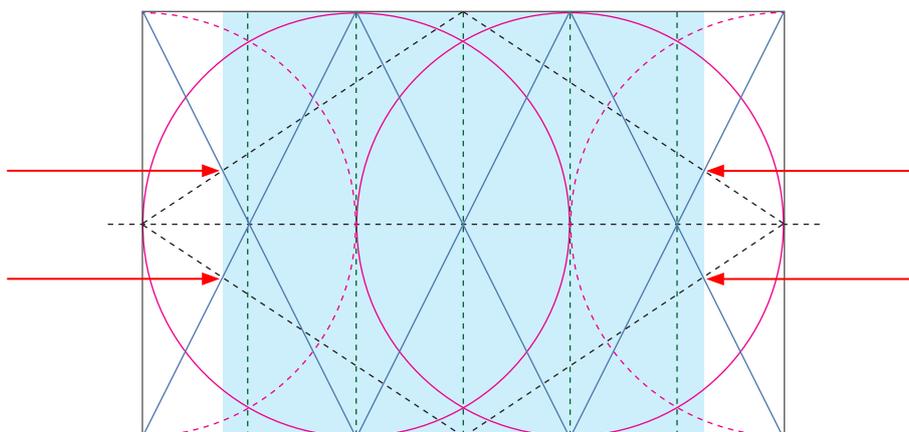
A modern attitude to placing the two gable posts, between the sill and collar, might have been to place them at equal thirds across the facade. I preferred to leave the central space narrower, in accord with the geometry, as this would provide a natural door space on the first floor and window space above it on the second. I also felt that on both floors the outer thirds were broken into by the angle braces

and the change from wall to roof, so although they were wider they were similar in area to the central spaces. Figure 49 shows how the corbels occupy the triangle between the anchorbeam, post and the straight gable brace angle and their resulting height and width dimensions. The housing of the corbels into the underside of the anchorbeam and inner face of the post are additional to the basic geometry.

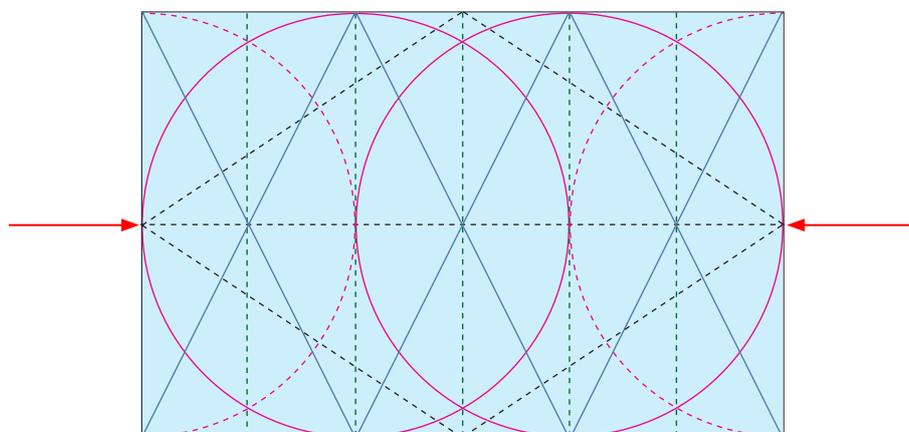
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52



The gable geometry can also be used for the side elevation and floor plan. In reality the geometry would be a single drawing but here, for clarity, the floor is shown separately on the gable geometry rotated through 90° into a horizontal position. There are several choices of floor length and three are shown in pale blue tone. The red arrows indicate the intersections where the floors terminate. Figure 50 shows the smallest floor with its length passing

through the outer vesica intersections to give a floor that is square and the same width as the gable facade. Figure 51 shows a floor that passes through the intersections of the large diamond and the diagonals and is slightly longer. In figure 52 the floor occupies the full geometry. The middle floor was chosen for the project to avoid the need for an extra bent and because the odd number of bents (5) is visually more pleasing than an even number.

53

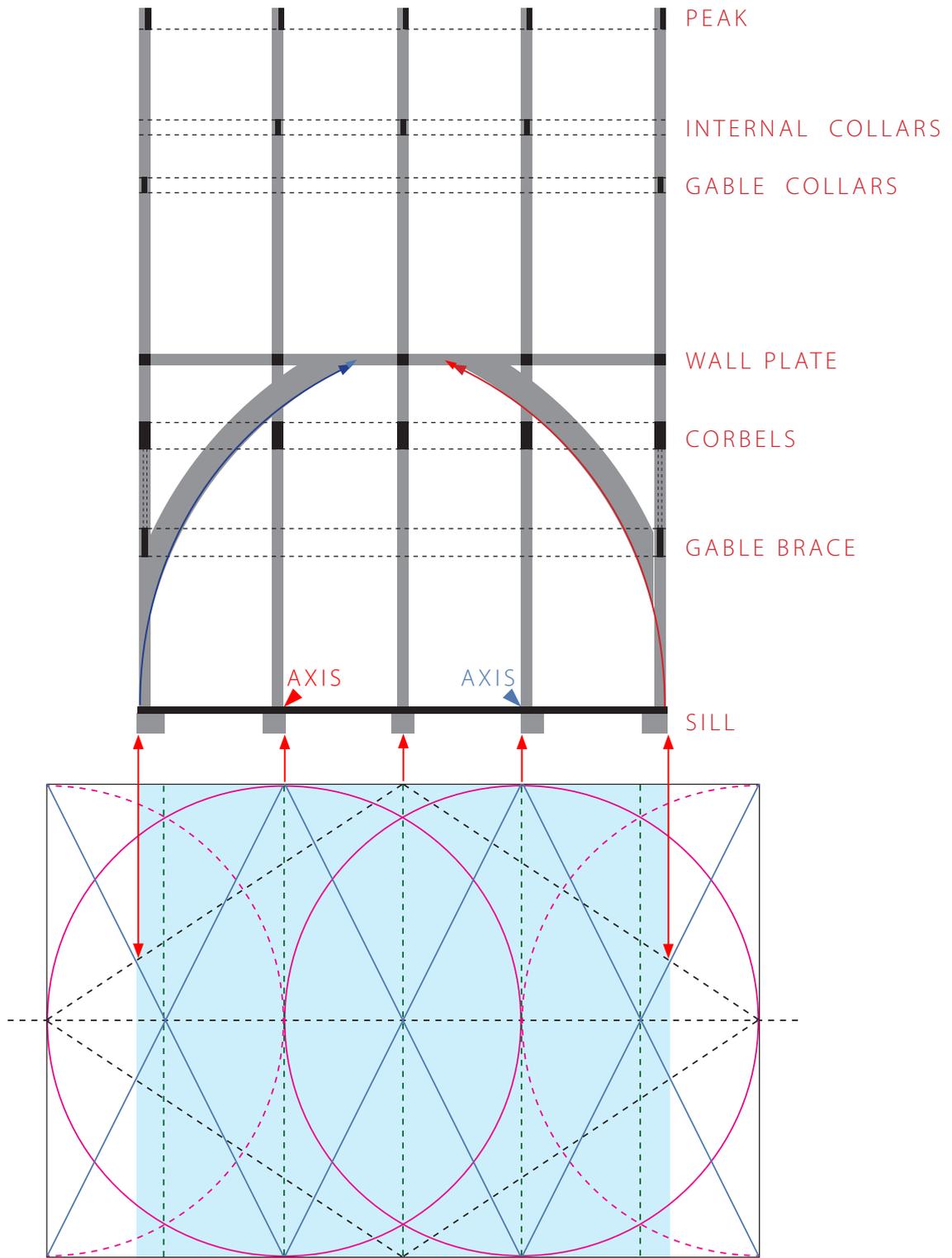
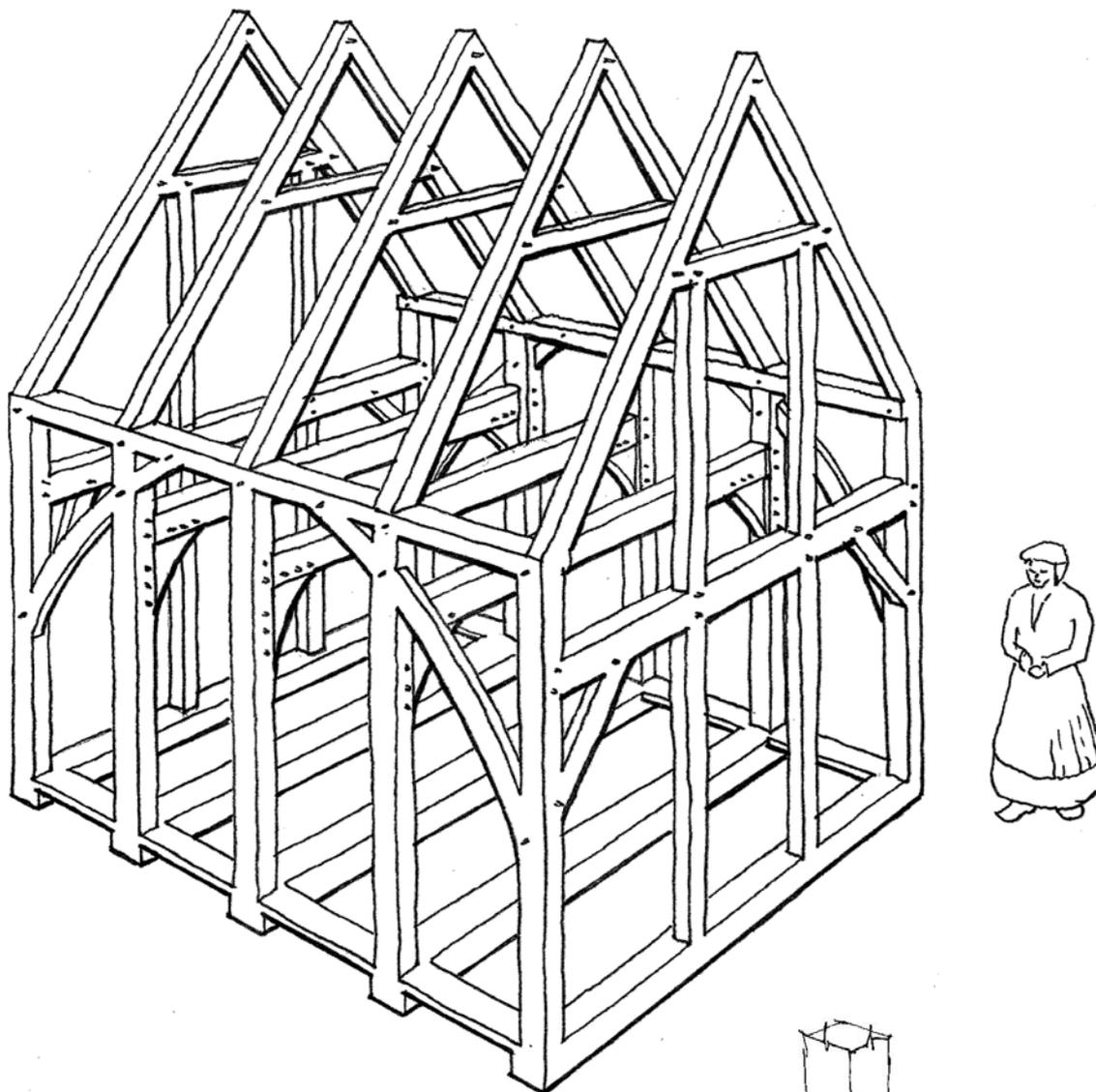


Figure 53 shows how the side elevation is derived from the floor plan. The frame height, though not shown here, is derived from the gable elevation which gives all the levels for peak, high and low collars, wall plate, corbels, gable braces and sills. The floor geometry gives choices for the positioning of the internal bents. With five bents, one at each gable and

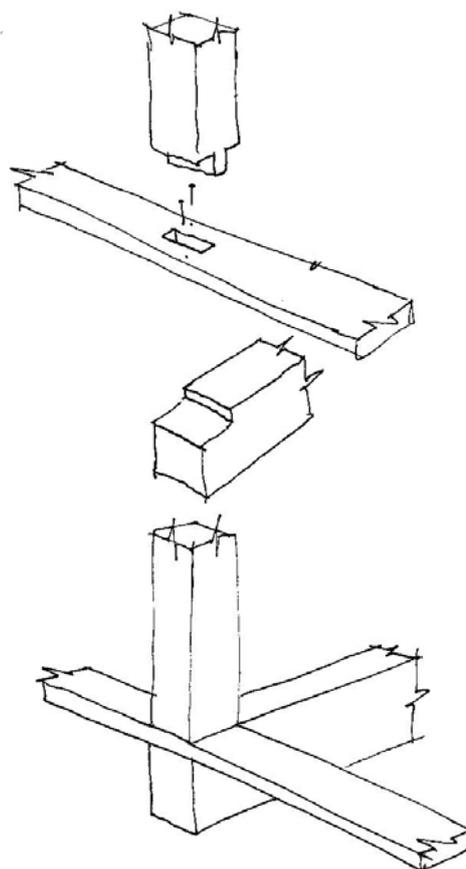
three internal bents, it follows that there will be a central bent. There are choices of position but here the central bent is centre-lined for internal visual appearance. The remaining two bents are on the central diameters of the two original circles. Axes for the arch braces are blue axis for blue arc and red axis for red arc, both swung from the gable outer faces.

54



Jack translated the geometrical drawings into a three dimensional perspective showing the completed frame, including a Dutch settler to give a sense of scale, figure 54. Because I was unfamiliar with the early settler sill construction, Jack included a sketch showing the jointing of the heavy cross building sill with the slender side wall sill to the post. At first I was disconcerted by the side wall sill which seemed extraordinarily minimal compared with the heavy English historic sills I was accustomed to but I could see that its function was more as a spacer to keep the bents in their correct spatial relationship. In fact the connection was rather clever with the sill pre-morticed right through for the post tenon and then simply nailed into place on the heavy bent sill, figure 55. For the course we would lay out the five heavy bent sills, nail them together with the side sills and use this platform to lay out other timbers for marking up and cutting.

55



Transatlantic communications 4

Suddenly it was October, time to get my paperwork and passport in order. Next thing I was driving across the Welsh border into England, past the Croeso i Loegr sign (*Welcome to England*), and into the medieval town of Shrewsbury with its numerous fine timber frame buildings. From Shrewsbury, a train to Birmingham International airport, overnight in an overheated hotel, up early and on the plane to the USA. After take off and the safety message, two little girls in the seats in front asked, *Are we going to land in the sea?* and, after we had climbed above the clouds, *Are we in heaven now?* As it happened it was a perfect flight, with the Statue of Liberty and New York's skyscrapers clearly visible as we descended parallel to the city and into Newark. From Newark I was due to fly to Albany where Whit and Gabel Holder were waiting to meet me and take me on to Bucksteep. But the Albany plane was somewhere else, waiting to fly to Newark but grounded due to severe weather conditions. What should have been a two hour wait expanded to ten but, when I finally reached Albany, Whit and Gabel were there with a car and sandwiches. On the road to Bucksteep we hit more problems: police road blocks were in place because a river had broken its banks and damaged a bridge, and we were diverted. It was two in the morning before we arrived at Bucksteep, found the keys that were left for us, unlocked our cabins and finally hit the sack.

Bucksteep Manor

Next morning we awoke to Bucksteep Manor, figure 56, a Victorian mansion in extensive lawned grounds and woodland, somewhere in the depths of Massachusetts. As well as the house there were annexes, figure 57, for residence and a huge marquee used for wedding receptions, figure 58. The marquee, which had the luxury of a board floor, would be our workspace for the duration of the course. But we still had a day to go and things to do: Whit and Gabel (what would I have done without them?) drove me to Will Beemer's Heartwood School to borrow various tools and his large wall mounted blackboard (for the geometry) and then called at Jack Sobon's house to make his acquaintance and discuss the course.

56
57
58



On course

Before leaving the UK I had received a list of the course participants including my minders, Whit and Gabel Holder, and Collin Beggs, who had been on the Gardener's Shelter course at Cressing Temple the previous year. My old friend Rob Hadden from Australia was also on the list so there would be a few familiar faces. At Bucksteep I discovered the list had a couple of typos, Brad Mores, with *es* in the wrong order, became Brad Morse and *Austin Pen*, with the whole name in the wrong order, metamorphosed from male Austin to female Pen! There were also names I knew from the pages of Timber Framing. The group totalled twenty-six and the camaraderie set in from the first moment.

In the Wedding Reception Marquee

We began by organising the marquee's floor space. I chose the corner furthest away from the side where an icy wind drove freezing rain straight in and set Will Beemer's large Heartwood School blackboard horizontally on a pair of trestles. Through trial and error I had found the horizontal board a better way to work. With a wall mounted board I had my back to the group and no-one could see through me to the drawing. With a horizontal board I faced the group, everyone could see the drawing and it was easier to ask and answer questions. Jack had the rest of the dance floor to himself! His plan was to hew and/or handsaw all the major timbers with some pre-cut timbers being used for the rafters to ensure that we attained the frame within our limited time scale. First he set out work stations for conversion of the timbers in the round. Figure 59 shows a timber anchored in place with rails and nails and chalk lined for hewing on its first side. In figure 60 Jack is using dividers to establish a parallel chalk line for the opposite side and, in figure 61, snapping the chalk line. Figure 62 shows Jack broad axing as close as possible to the chalk line and, in figure 63, side axing flush with the line. Jack stressed that it made the work more accurate if the side axe ran between the solid timber and the wood being cut away, figure 64, as this acted as a guide for the axe, steering into position tight against the chalk line. In figures 65 and 66 Gerald David side axes the timber to a precise finish.

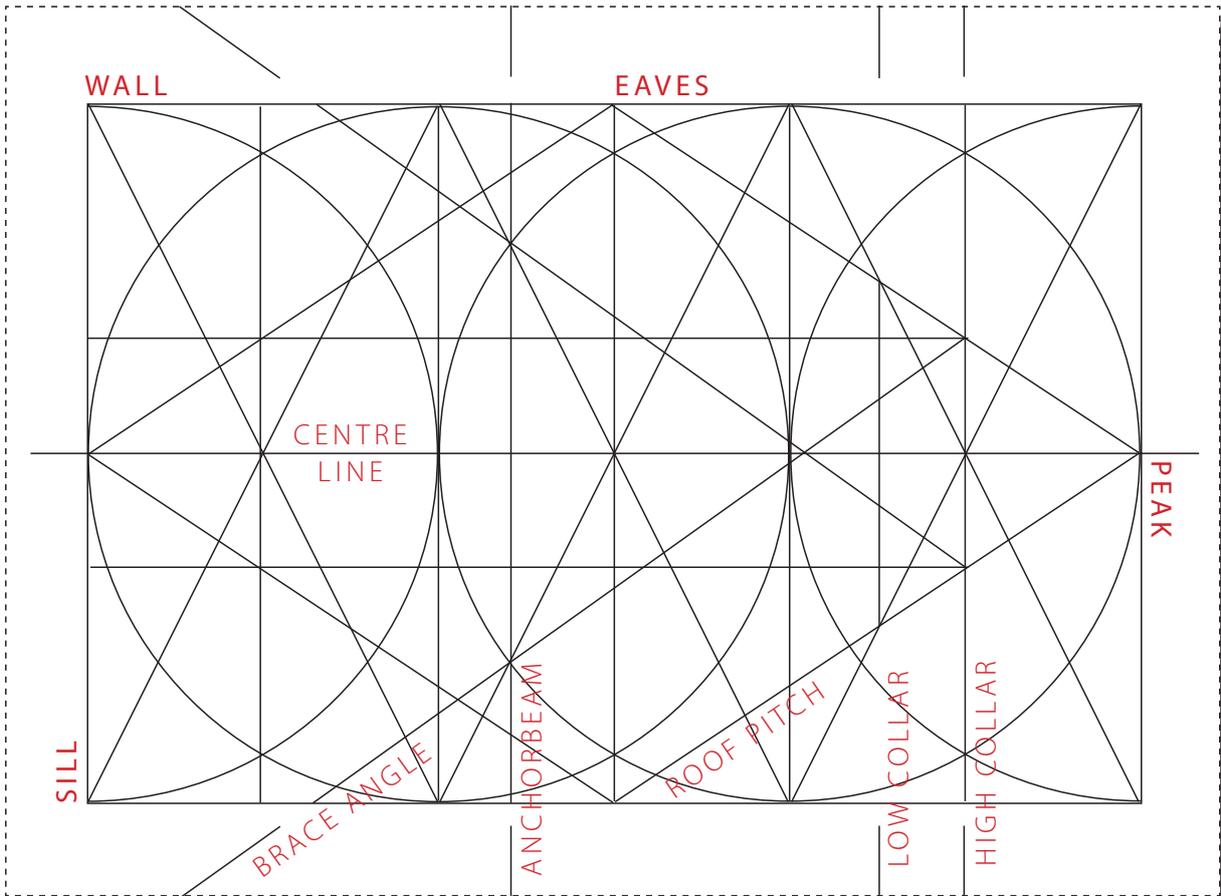
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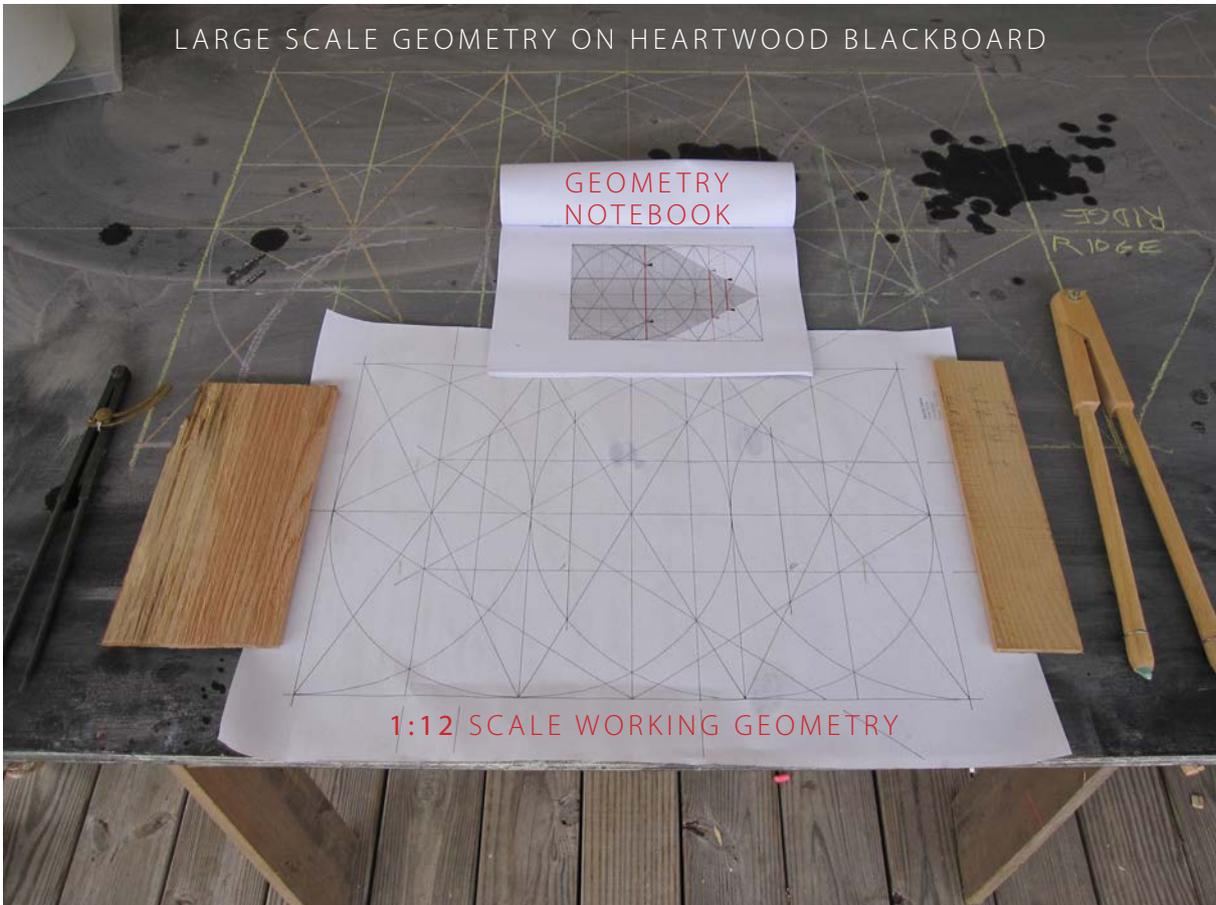
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LARGE SCALE GEOMETRY ON HEARTWOOD BLACKBOARD



Geometry 1 STEPPING OUT

With the sills hewn it was time to introduce the building's geometry and set out the floor platform. I had brought two sets of geometrical drawings with me ~

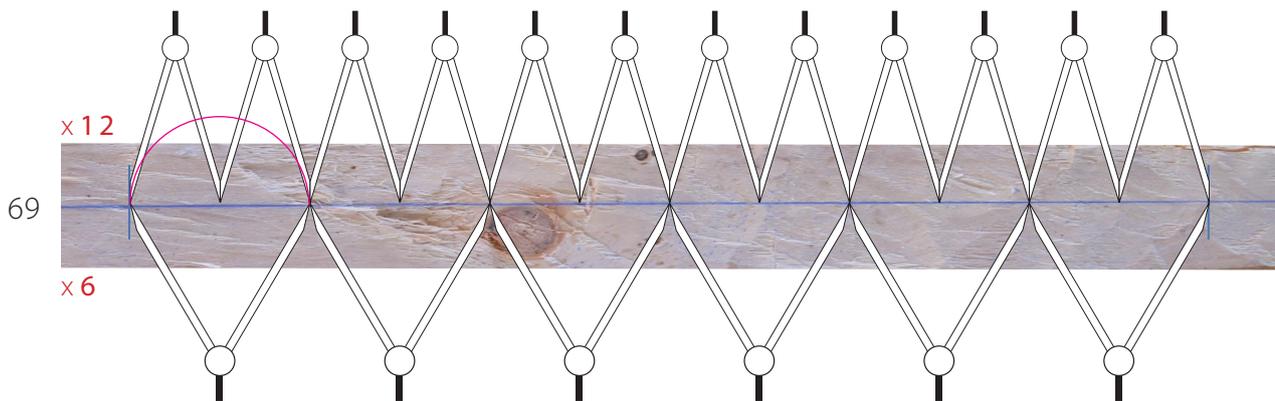
Large **A2 sheets** of 1:12 scale drawings that were the working sheets for the project, figure 67. I had new sheets every day in case they became wet and expanded away from scale or were damaged in some other way. Some of the major alignments, such as the anchorbeam and collar levels, were projected out into the margins to enable easy reference. We would take our divider readings directly from these sheets and step them out along chalk lined timbers.

An **A4 notebook**, figure 68, showing the full geometrical development from centre line and the original two circles through to the final corbel and brace geometry, each stage on its own page. The notebook was available all day every day for reference so that past, present

and future geometrical stages could easily be referred to.

Our specific stepping out procedure was to take the 1:12 divider reading from the A2 sheet, make *two* 1:12 steps along the chalk line, open the divider to double (which makes the scale 1:6) and then step out *five* further steps to make six in total. Doubling the first step is especially useful for scales such as 1:24 or greater as it halves the step counting and makes it less prone to error. Figure 69 shows a 1:12 divider reading above the chalk line and 1:6 below the line. Doubling the divider reading came as a surprise to Jack but he was very enthusiastic about it. Of course, it can only be done with even number scales, 1:8, 1:10, 1:12, etc, where the number can be halved.

Once the heavy sills were stepped out for length they were scribed, cut and laid in position for the light sill assembly, figure 70. The layout was set square using 3 4 5 triangulation and, once levelled, we had our framing floor.

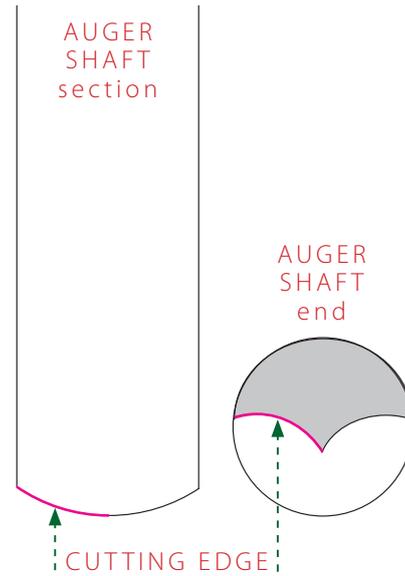


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T Augers and Drilling Machines

According to Jack, the mortices that he observed in early settler frames were first drilled with T spoon augers (T being the shape of the auger's handle and shaft) and then cut with chisels, the spoon auger leaving its characteristic curved indents in the floor of the mortise. However, because the spoon auger was prone to skidding on the timber surface, a small disc of auger diameter was cut from the timber to locate and guide the auger accurately as drilling began. Figure 71 shows Jack cutting the disc with a curved gouge. Figure 72 shows the spoon auger in place. Figure 73 shows the auger's shaft in section and from the end, half of which is sharpened (the grey tone represents open space). Figure 74 shows three of the more conventional spiral T augers ready to drill out mortices. The spiral T augers were the fore-runners of the adjustable brace with fixed, forward and reverse ratchet, figure 75. I still have the American brace my father used.

Figure 76 shows the handsome heraldry of Tim Beale's drilling machine, THE BOSS MCH, a hundred and thirty years old and still going strong, American patent PAT DEC 19 1882. The machine features a seat so that the operator's weight keeps the machine steady while drilling. Figures 77 and 78 show Tim operating the machine and figure 79 shows the precision result. Figure 80 shows one of the machine's tactile vesica handles that spin on a central axis and the simple but beautiful square and compass geometry that defines its form.

75



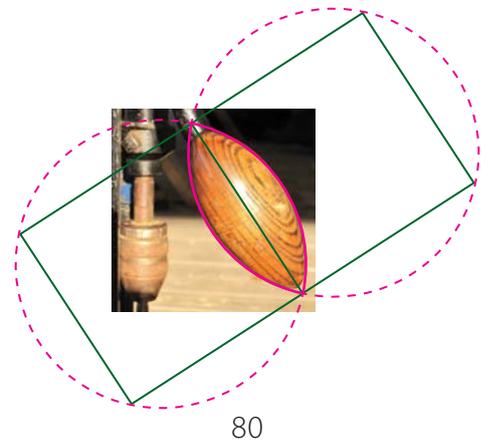
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Geometry 2 ARCH BRACES

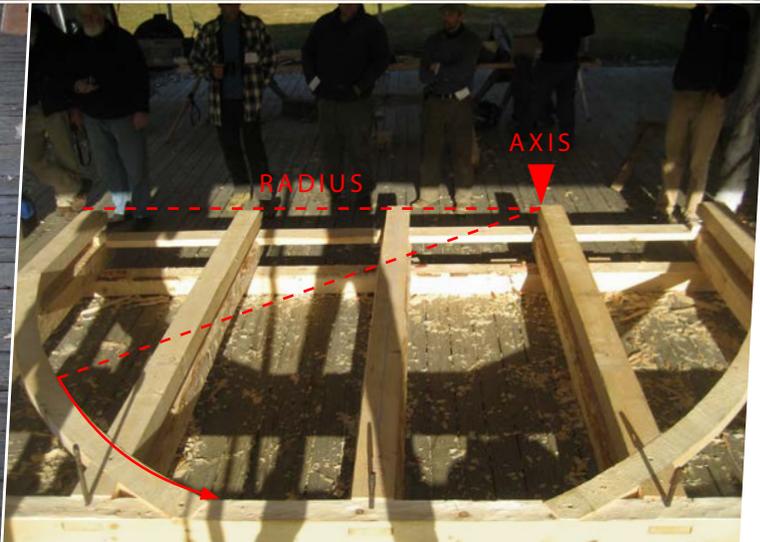
The frame has two arched braces in each side wall, rising from the sill to wall plate from the posts at either end of the frame. Jack selected a large timber that could be cut to the required curve and then trestle sawn into the four braces. Figure 81 shows the Holder brothers marking out the log and figure 82 shows the hewn section. In figure 83 the log is on its side with an improvised trammel (two lathes clamped together) marking the brace curvature. Figure 84 shows the trammel lines and figure 85 shows Gabel Holder, left, and Rob Hadden side axeing the curve ready for sawing. In figure 86, top dog Michael Burrey guides the saw. Figure 87 shows four braces and figure 88 shows a wall frame assembled, indicating how the axis and curve can be taken from the frame. The equilateral triangular lap joint, figure 89, was used in The Gardener's Shelter project at Crossing Temple in 2008 where it can also be seen in the 13th century Barley Barn, dendro-dated

85



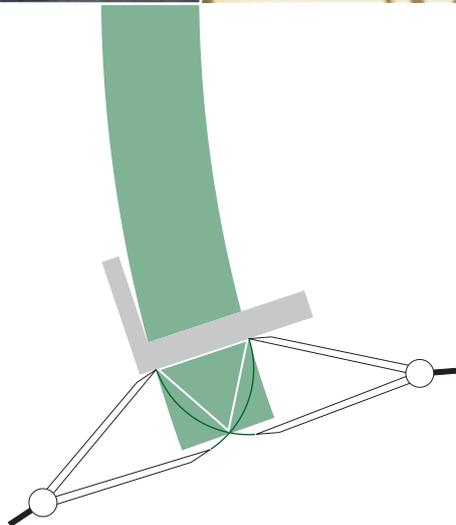
to 1220, though it is probably French in origin. So in some ways it is strange to record its use in Massachusetts although, on reflection, no more or less strange than other characteristics of the Dutch settler frame we were busy cutting. The joint is approaching 800 years old!

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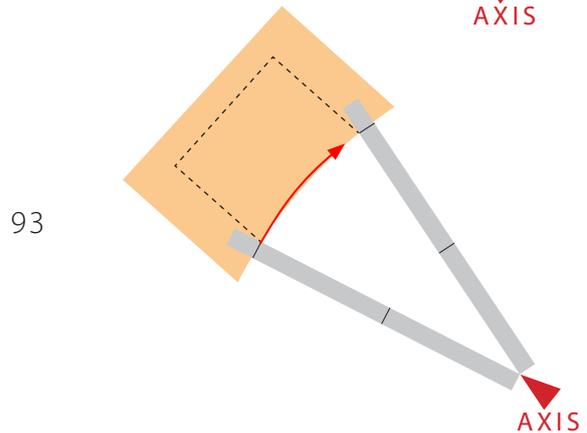
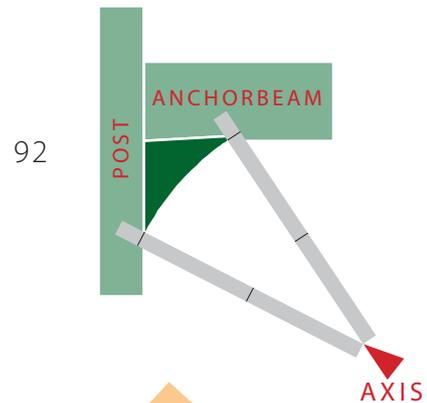
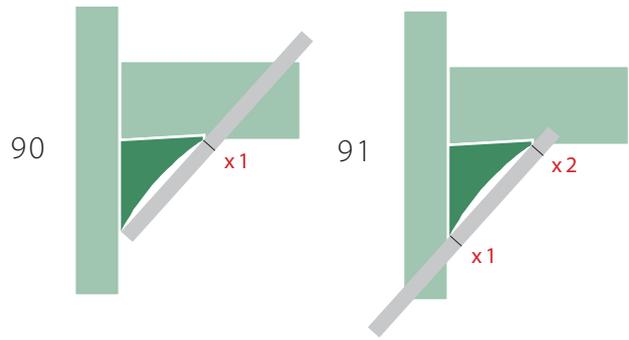


Geometry 3 CORBELS

The corbels were the most dramatic element of the frame, equal in thickness to the anchorbeams that they would link to the external wall posts and, like their Dutch settler ancestors, housed into both. Because the corbel was identical in thickness to the anchorbeam, the housing would be visible after assembly, rising at a shallow angle into the anchorbeam. Looking at the drawings and photographs of early Dutch settler buildings that Jack sent to me it seemed as if this shallow angle was the diagonal of the anchorbeam, from post to opposite post, a simple chalk line snapped right across the beam. This could be done easily during test assembly and the angle transferred to the corbel. But I can't be certain of this. Alternatively, the corbel's housing into the post was invisible after assembly because the post was thicker in section than the corbel.

Jack had had six big section timbers cut to length prior to the project. The corbels were marked out for anchorbeam and post tenons first and these were cut. The geometry of the corbel's curve was then marked out for cutting. Because we had six identical corbels to cut I decided that we should mark out the geometry on a template and then scribe the curve onto the corbels. This would also allow us to scribe both sides of each corbel. The geometry of a settler corbel is shown in figures 37 and 38 and a scale drawing geometry of the curve is shown in figures 47, 48 and 49. At Bucksteep the curve had to be constructed as full scale geometry. Remembering that the curve's radius was twice the distance across the curve from end to end, it was easy to mark and double this distance on a straight lath, figures 90 and 91. A second lath could be marked from the first and the two placed end to end to define the axis of the arc, figure 92.

We found a piece of plywood suitable for the template and placed it in position in relation to the laths. Then, from the axis, we could swing the template's arc, figure 93, and cut the template to its correct size, along the dashed line. Finally we could place the template in the correct position on the corbel blanks, scribe the arc and jigsaw it out. In figure 94 Emmanuel Benetollo uses a flexible Japanese saw to cut the template's corbel arc.



Figures 95, 96, 97 and 98 show stages in cutting the corbel's tenons to fit the mortices in the post and anchorbeam. In figure 99 a saw cut is made down to the centre of the corbel's arc and in figure 100 the waste wood is axed away. Figure 101 shows Jack cutting the curve with an adze and, in figure 102, refining the surface with a spokeshave. Figure 103 shows the template and a completed corbel. While using the axe, adze and spokeshave to

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shape the corbel's curvature, the tools are all used from the outer edges of the arc, working inwards towards the centre.

In figure 104 Matt Doner test fits a finished corbel into a post held steady by Adam Valesano. The housing and mortice visible to the left of the corbel is for the anchorbeam. Figure 105 shows the corbel in place with the post housing concealed and the corbel's arc sweeping elegantly from the surface of the post.

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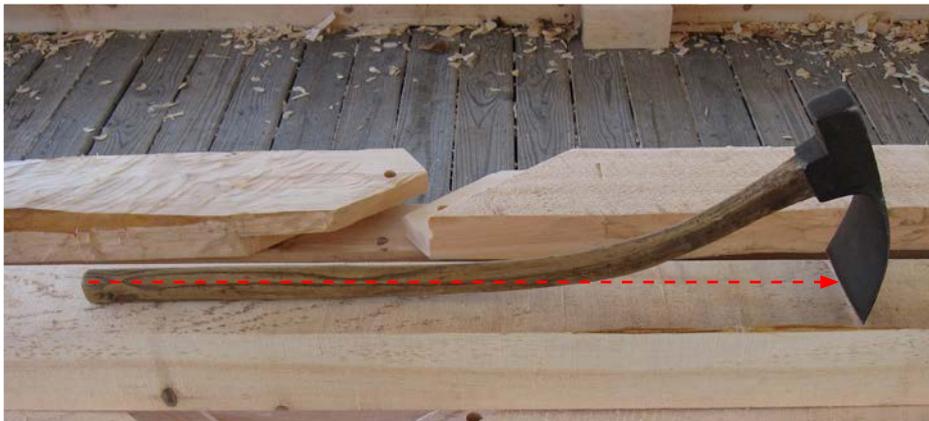


Geometry 4 THE ADZE

The adze Jack used to cut the corbel curvatures was a superb tool. Jack spoke about the handle at length, telling how he had spoke-shaved it thinner so that it was resilient and absorbed the continuous shock of the cutting impacts. He found this extended the length of working time before fatigue set in.

As Jack demonstrated the use of the adze I was observing the form of the tool. Figure 106 shows the beautiful ergonomic geometry of the adze with the centre of the cutting edge in perfect alignment with the handle's centre. Because the handle is straight for over half its length, it allows the guiding hand to move closer to the blade, extending eye/hand control right to the blade's cutting edge. The length and width of the blade and tool head casting fits precisely within a double square, figure 107, and if a circle is drawn through the lower square's corners, the handle shaft is fitted exactly on the circle's circumference. The cutting edge curvature ensures that the centre of the blade makes the cut and that the blade edges do not cause scars. The perfect tool.

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Peg Making

Alongside the frame's larger elements, such as anchorbeams and corbels, it was also necessary to produce the smallest. Figures 108, 109, 110 and 111 show the parallel gridding of a full oak section, methodically cut into grid squares using an L-shaped froe that splits the timber along its grain. Figure 112 shows Jack on the shaving horse, which grips the stick while the drawknife refines its parallel square section into a tapered octagon, perfect for pegging the frame. Pegs made in this way are the strongest and are crucial to the frame's integrity.



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Logos

Two further small elements of the frame were the logos that would be added to two of the anchorbeams. Of the five potential anchorbeams, those in the gable walls would eventually be boarded and therefore invisible from the building's exterior. This left the three interior anchorbeams with corbels. Eliminating the central anchorbeam left the two beside the gable walls for the locations of the logos, each logo at the centre of its beam and facing towards its adjacent gable.

Will Beemer (TFG Chair at the time of the project) produced a TFG branding iron, the kind of thing we had only seen in the UK in cowboy films. He built a small fireplace from concrete blocks, set fire to a pile of offcuts and shavings, heated the iron and was soon testing it on waste pieces of timber. The exact location was marked on the anchorbeam with chalk and the striking brand burnt into place, figure 115. Figure 116 shows Will branding the beam.

Ellen Gibson carved a combined geometry and date for the other anchorbeam. The geometry showed the centre line, two circles and bisected vesica perpendicular, the project's core geometry, and the date in Roman numerals, MMIX (M = 1000, MM = 2000, I = 1, X = 10, IX = 10 minus 1). Figure 117 shows Ellen carving and figure 118 shows the result on the beam.

Marking the frame in this way gives the building an identity beyond the reality of the frame itself. In the UK there are thousands upon thousands of anonymous historic frames and only a small percentage that have either construction dates or owner's initials carved. Sometimes the initials are those of a bride and groom at the time of their marriage. There was also a tradition of scribing small geometries, often a daisy wheel, onto the frame timbers and sometimes, if measured drawings are available, the compass geometry of the wheel proves to be the design method used for the frame. The Dutch House is well recorded. Will's TFG brand and Ellen's carved geometry and date give future generations all they need to know about the building's origins. And through the TFG and perhaps through this book, they can learn more about who cut the frame at Bucksteep Manor in Massachusetts in November 2009.

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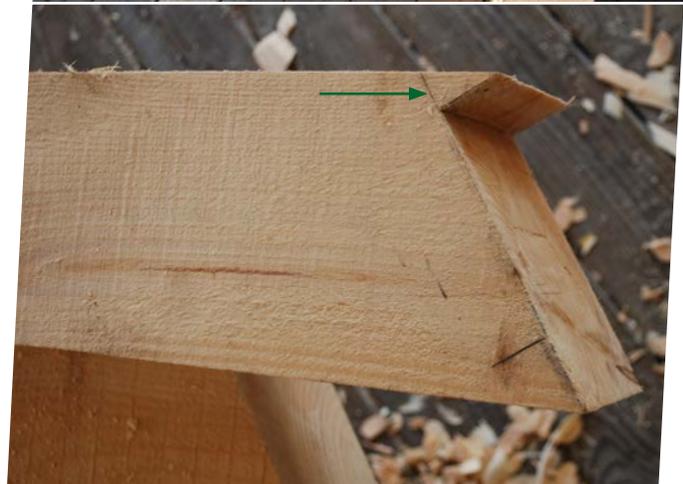
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Meanwhile, inside the Marquee

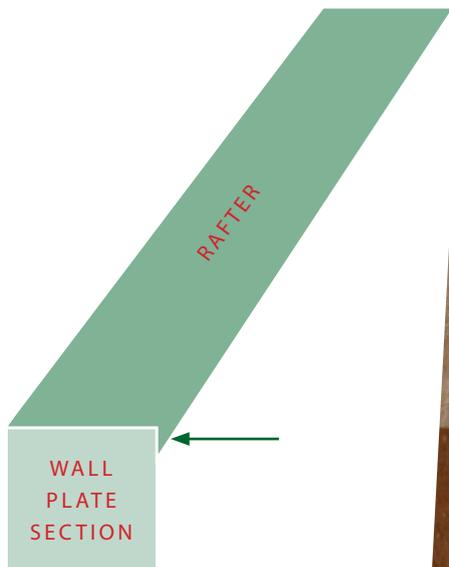
Rafters were set out, cut, scribed, assembled in pairs with collars in place and temporarily pegged. In the same way that the curvature of the corbels was marked out once on a sheet of ply and a template cut rather than trammel six separate corbels, the first rafter couple and collar were the template for the remaining four couples, each pair set over the ones below. Figure 119 shows the first pair of rafters joined and temporarily pegged on the underside so that the second pair can be aligned above them. In figure 120 the second pair are assembled in position. Figure 121 shows the five rafter pairs completed and stacked, each marked with its Roman numeral, I II III IV and V, the numbers cut with a 1 inch chisel.

Compared to Welsh principal rafter trusses, which are constructed from heavy section oak, the Dutch settler rafters seemed flimsy to say the least. Although they tapered from wall plate to peak and were triangulated by their collar, they were only just wide enough to provide a tiny bird's mouth on the inside of the rafter and plate. Figure 122 shows the rafter end, cut to fit the wall plate, the tiny bird's mouth indicated by the arrow. An arrow also indicates the bird's mouth in figure 123 which shows the relationship between the wall plate and rafter. Apart from the bird's mouth, the rafters have no hint of a joint and, once in position they are simply nailed to the plate. This simple, light roof construction can be found in East Anglia, the area of eastern England where Dutch engineers drained the Fenland marshes.

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And outside the Marquee

The floor, made up of the five heavy timber cross wall sills linked by two slender side wall sills had been both the first stage of the Dutch house construction and a framing floor for each of the successive stages. Figure 124 shows the floor cleared and ready for the frame's test assembly on the lawn outside the marquee. A discussion is taking place about how best to do this and Jack's decision is that we have enough man- and woman-power to, literally, carry out the task, figure 125. From my position in the back row it felt fairly heavy. My training sessions with the compass and chalk had been futile as far as weightlifting was concerned but I lifted correctly from a crouching position like the rest of the team and then we were outside, carefully lowering the floor onto blocks we had pre-set on the ground. Raising a frame is always gratifying, a classic example of

all the careful layout, scribing, axeing, sawing, cutting and drilling metamorphosing smoothly from, in this case a geometrical drawing, into its three dimensional form. Figure 126 shows the first floor (ground floor in the UK) complete up to the anchorbeams and with the wall plates being placed. The side view in figure 127 shows Autumn Bauman hammering the arch brace's 800 year old joint into its location and in figure 128 Steven Barry holds the first rafter couple steady on the wall plates ready for the nails to be hammered temporarily in (using those clever double headed nails that are easy to pull out again). The final rafter couple go up, in figure 129, to complete the frame. An hour later the nails were pulled, the frame was dismantled again, packed into trailers and onto car roofs for the journey to Saratoga Springs to be displayed at the Saratoga Springs Hilton Hotel Exhibition Centre, *see back cover*, and auctioned at the TFG's Eastern Conference.

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Dark Evenings : Day's Eye

As Autumn grew colder, the days shorter and work often ended in failing light we were all glad to head across the lawn to the warm welcome in Bucksteep Manor where our chef, Maureen Brennan of Windsor, fed us like kings. Each day, after the evening meal, there was a talk: Jack spoke from his knowledge of the early Dutch settler buildings in America and his experience using hand tools; Rob Hadden from Australia told us of his unending project in Castlemaine, Victoria, building what appears to be an entire English village; I showed photographs of historic English and Welsh timber frames and ran through some *Useful Geometries for Carpenters*. The three of us were caught on camera, below.

Jack and I had discussed the presence of daisy wheels on buildings from various cultures and he was of the opinion that they were sun symbols and often found scribed or even painted at large scale on the south face of buildings. I mentioned that in Elizabethan England the word eye was pronounced e'e without the y (as in sheep) and that daisy was a contraction of the two words Day's Eye. The reason for this is that the daisy always faces the sun, east at sunrise, south at mid day and west at sunset. In other words, the flower watches the trajectory of the sun. Jack seemed delighted with this and said it was the high point of his week!

My high point was working with Jack on my first visit to the USA and being part of an international (mainly American) team from three continents on two of the Earth's hemispheres.

LS RH JS



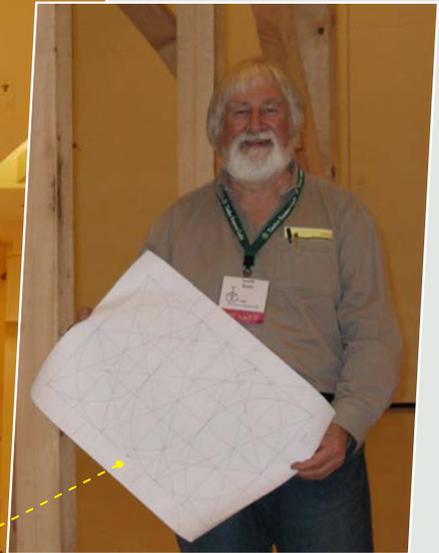
The Dutch House Team Key

Main photograph, from the top clockwise ~
MM Mike McLaine **MD** Matt Doner
WH Whit Holder **BM** Brad Morse **JS** Jack Sobon
TB Tim Beale **EG** Ellen Gibson
MP Malcolm Phinney **EB** Emmanuel Benetollo
PA Pen Austin **AB** Autumn Bauman
SB Steven Barry **LS** Laurie Smith
RH Rob Hadden **DW** Dick Warner
DS Dave Shepard **GD** Gerald David
AV Adam Valesano **SG** Steve Grimm
JF Jordan Finch **JT** John Tauke **TW** Trey Warren
GH Gabel Holder **ME** Miles Eddins

Missing from main photograph ~
MB Michael Burrey **EB** Eric Braymer
AB Aaron Bauman **CB** Collin Beggs
SM Scott McDowell







Triple Assembly 2, see next page

Triple Assembly 1

The Dutch house frame was assembled three times with the first assembly at Bucksteep Manor in Massachusetts where the project had taken place in the open-sided shelter of the wedding marquee. This was the test assembly to check the accuracy of all the joints and, when perfect, to mark the timbers for re-assembly. After a week of virtually constant rain and icy winds we were blessed with a dry day for the raising.

Triple Assembly 2

The photograph on the left shows the second assembly of the Dutch house frame in the exhibition hall of the Saratoga Springs Hilton Hotel where the Timber Framers Guild Eastern Conference would be held over the weekend. The frame was on display to Guild delegates prior to the fund raising auction on the Saturday evening. The lady in the doorway was looking at the geometrical design that was laid out on the plank at her feet. I was standing nearby and she turned to me and said *Look at this, the frame was built from this drawing*. So I replied that it was my drawing and we had an enjoyable conversation about the simplicity of compass geometry, in this case two-circle geometry, and how it brings visually pleasing proportions to a frame. Like many other carpenters at Saratoga Springs she was excited by the elimination of modern calculators, computers, maths that gave her a headache and the fact that, as the project title said, we were on *a geometrical design and eighteenth century hand tool course*.

Triple Assembly 3

In the Saturday evening auction the winning bid went to Paul Thompson from Rumley in Texas who reconstructed the frame there for the third, and hopefully the final time, adding a verandah outshot on one side and a small room on the other. Sarking boards, slates, a stone plinth and stone chimney completed the little building.

It is intriguing to me that the equilateral triangular joints connecting the arch braces to the side wall plates almost certainly began life as a Norman French design that was used in England when the Knights Templar built the Barley Barn at Cressing Temple in Essex in 1220 AD. It was used again in 2008 when the Carpenters' Fellowship built the Gardener's Shelter at Cressing 788 years later. And now it has reached Texas!

www.historicbuildinggeometry.uk

