Appleton Octagonal Pavilion

Geometrical Design at Trillium Dell

Laurie SMITH
THEGEOMETRICALDESIGNWORKS

Text
Geometry
Photographs*
Book Design

* Several members of the team gave their photographs for this booklet but special thanks are due to Kendell Anquist for his comprehensive collection.

Laurie Smith is an independent early-building design researcher, specialising in geometrical design systems. Because geometry was part of the medieval educational curriculum he uses geometrical analysis to excavate and recover the design methodologies of the past, a process he thinks of as design archaeology. He lectures, writes and runs practical workshops on geometrical design and publishes his work through his website HISTORIC BUILDING GEOMETRY.

Appleton Octagonal Pavilion

A Geometrical Design Project at Trillium Dell Timberworks, Knoxville, Illinois

JUNE 14 – 22, 2014

This project was initiated and hosted by Rick and Nicole Collins of Trillium Dell Timberworks, Knoxville, Illinois. The timber for the project came from their own land and they fed the team of carpenters from their own farm. Rick and Nicole are keen educationalists and the project was seen in this light. Two trainee carpenters from the French Compagnon were also at Trillium Dell. The completed frame was also a gift from Rick and Nicole to Appleton Community Voluntary Fire Service as a focus for their essential fund raising.

HISTORIC
BUILDING
GEOMETRY
Laurie
SMITH

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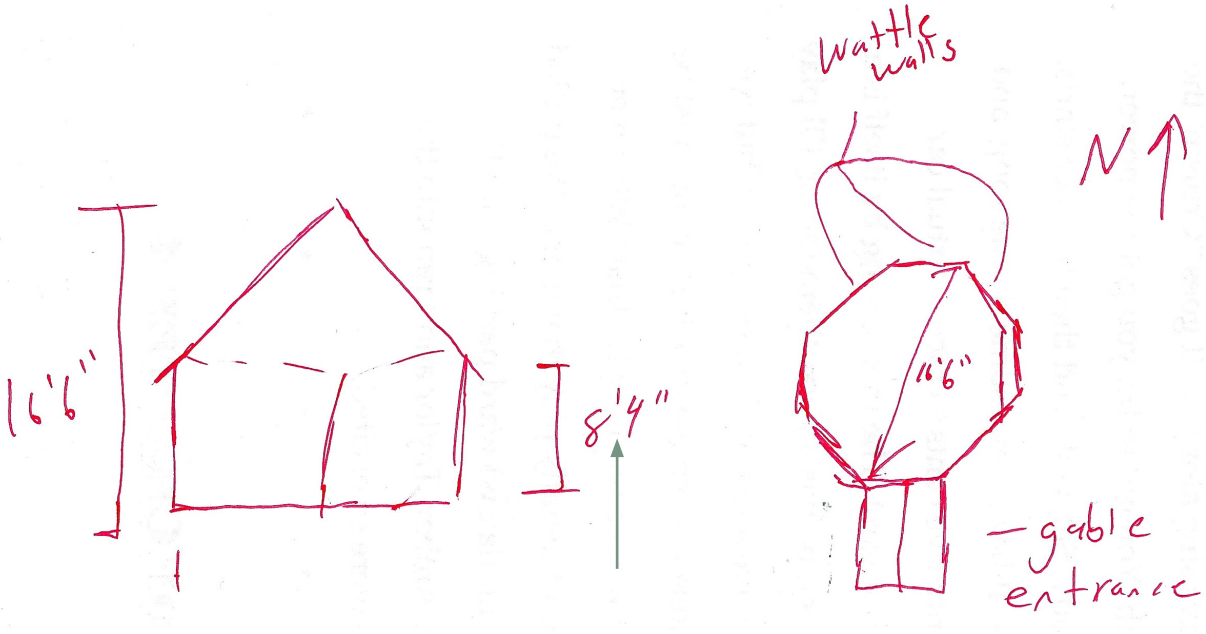
Appleton Octagonal Pavilion

Introduction

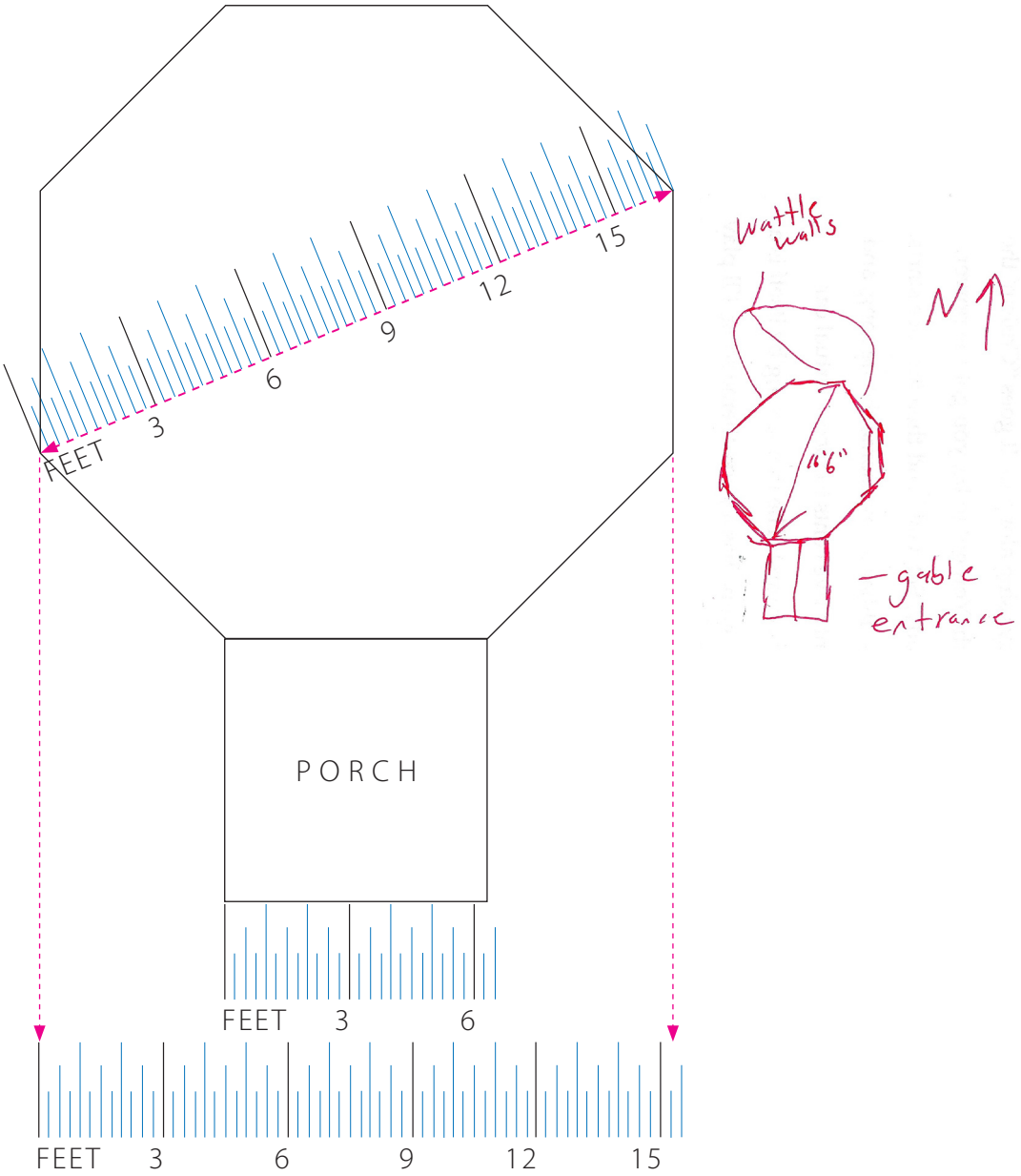


Many years ago when I taught on the ceramics and glass degree course within the School of industrial Design at Leicester Polytechnic in the UK, the institution ran a series of exhibitions, one of which featured the design, development and manufacture of the famous Mini car. Exhibit number 1 was a thumbnail sketch by Sir Alec Issigonis, showing his idea for a vehicle with wheels right at the corners and, crucially, an engine placed transversely between the front wheels to give the first ever front wheel drive car.

So, when I received an email with a thumbnail sketch for an octagonal pavilion from Rick Collins, I recognised it's potential. The following pages record the transatlantic email dialogue that took us from the thumbnail sketch to a geometrically designed octagonal frame and then to Trillium Dell Timberworks in Illinois where a team of American and English carpenters, engineers and architects cut and raised the frame.

Appleton Octagonal Pavilion Elevation and plan sketch

Rick's initial sketch gave the frame a diagonal and height from ground to ridge of 16 feet 6 inches[1] and ground to eaves as 8 feet 4 inches (arrowed). 16 feet 6 inches is 1 Rod, Pole or Perch, a dimension found in medieval buildings. For example, the Barley Barn, built by the Knights Templar at Cressing Temple in Essex in 1220, is 49 feet 6 inches or 3 Rods wide. So I knew where Rick's dimensions were coming from. But I was puzzled by the ground to eaves dimension because half of the full height of 16 feet 6 inches is 8 feet 3 inches so I emailed Rick to see if there was any reason for the extra inch. It was a miscalculation!

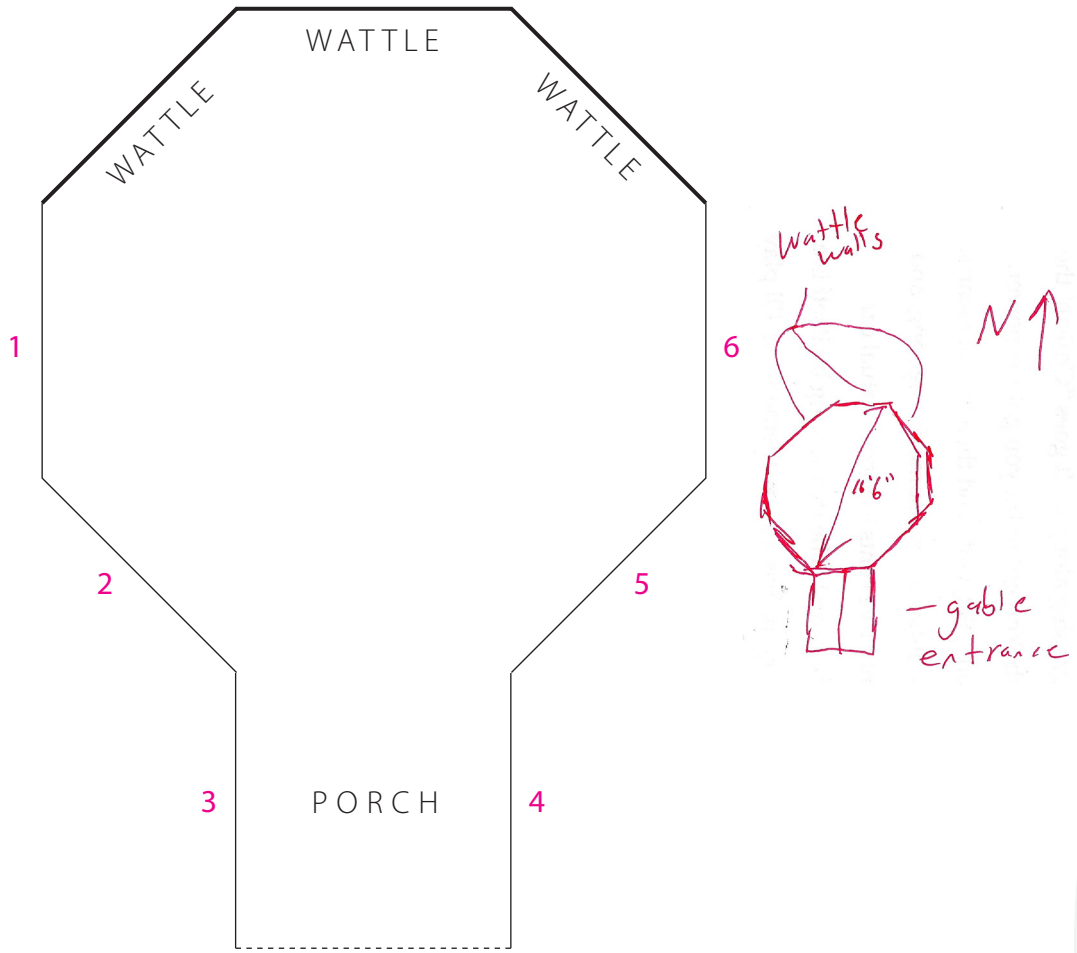


Appleton Octagonal Pavilion Plan Questions about plan dimensions

Drawing an accurate measured version of the octagonal frame gives 16 feet 6 inches across its angle to angle diameter and the length across from wall to wall as 15 feet 3 inches (see lower ruler).

If timbers are placed inside these dimensions the interior would be approximately 15 feet across between angles and 14 feet between the walls. *Is this space large enough?*

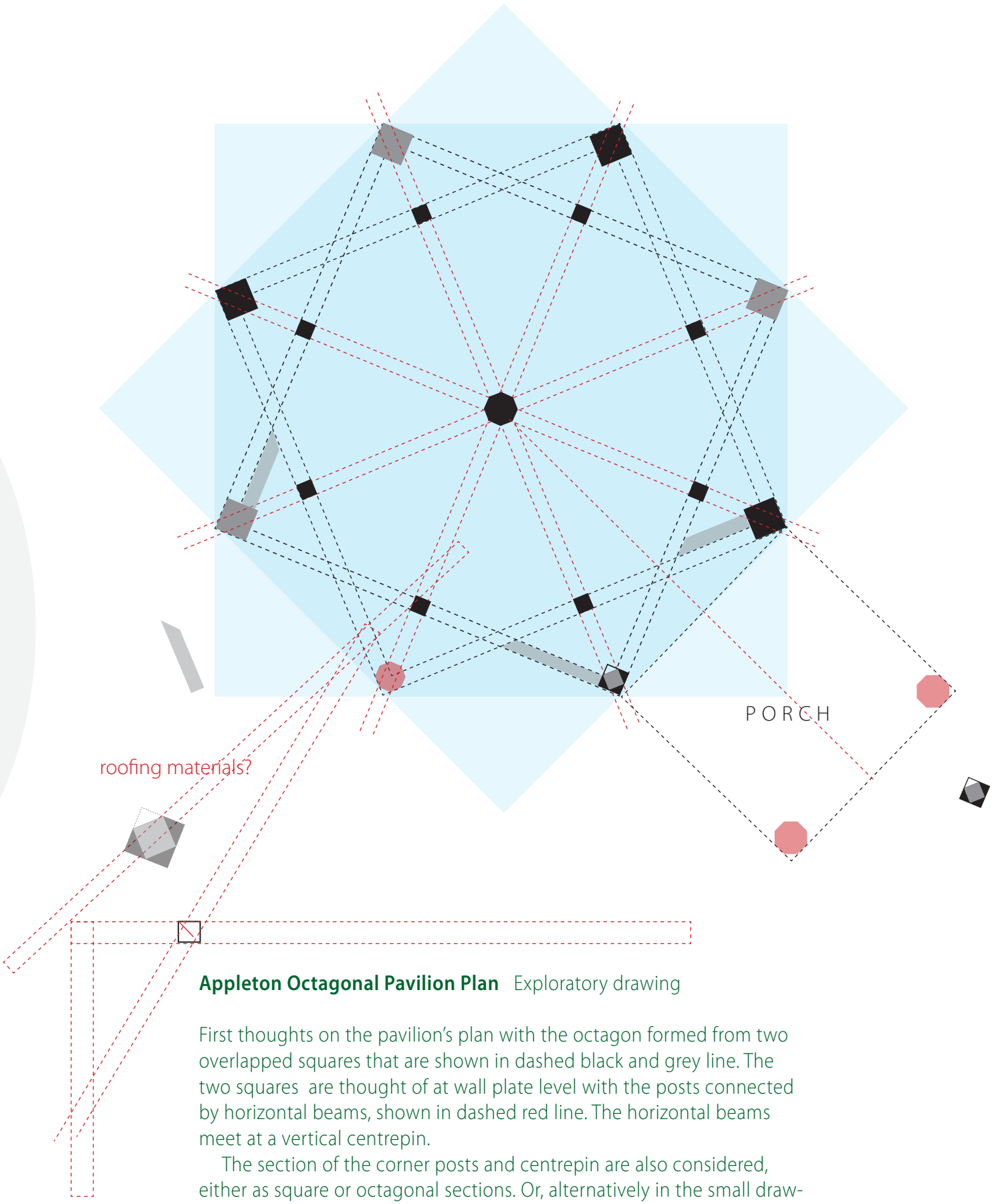
If an entrance is based on one side of the octagon it would be 6 feet 3 inches wide. *If timbers are placed inside this dimension it would leave an entrance of slightly less than 5 feet in width. Is this wide enough?*



Appleton Octagonal Pavilion Plan Questions about wall infilling

Rick's sketch shows the three walls opposite the entrance as wattle.

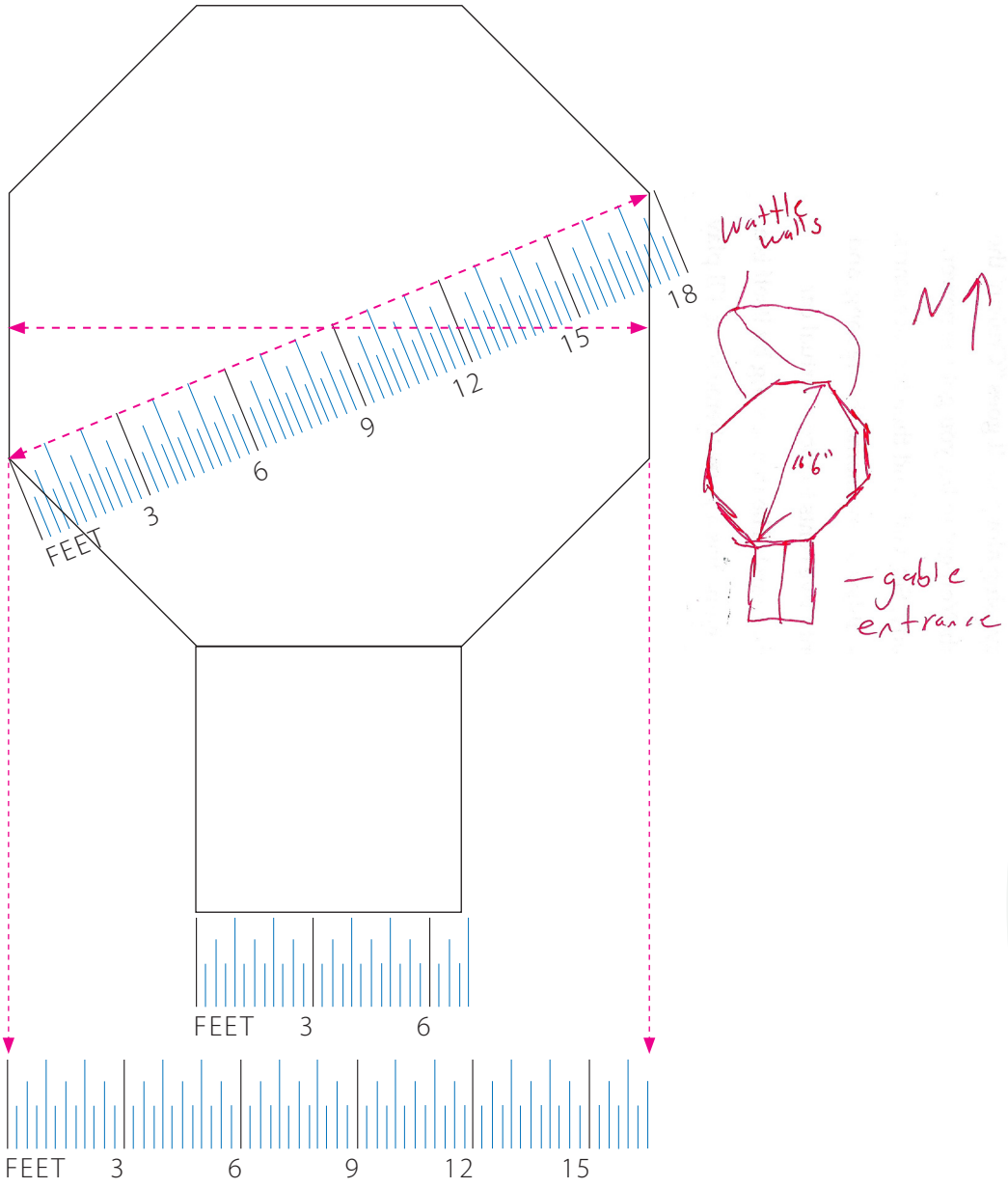
Are walls 1 to 6 to be open frames that can be walked through?
If walls 1 to 6 are open do you visualise any bracing in these walls?
Do you visualise the wattle infill as similar to the wattle panels in the Gardener's Shelter at Cressing Temple? Or do you have other infills in mind?



Appleton Octagonal Pavilion Plan Exploratory drawing

First thoughts on the pavilion's plan with the octagon formed from two overlapped squares that are shown in dashed black and grey line. The two squares are thought of at wall plate level with the posts connected by horizontal beams, shown in dashed red line. The horizontal beams meet at a vertical centrepin.

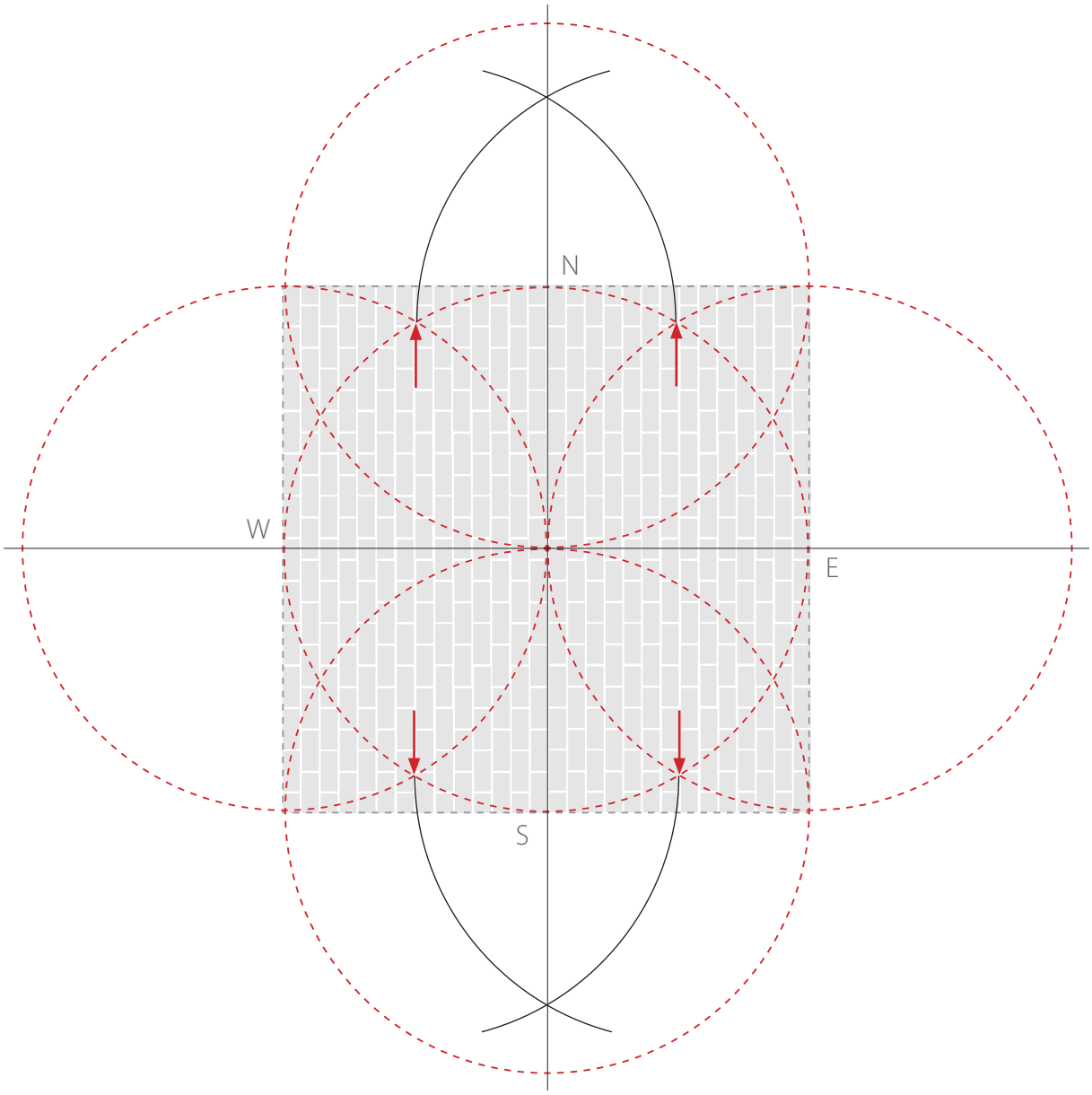
The section of the corner posts and centrepin are also considered, either as square or octagonal sections. Or, alternatively in the small drawings at the sides as a chamfered square with the chamfer defined by a whirling square (a diamond within a square).



Appleton Octagonal Pavilion Plan Revised dimensions

Rick and I discussed his proposed dimensions and agreed to a slight increase in scale, easily attained by making the Rod the wall to wall dimension rather than the angle to angle diameter. So, if the octagonal frame is 16 feet 6 inches across its diameter from side to side the length across from angle to angle is just under 18 feet. If timbers are placed inside these dimensions the interior would be approximately 17 feet across between angles and 15 feet between the walls.

Similarly, an entrance based on one side of the octagon would be 6 feet 9 inches wide and timbers placed inside this dimension would leave an entrance of around 5 feet 6 inches in width.

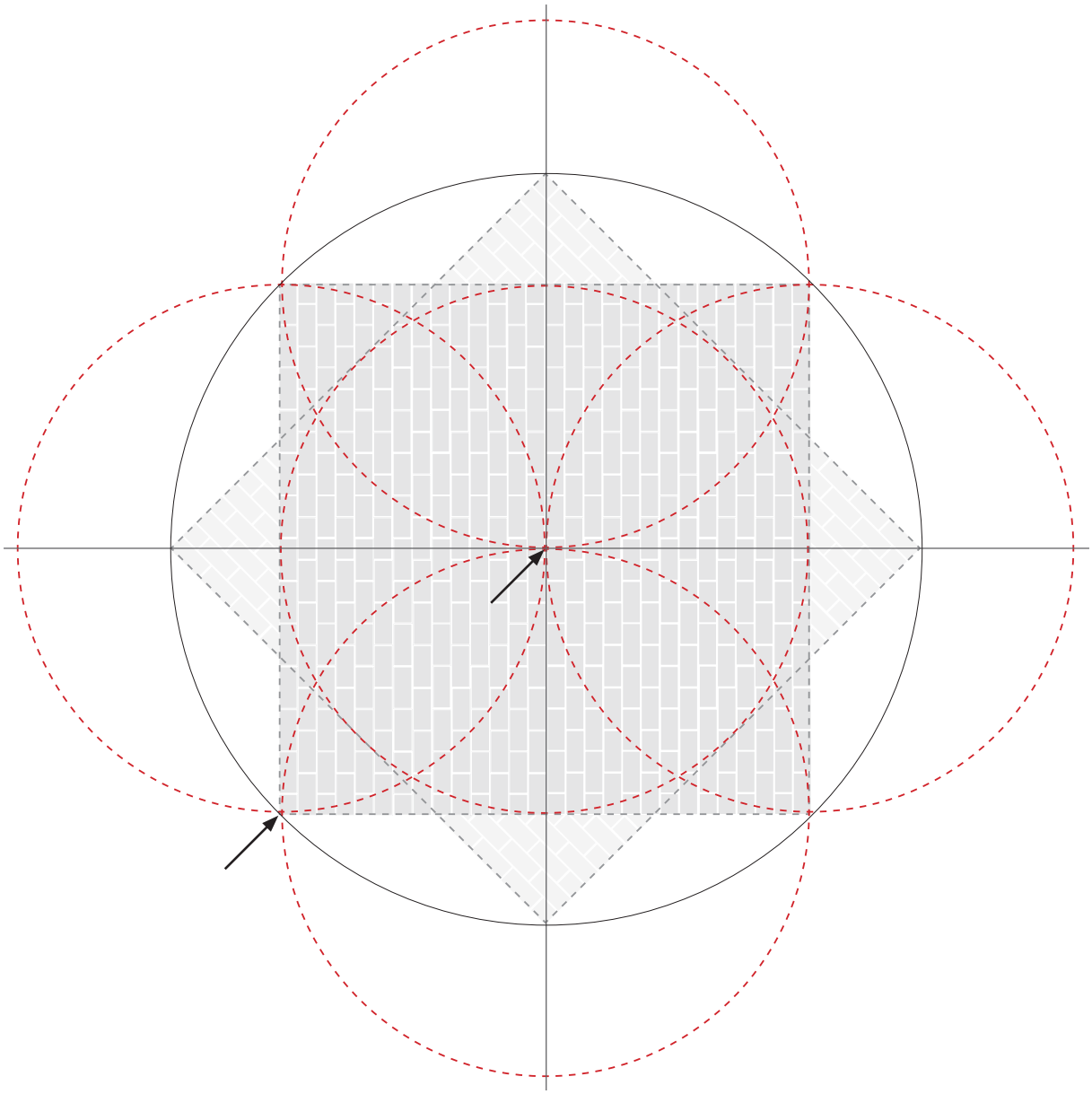


Appleton Octagonal Pavilion Plan Floor geometry stage 1

I decided to use five circle geometry to design the octagon's floor plan because it is the easiest way to draw a perfect square. The drawing shows the first square in brick tone as Rick had suggested a brick pavilion floor. The drawing sequence is given below –

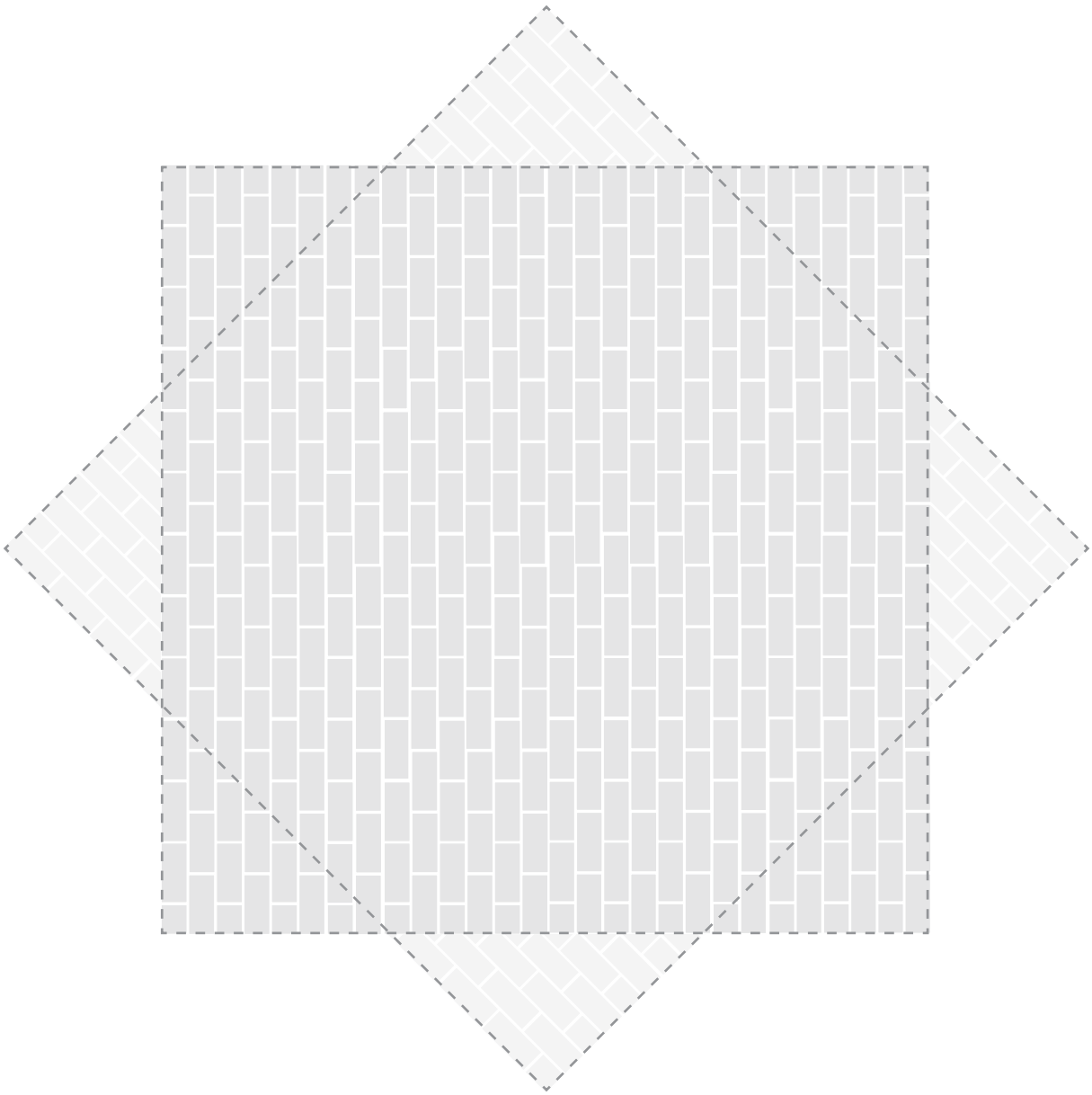
1 Draw the horizontal centre line
2 Draw the vertical perpendicular[1]
3 Draw the central circle from the intersection of the perpendiculars
4 Draw the four outer circles from the N S E and W poles (where the central circle cuts the perpendiculars)

[1] The vertical perpendicular is drawn through the intersection of arcs drawn from the four intersections marked by the red arrows.



Appleton Octagonal Pavilion Plan Floor geometry stage 2

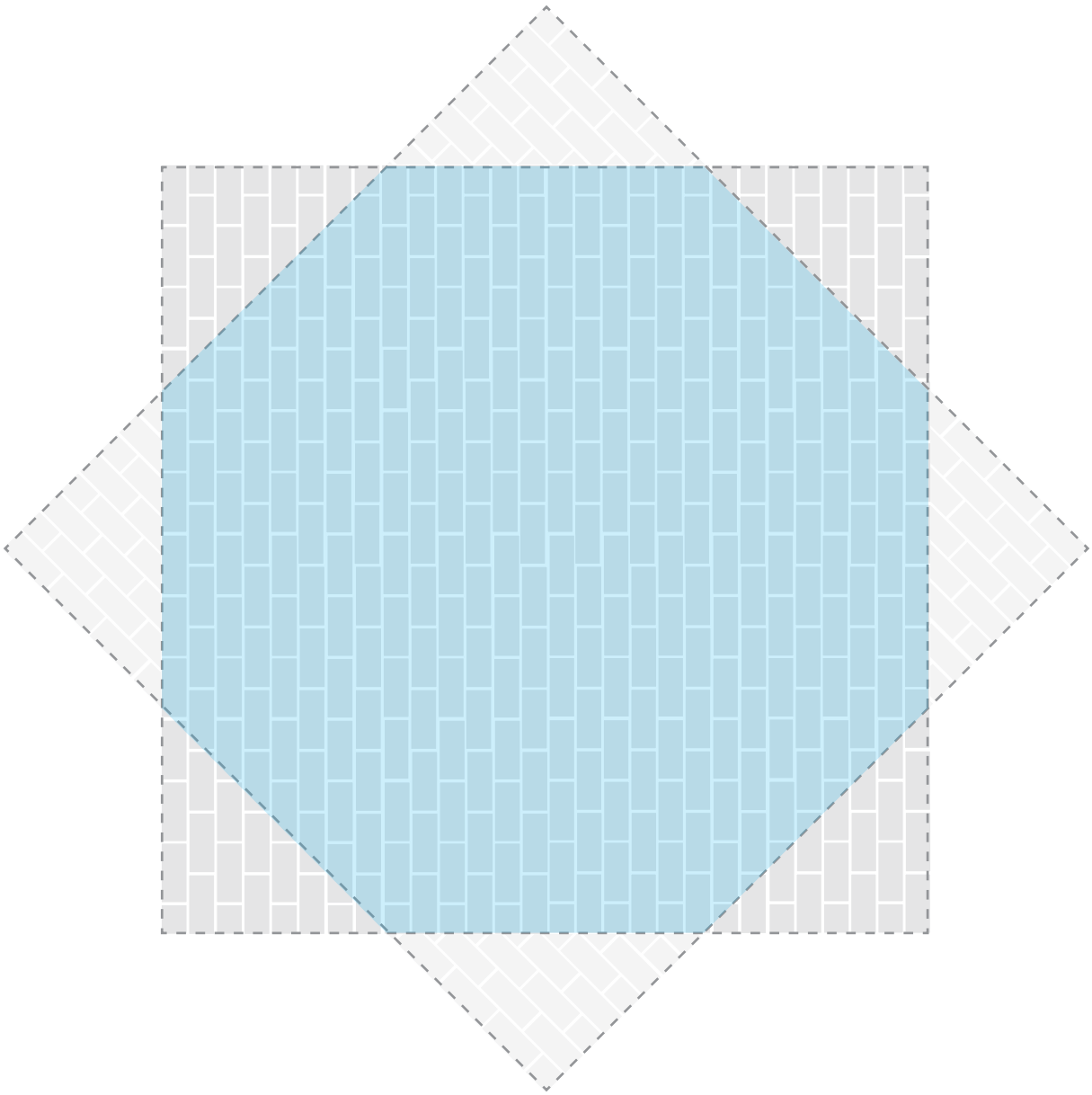
1 Draw a large circle from the intersection of the perpendiculars (at the central black arrow) so that it passes through the intersections of the outer circles (at the outer black arrow)
2 The large circle cuts the perpendiculars at the corners of a diamond
The diamond = the square and they combine in an octagon star



Appleton Octagonal Pavilion Plan Floor geometry stage 3

The octagon star is shown as a brick paved area that includes the pavilion's floor.

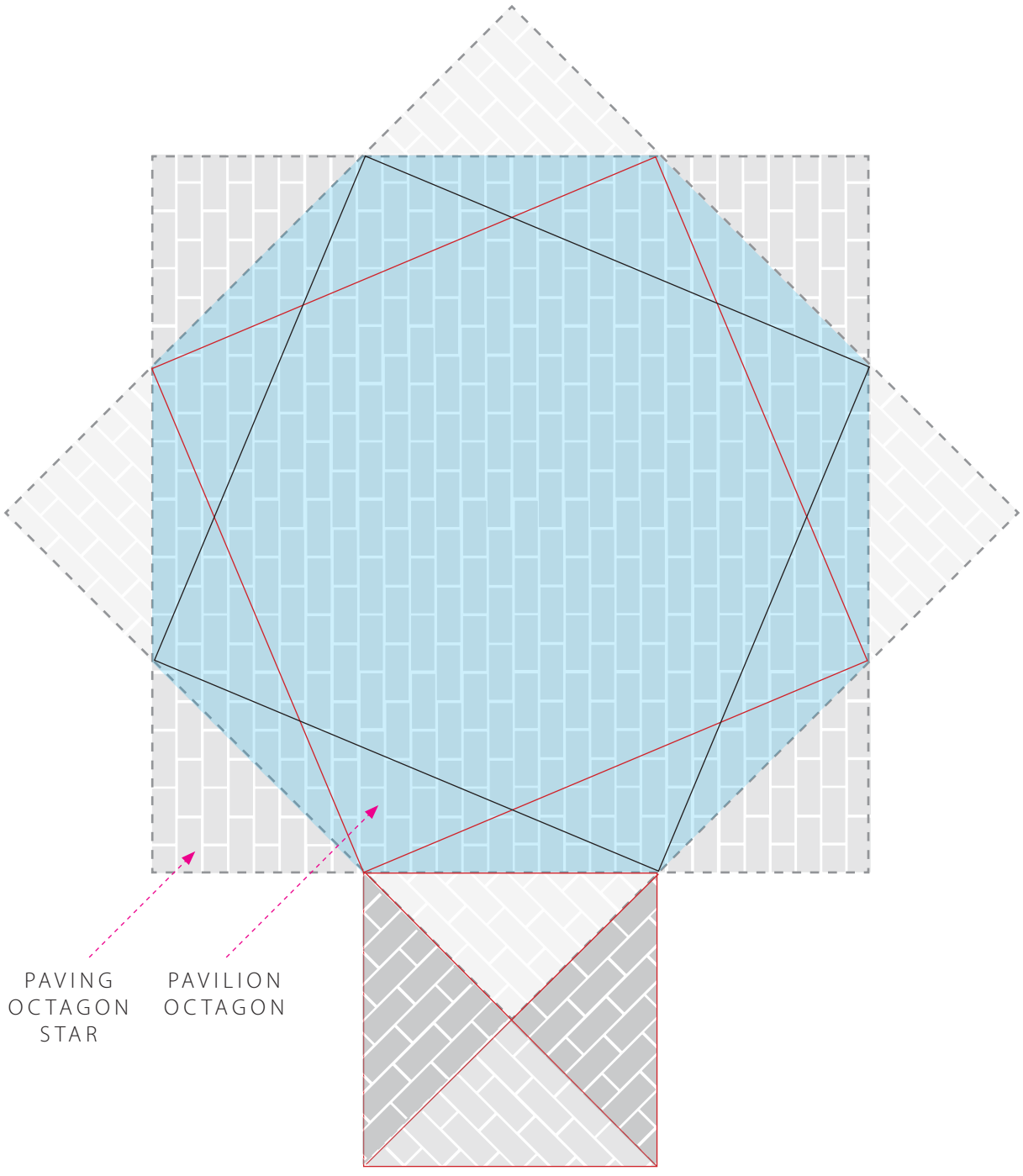
The bricks are laid to follow the angles of the square and diamond so that only the corner triangles of the diamond show (these are shown in paler tone).



Appleton Octagonal Pavilion Plan Floor geometry stage 4

The two squares that comprise the octagon star intersect each other at the angles of an octagon (shown in blue tone).

The blue octagon is the pavilion's floor plan. The thought at this stage of the design is that the floor of the pavilion would project beyond the internal boundary to define an external octagon star.

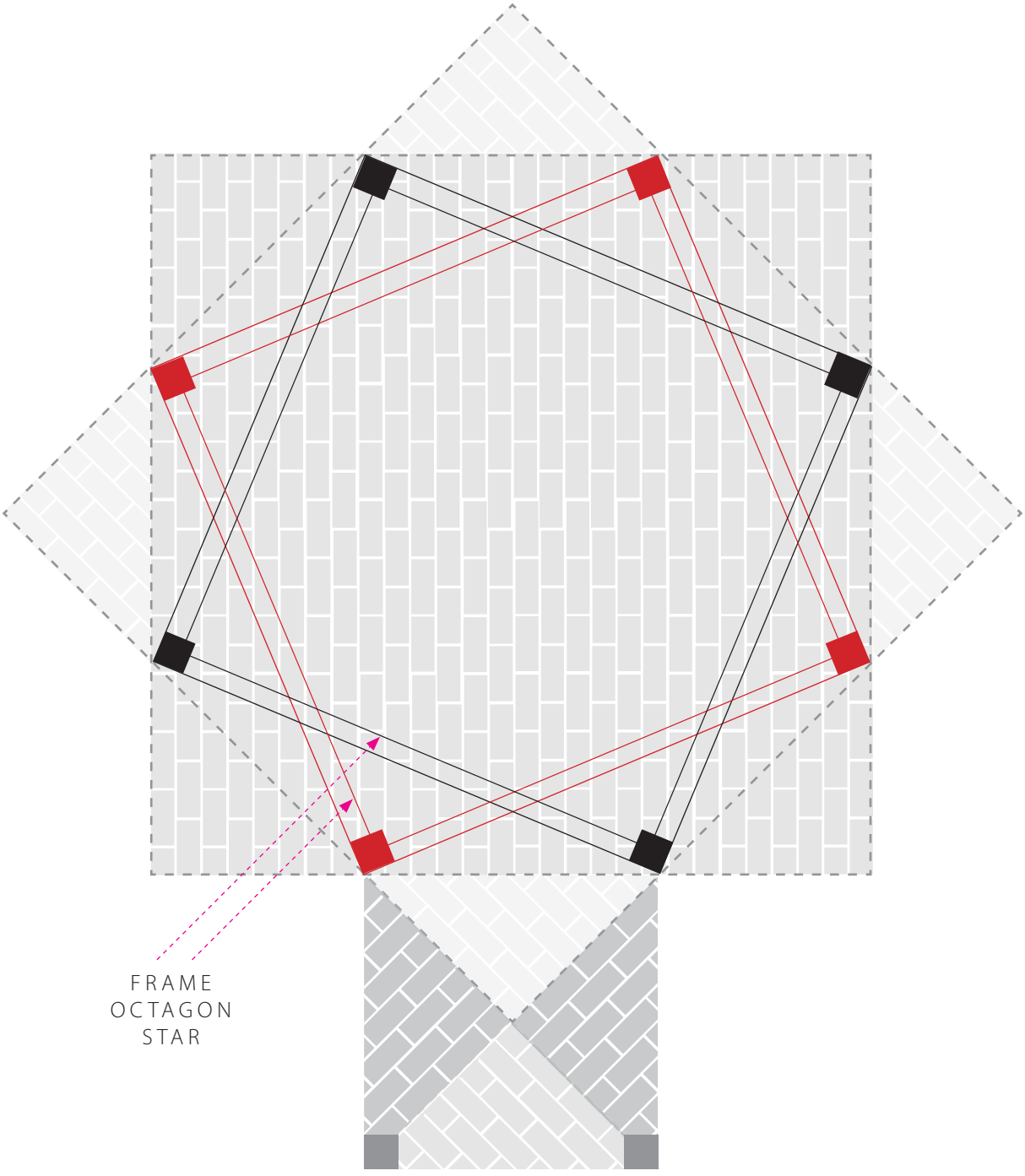


Appleton Octagonal Pavilion Plan Floor geometry stage 5

Alternate angles of the octagon (shown in blue tone) can be connected to form two squares (shown in red and black line).

The two squares interlace to form a second, internal, octagon star (in alternating red and black line).

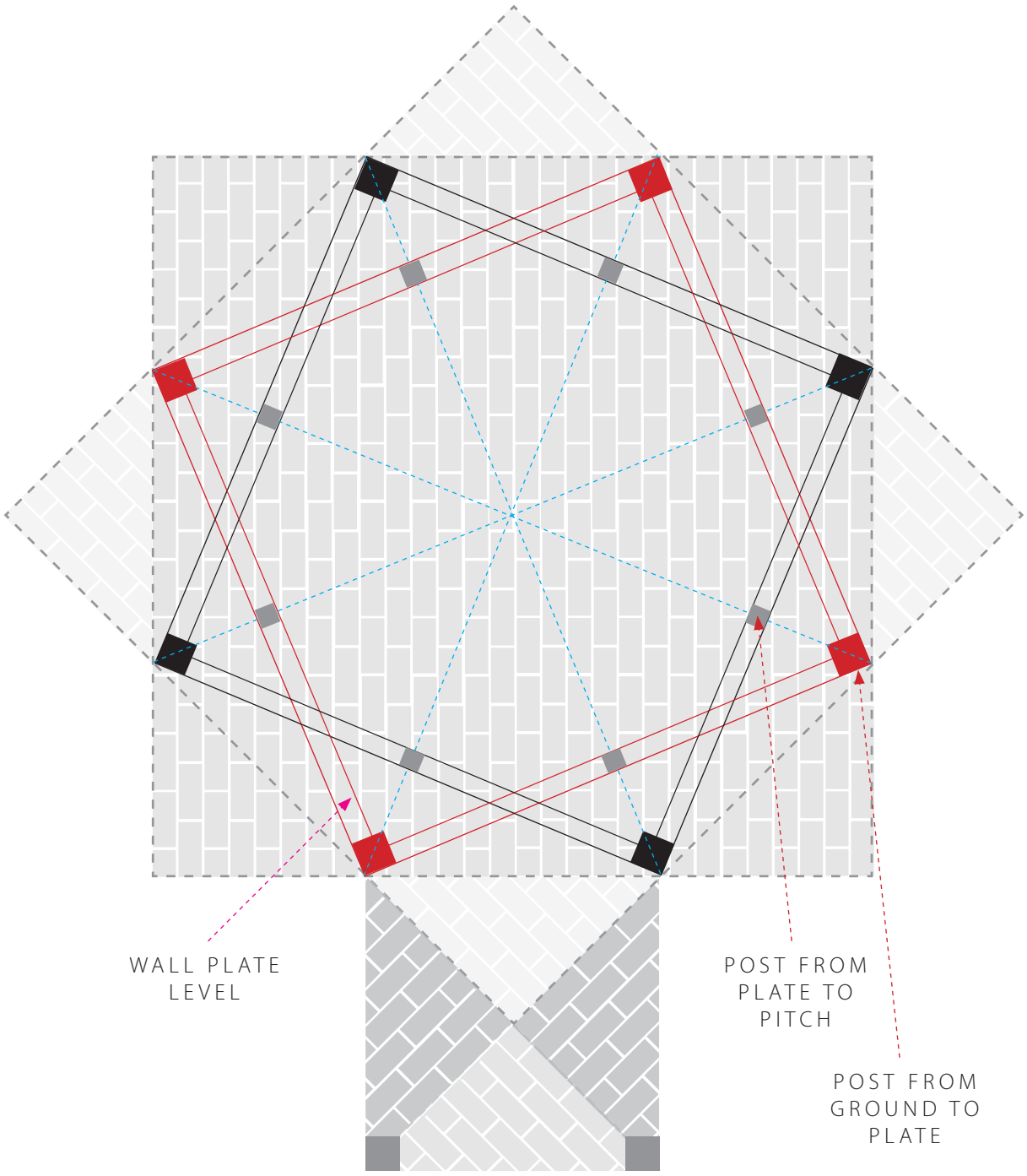
A small square is projected from one of the blue octagon's sides to give the floor area for the pavilion's entrance and the paving pattern is continued within it. A square is chosen so that the floor pattern fits.



Appleton Octagonal Pavilion Plan Floor geometry stage 6

The two squares that comprise the internal octagon star give the outer faces of a ring of intersecting wall plates.
The red and black plates could be either halved at their crossing to give a single level for the wall plates or mortice and tenoned to the posts at two separate levels.

It is clear at this stage that although the eight posts (shown in solid red and black) stand at the angles of the octagon they do not form an octagonal perimeter to the frame but have more of a reciprocal pattern.

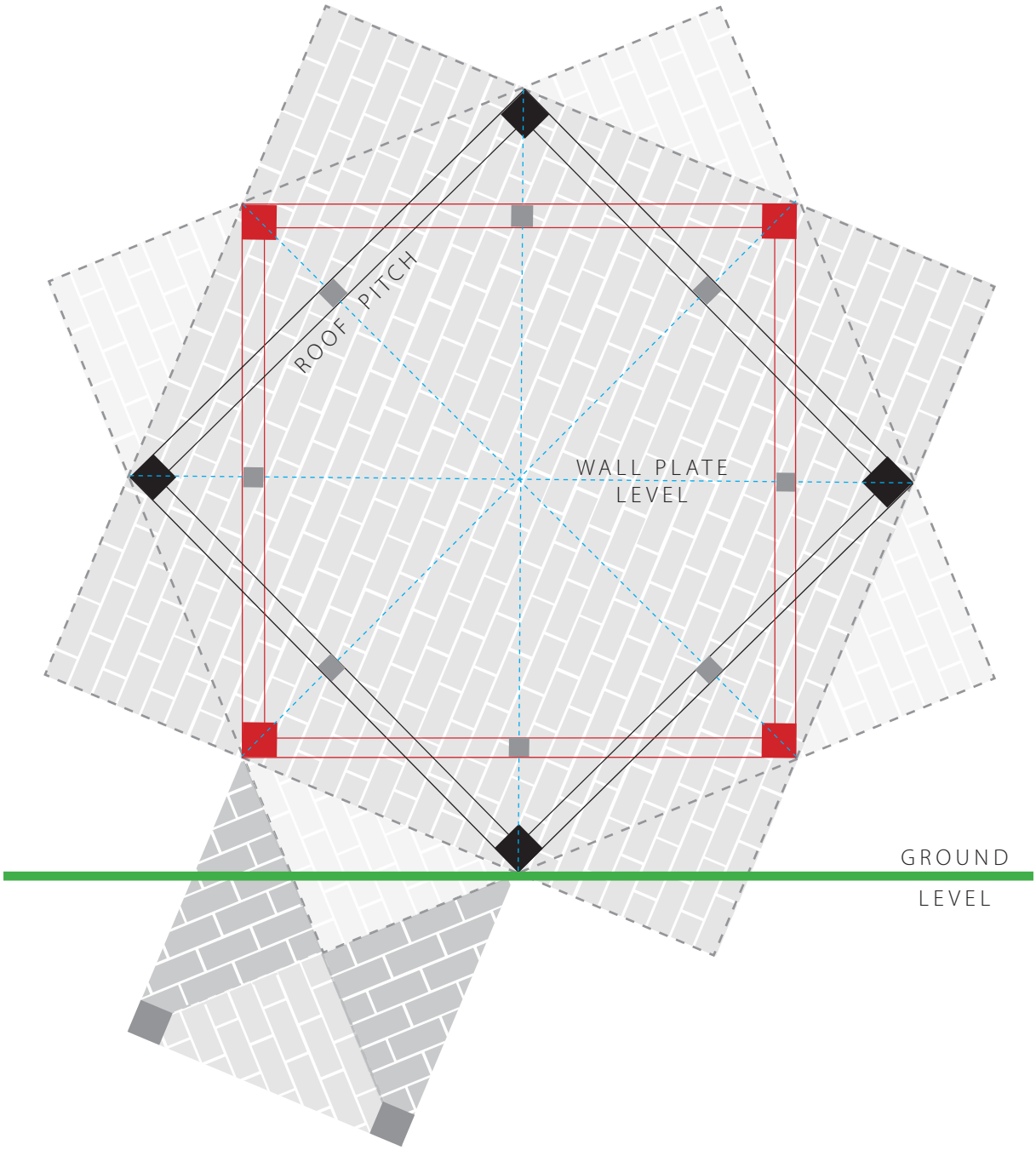


Appleton Octagonal Pavilion Plan Frame geometry stage 1

Looking at the drawing in **PLAN**, the red and black squares mark the wall plate level of the frame. The dashed blue lines are not timber locations but mark the diagonals of the red and black squares.

The red square's diagonals cut the black square's sides at their centre points (and vice versa).

Posts (shown as small grey squares) rise vertically at wall plate level from the blue diagonals' centre points upwards to the roof plane.

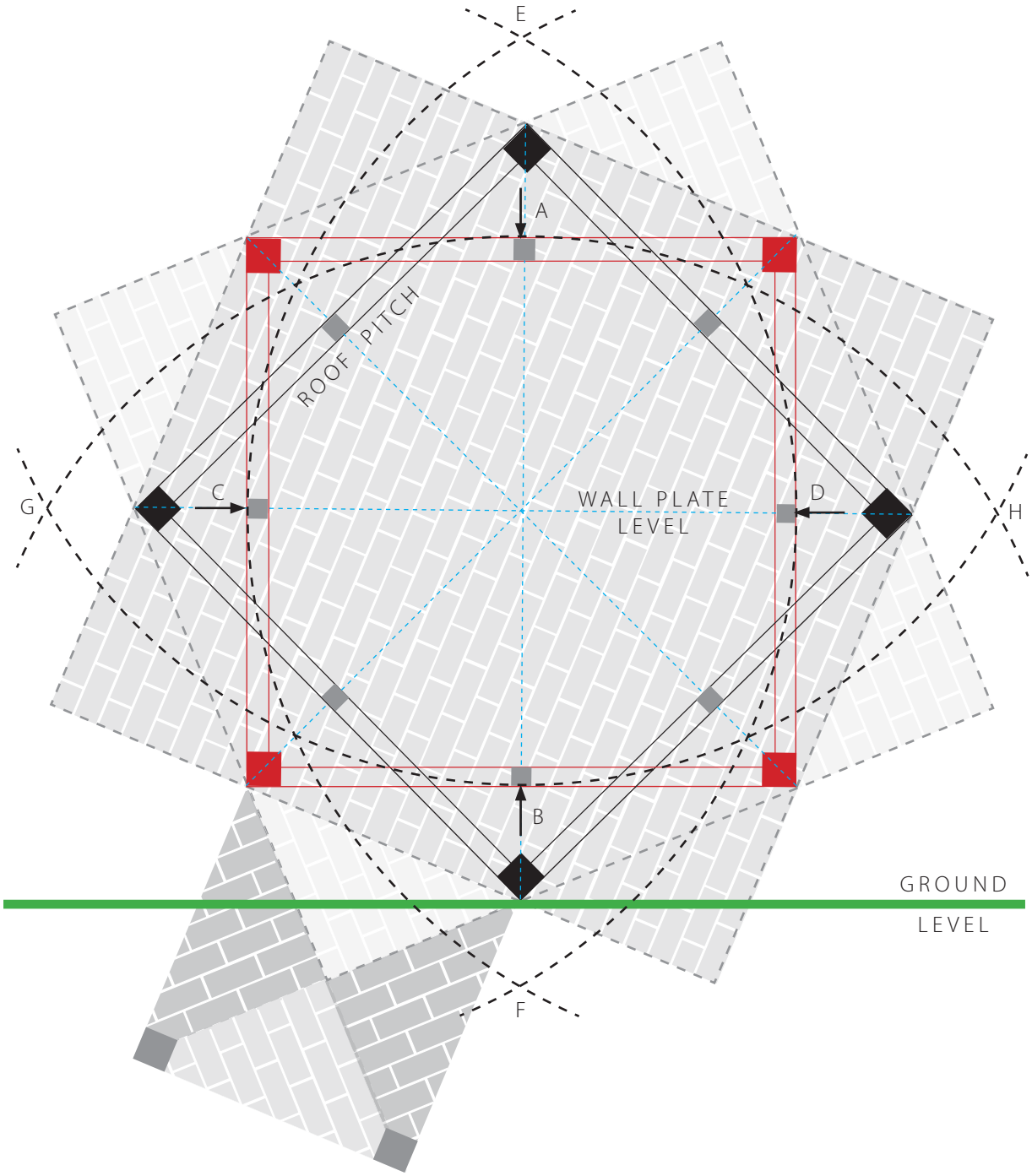


Appleton Octagonal Pavilion Elevation Frame geometry stage 2

Looking at the drawing as an **ELEVATION**, the red and black squares are revolved so that the red square's base is parallel to the ground level.

The black square (which has become a diamond) gives the angle of the roof pitch in its upper half (but further geometry is needed to establish its precise position) and a wall plate level across its horizontal diagonal.

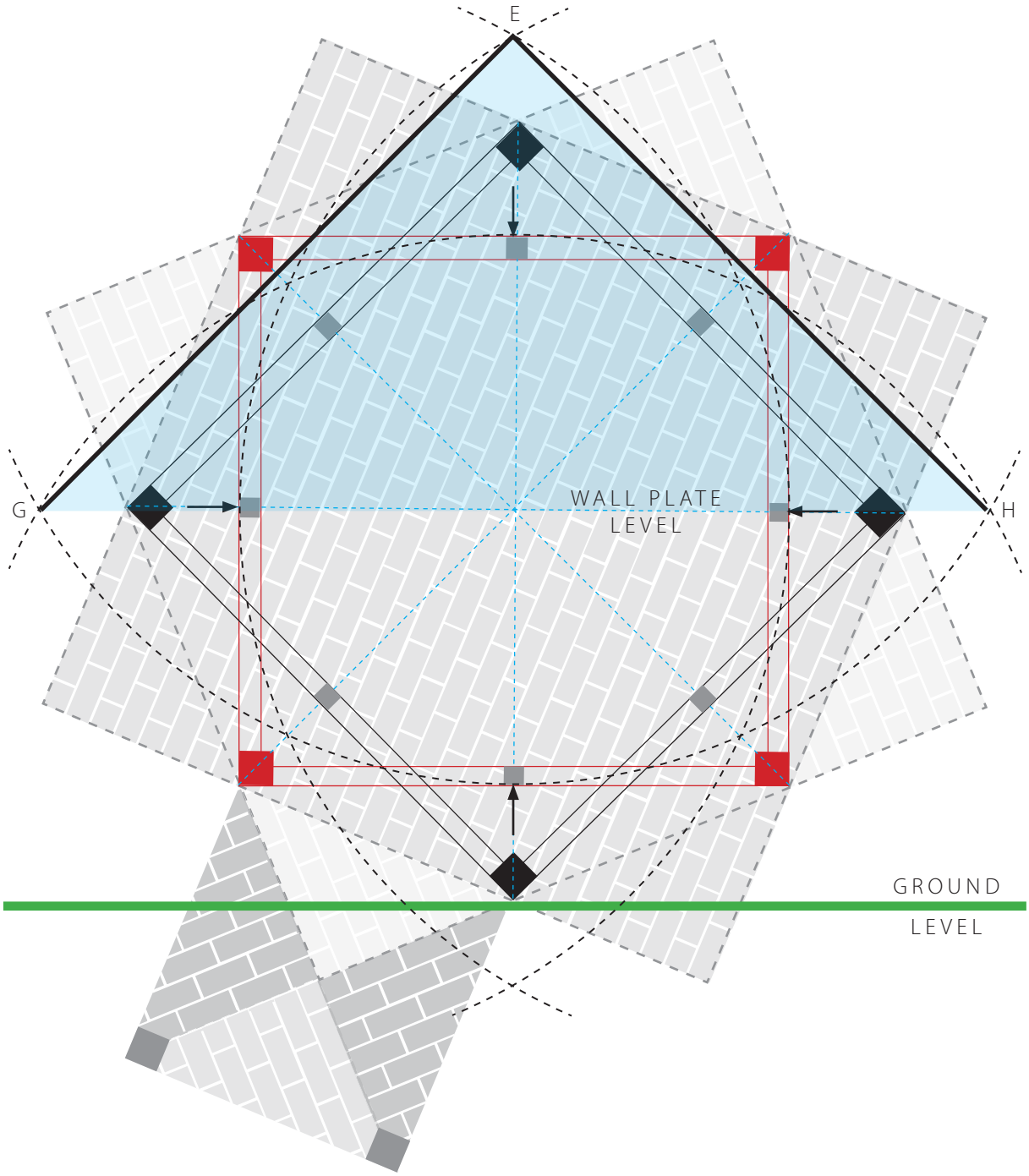
An exciting aspect of the geometry is that the plan and section are identical.



Appleton Octagonal Pavilion Elevation Frame geometry stage 3

Looking at the drawing as an **elevation**, identify the small grey posts (indicated by black arrows) at the centres of the wall plates in the red square.

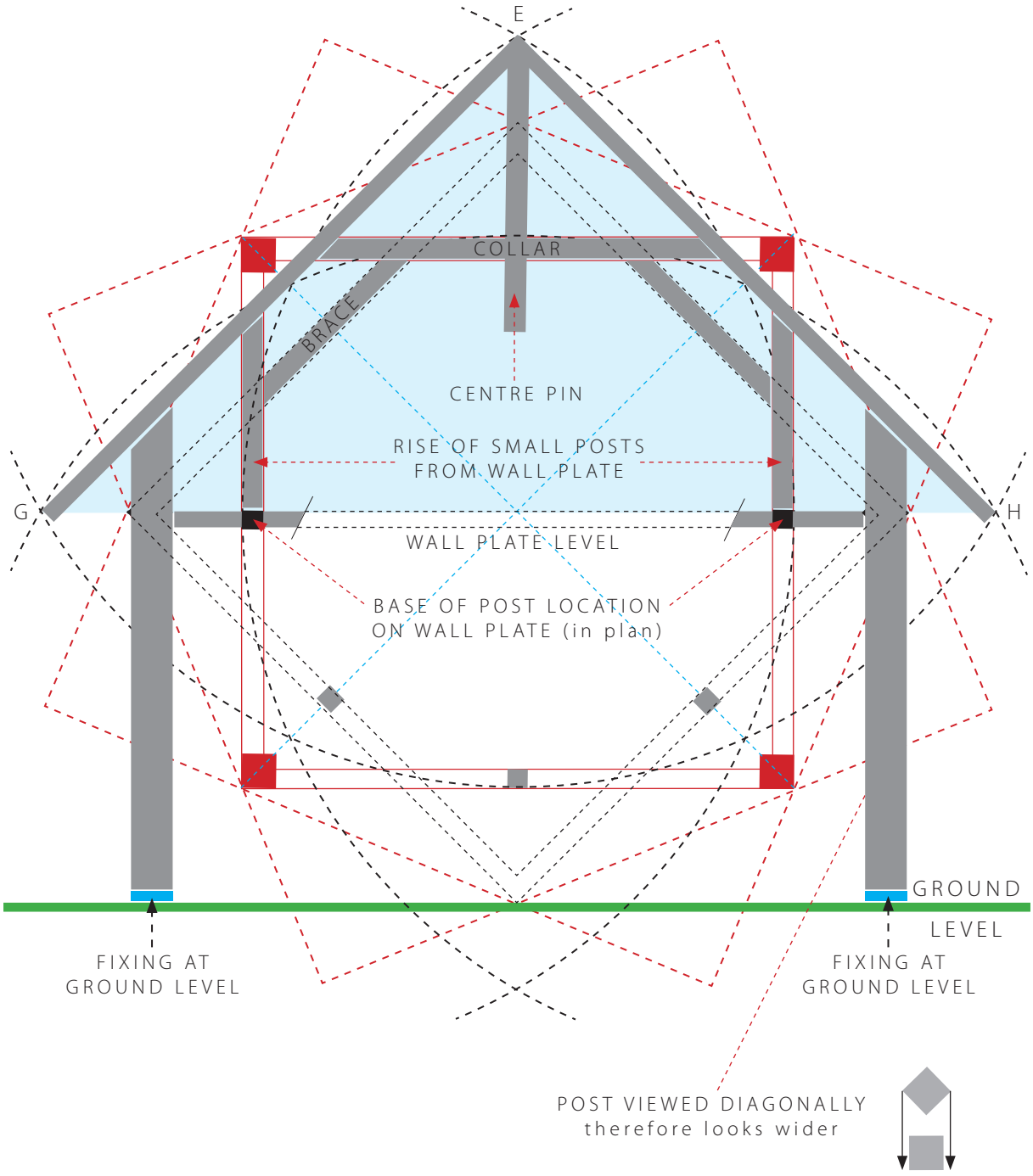
Taking the outerface centres of the small grey squares as the cardinal points A B C and D, use radius AB and radius CD to draw pairs of vertical and horizontal arcs (in dashed black line) that intersect beyond the corners of the black square at E F G and H.



Appleton Octagonal Pavilion Elevation Frame geometry stage 4

Looking at the drawing as an **elevation**, identify the points E G and H at the intersections of the arcs.

EGH = the roof triangulation from wall plate level to ridge (shown as a blue tone and heavy black line).



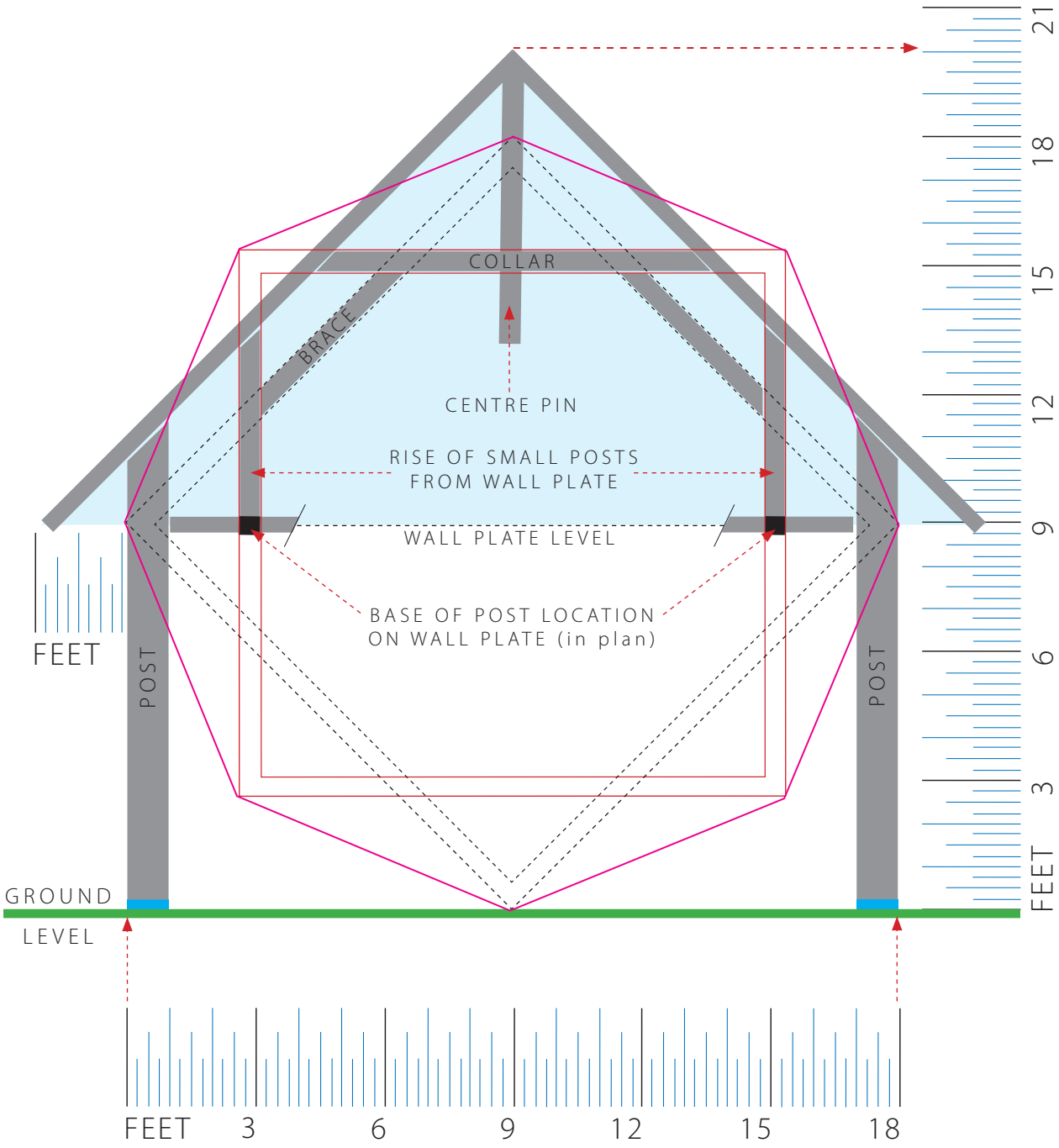
Appleton Octagonal Pavilion Elevation Frame geometry stage 5

For clarity, the brick floor octagon star is reduced to a dashed red outline.

Looking at the drawing as an **elevation**, EGH = the roof triangulation from wall plate level to ridge (shown as a blue tone). The principal rafters GE and EH are shown as grey tone.

The braces and collar follow the geometry of the red and black squares, parallel to the roof pitch, so that the geometry is identical in the horizontal and vertical planes.

NOTE The drawing introduces the centre-pin at the ridge apex.

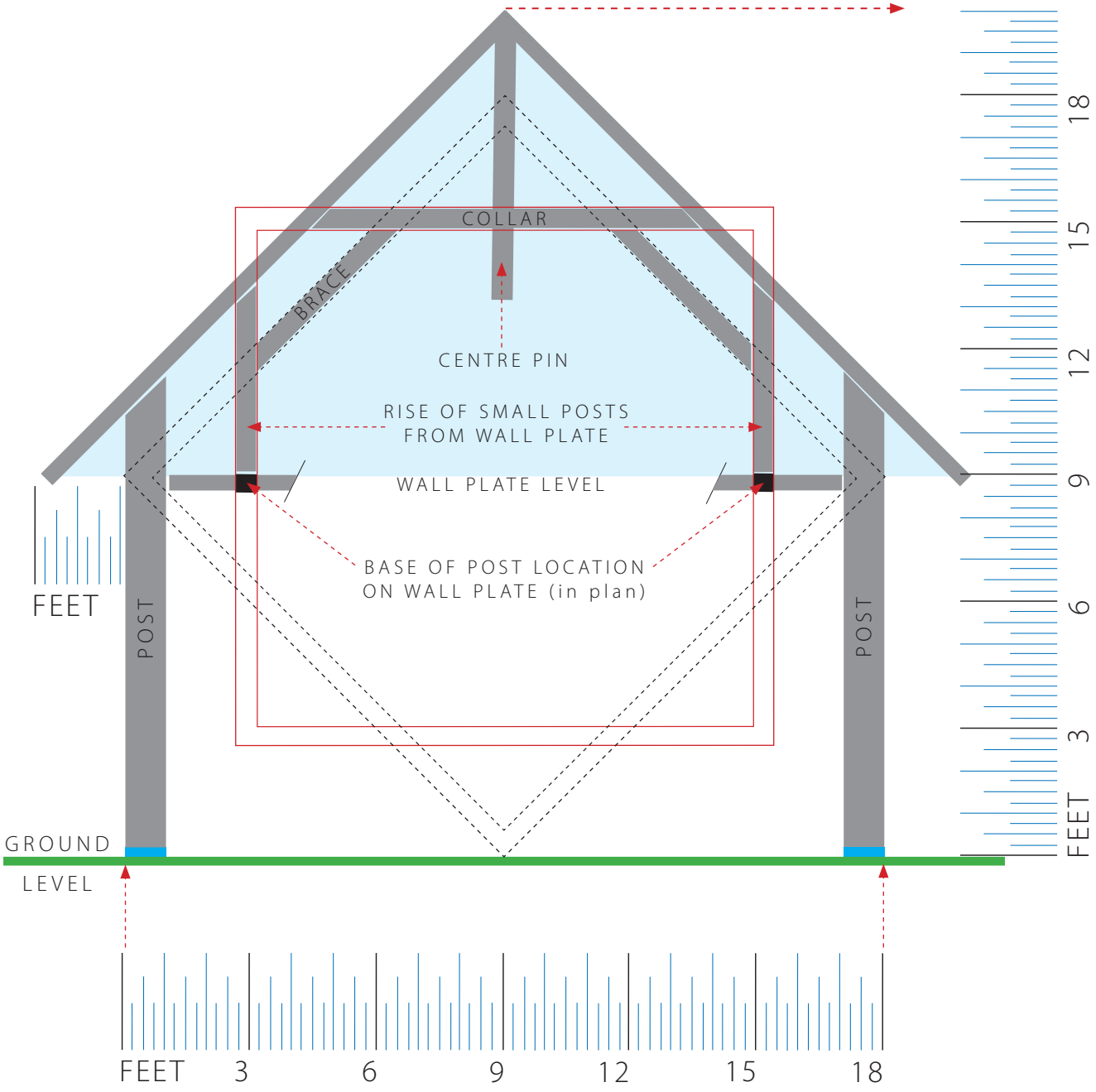


Appleton Octagonal Pavilion Elevation Frame geometry stage 6

For clarity, all the construction lines are removed and the plan octagon is shown in solid magenta line.

The **elevation** shows the geometrical proportions of the frame at the outer faces of all timbers (but the timbers are not shown to scale or to proportion at this stage).

The frame octagon is 16 feet 6 inches wide face to face, 18 feet wide angle to angle (as shown by the ruler below the drawing) and 20 feet from ground level to peak. It is 9 feet from ground level to the eaves and the internal wall plate interlace. The eaves overhang is 2 feet.

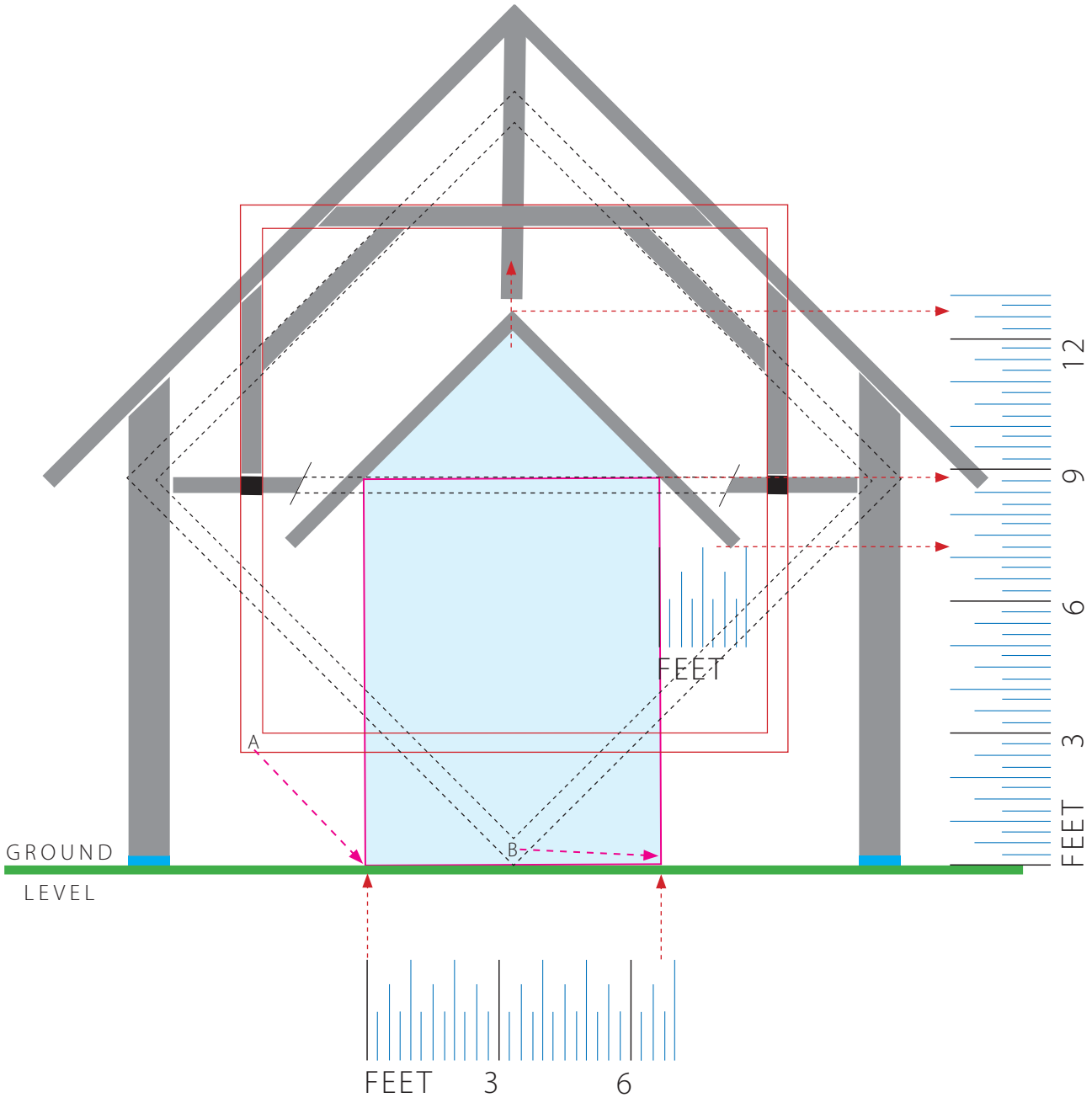


Appleton Octagonal Pavilion Elevation Frame geometry stage 7

For clarity, all the construction lines and the plan octagon are removed.

The **elevation** shows the geometrical proportions of the frame at the outer faces of all timbers.
The timbers are not shown to scale or to sectional proportion at this stage.

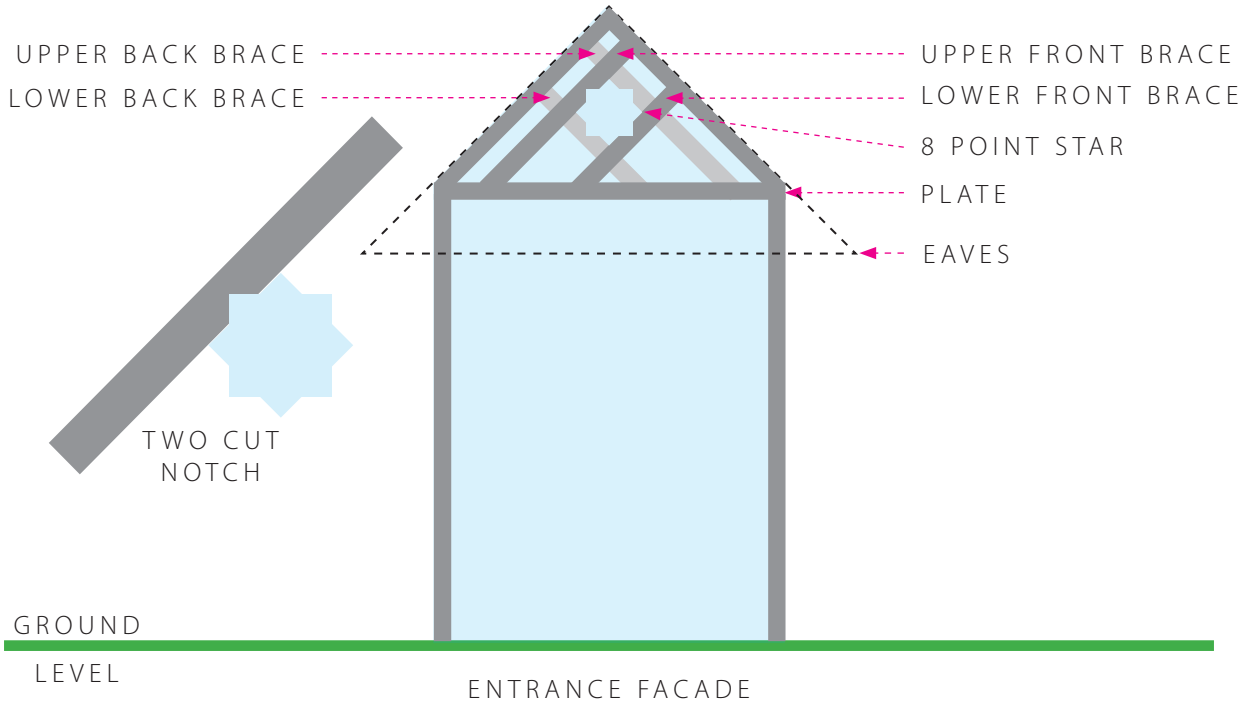
The frame octagon is 16 feet 6 inches wide face to face, 18 feet wide angle to angle (as shown by the ruler below the drawing) and 20 feet from ground level to peak. It is 9 feet from ground level to the eaves and the internal wall plate interlace. The eaves overhang is 2 feet.

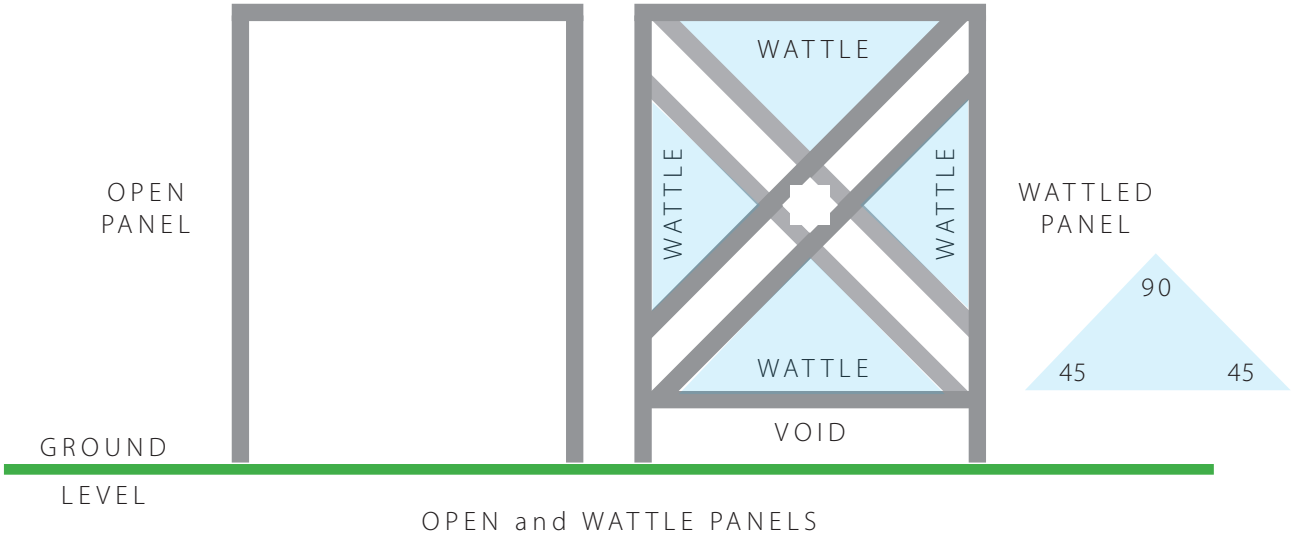


Appleton Octagonal Pavilion Porch Frame geometry stage 8

The **elevation** shows the geometrical proportions of the frame at the outer faces of all timbers.
The timbers are not shown to scale or to sectional proportion at this stage.

This drawing establishes the proportions of the entrance facade which is shown in blue tone. The width is defined by the distance between the octagon's posts at A and B. The height is defined by the wall plate level. The pitch is parallel to the octagon's roof. The entrance is 6 feet 8 inches wide to its outer faces, 8 feet 10 inches high to the top of the plate, 7 feet 3 inches to the eaves and 12 feet 7 inches to the ridge.





Appleton Octagonal Pavilion Porch Frame geometry stage 9

The upper drawing shows suggested bracing between the porch wall plate and principal rafters. The braces form a central diamond. V notches cut in each face of the diamond combine with the angles between the timbers to form an 8-point star. The braces are framed in two pairs that pass in the front and rear halves of the plate. There are also 8 spaces surrounding the star. These configurations continue the theme of the octagon in a related but visually different way.

The lower drawing shows the frame's side panels. Five pavilion sides and two porch sides are open and three pavilion sides are framed for wattle panels to match the character of the entrance facade. Alternatively, the three decorative panels could be filled entirely with conventional wattle.

Laurie Smith <laurie@thegeometricaldesignworks.com>
To: Rick COLLINS <r.collins@trilliumdell.com>
APPLETON PAVILION roof details

Hello Rick and Nicole

A few queries. You say the roof will be steel so I would like a bit more info in relation to an 8-sided roof ~

QUESTIONS
Q1 Will the roof be in 8 separate panels?
Q2 How will they be joined where they meet?
Q3 Will the steel be flat sheet or corrugated?

You suggested 3 walls being infilled with wattle. Another query about this ~

Q4 Do you visualise the panels being completely filled (ground to plate & post to post)?

With good wishes

Laurie

Rick COLLINS <r.collins@trilliumdell.com>
To: Laurie Smith <laurie@thegeometricaldesignworks.com>
Cc: Nicole Collins <nicole@trilliumdell.com>
Re: APPLETON PAVILION roof details

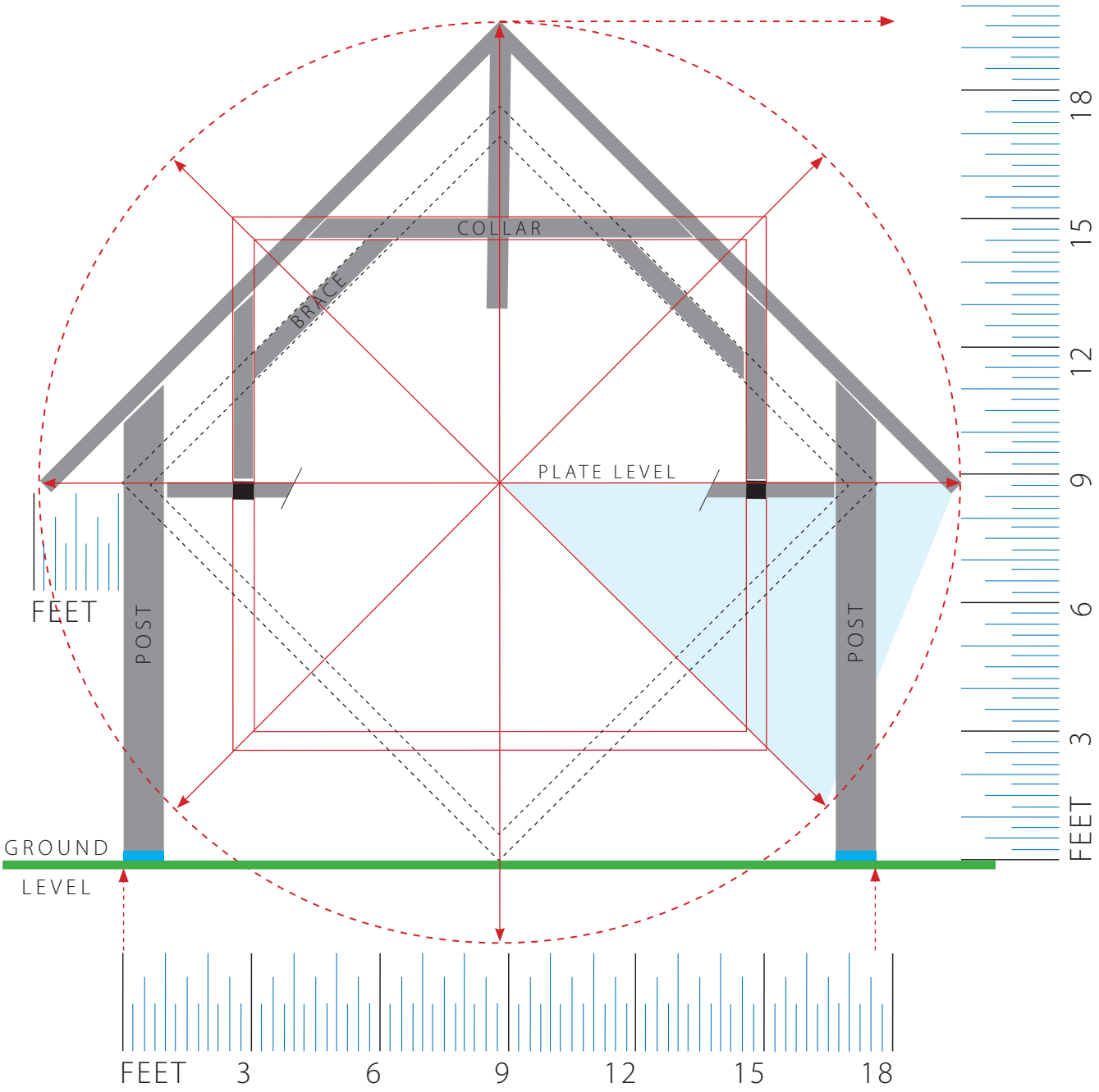
Hi Laurie.

ANSWERS
Q1 The roof will be installed in sheets approx 12"-16" wide, or if I go with cheaper stuff 30" - 36" wide. With fasteners every 12" into the solid hardwood decking. The steel runs perpendicular to the purlins, or parallel to the rafters…however you want to view it.
Q2 The roof steel will overlap each other at the seams.
Q3 It may be flat panels with 12" to 16" of flat steel between each rib or seam
Q4 I think the wattle should start 1' above grade, and continue up to the plate.

It may help to understand that the roof will be totally sheathed in hard-wood decking 3/4" thick, so no roof material will be visible from below…

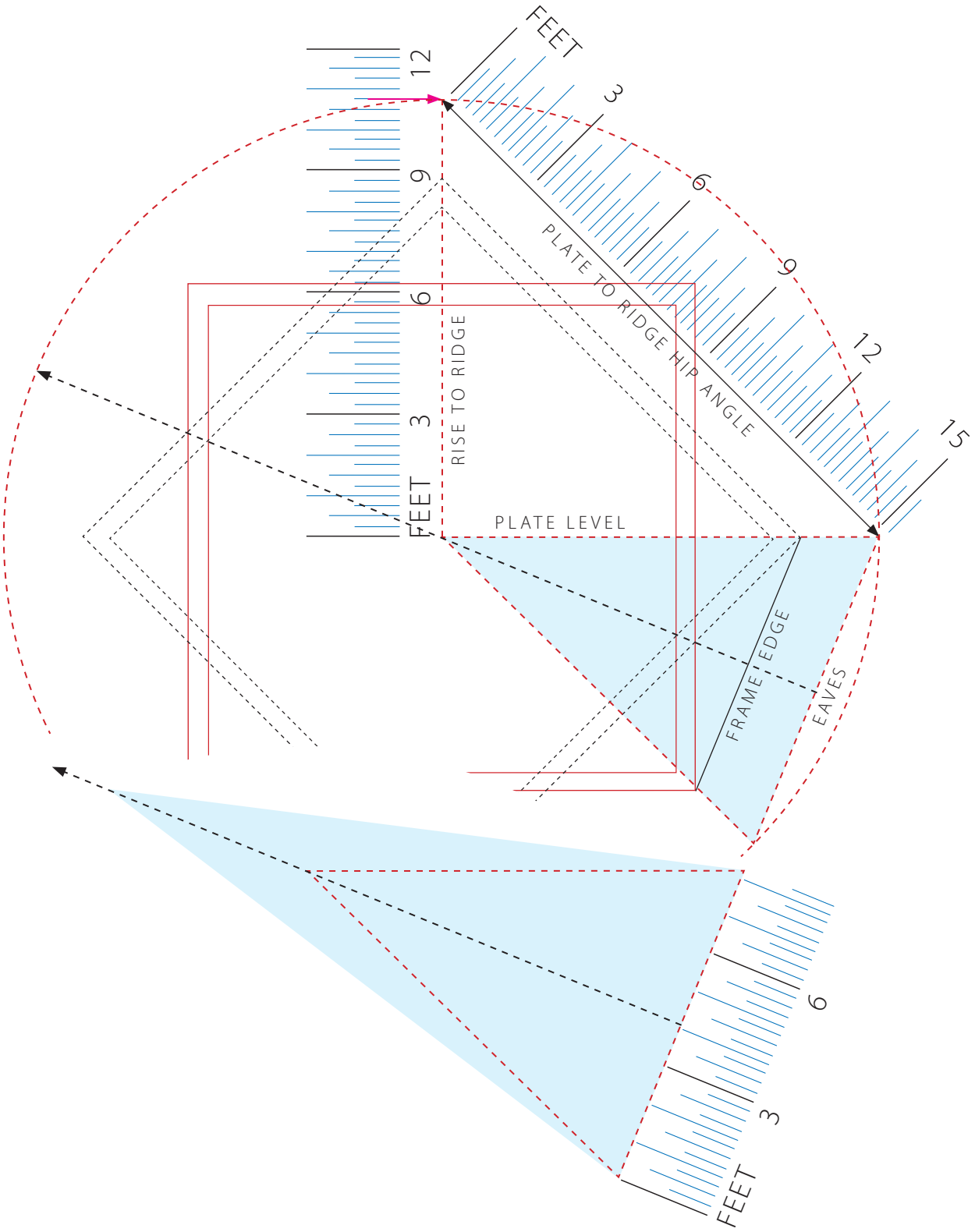
Appleton Octagonal Pavilion Questions and Answers

With the Atlantic in between it was useful to have email communication. The drawings were also sent back and forth as PDFs.



Appleton Octagonal Pavilion Roof Roof geometry stage 1

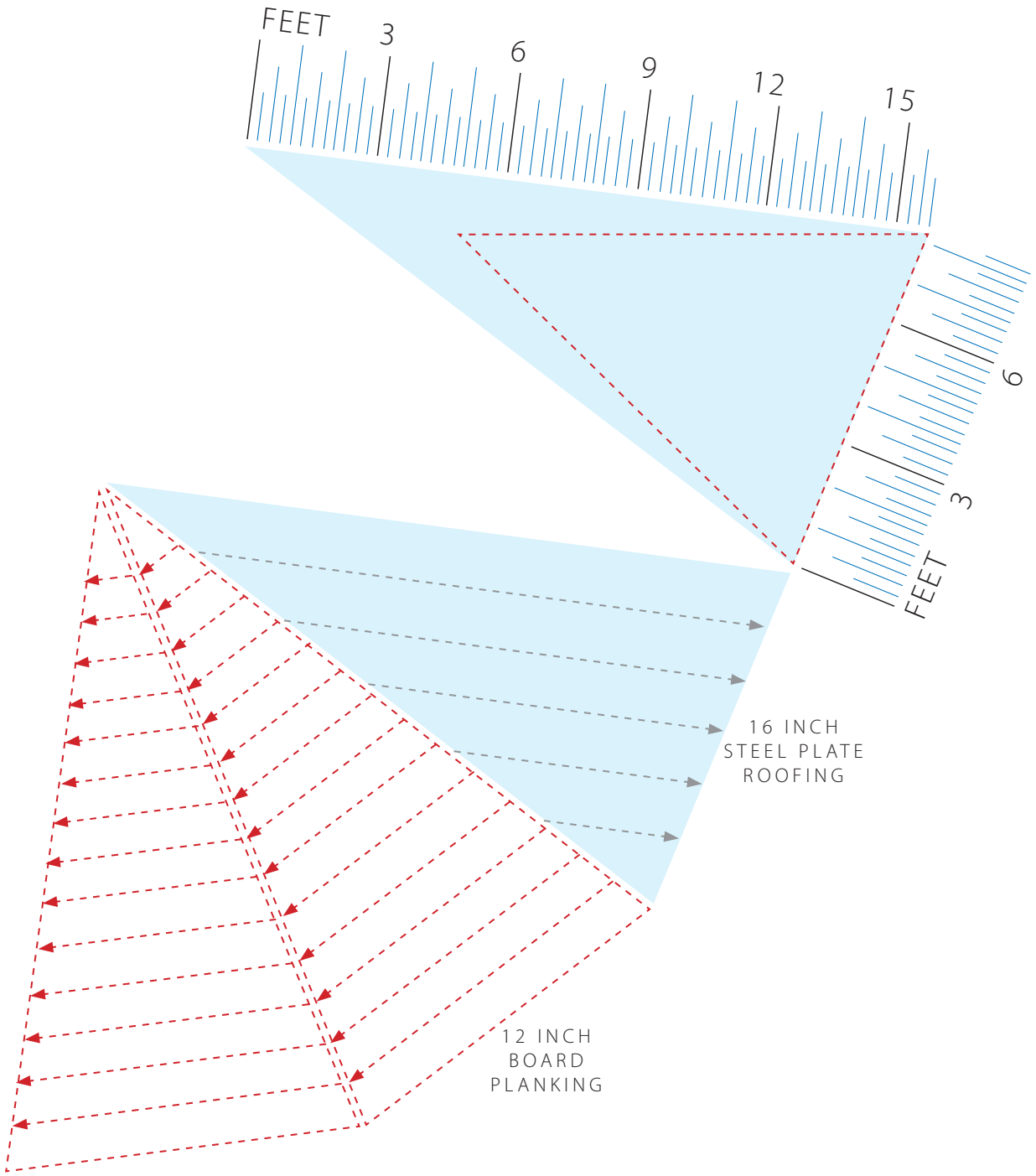
The drawing shows one of the 8 sectors of the octagon roof (in blue tone) projected out to the eaves (indicated by dashed red circle). The roof sector is seen in plan view, like a slice of cake at ground level. The next drawing introduces the geometry of the pitch.



Appleton Octagonal Pavilion Roof Roof geometry stage 2

The main drawing shows one of the 8 sectors of the octagon roof in plan (in blue tone) divided by a dashed centre line (from the centre of the eaves through the centre of the roof). The plate to ridge hip angle, shown upper right, is just over 15 feet long and the rise from plate to ridge is 10 feet 9 inches.

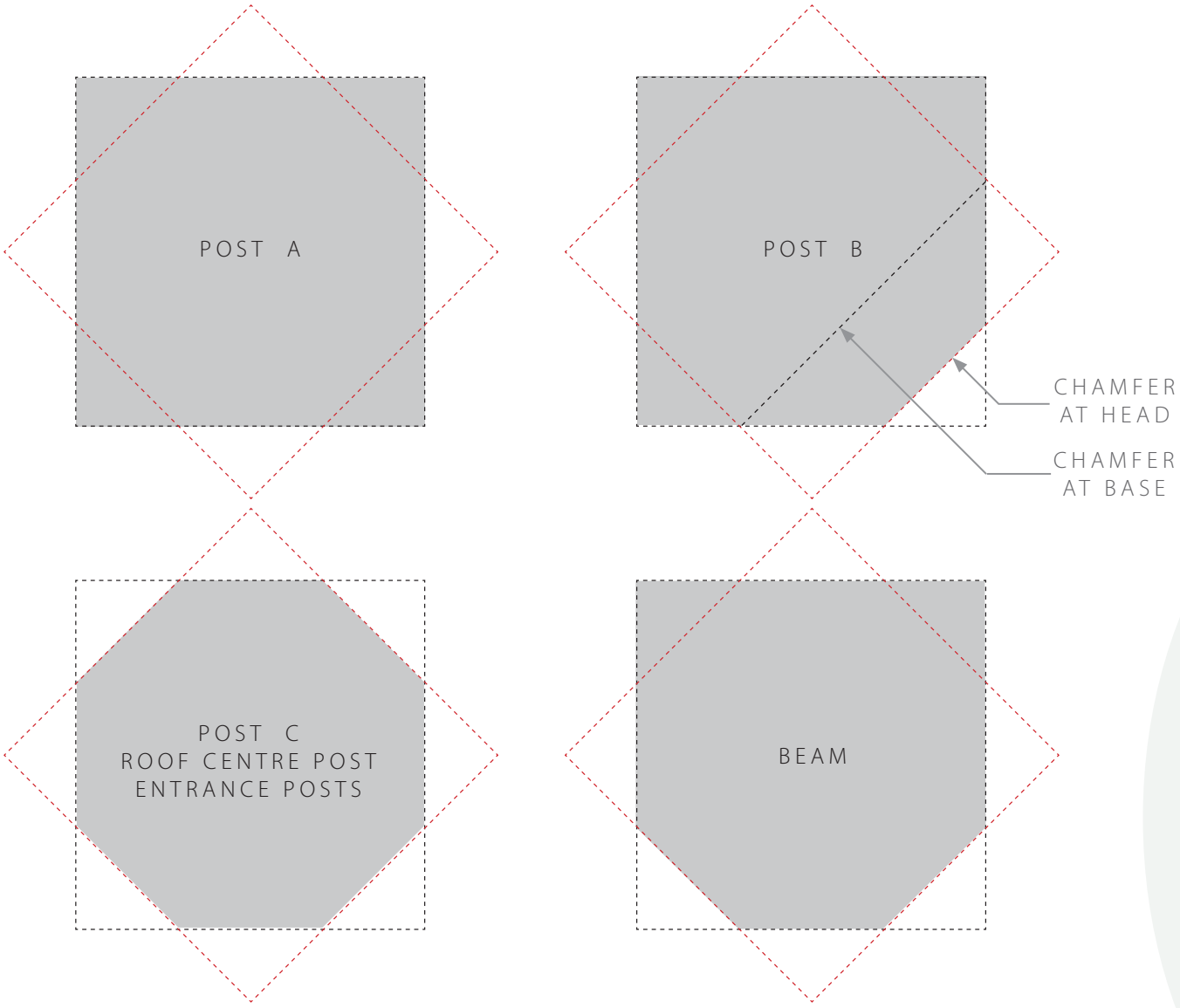
The lower drawing shows the plan triangulation of the sector extended to fit the hip from eaves to ridge.



Appleton Octagonal Pavilion Roof Roof geometry stage 3

The upper drawing shows the triangulation of one of the 8 sectors of the octagon roof (in blue tone). The horizontal plan triangle is shown in dashed red line. The sector is 15 feet 9 inches long by 8 feet 3 inches wide at the eaves.

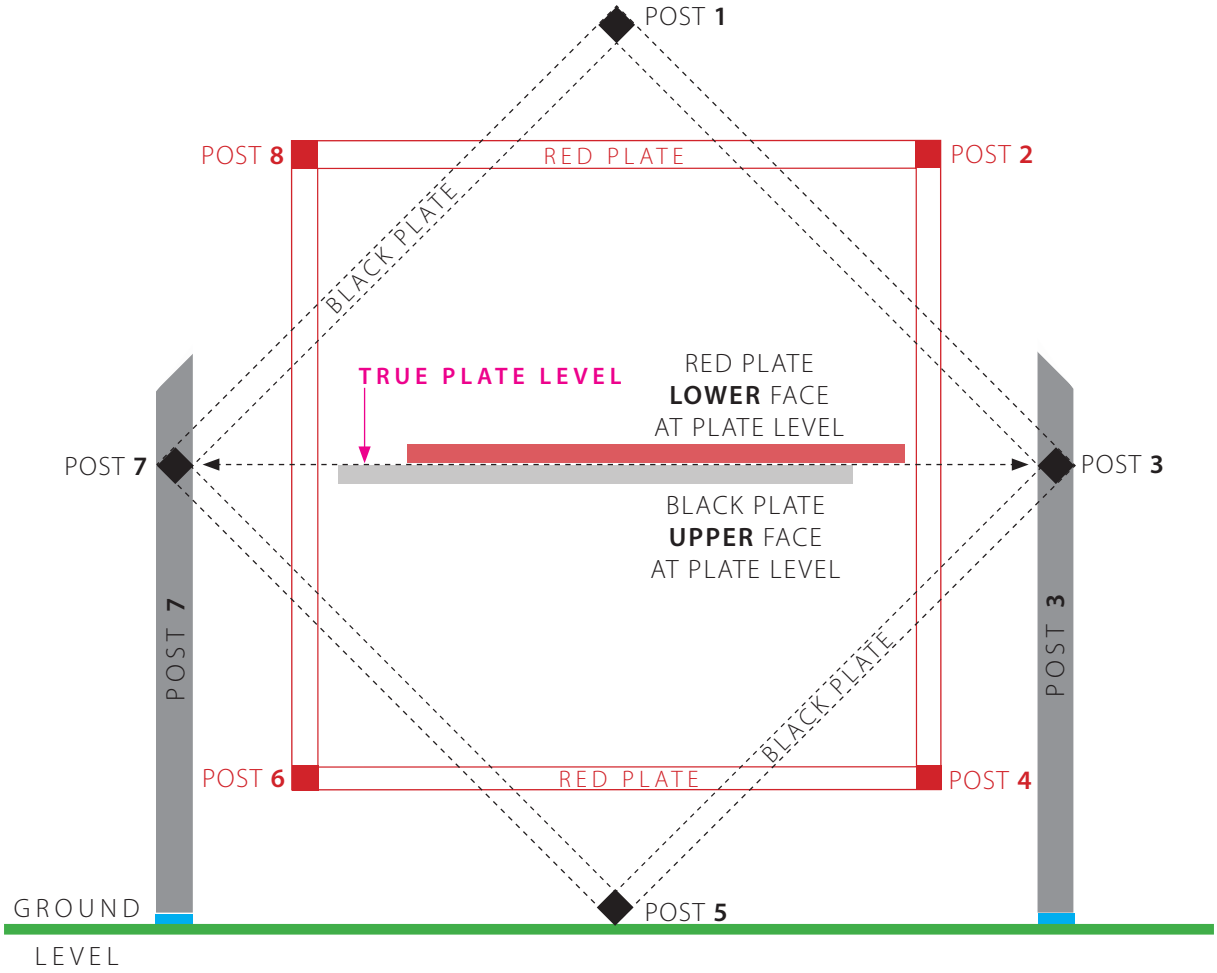
The lower drawing shows the two layers of the sector, 12 inch planking in red dashed line and 16 inch steel cover sheeting in dashed grey line. The steel runs parallel to one side of the sector.



Appleton Octagonal Pavilion Posts Timber sections

The drawings show three alternative post sections and a beam section.

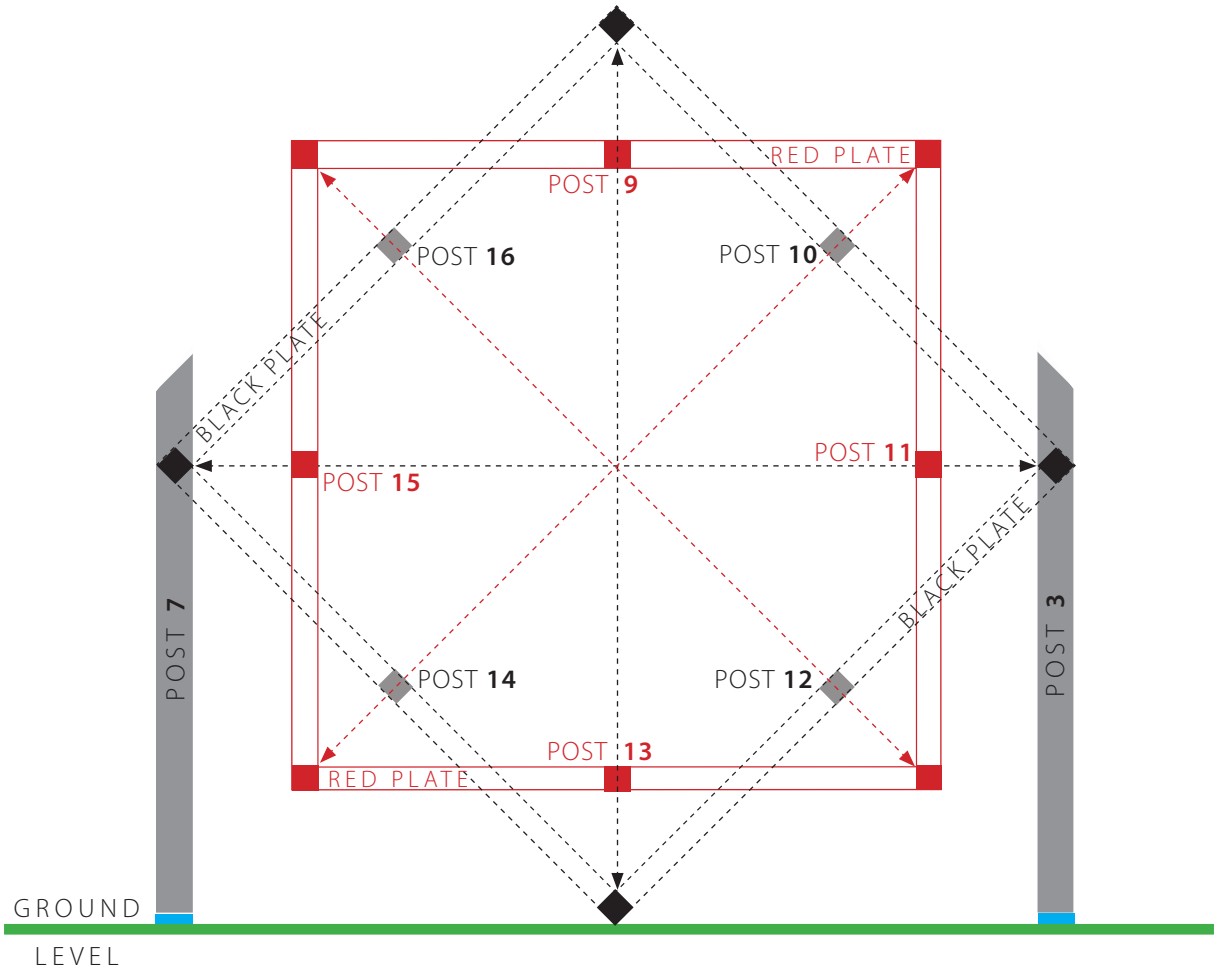
Post A Standard corner posts for the two interlaced squares (the 8 main posts).
Post B Alternative post section square on it's outer face and chamfered towards the pavilion's interior.
Post C Suggested centre post connecting the collars to the ridge.
An alternative section for the porch front entrance posts.
Beam The beams are chamfered on the inner face to bring some visual detail into the Pavilion.
The timbers are not shown to scale at this stage.



Appleton Octagonal Pavilion Posts and Plates Geometry stage 1

The drawing shows the frame's plan at ground and wall plate level, both of which are identical. The 8 posts of the octagon are framed in two squares of 4 posts each, the red square and black square respectively. The red and black squares are framed to rest upon each other, either side of the true wall plate level. The red plate is above the true level and the black plate below the true level. This is easily attainable because the octagon's 8 posts rise to a higher level.

The drawing can also be read as an elevation with the true wall plate level exactly half way between ridge level at Post 1 and ground level at Post 5.



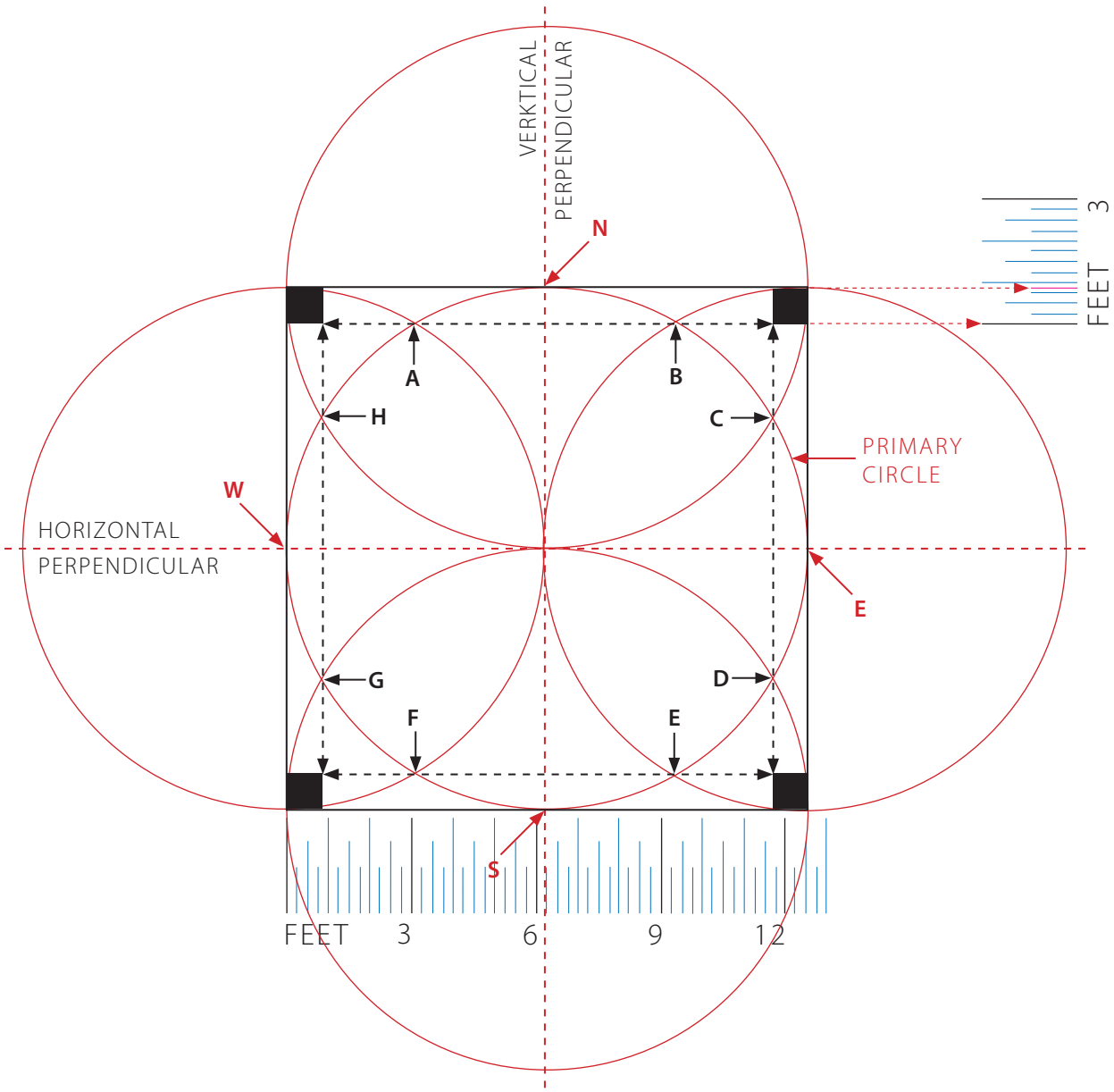
Appleton Octagonal Pavilion Posts and Plates Geometry stage 2

The 8 posts rising from the red and black wall plate levels to support the roof are shown as posts 9 to 16. Posts 9, 11, 13 and 15 stand on the red square's wallplate. Posts 10, 12, 14 and 16 stand on the black square's wall plate.

NOTE 1 There are no wall plates crossing the frame. The wall plates form an octagon star ring beam with open space at the frame's centre.

NOTE 2 Because the red and black squares are placed above and below the true wall plate level it follows that posts shown red (9, 11, 13 and 15) and posts shown black (10, 12, 14 and 16) will be of different lengths. Black posts 10, 12, 14 and 16 rise from the upper face of the black square at the true plate level. Red posts 9, 11, 13 and 15 rise from the upper face of the red square, the thickness of the red plate above the upper face of the black plate.

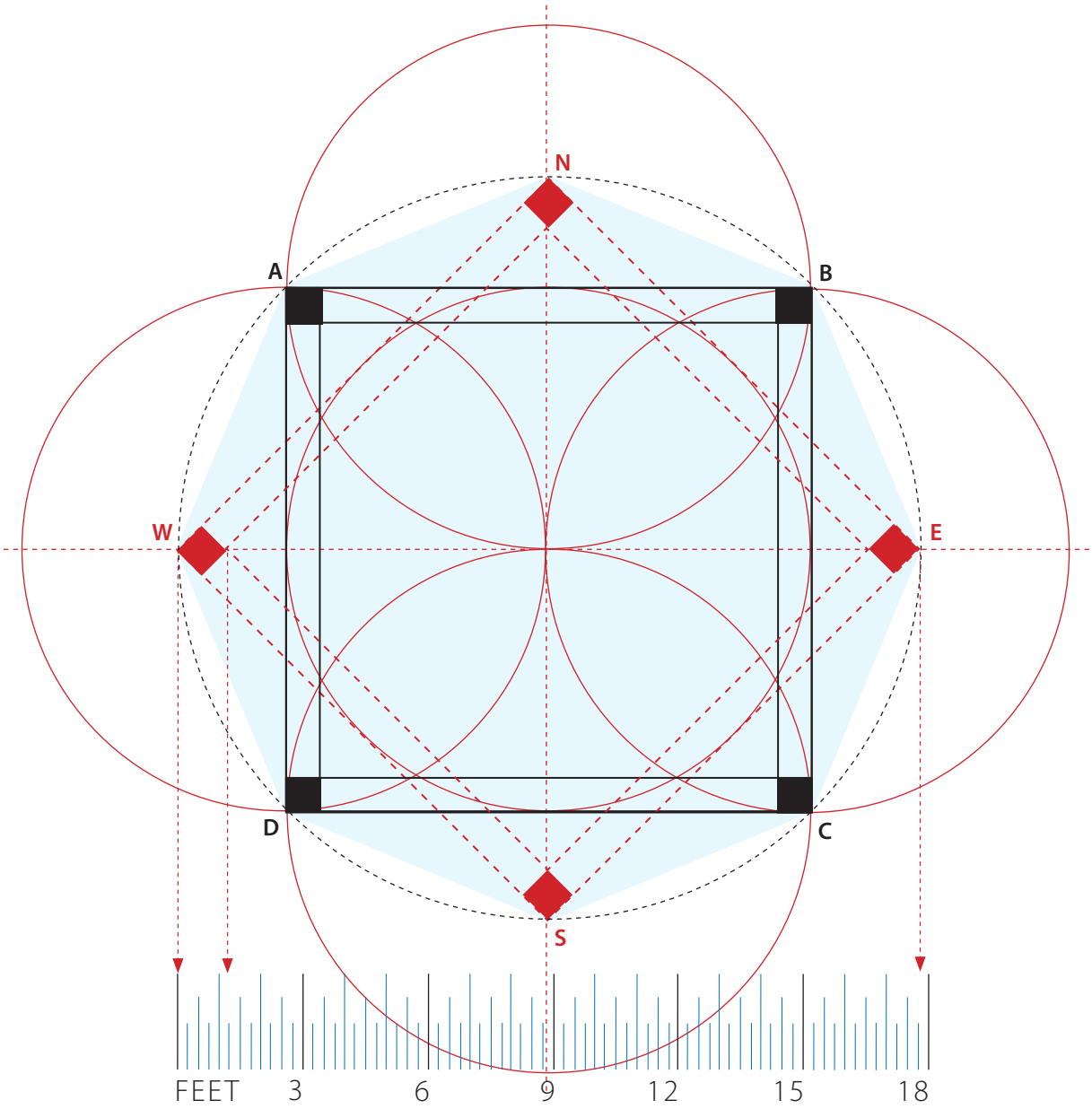
NOTE 3 Despite their different lower levels on their respective plates all the rising posts reach identical upper levels in the roof structure.



Appleton Octagonal Pavilion Dimensions Timber dimensioning 1

Establishing an initial post section from the same geometry as the frame.
The drawing shows the first stage of the frame plan, four posts at the corners of a square ~

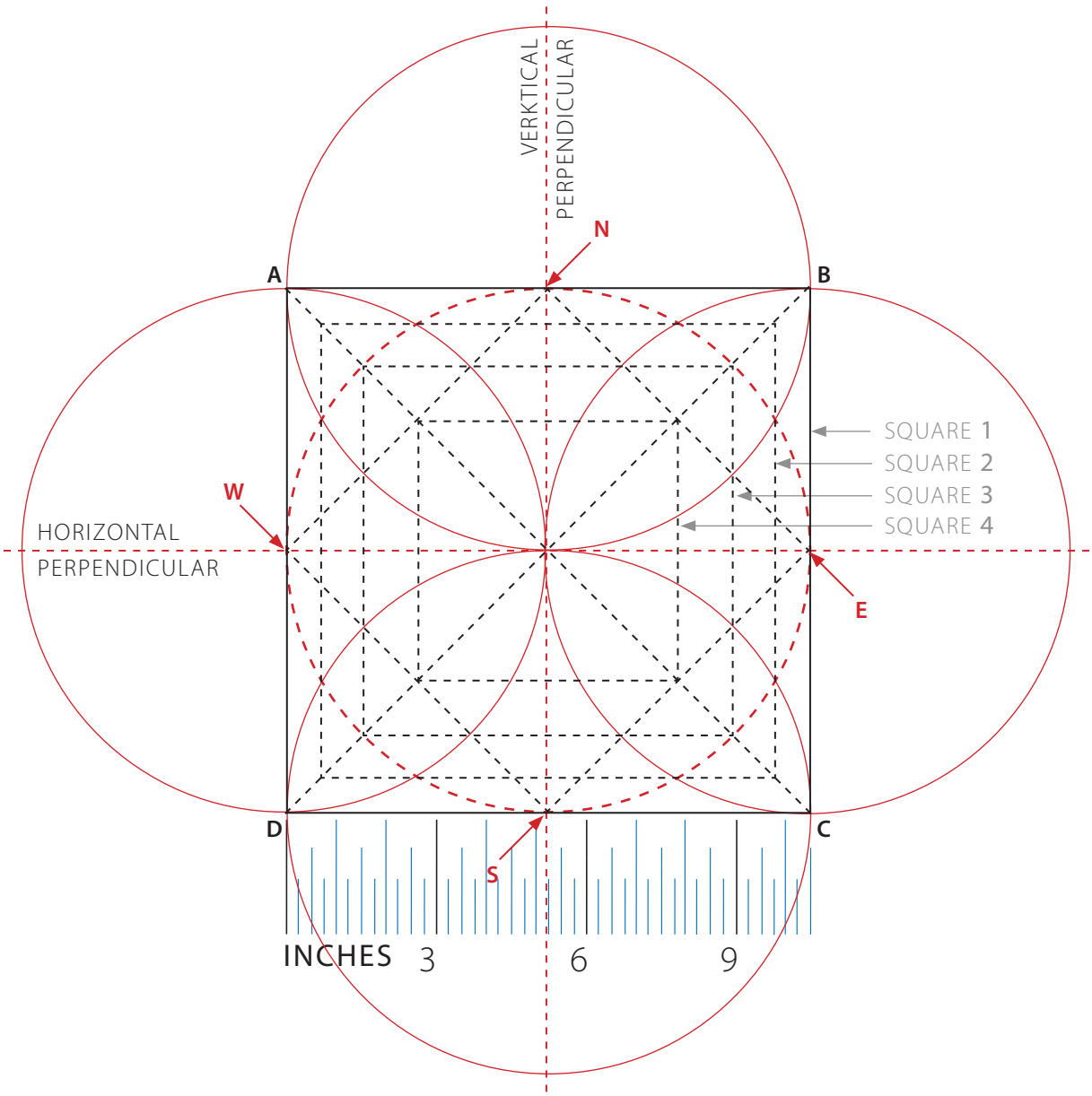
1 The primary circle is drawn from the intersection of horizontal and vertical perpendiculars.
2 Four outer circles of identical radius are drawn from the primary circle's poles, N S E and W.
3 The black square is drawn between the intersections of the four outer circles.
4 The outer circles cut the primary circle at points, A B C D E F G and H
5 A smaller, inner square is drawn through AB, CD, EF and GH
6 The distance between the two squares = the maximum timber dimension.
7 The maximum timber dimension = the square's four corner posts (shown as black squares). The posts are 10½ inches square in section.



Appleton Octagonal Pavilion Dimensions Timber dimensioning 2

Establishing an initial post section from the same geometry as the frame.
The drawing shows the second stage of the frame plan, eight posts (four black and four red) at the corners of an octagon. The octagon footprint is shown as a blue tone ~

1 A new circle (in dashed black line) is drawn through the post corners at A B C and D.
2 The new circle cuts the horizontal and vertical perpendiculars at N S E and W.
3 The red square is drawn between N S E and W to overlap the black square.
4 The red square posts are constructed identically to the black square posts (see previous page)
5 The full width of the red square is just under 17 feet 10 inches.
6 The distance across the red post diagonal is 1 foot 3 inches.

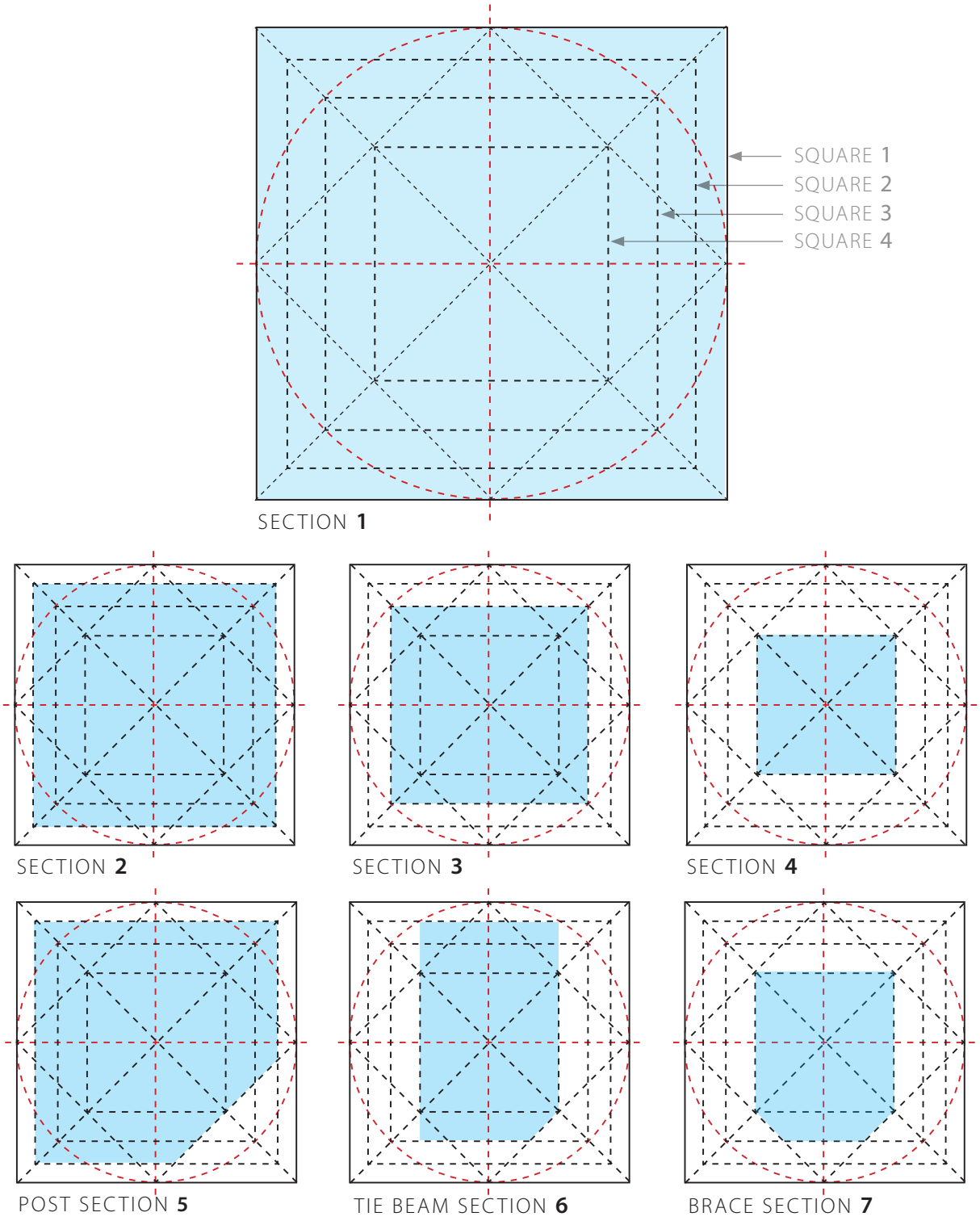


Appleton Octagonal Pavilion Dimensions Timber dimensioning 3

A range of diminishing square timber sections can be derived from the initial geometrical post section ~

1 The primary circle (in dashed red line) is drawn from the intersection of horizontal and vertical perpendiculars.
2 Four outer circles of identical radius are drawn from the central circle's poles N E S and W.
3 The largest square is drawn between the intersections of the four outer circles at A B C and D.
4 Diagonals AC and BD and the whirling square N S E W form a geometrical grid.
5 A series of harmonically related diminishing squares can be drawn using the grid.
6 The diminishing squares and diagonals give potential timber sections. FromABCD inwards, the four square sections are ~

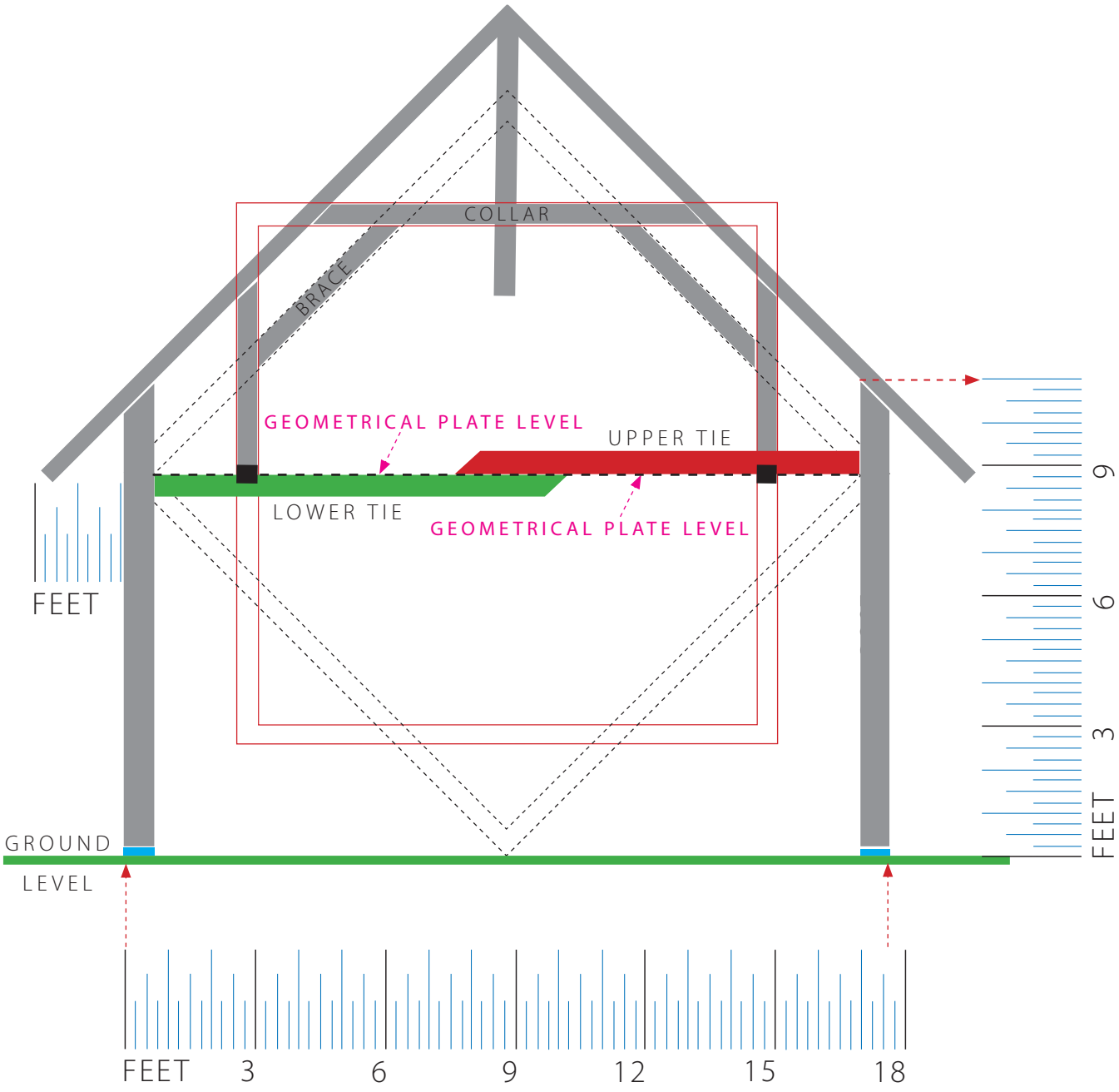
1 = 10½ inches **2** = $9^{1}/_{8}$ inches **3** = $7^{3}/_{8}$ inches **4** = 5¼ inches



Appleton Octagonal Pavilion Dimensions Timber dimensioning 4

A range of plain and chamfered potential timber sections can be derived from the initial post section and grid (there are many others).

NOTE If timber of this scale is not available (or necessary) the same geometrical sections can be drawn from the largest timber size available so that we have related proportions.

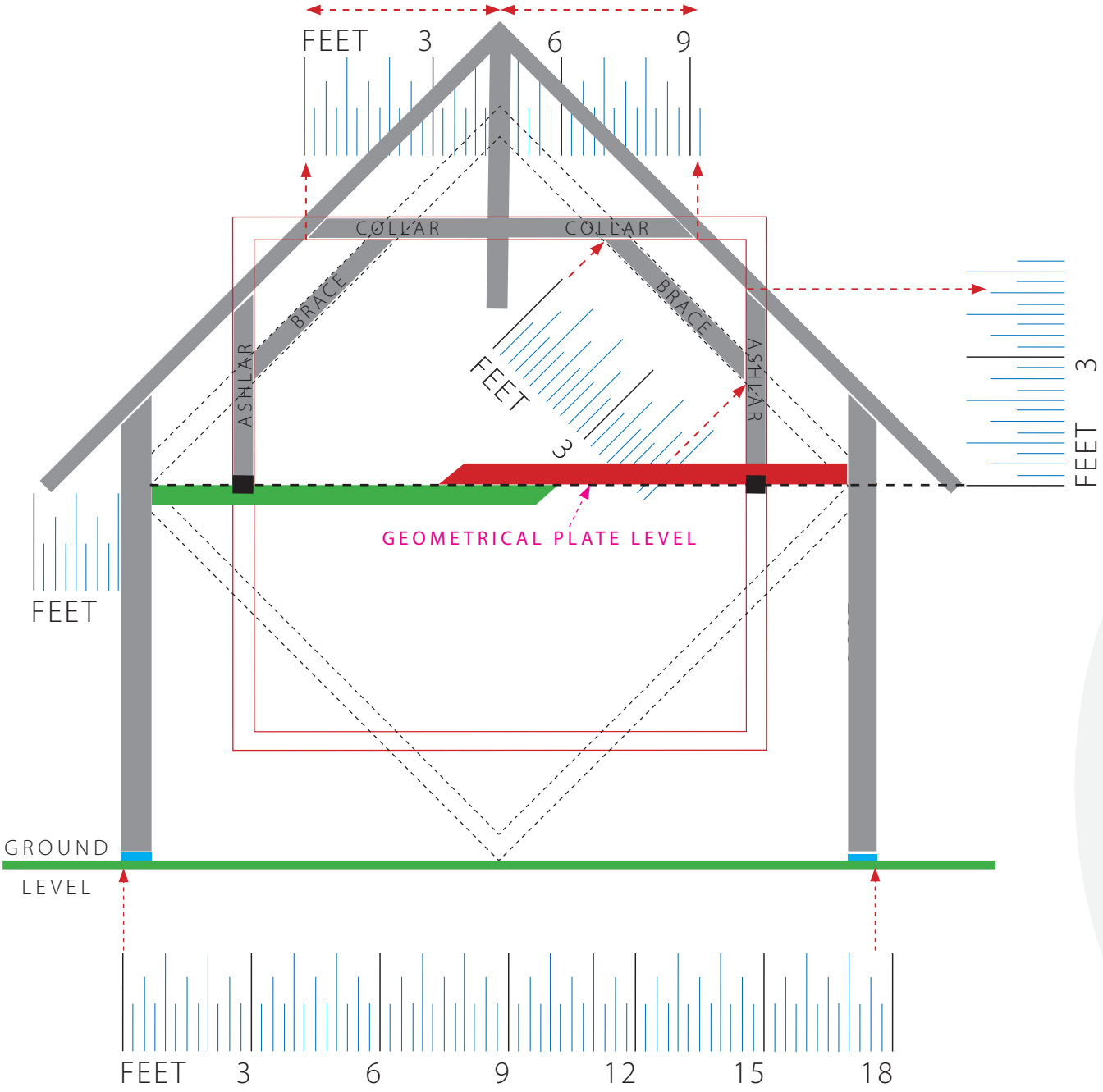


Appleton Octagonal Pavilion Timber dimensioning 5

Using the geometry and rule to give timber lengths ~

The eight octagon posts are 11 feet from ground level to roof pitch. The dimension makes NO allowance for joints.

NOTE The upper and lower tie beams share a common geometrical plate level so that in terms of real timber the upper ties rest on the lower ties where they pass across them. Rick and I discussed alternatives such as halving the tie beams where they pass each other but decided to retain the maximum strength of the timbers by keeping them intact.

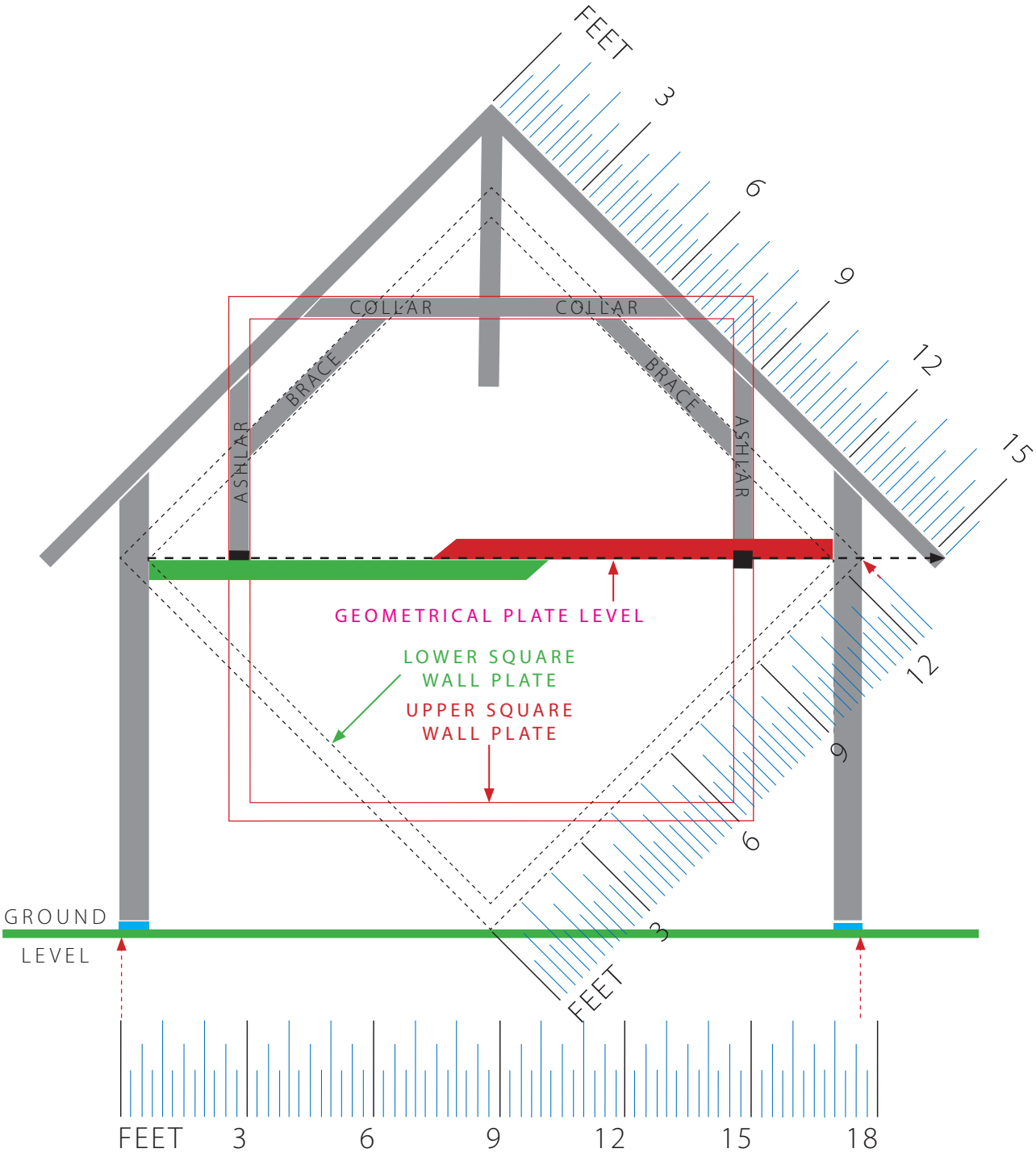


Appleton Octagonal Pavilion Timber dimensioning 6

Using the geometry and rule to give timber lengths ~

The eight octagon ashlar posts are 4 feet 6 inches from the common geometrical plate level to the roof pitch.
The eight braces are 4 feet 9 inches from ashlar to collar.
The collars are 4 feet 9 inches rom the centre post to the principals (the same as the ashlar posts).
The dimensions make NO allowance for joints.

NOTE The four ashlar posts rising from the upper square (shown in red tone) are shorter than the four rising from the lower square (shown in green tone) by the depth of the tie beam section.



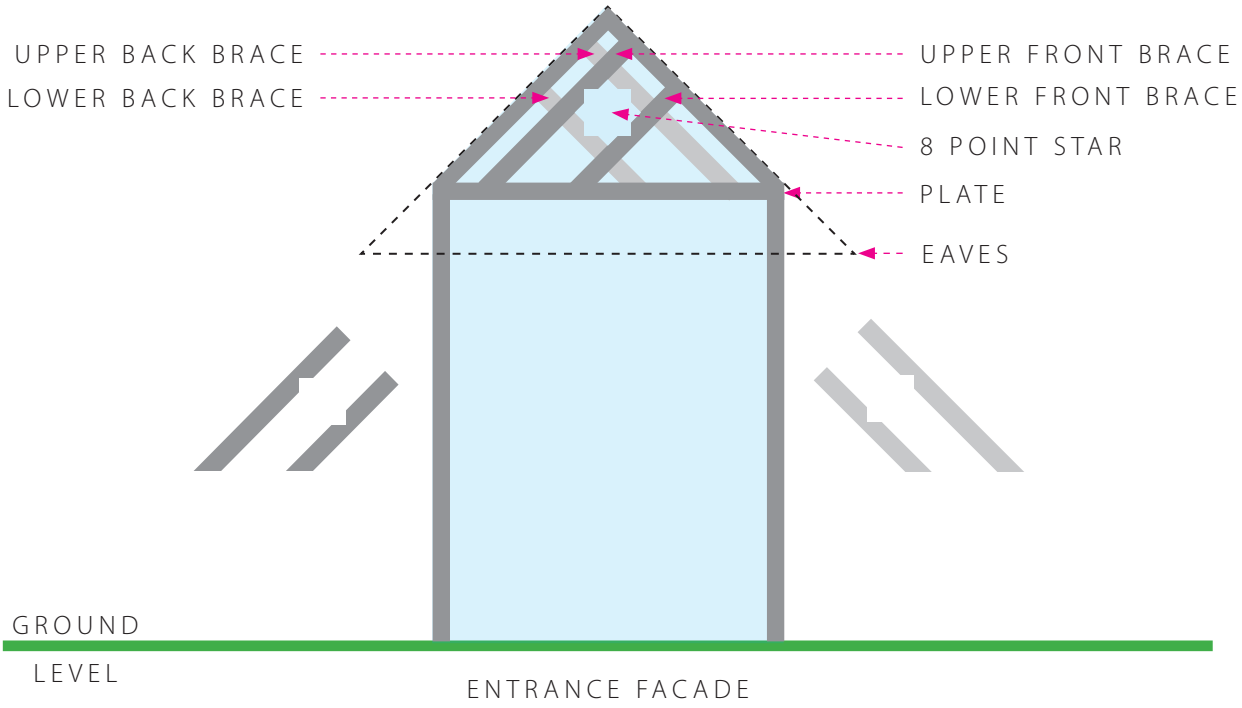
Appleton Octagonal Pavilion Timber dimensioning 7

Using the geometry and rule to give timber lengths ~

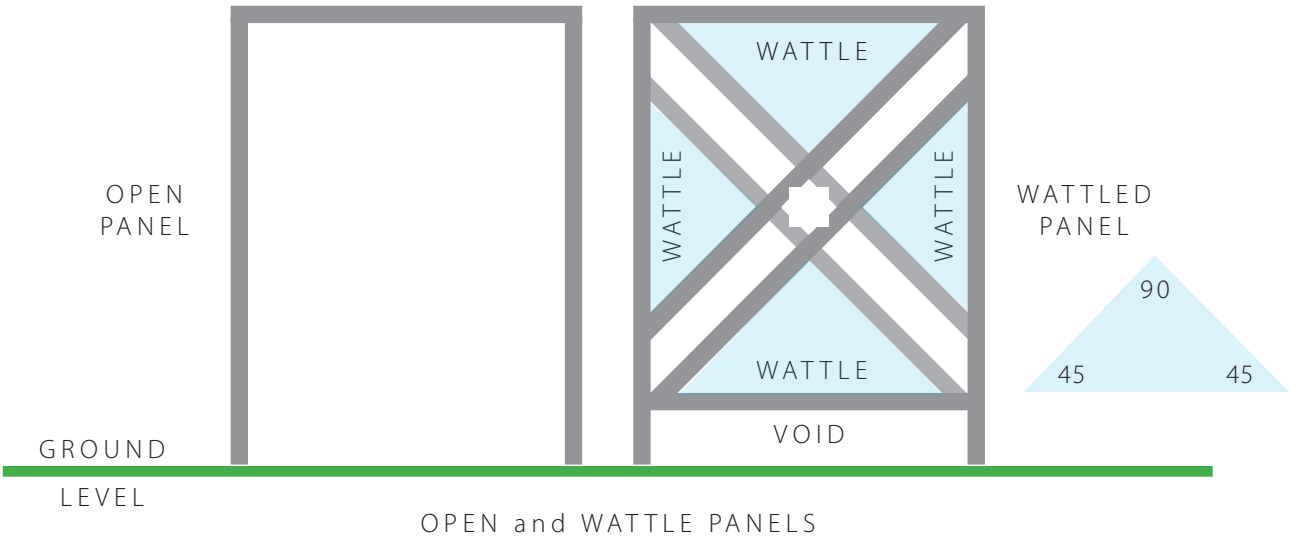
The eight octagon principal rafters are 15 feet 4 inches in length from the ridge to the eaves geometrical plate level. The upper and lower square wall plates are 12 feet 6 inches long on all four sides. The dimensions make NO allowance for joints at the corner posts.

NOTE There is NO section suggested for the principals.

NOTE 2 Around this stage in the design Rick and I decided that all timbers would be left in their cut sections except for the octagonal centrepin.



ENTRANCE FACADE

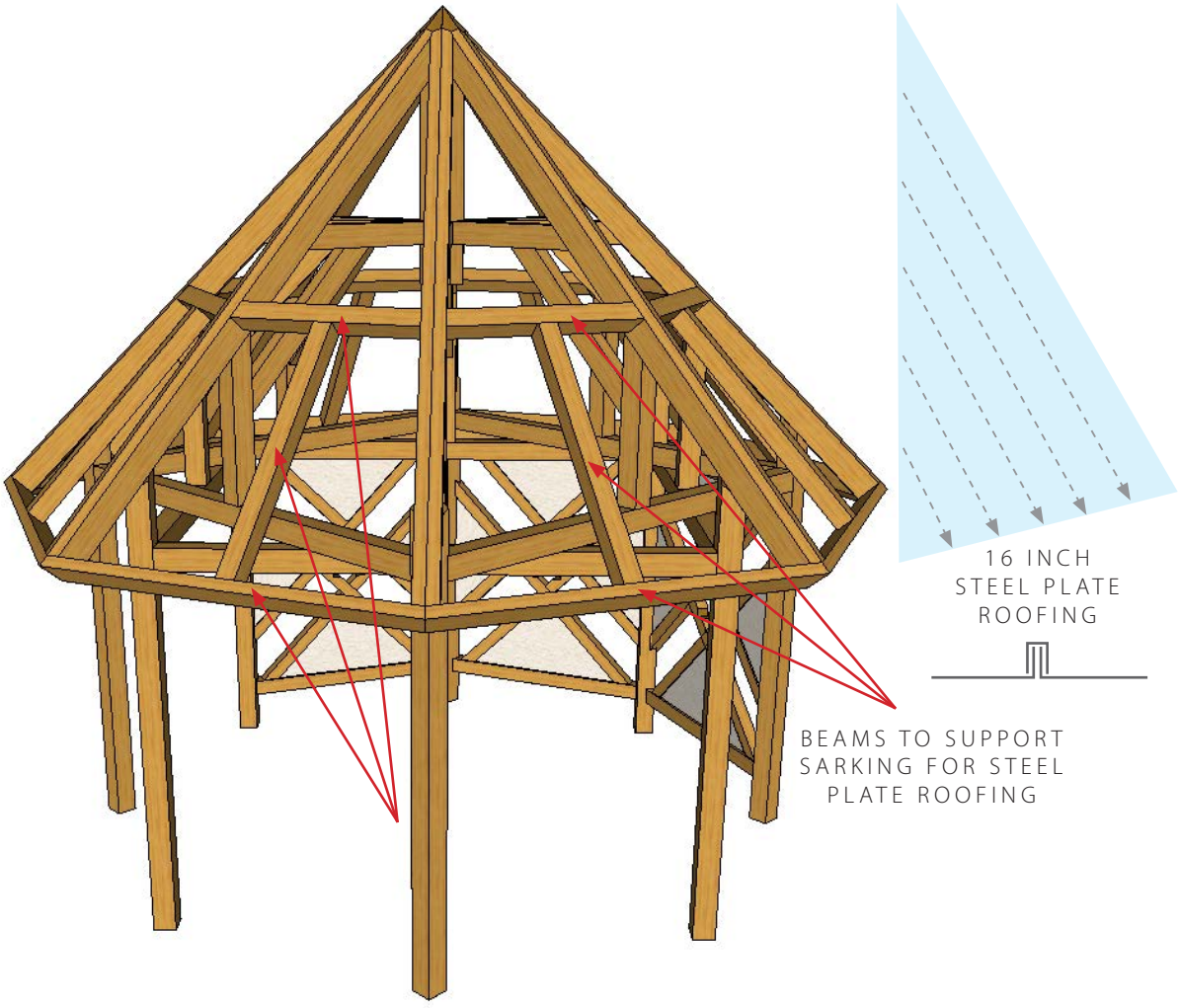


OPEN and WATTLE PANELS

Appleton Octagonal Pavilion Bracing and wattling

I decided that the braces in the porch gable should be joined into the front and rear halves of the plate so that they passed diagonally between the porch wall plate and principal rafters. V notches, cut into the face of each timber, combine with the angles between the timbers to form an 8-point star, a visual focus as the pavilion is approached.

The lower drawing shows the frame's side panels, either plain or braced by passing diagonals. Because of their greater section and strength the braces are halved where they pass and V notched to form octagonal stars. The configuration generates triangular panels suitable for woven wattle though, in the pavilion's final form the wattling was ommitted. Braced and open panels alternate around the frame.



Appleton Octagonal Pavilion Computer Visualisations

Around this stage in the design Rick or perhaps Joe Miller of Fire Tower Engineered Timber, Inc. of Providence, Rhode Island provided computer visualisations of the pavilion. Joe was one of the project tutors.

The perspective of the pavilion shows the original configuration of three wattle panels on the right and additional timbers in the roof planes to support sarking boards which, in turn, would support the steel plate roofing. In the final construction these additional timbers were ommitted and replaced by heavier section sarking. This eliminated some unnecessary timber and carpentry, saved time and brought a simpler, more elegant resolution to the interior of the roof.

Within each octagon roof triangle, shown in blue tone, the steel plates would run parallel to one edge of the triangle, as shown by the dashed grey lines in the right hand drawing. The perspective makes clear the passing of the main tie beams in a ring around the outer boundary of the frame, a configuration that keeps the centre of the frame clear between ground level and the principal rafters in the form of an octagonal dome.

Geometrical Weekend Rendezvous

HOSTED BY TRILLIUM DELL TIMBERWORKS

June 21 & 22 2014 : Knoxville Illinois

Free camping & facilities. Meal tickets available for purchase.

This two-day rendezvous/raising is OPEN TO ALL, and is being held in conjunction with:

Geometrical Building Design Intensive

TAUGHT BY LAURIE SMITH & RICK COLLINS

June 14–22 2014

Follow a geometrically designed octagonal hardwood frame from start (a pair of dividers) to finish (an open air pavilion for the community of Knoxville)... Expand your knowledge of medieval frame design, compound roofs & hand tools.

ABOUT THE INSTRUCTORS:

SPECIAL GUEST FROM THE U.K.- LAURIE SMITH will lead the study of geometrical methods commonly used to design, layout, and build historic structures- and their components. Laurie Smith is an independent early-building researcher, specializing in geometrical design systems commonly used from the medieval period to the turn of the century. His study is focused on medieval structures where he lives in England and Wales. Laurie lectures and writes extensively on his findings. He also runs practical workshops on geometrical design. In 2009 and 2010, he designed structures for, and taught at TFG events in MA and CO.

RICK COLLINS (Journeyworker/ owner Trillium Dell Timberworks) will teach cutting, tooling approaches and techniques using both hand and power tools. Rick Collins founded Trillium Dell in 1996. He has intensively studied the methods and tooling used by Europeans who settled the Midwest from the 1600s through the 1800s. These studies have led him to travel throughout the US and Europe over the last two decades, and offered the opportunity to work and learn with some of the greatest master builders, craftspeople, and building historians in both continents.

$1500 tuition includes lodging (bunks & camping), fantastic meals & supplies.
Scholarships available upon review.
Limited spaces – Please submit resume or cv today.
Contact Nicole Collins: nicole@trilliumdell.com

Reality appears over the Western Horizon Advertising and Enrolment

Trans-Atlantic correspondence was coming to a conclusion: Rick and Nicole were advertising the project, above. ESTA forms (Electronic System for Travel Authorisation) were completed and approved and flights booked. Two tick box questions on the ESTA form left me baffled ~

Are you applying to enter the United States in order to carry out espionage?
Are you applying to enter the United States to carry out an act of terrorism?

Well, terrorism since you ask, but only after I've completed my espionage!

Appleton Octagonal Pavilion Setting out

Inside one of Trillium Dell's workshops, the upper photograph foreground shows the two overlapped squares of an octagon star marked out from perpendicular centre lines. A second star is being laid out in the background. The chalk lines are sprayed with acetate for durability.

The lower photograph shows members of the team standing at the star's angles, excatly where the pavilion's posts will stand, to give a first sense of the pavilion's internal scale. Nicole Collins is nearest the camera.

Appleton Octagonal Pavilion Laying up 1

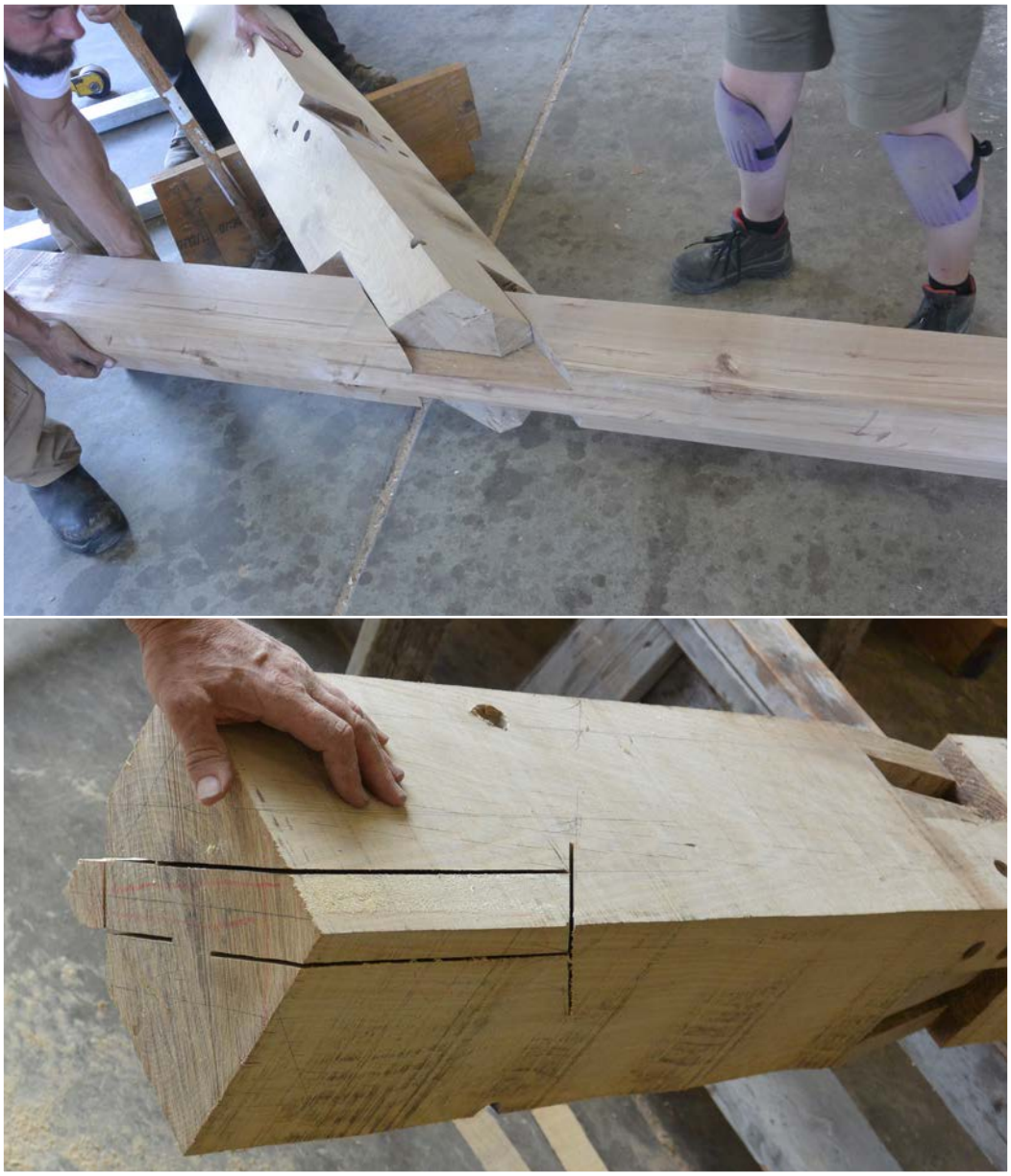
The upper photograph shows a layup of two posts, set on their diagonals to left and right, and two principal rafters. The posts are set diagonally because the principals will be jointed through them diagonally. A gap is left between the principals and collars at the centre to allow for the centrepin. The first ashlar piece is laid up on the left.

The lower photograph shows an angle brace on the left, ready for levelling and scribing.

Appleton Octagonal Pavilion Laying up 2

The upper photograph shows the levelling of a tie beam between two posts prior to scribing for cutting. The posts are set square because the tie beam forms one side of a square frame of four posts liked by ties.

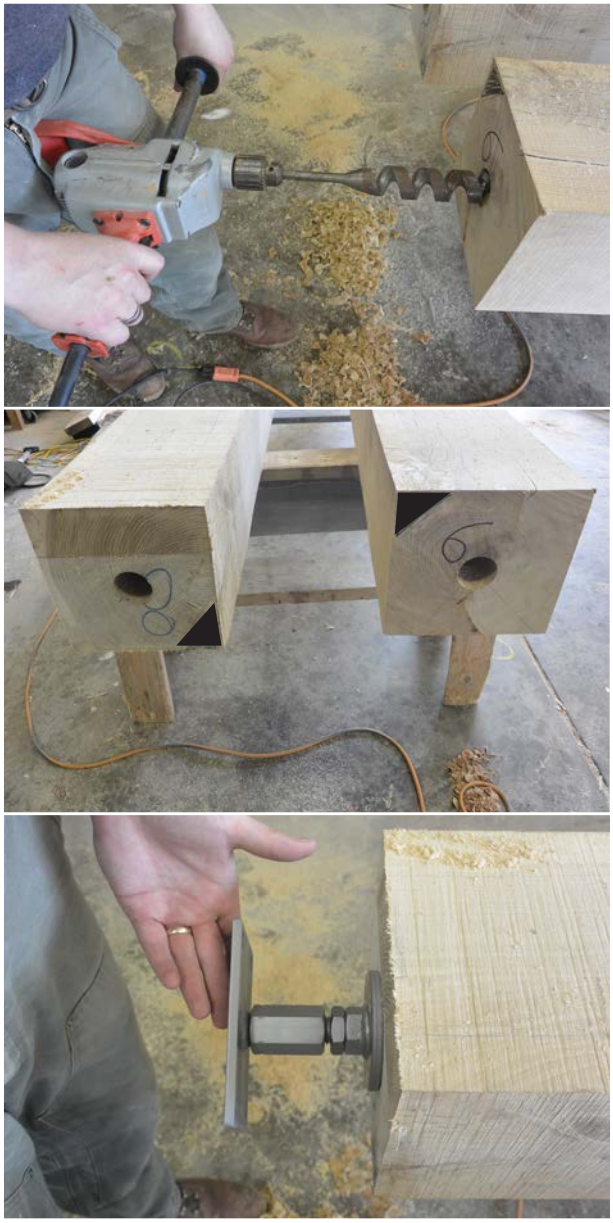
The lower photograph shows the housed mortices for fitting two adjacent tie beams on two sides of the square. The peg holes are drilled to avoid collisions between the pegs. The chalk lines marking the outer edge of the mortices have been overdrawn in red line for clarity.



Appleton Octagonal Pavilion Post and Principal Rafter

The upper photograph shows a principal rafter being test fitted into a post head open mortice.

The lower photograph shows preliminary circular saw cuts on the way to the post head's open mortice. The housed tie beam mortices can be seen on the right edge of the image.

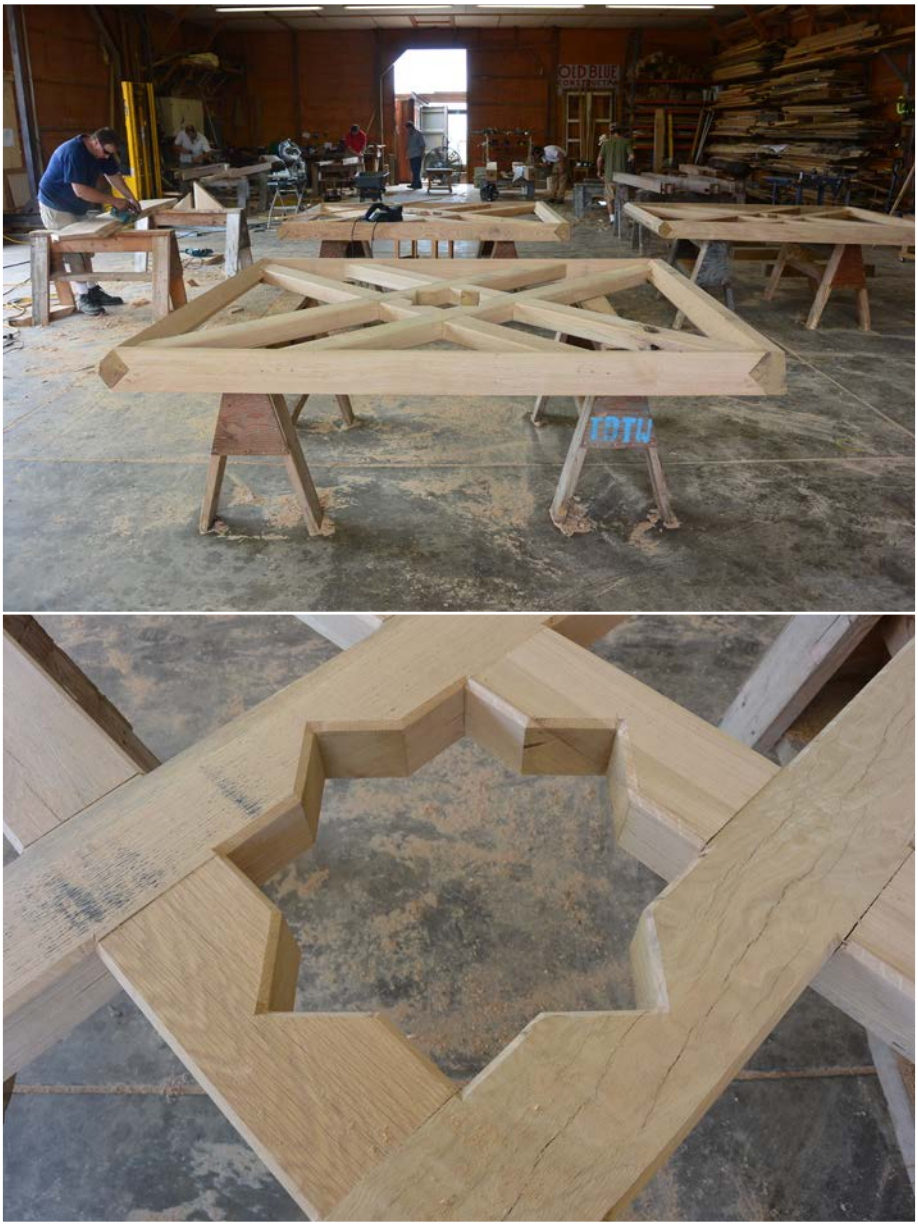


Appleton Octagonal Pavilion Post fixings

The upper photograph shows the foot of a post being drilled to take a stainless stell fitting to anchor the foot when the frame is erected in its final position.

Each of the 8 posts is numbered. The central photograph shows posts 6 and 8 after drilling with the outer face corner of the octagon marked by a triangle (the triangles are emphasised in this image).

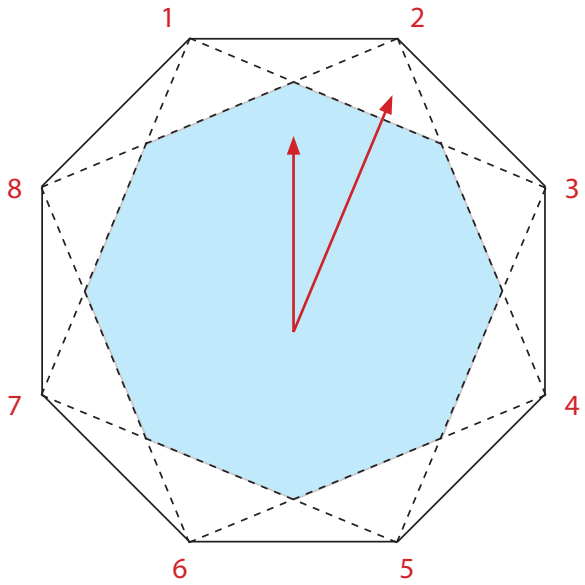
The lower photograph shows a stainless steel fitting installed. The fitting can be adjusted for height to keep all the post feet level on site.



Appleton Octagonal Pavilion Cross-braced panels

The upper photograph shows three braced panels cut and assembled on trestles in the workshop reday for installation in the frame after it is raised. The panels are designed to locate between the posts leaving a foot or so of clear space above ground level.

The lower photograph shows the central element of the frame where the four notched timbers intersect each other to form an octagon star, the visual focus of the panel. The star is formed from two overlapped squares, exactly the same format as the posts and tie beams.



Appleton Octagonal Pavilion The Centrepin 1

The upper left image shows the centrepin after scribing and cutting, the central image shows the lower end of the pin in close up and the right hand image shows the upper apex termination where the principal rafters meet. Rick had reserved a 10 inch square beam of walnut specifically for the centrepin and this valuable timber's colour and grain can be seen in both images. The left image also shows three of the eight mortices for locating the collars and, above them the diminishment of the pin's section.

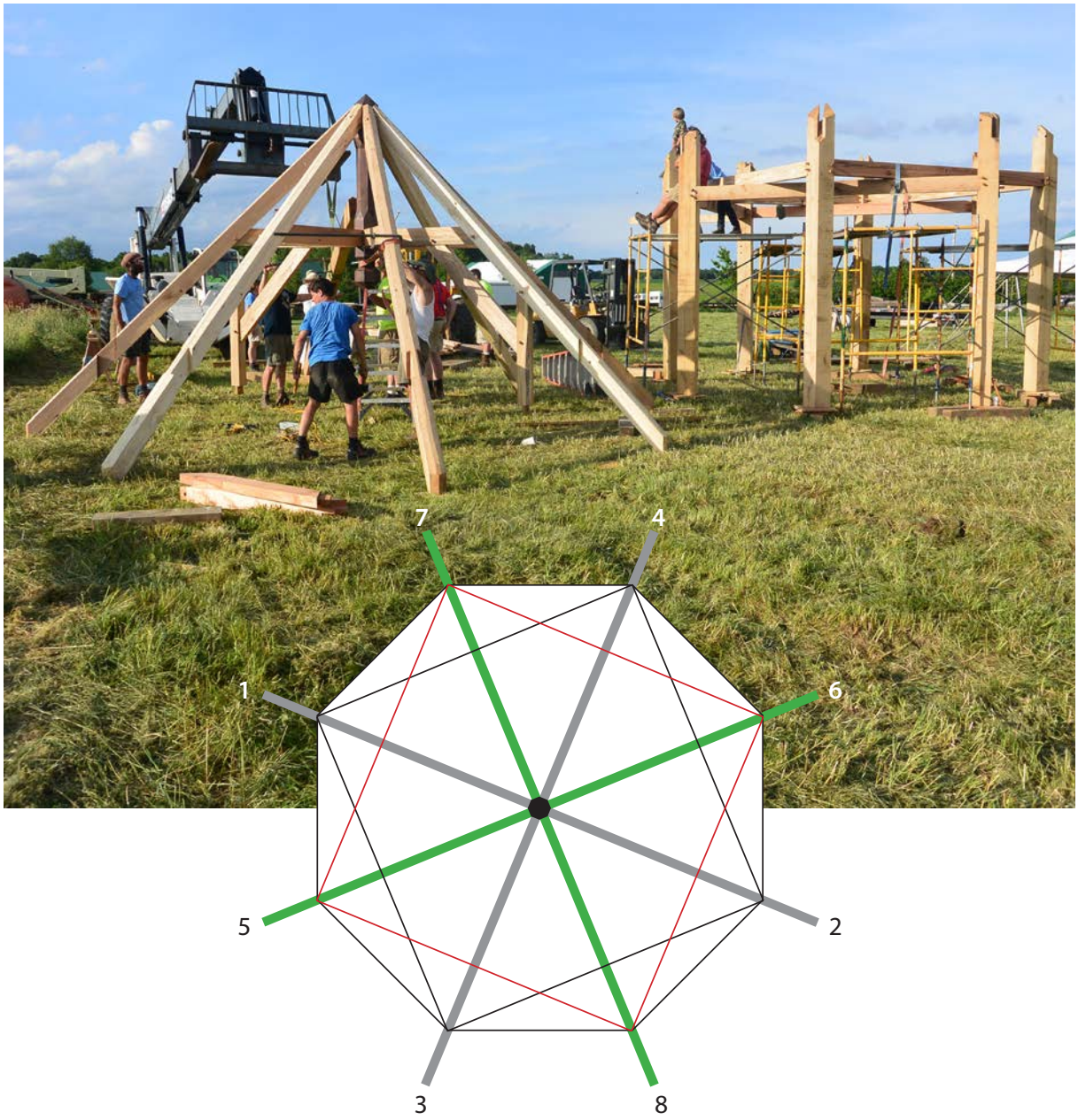
The lower diagram shows the geometry of the pin's two sections, numbers 1 to 8 indicating the outer section. The inner section, in blue tone, is scribed and cut according to the diagram with saw cuts between every second point, 1 to 3, 2 to 4, 3 to 5 and so on around the pin. The larger and smaller sections have different orientations, as indicated by the red arrows from the pin's axis, and are linked by opposing triangles.

Appleton Octagonal Pavilion The Centrepin 2

The transition between the centrepin's larger and smaller octagonal boundaries can be seen clearly in this photograph as rings of alternating triangles. In this image the pin is upside down with the finial shown in the previous photographs just beyond the mortices for the collars at top of the image. The principal rafters meet the pin just below the base of the photograph. It can be seen that the pin has its larger boundary exactly where other timbers are jointed to it and its smaller boundary in the sector linking the two jointed sectors. This cuts down the weight of the pin without any loss in mechanical strength but also, importantly, gives it a lighter and more elegant visual character at the centre of the roof. The scribing and cutting of the pin, which required great precision, was the single most time consuming element of the project's carpentry

Appleton Octagonal Pavilion Raising the Posts

The eight posts were raised in two groups of four, to form squares 1 3 5 7 and 2 4 6 8. The lower of the tie beam squares were pegged together first so that they gave support to the upper tie beams as they were fitted and pegged in place. Once the principal rafters are in place the posts will stand slightly inside the outer boundary of the pavilion. The feet are are supported on offcuts to establish a level.



Appleton Octagonal Pavilion Raising the Principal Rafters 1

The eight principal rafters were pegged to their collars and then raised in diagonal pairs in relation to the octagonal geometry, with diagonal 1 - 2 first and then diagonal 3 - 4 at right angles to it. The centrepin was supported in a vertical position by Rick's TEREX crane to enable the pegging of the principals and collars. The remaining four principals were similarly connected in the numerical order shown. The diagonal assembly and numerical order kept the roof frame in balance.

Once the principals and collars were pegged to the centrepin the small, vertical ashlar posts and braces were added to complete the roof frame.

NOTE Collars 1 2 3 and 4 were secured to the centrepin by concealed steel bolts. The bolts run through the centrepin with washers and nuts recessed in the collars at either side.

Appleton Octagonal Pavilion Raising the Principal Rafters 2

Once the roof frame was assembled on the gound and all pegs were in place it was lifted in its entirety by Rick's TEREX crane. The white arrows in the photograph indicate the tenons at the lower end of the small, vertical ashlar posts which will fit the mortices in the tie beam squares. The ashlar posts are in two lengths in order to fit the two levels of the tie beams.

Appleton Octagonal Pavilion Raising the Principal Rafters 3

The photograph shows Rick manoeuvring the roof assembly into position with the principals slipping into their post mortices and the small, vertical ashlar posts fitting into their mortices in the tie beams.

The porch assembly can be seen at the front of the frame, awaiting its own roof structure. The two square section tie beams, indicated by white arrows, are chamfered with triangles on their front corners to generate octagonal ends.

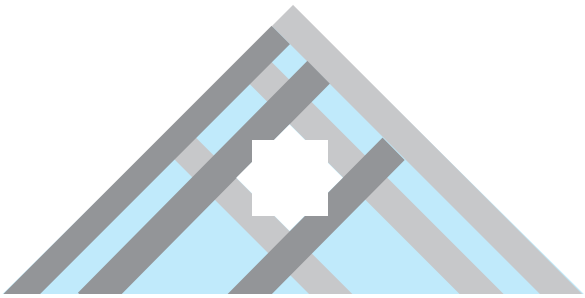
Appleton Octagonal Pavilion Centrepin

With the frame raised the function of the centrepin as the core of the roof framing becomes evident, each of its eight faces connected to a principal rafter at its head and a collar just above the base. The base itself is terminated with a multi-faceted octagonal form. The photograph clearly shows the geometrical relationship between the main octagonal boundary, marked by the red arrow, and the narrower sector between the peak and the collars, indicated by the black arrow.

Appleton Octagonal Pavilion Topping Out

The traditional topping out ceremony usually involved the youngest carpenter in the team climbing to the apex of the frame and nailing in place a sprig of tree in leaf. The tradition was a homage to the trees that had been felled, converted and used to construct the frame and a symbolic re-assembly of the tree.

The ceremony at Trillium Dell was different, the apex approached from above on a cherry-picker controlled by Jordan Finch, one of the project tutors, with myself, Rick's son Liam and Jordan's son Asher along for the ride. Liam and Asher, as the youngest there, hammered in the nail that held the leafy sprig in place. The photograph was taken from the cherry-picker just as light was fading and the artificial lights were illuminating the frame.



Appleton Octagonal Pavilion The Porch

The final element of the structure was the porch. The rafters were bird-mouthed to fit the wall plates and the four notched timbers were pegged into place to form the facade's octagon star, seen above from inside the pavilion frame and, below, in the diagram. The two heavy timbers at the top of the image are each a side of the two overlapped squares that make up the frame's octagon, the upper timber's lower face and the lower timber's upper face sharing the geometrical wall plate level shown in white line.

Appleton Octagonal Pavilion The Pavilion floodlit

The sun set to reveal a deep purple-blue sky, a perfect backdrop to the floodlit pavilion. The intense heat and focussed work of the project gave way to that sense of release when a job is satisfactorily completed. An outstanding detail: the cross-hatched octagon star frame at the centre of the image, above, was one of three so two remained to be fitted.

But meantime it was a moment to relax, drink some of Rick and Nicole's home brew and take stock of our new frame, especially because it would soon be roofed over and would then only be visible internally. For now, the whole structure and it's geometrical logic were open to the eye and the sky.

From a personal point of view it was rewarding to finally see the geometry translated into timber and to see it expressed in both plan and section, the culmination of a long journey made possible by the great team of carpenters working together at Trillium Dell.

Appleton Octagonal Pavilion The Traditional Team Photograph

The final stage of celebration on most timber frames is the team photograph where all, or as many members as possible, climb the frame to face the camera. All names shown are to the left of their vertical line. Asher Finch (son of Jordan Finch) and Liam Collins (son of Rick and Nicole, our hosts) were the boys who nailed on the bough in the topping out ceremony. Absent from the photograph were Bryson Crabtree and Patrick Phillips. Apologies to a few faces that remain anonymous and for a few forgotten surnames. The workshop *mug shots* are shown opposite ~

1 2 3
4 5 6
7 8 9
10 11 12
13 14 15

1 John
2 Will
3 Chris
4 Patrick
5 Kendell
6 Michael
7 Miles
8 Jane
9 Aaron
10 Barbara
11 Joe
12 Brad
13 Kurt
14 Tom
15 Thomas

Appleton Octagonal Pavilion Postscript

Some months after the frame was erected Rick lifted it onto his low loader for transportation to Appleton Community, about three miles down the road and the project was complete. Back in England, looking through the hundreds of photographs brought back special memories. Tutor Jordan Finch's son Asher knocking wedges into the centrepin cuts to keep the saw clear. Thomas showing me his model rhombicuboctahedron with its 8 triangular and 18 square facets (the inspiration for the centrepin's slightly simpler terminal). Rick's son Liam showing me his toad when the frame was being raised. I was pleased with the octagon star bracing. Last but not least, the great hospitality that Hilary (right) and I (left) received from Rick and Nicole and their family was well beyond our expectations.

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