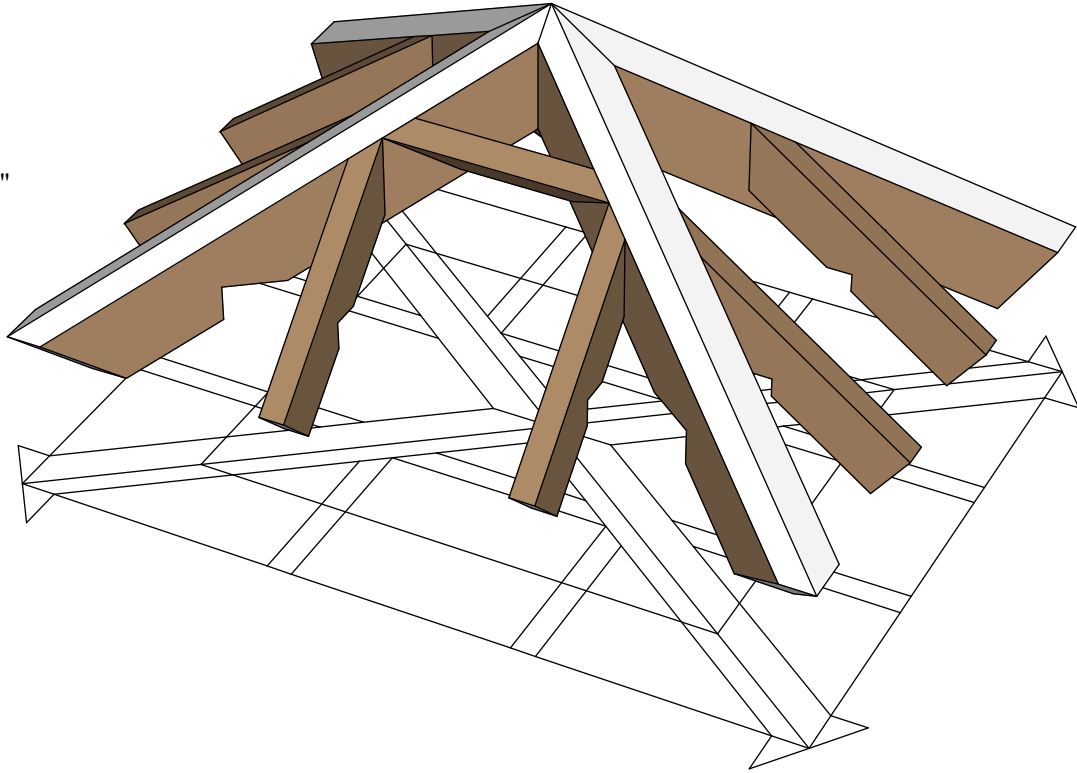


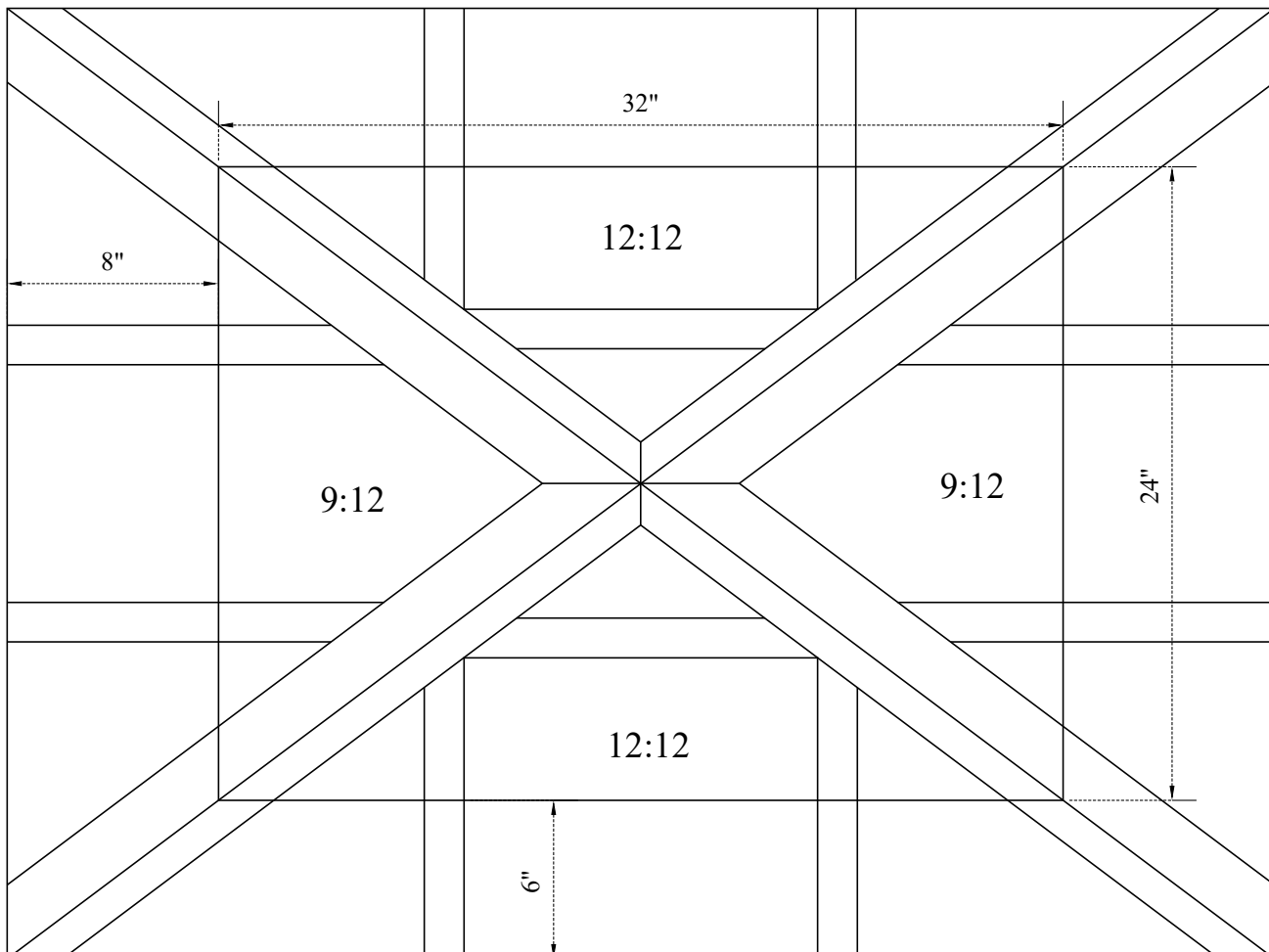
## Level 2 Roof Cutter's Task Model

Each participant is to layout and cut one hip rafter, two jack rafters, and one end of a purlin rafter. There will be four participants that cut and build each task model. Anyone who takes this exam at home must layout and cut all 4 hip rafters, 8 jack rafters and two purlins. Participants must have their instructor verify the rafters have all of the correct layout lines on the rafter before they are allowed to cut the rafter with power tools. Participants taking this exam at home must take pictures of all of their rafters before the rafters are cut. Layout the plan view of this unequal pitched pyramid roof, with square cut rafter tails, on a sheet of plywood 24" x 32". The rafter tails will extend past the sheet of plywood. Participants must print their name, with a felt tip pen, on each rafter.

- Deck Angles = 90°
- Pitch 9:12, 36.869897°
- Pitch 12:12, 45°
- 9:12 Profile Rafter Run = 16"
- 12:12 Profile Rafter Run = 12"
- Rafter Overhang Run on 9:12 side = 8"
- Hip Rafter Material 4x6
- Jack Rafter Material 2x4
- Purlin Rafter Material 2x4
- Rafter Tail Slope = 90°
- HAP = 3 1/2"

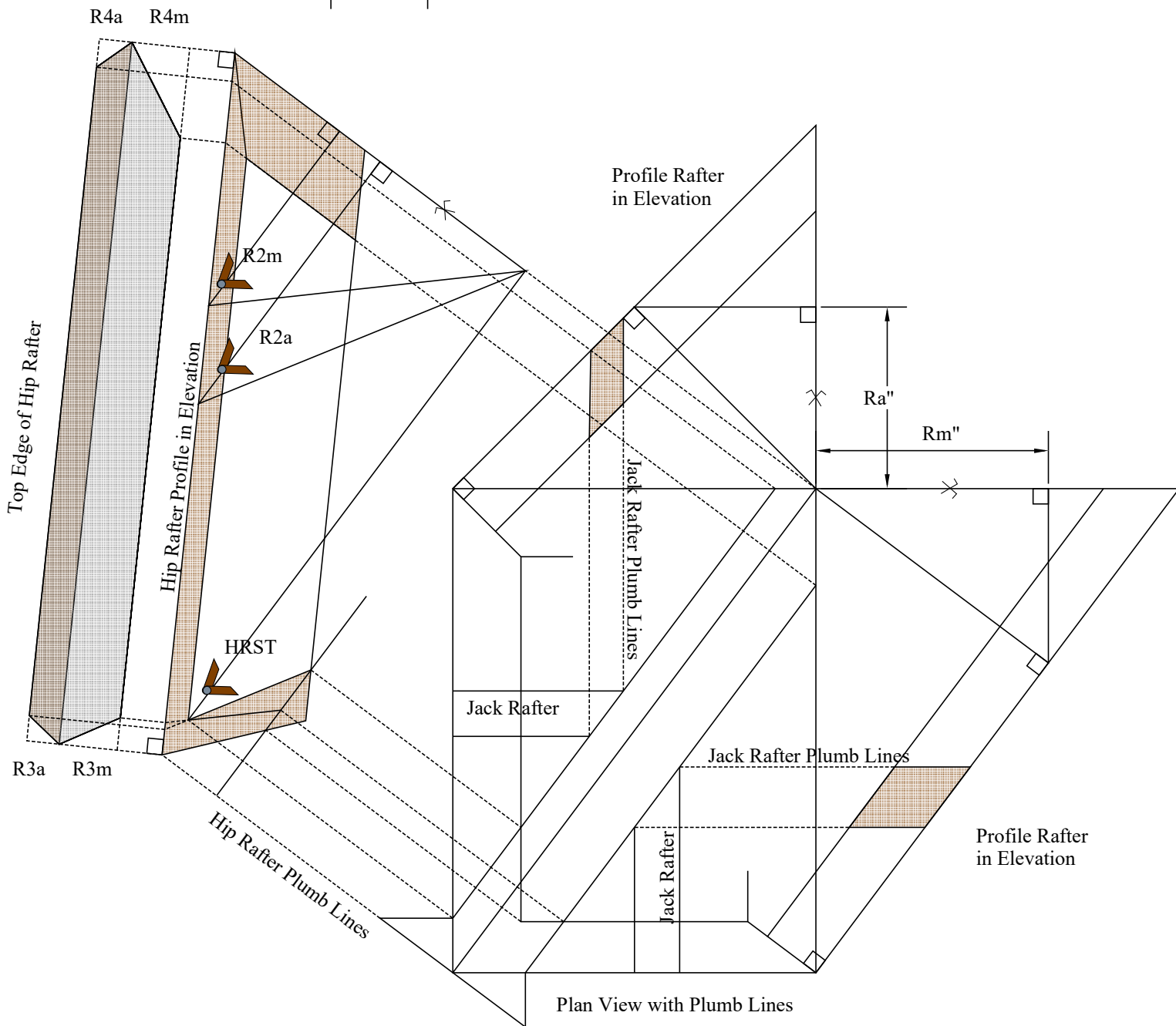
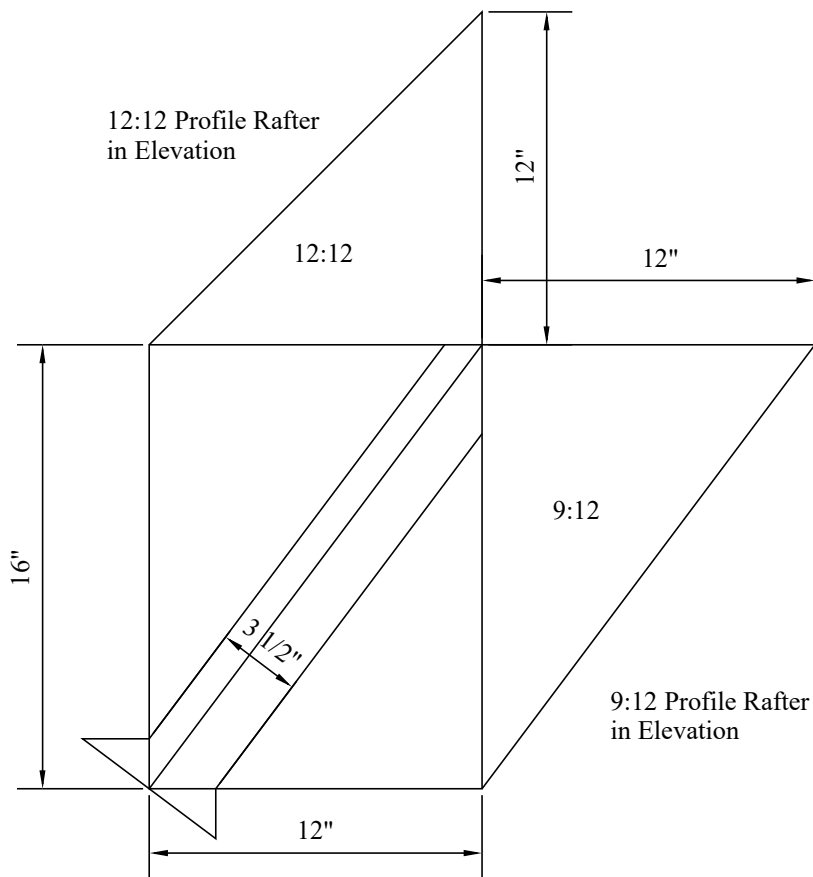
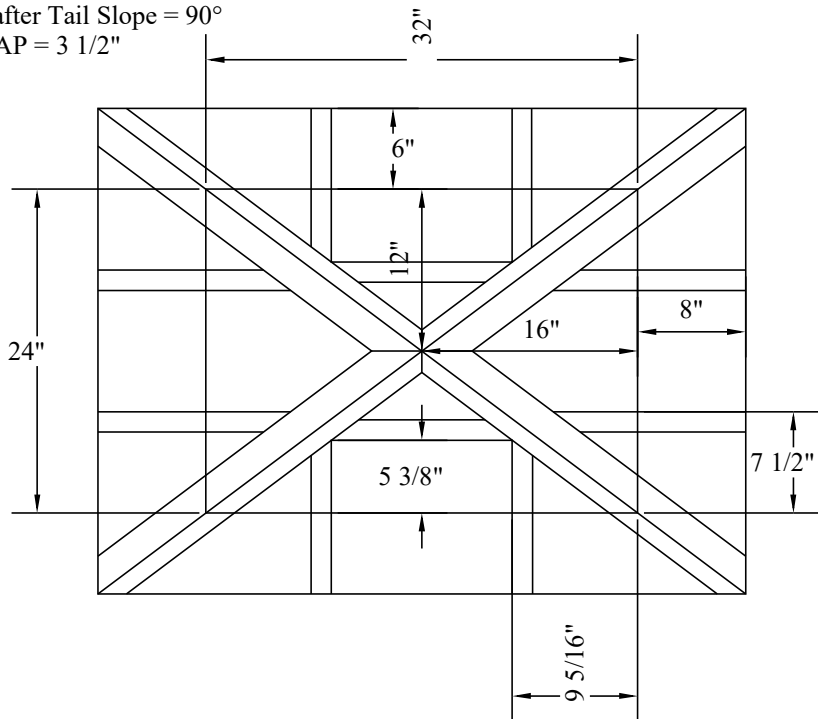


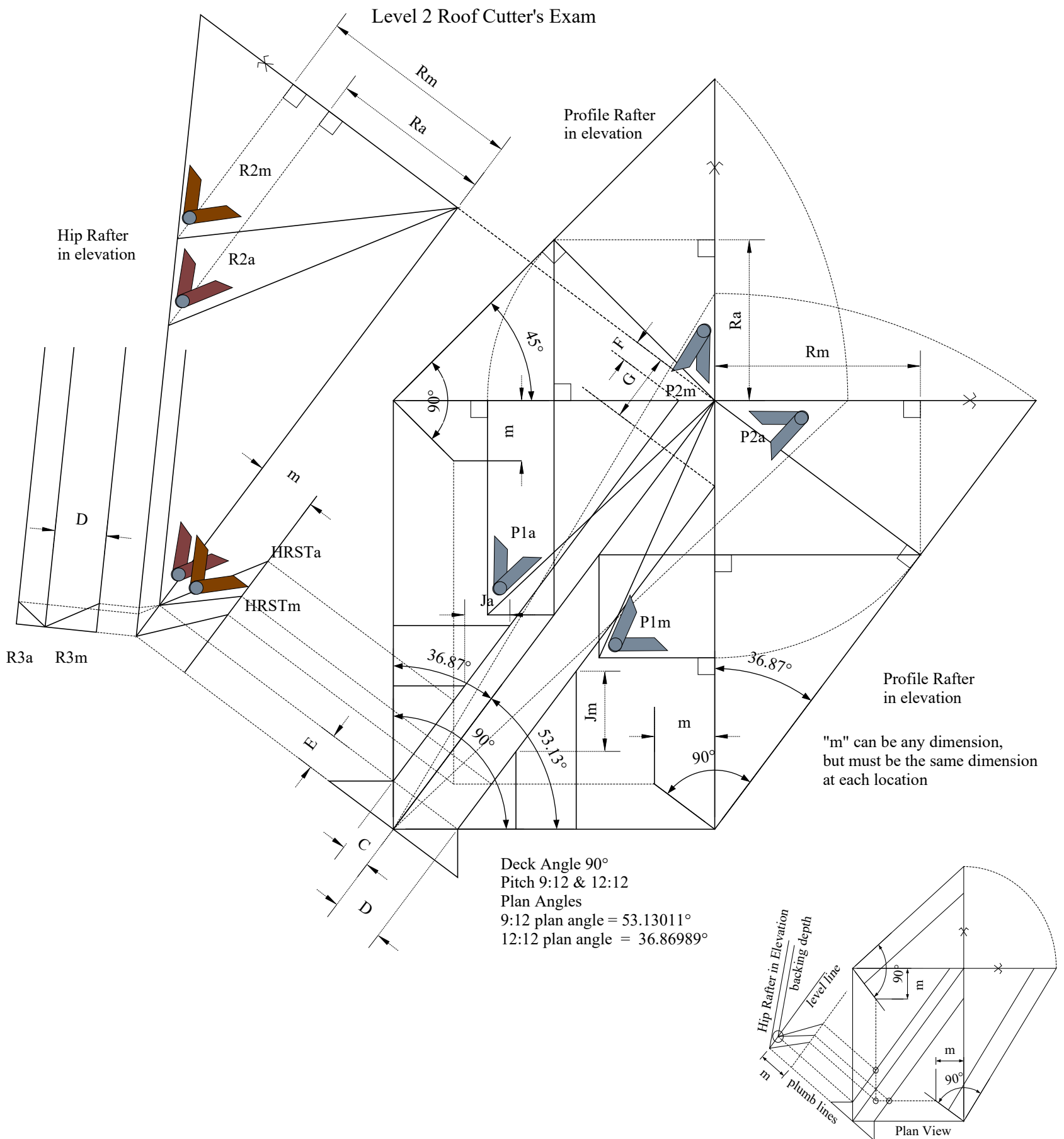
Plan View



Level 2 Roof Cutter's Task Model

Deck Angles = 90°  
 Pitch 9:12, 36.869897°  
 Pitch 12:12, 45°  
 9:12 Profile Rafter Run = 16"  
 12:12 Profile Rafter Run = 12"  
 Rafter Overhang Run on 9:12 side = 8"  
 Hip Rafter Material 4x6  
 Jack Rafter Material 2x4  
 Purlin Rafter Material 2x4  
 Rafter Tail Slope = 90°  
 HAP = 3 1/2"





This drawing is a combination of French art du trait and German Shiften. Start the drawing with a plan view of the hip rafter, drawing the hip rafter shift-offset for equal height shoulders. Then draw the profile rafters in elevation using the same height for the rise of the rafter. Next, draw the hip rafter in elevation using the same rise. The hip rafter purlin housing angles are drawn using the French technique and the hip rafter witches cut on the hip rafter tail is drawn using the German technique. This drawing should be the base for all your geometric roof plans in plan view. The most important part of this drawing are the plumb lines. The drawings do not have to be full scale in length, however the width of the hip rafter and jack rafters must be drawn to the correct width. This drawing is about 48" x 48".

In this geometric drawing the purlin rafter miter angles on the stick-timber are P1m and P1a. The purlin rafter top bevel cut angle can be laid out using the roof sheathing angle P7 or  $90^\circ - P2m$  and  $90^\circ - P2a$ . R2m and R2a are the hip rafter purlin housing angles on the stick-timber. The angles to cut the hip rafter for square tail alignment on the hip rafter, HRSTm and HRSTa, are the same angles as the hip rafter housing angles, because the tails are at  $90^\circ$  to the roof surface plane. You can use either technique to develop the hip rafter square tail alignment angle. However, by developing the plumb lines for HRSTm and HRSTa they develop the hip rafter top bevel angles R3m and R3a on an unbacked hip rafter.

## Level 2 Roof Cutter's Exam

This level 2 roof cutter's compound skills test can be solved with a combination of geometric drawings, trigonometry, framing square, or practical skills. Determine all of the dimensions and angles for this roof from the following information. These exams follow the WorldSkills carpentry competition layout format. The main focus of this exam is transferring plumb line dimensions from a plan view drawing to the timber that automatically develop the top bevel angles on the timber. The hip rafters and jack rafters must be completely laid out, as if you were going to cut the rafters with a handsaw. However, after the rafters are completely laid out you can cut the rafters with a handsaw, draw knife, hand plane or power tools. The hip rafters will have a minimum of 30 layout lines on the rafter. The jack rafter will have a minimum of 16 layout lines. You can use calculators(CMC) or 2D CAD drawings, but no iPhone or Android apps. You must be able to show graphic proof of your plumb line shift calculations. All plumb rafters must be laid-out using plumb lines from a plan view drawing.

The roof in this test is an Irregular hip roof with a deck angle of  $90^\circ$ . The rafter tails will be level at the eave line in the horizontal plane and the rafters will be cut square to the roof surface plane. The hip rafter tails will have the witches cut, to align the hip rafter tail with the common rafter tails of the two different pitches. The hip rafter will be edge beveled and be offset at the intersection of the eave line to allow for equal height shoulders on each side of the hip rafter for roof plane alignment.

Deck Corner Angle =  $90^\circ$

Main Pitch 9:12

Adjacent Pitch 12:12

Plan View building dimension are 21' - 0" x 19' - 0"

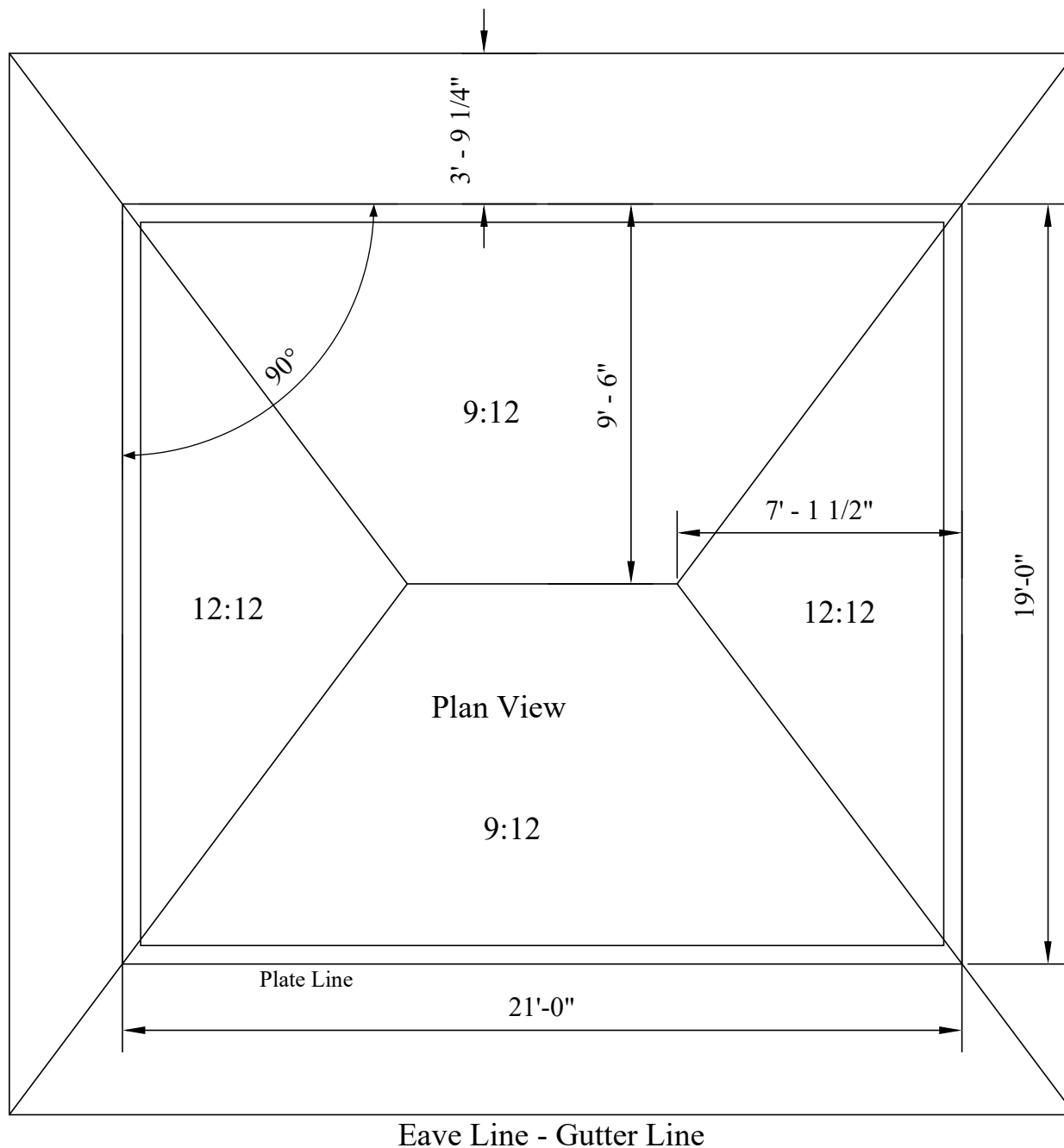
Overhang run of 3' - 9 1/4" for the main 9:12 Pitch

Hip Rafter width = 8"

Jack Rafter 6" x 10"

Jack Rafter spacing is 19.2" on center from the corner of the plate line.

Height above plate for the common rafters will be 8 1/4"



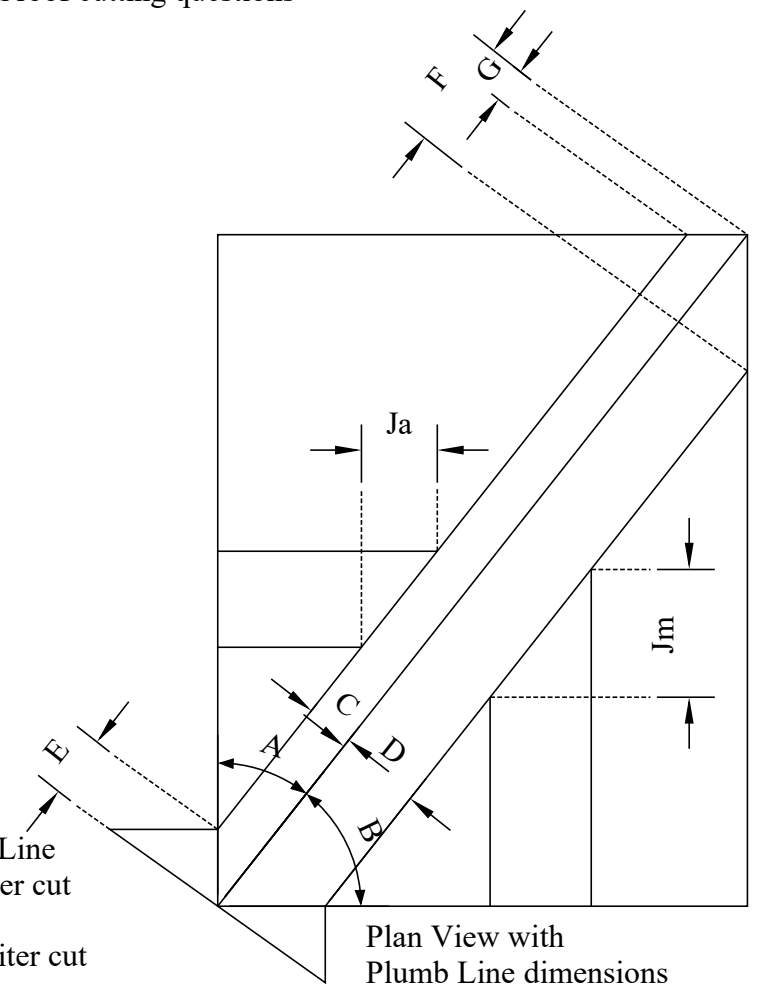
Level 2 Roof Cutter's Exam Questions

Provide dimensions or angles to these Level 2 Roof Cutter's Exam roof cutting questions

- Plan Angle A
- Plan Angle B
- Hip Rafter Slope Angle and Framing Square Usage
- Main 9:12 Common Rafter Length to theoretical Ridge Line
- Main 9:12 Overhang Rafter Length
- Adjacent 12:12 Common Rafter Length to theoretical Ridge Line
- Adjacent 12:12 Overhang Rafter Length

- Hip Rafter Length to theoretical Ridge Line
- Hip Rafter Overhang Length
- Main 9:12 Hip Rafter Backing Angle
- Adjacent 12:12 Hip Rafter Backing Angle
- Hip Rafter Backing Depth
- Hip Rafter Offset Dimension C
- Hip Rafter Offset Dimension D
- Hip Rafter Plumb Line Shift Dimension E
- Hip Rafter Plumb Line Shift Dimension F
- Hip Rafter Plumb Line Shift Dimension G

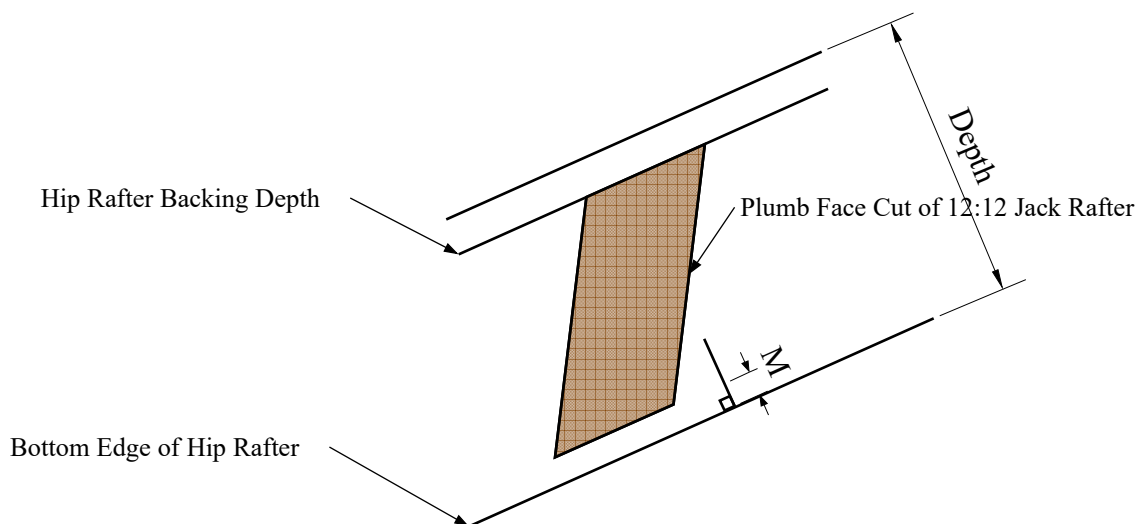
- Jack Rafter Plumb Line Shift Dimension Jm
- Jack Rafter Saw Blade Bevel Angle to Cut Main 9:12 Miter Line
- Jack Rafter Plumb Line Shift Dimension Ja
- Jack Rafter Saw Blade Bevel Angle to Cut Adjacent 12:12 Miter Line
- Length of First Jack Rafter for the 9:12 Pitch to short point of miter cut
- Jack Rafter Length Difference for the 9:12 Pitch
- Length of First Jack Rafter for the 12:12 Pitch to short point of miter cut
- Jack Rafter Length Difference for the 12:12 Pitch
- Jack Rafter Layout Dimension on Hip Rafter for 9:12 Pitch
- Jack Rafter Layout Dimension on Hip Rafter for 12:12 Pitch



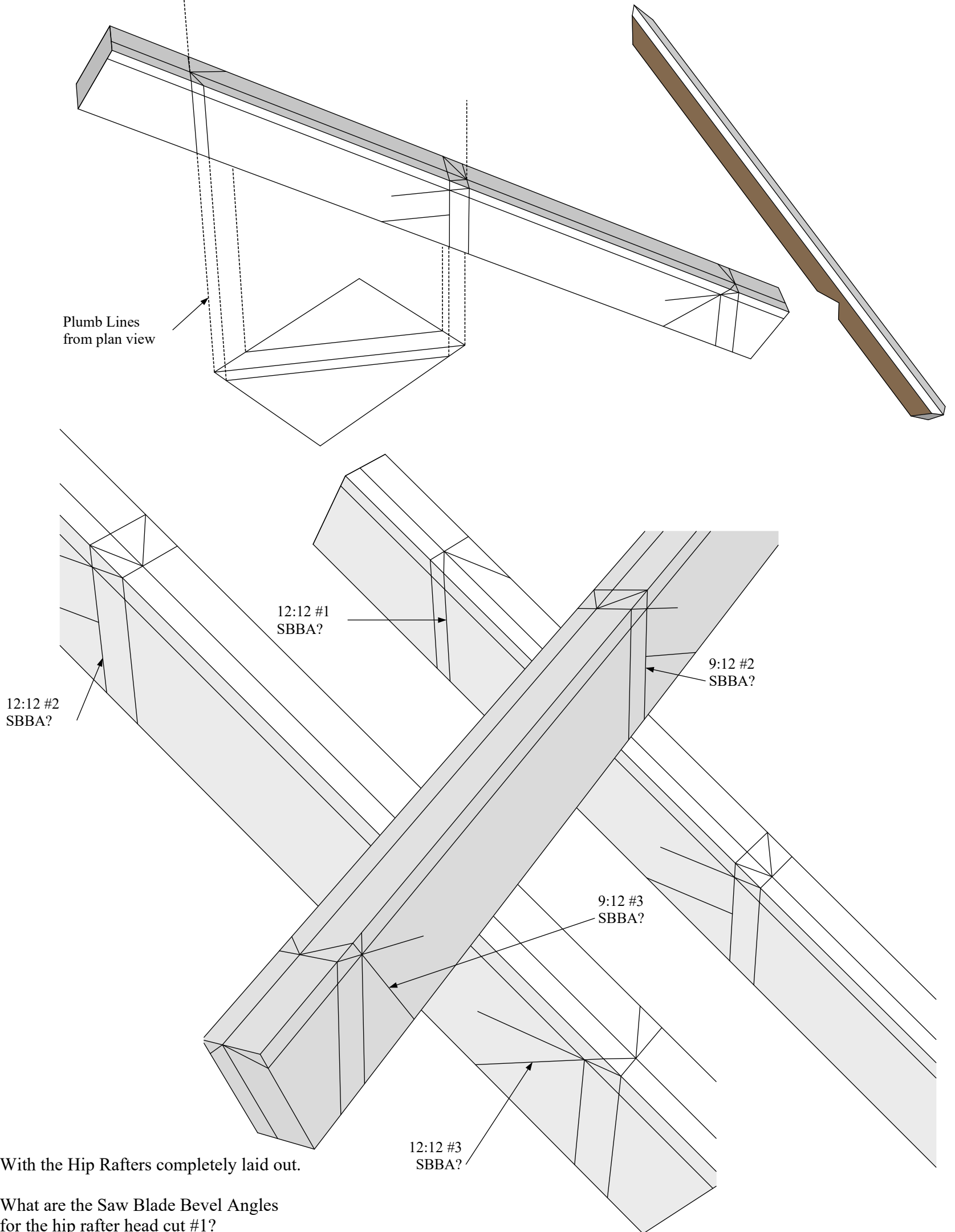
- Roof Sheathing Angle for 9:12 Pitch
- Roof Sheathing Angle for 12:12 Pitch
- Purlin Rafter Miter Angle for 9:12 Pitch
- Purlin Rafter Saw Blade Bevel Angle for 9:12 Pitch
- Purlin Rafter Miter Angle for 12:12 Pitch
- Purlin Rafter Saw Blade Bevel Angle for 12:12 Pitch
- Miter Angle to cut 2x6 T&G Roof Decking in the roof surface plane for the 9:12 Pitch
- Saw Blade Bevel Angle for 2x6 T&G Roof Decking for the 9:12 Pitch
- Miter Angle to cut 2x6 T&G Roof Decking in the roof surface plane for the 12:12 Pitch
- Saw Blade Bevel Angle for 2x6 T&G Roof Decking for the 12:12 Pitch

- Hip Rafter Miter Angle K for witches cut for 9:12 Pitch
- Hip Rafter Saw Blade Bevel Angle for witches cut for 9:12 Pitch
- Hip Rafter Miter Angle K for witches cut for 12:12 Pitch
- Hip Rafter Saw Blade Bevel Angle for witches cut for 12:12 Pitch

The depth of Hip Rafter material for a 1 1/2"(M) reveal on the bottom of the hip rafter, below the 12:12 jack rafter.



Level 2 Roof Cutter's Exam Questions



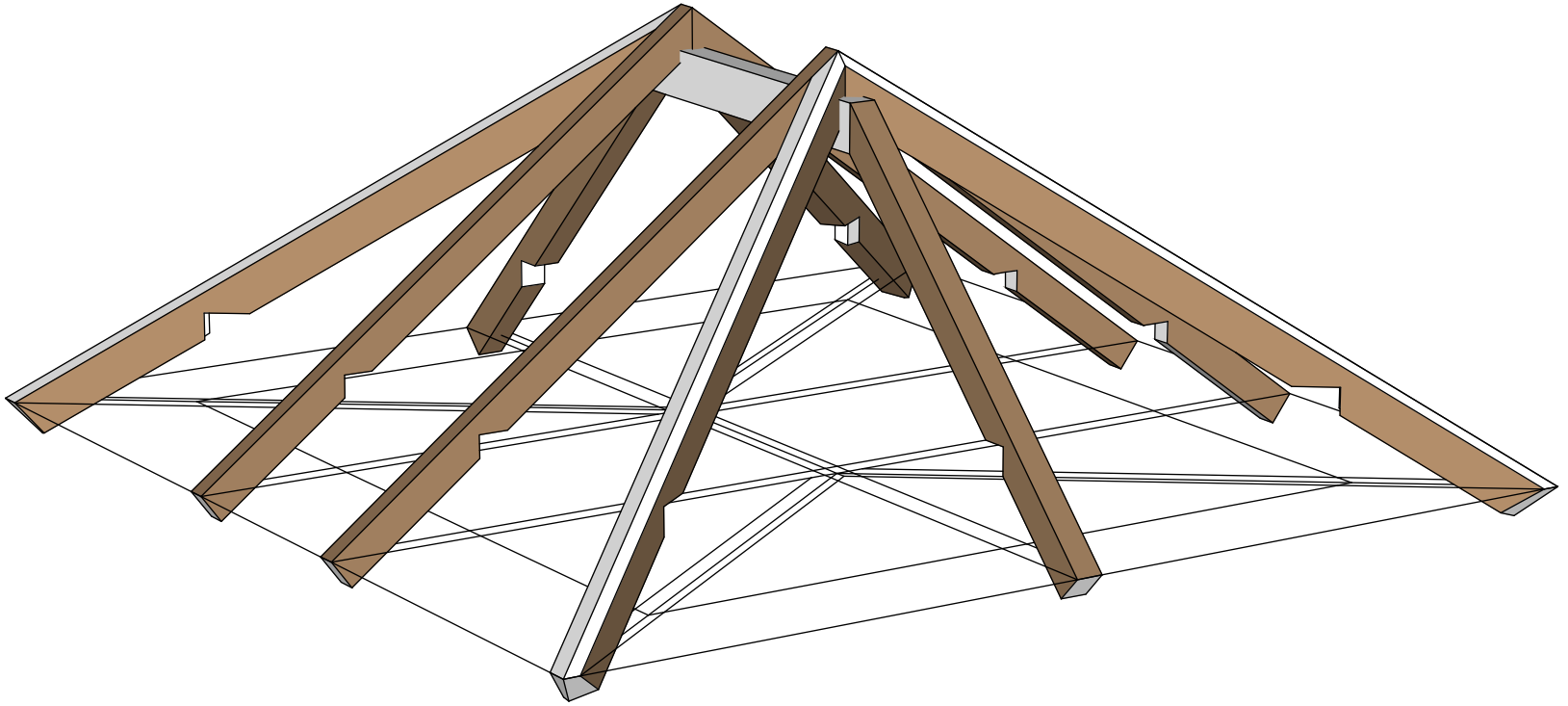
With the Hip Rafters completely laid out.

What are the Saw Blade Bevel Angles for the hip rafter head cut #1?

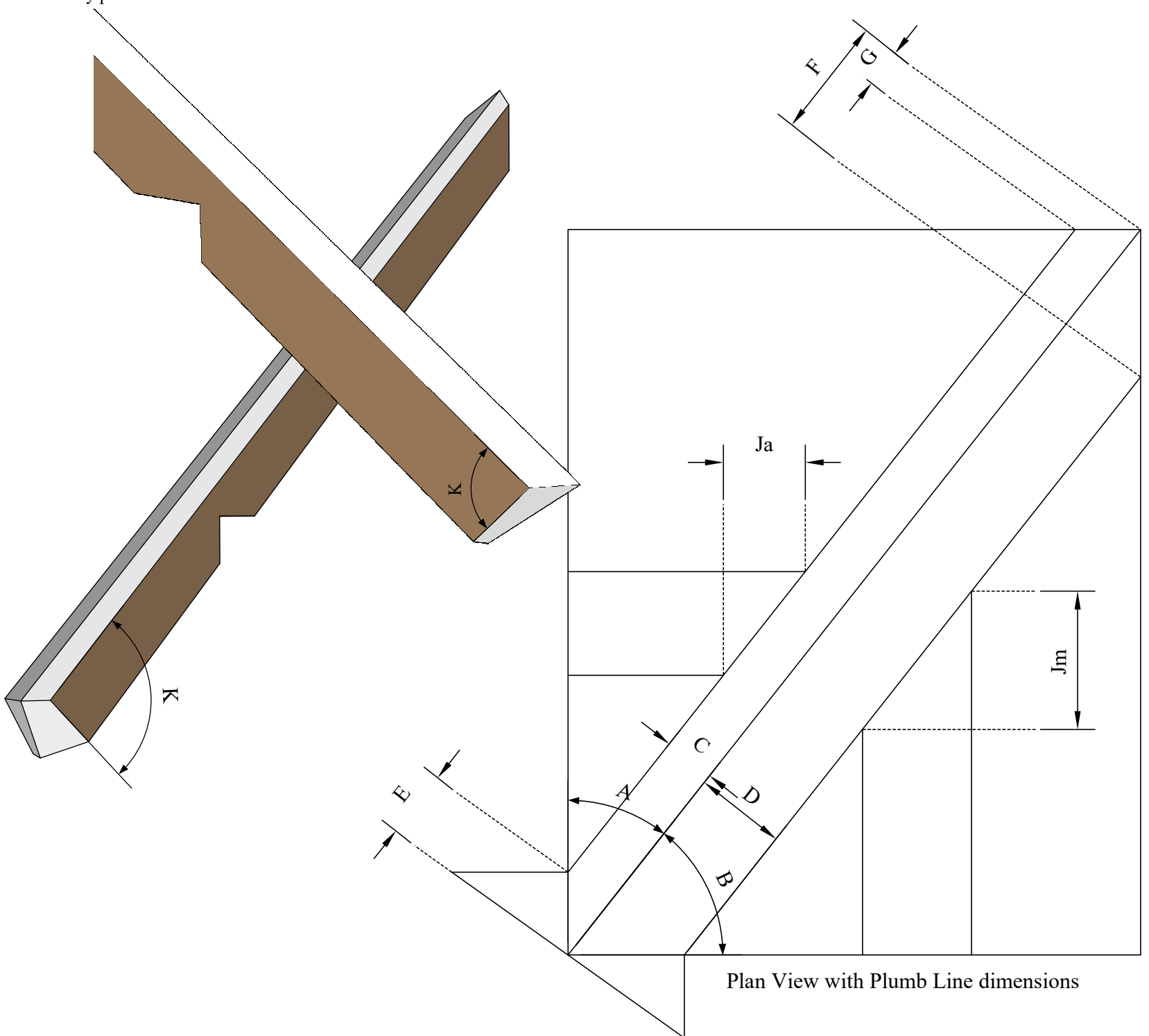
What are the Saw Blade Bevel Angles for the hip rafter seat cut miter lines #2?

What are the Saw Blade Bevel Angles for the hip rafter tail cut #3?

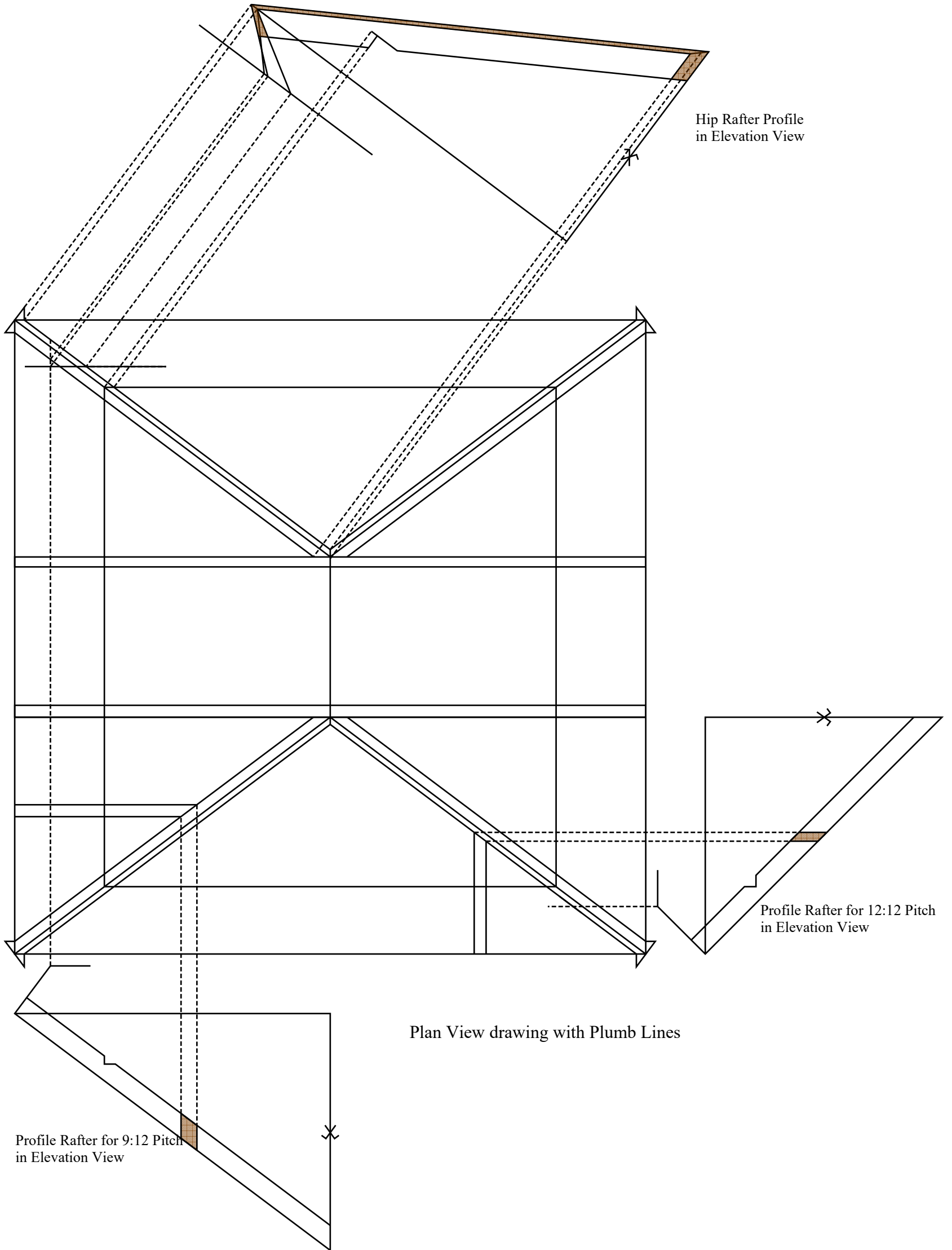
Level 2 Roof Cutter's Exam



Unequal pitched roof, Hip Rafter and Jack Rafter plumb line shift board. This technique does not require the hip rafter and profile rafters to be drawn in elevation-profile. The hip rafter run lines in plan view are drawn to the correct width, but the length of the hip rafter run is not the true length of the hip rafter run in plan view. This can be drawn on a 48" x 48" piece of plywood on the jobsite. This technique is used to transfer the plumb lines in a plan view drawing to the timber. One way to think of a plumb line shift board, is the board plan view drawing has zero pitch, but can be used for any pitch.



Level 2 Roof Cutter's Exam

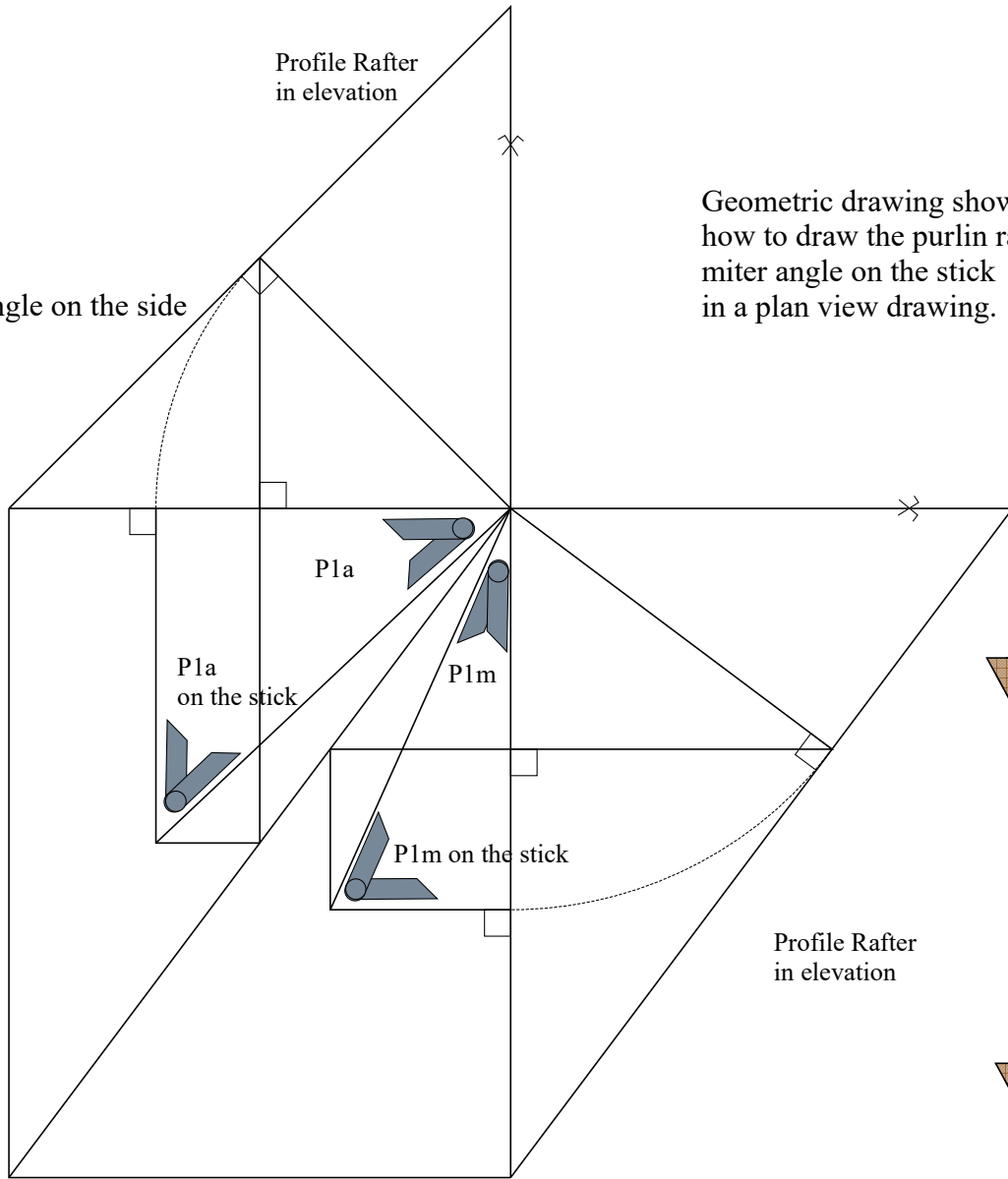




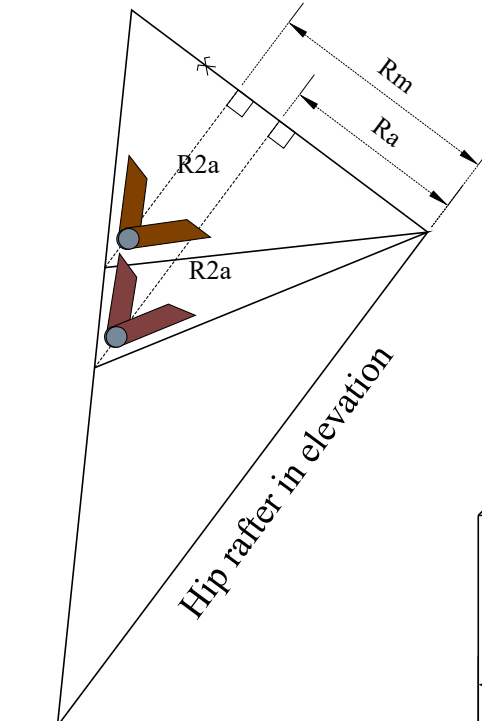
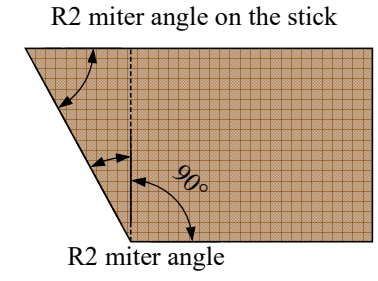
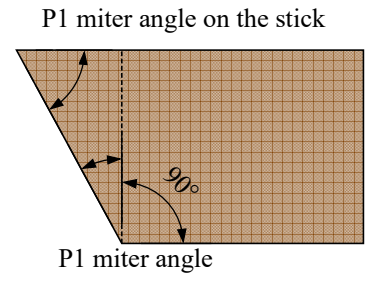
Level 2 Roof Cutter's Exam

P1 = Purlin Rafter miter angle on the side of the purlin rafter  
 P1m = main side  
 P1a = adjacent side

Geometric drawing showing how to draw the purlin rafter miter angle on the stick in a plan view drawing.



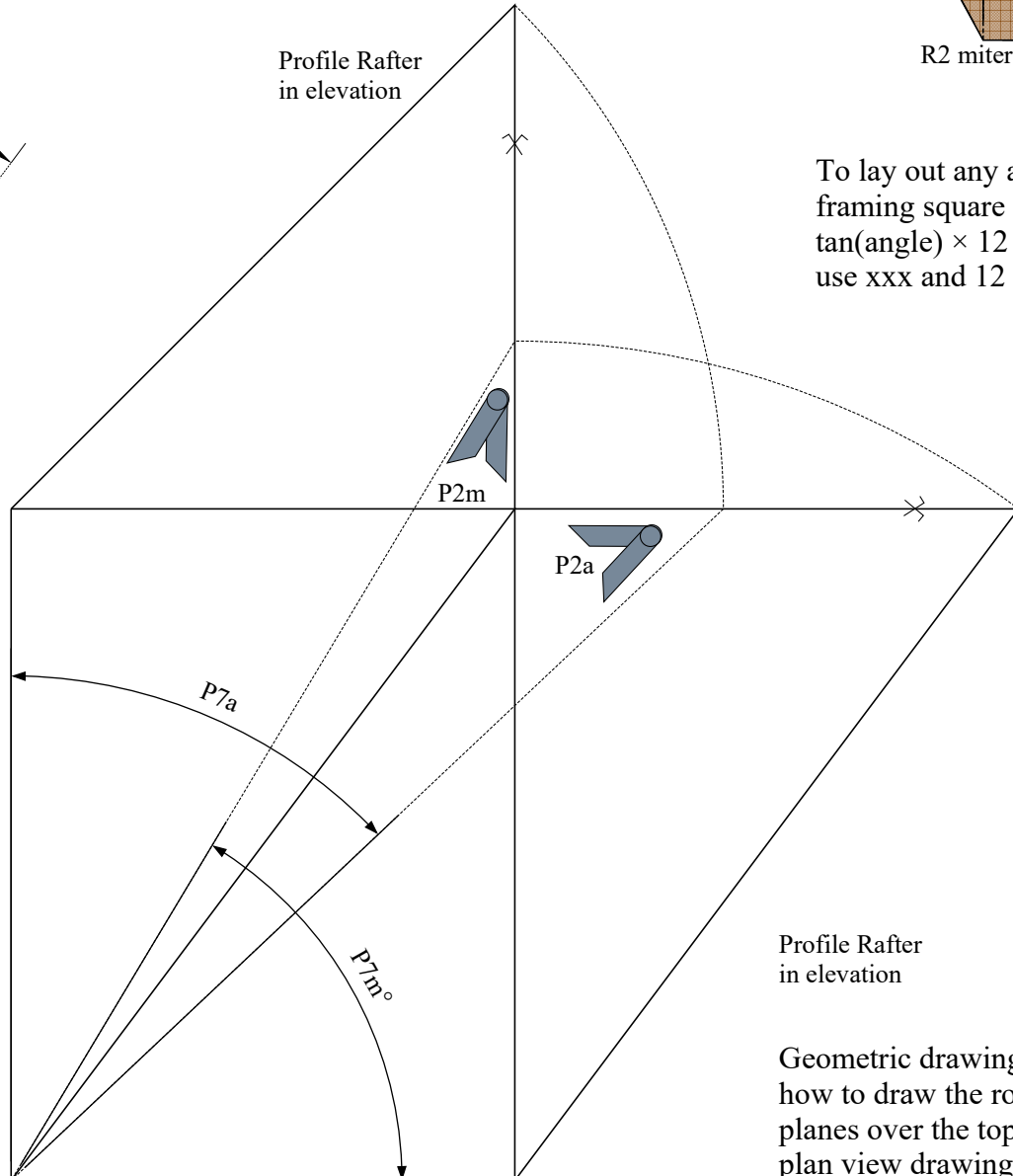
Hip rafter housing angle  
 R2 is the same angle for square tail hip rafters.  
 This drawing shows the miter angle on the stick.



Profile Rafter in elevation

To lay out any angle using a framing square  
 $\tan(\text{angle}) \times 12 = \text{xxx}$   
 use xxx and 12 on the square

P7 = Roof Sheathing Angle  
 P7m = main side  
 P7a = adjacent side  
 P7 is the bevel angle on the top edge on purlin rafters

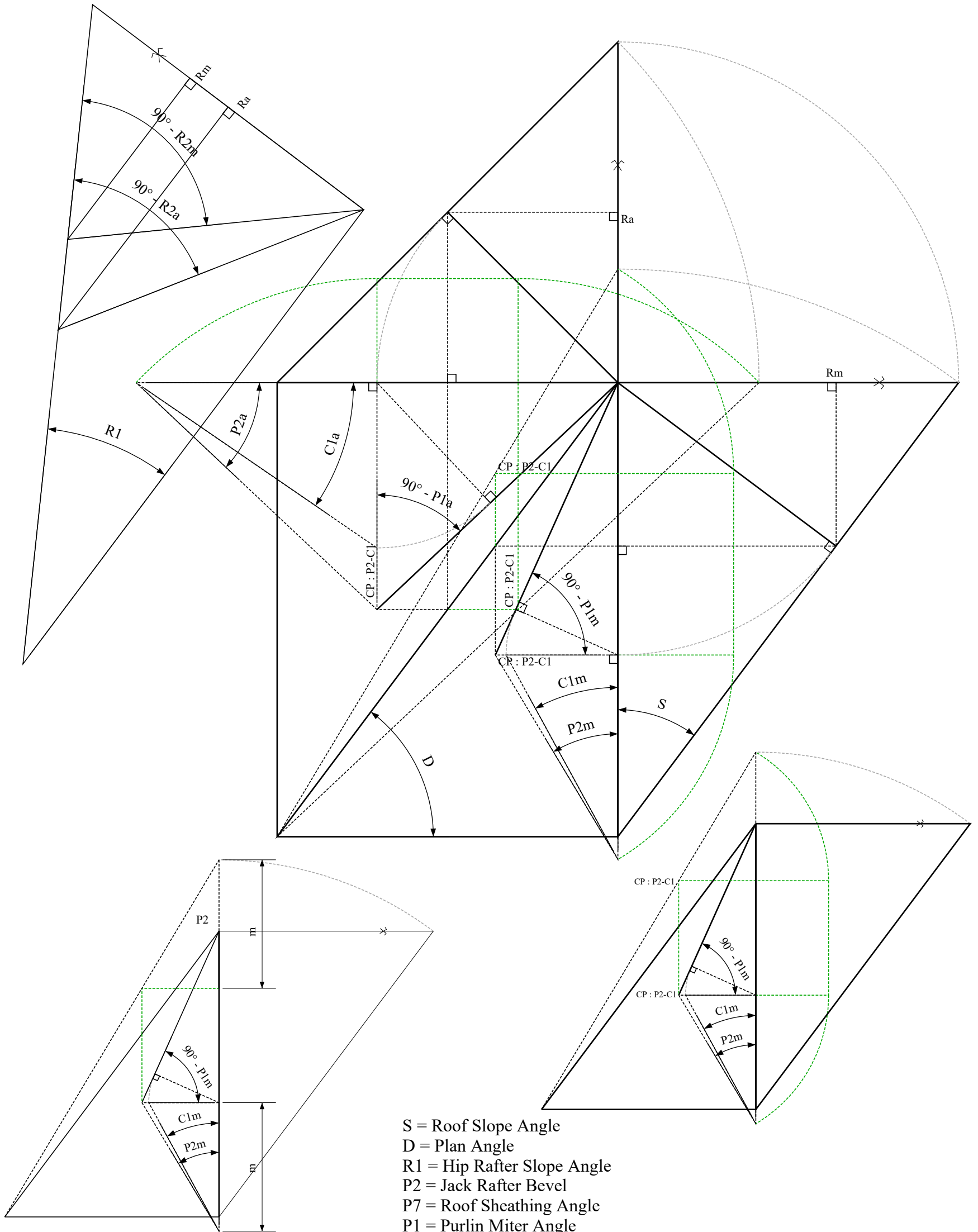


Profile Rafter in elevation

Geometric drawing showing how to draw the roof surface planes over the top of a plan view drawing.

## Level 2 Roof Cutter's Exam

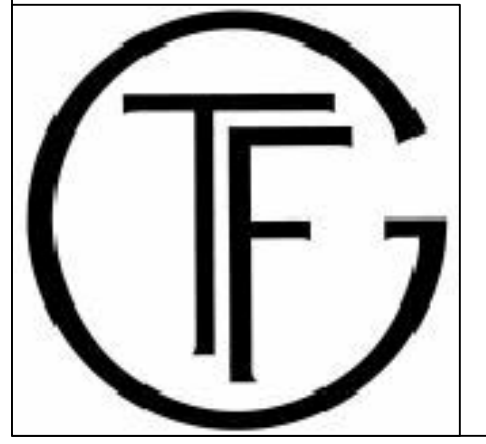
TFG - Roof Framing Kernel geometric development for the purlin miter angle and the SBBA for purlin rafters and square tail hip rafters. This geometric development can be developed with just a framing square. This works on all plan angles with equal pitched roofs or unequal pitched roofs.



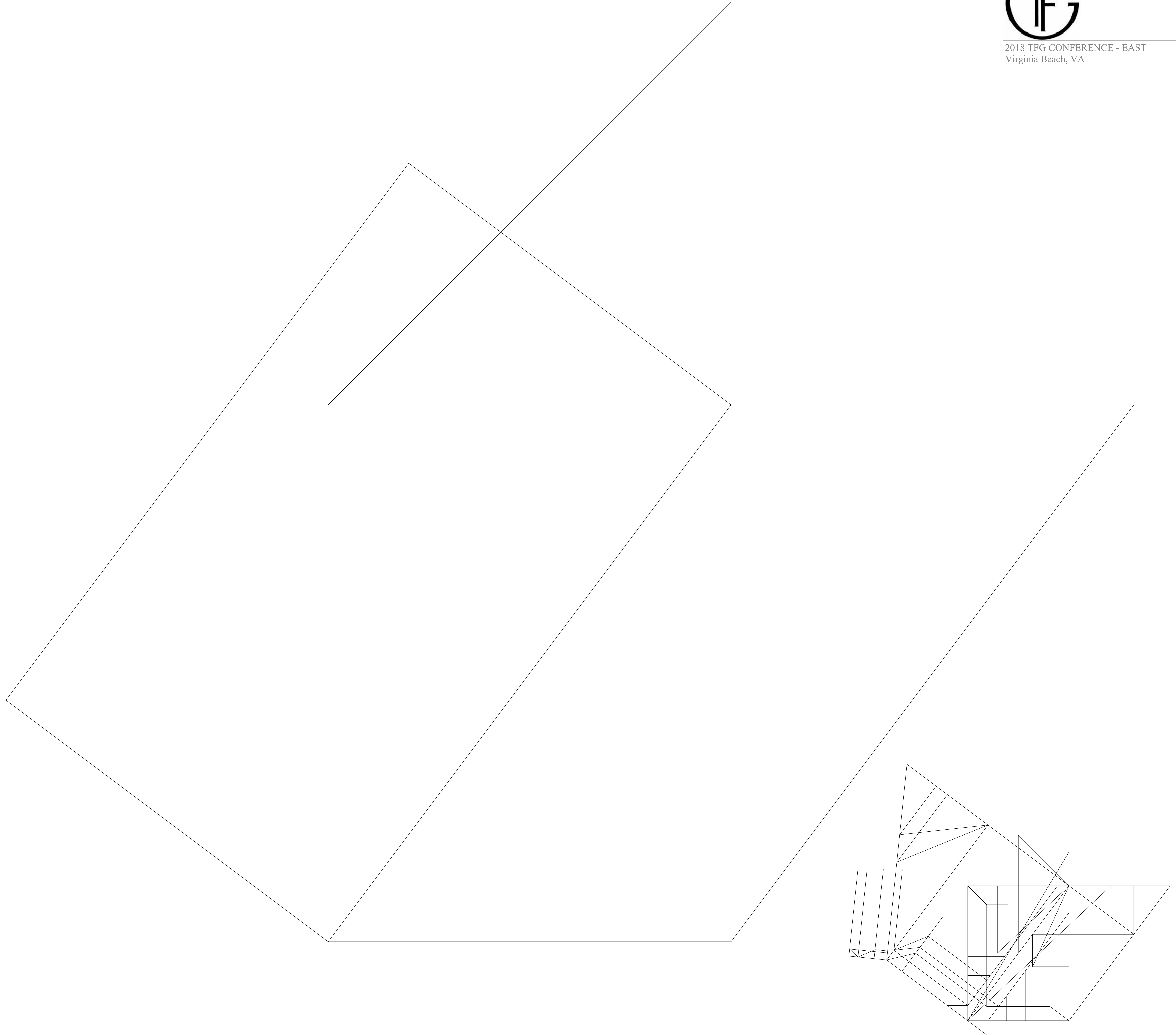
Alternate method: use dimensions to develop the geometry for the saw blade bevel angle C1.

- S = Roof Slope Angle
- D = Plan Angle
- R1 = Hip Rafter Slope Angle
- P2 = Jack Rafter Bevel
- P7 = Roof Sheathing Angle
- P1 = Purlin Miter Angle
- R2 = Hip Rafter Purlin Housing Angle & Square Tail Hip Rafter Miter
- C1 = SBBA for Purlin Miter Line, Hip Rafter Square Tail Miter Line
- CP : P2-C1 = Center point of Arc to develop lines for P2 - C1 development

# Level 2 Task Model



2018 TFG CONFERENCE - EAST  
Virginia Beach, VA



# Level 2 Task Model



2018 TFG Conference-East  
Virginia Beach, Virginia

