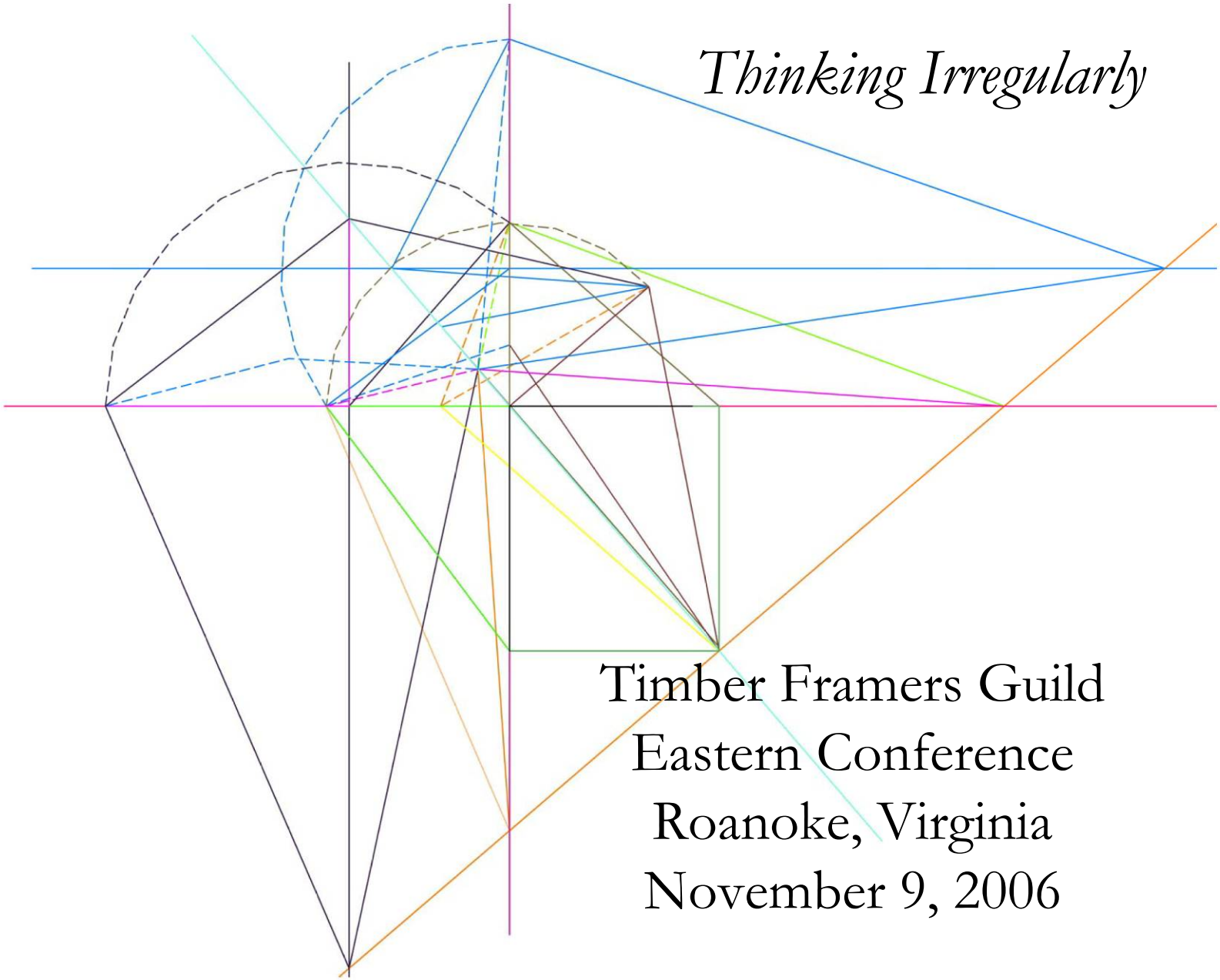


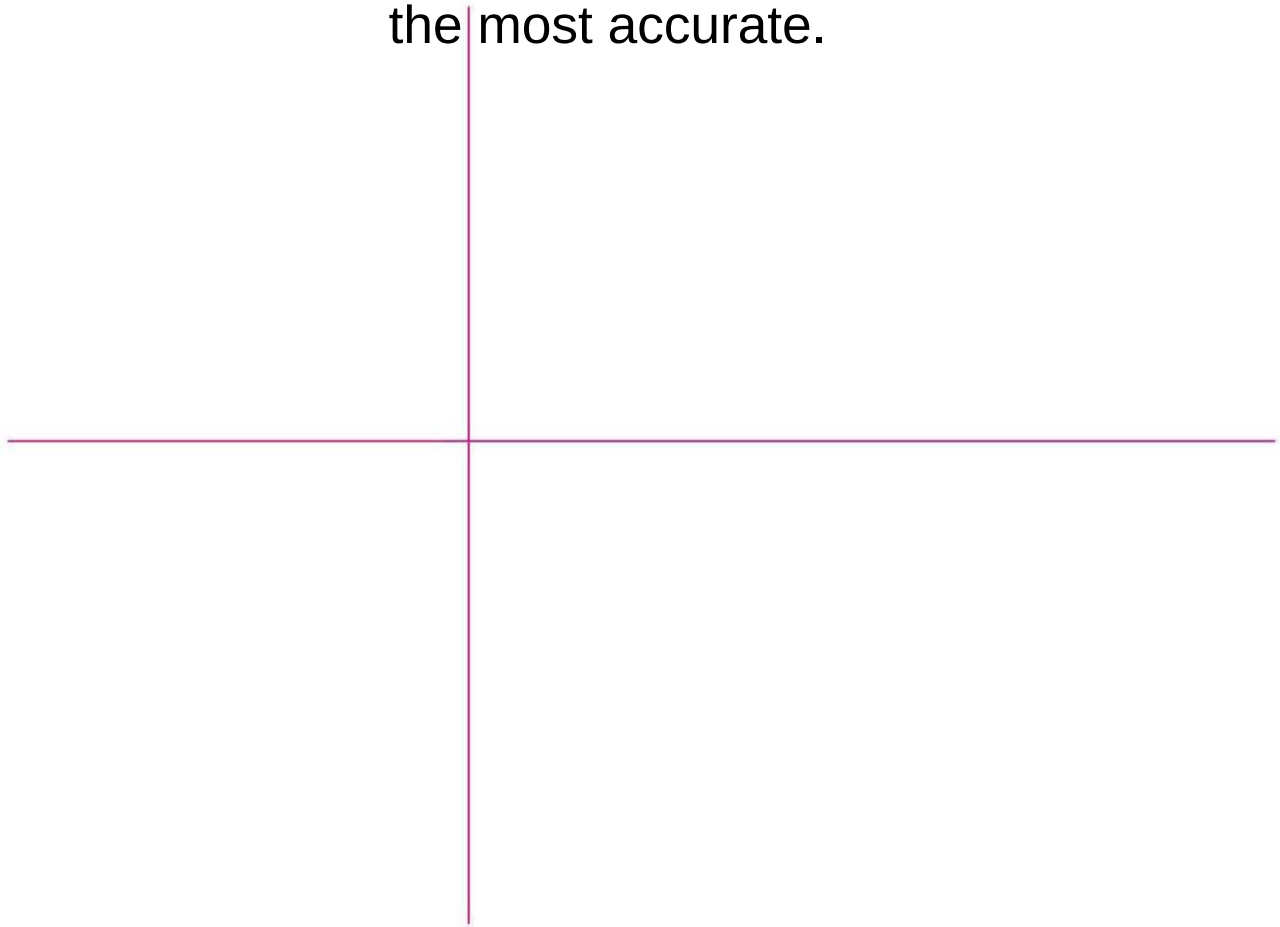
Thinking Irregularly

Timber Framers Guild
Eastern Conference
Roanoke, Virginia
November 9, 2006

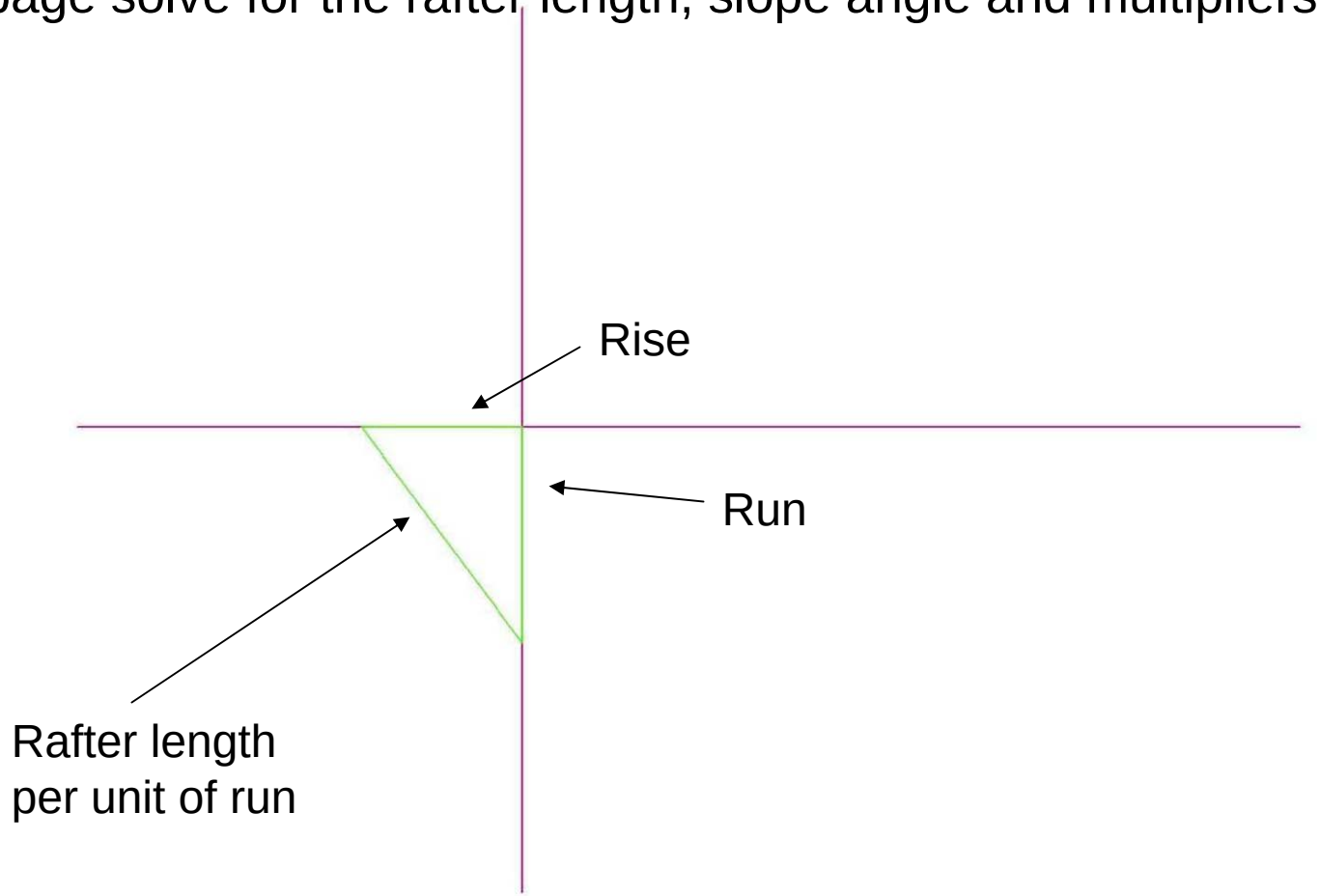
Basic information

- Main Roof slope is 9 : 12
- Adjacent Roof slope is 10-1/2 : 12
- Run of main roof is 12’
- The eaves are level and at 90 degrees to each other in plan view.

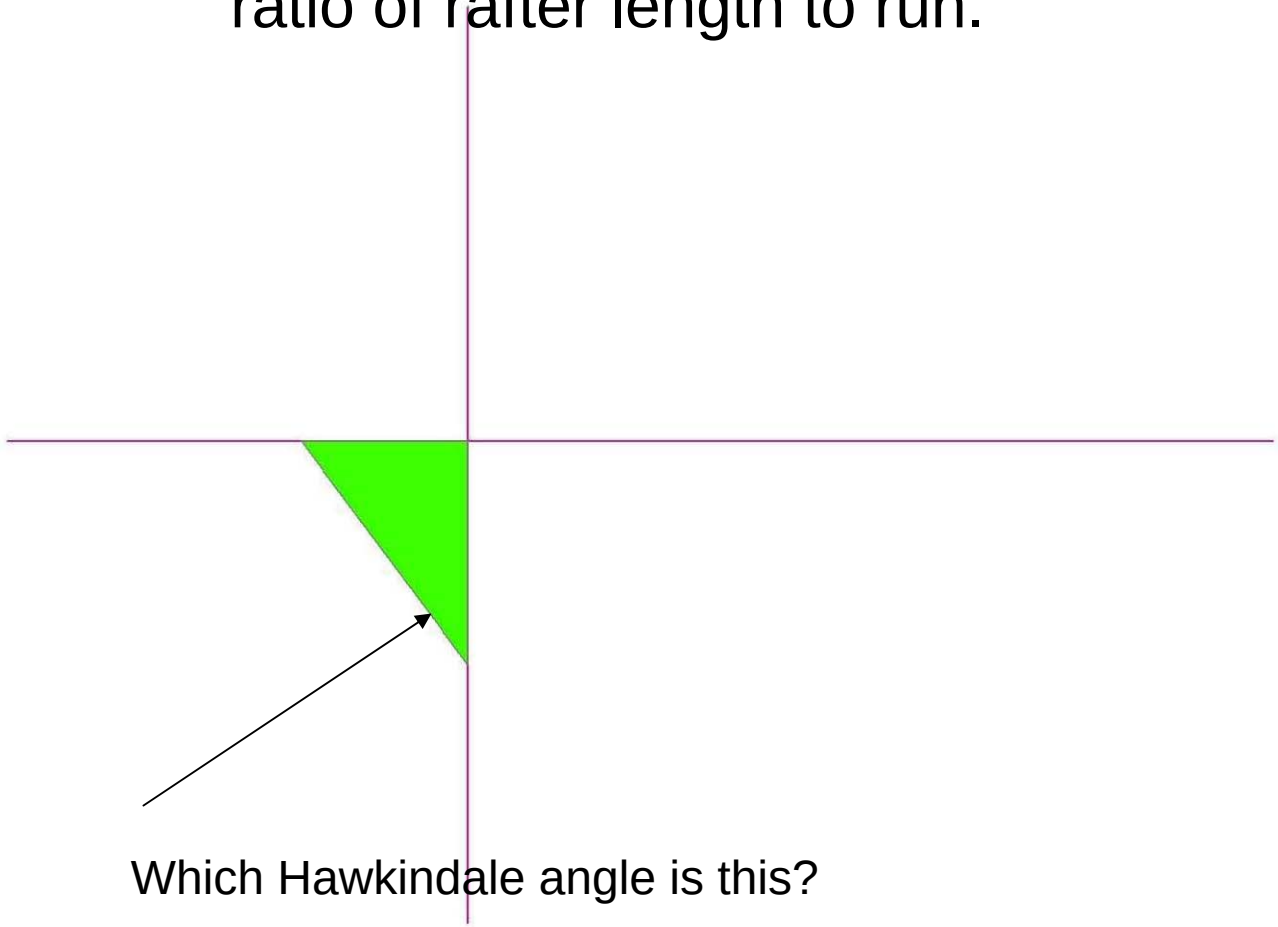
From the lower left hand corner of the 30 x 24 paper measure over 12.5 inches and up 14.25 inches.
Draw two lines as shown. The squarer the better. Graphic methods are the most accurate.



Draw the triangle that represents the Main roof elevation view to scale: ½” =1’. The rise is 9’ and the run is 12’. Working on the handout page page solve for the rafter length, slope angle and multipliers.

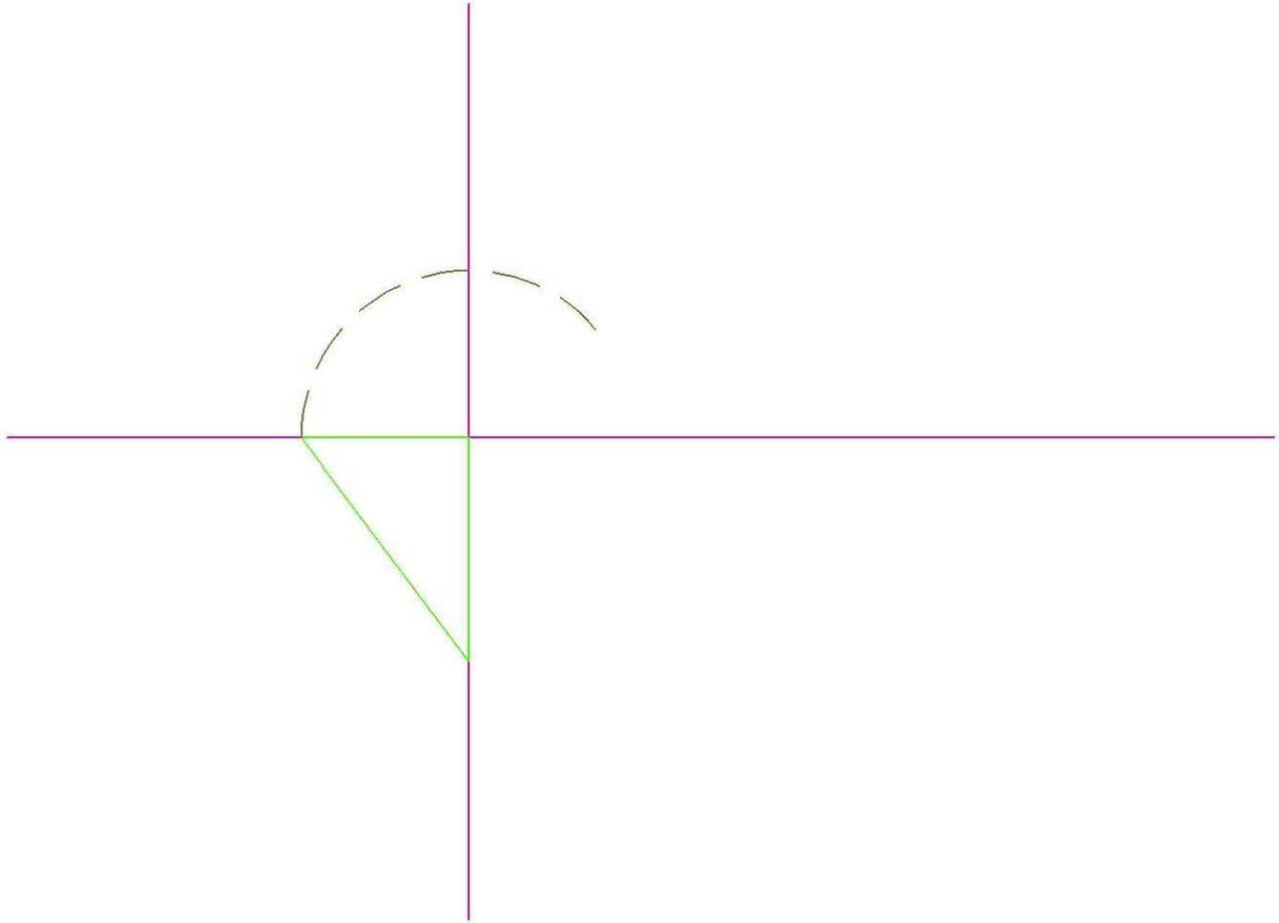


This triangle contains all the basic information needed to cut the Main common rafters: Plumb and level cuts and the ratio of rafter length to run.

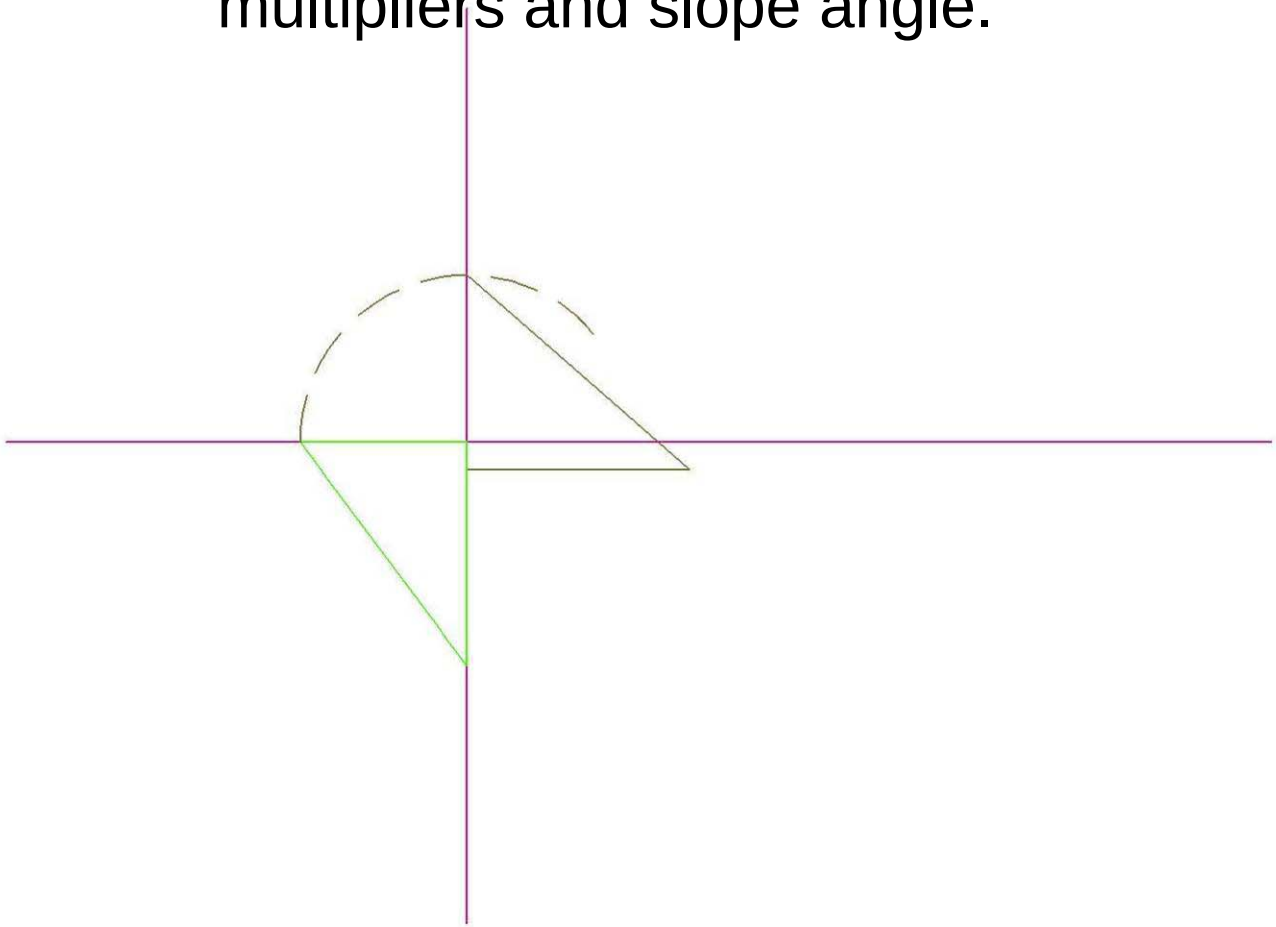


Which Hawkindale angle is this?

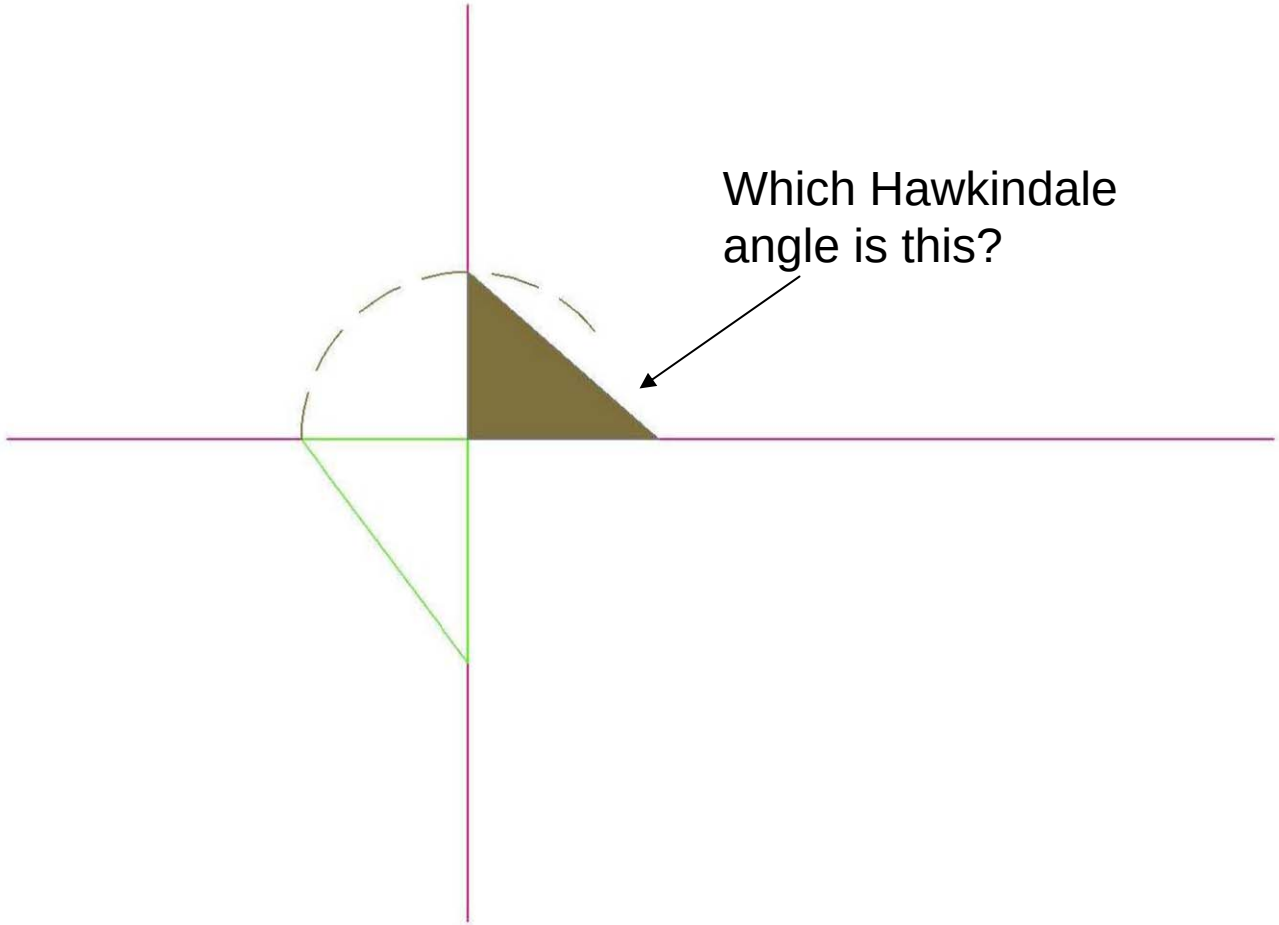
Using your compass swing an arc representing the common rise



This new triangle represents the adjacent roof slope. The rise will be the 9’ but the pitch is 10-1/2:12. Solve for the multipliers and slope angle.

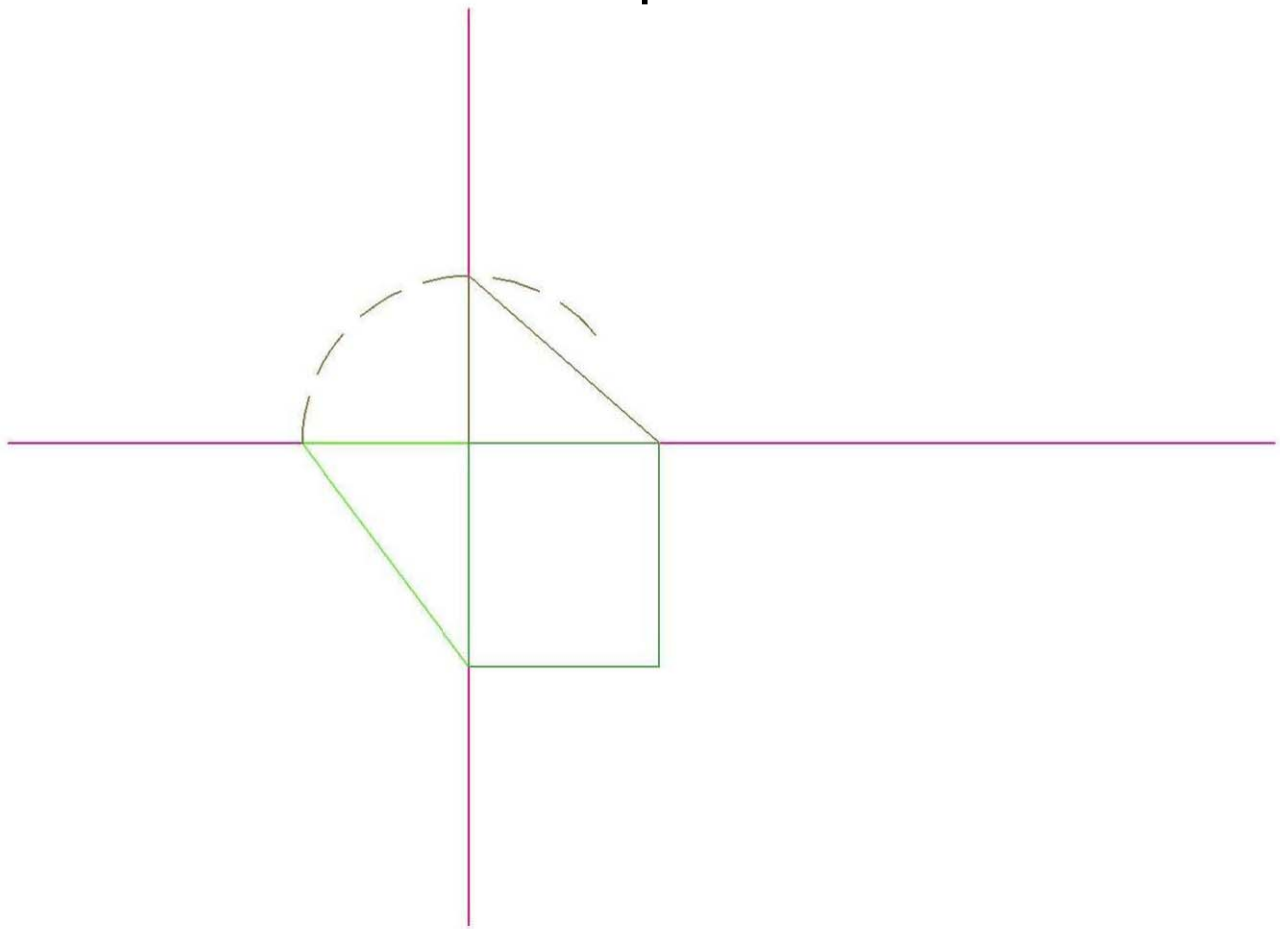


Using the multiplier that relates rise to run determine the run.

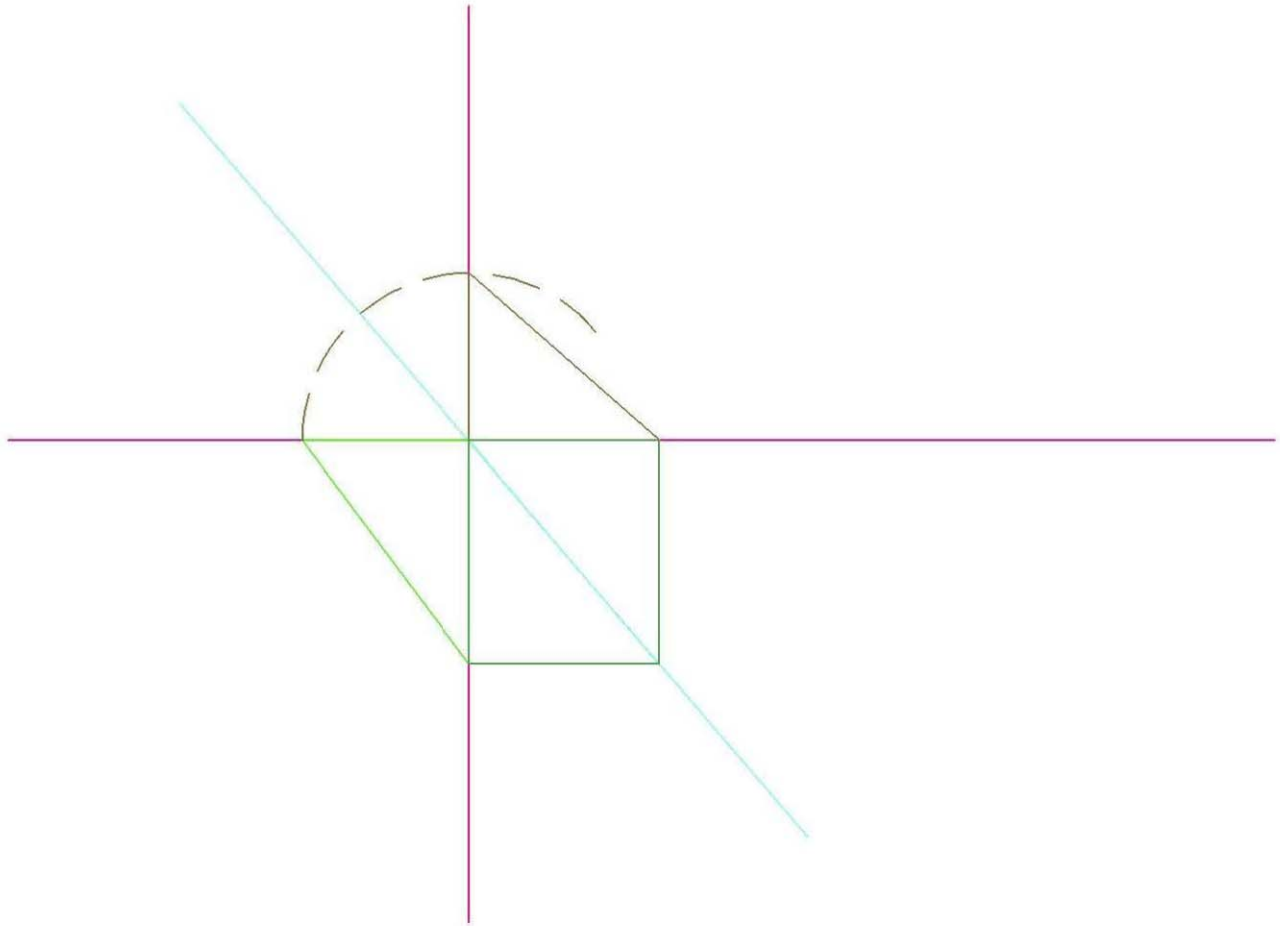


Adjacent common rafter elevation

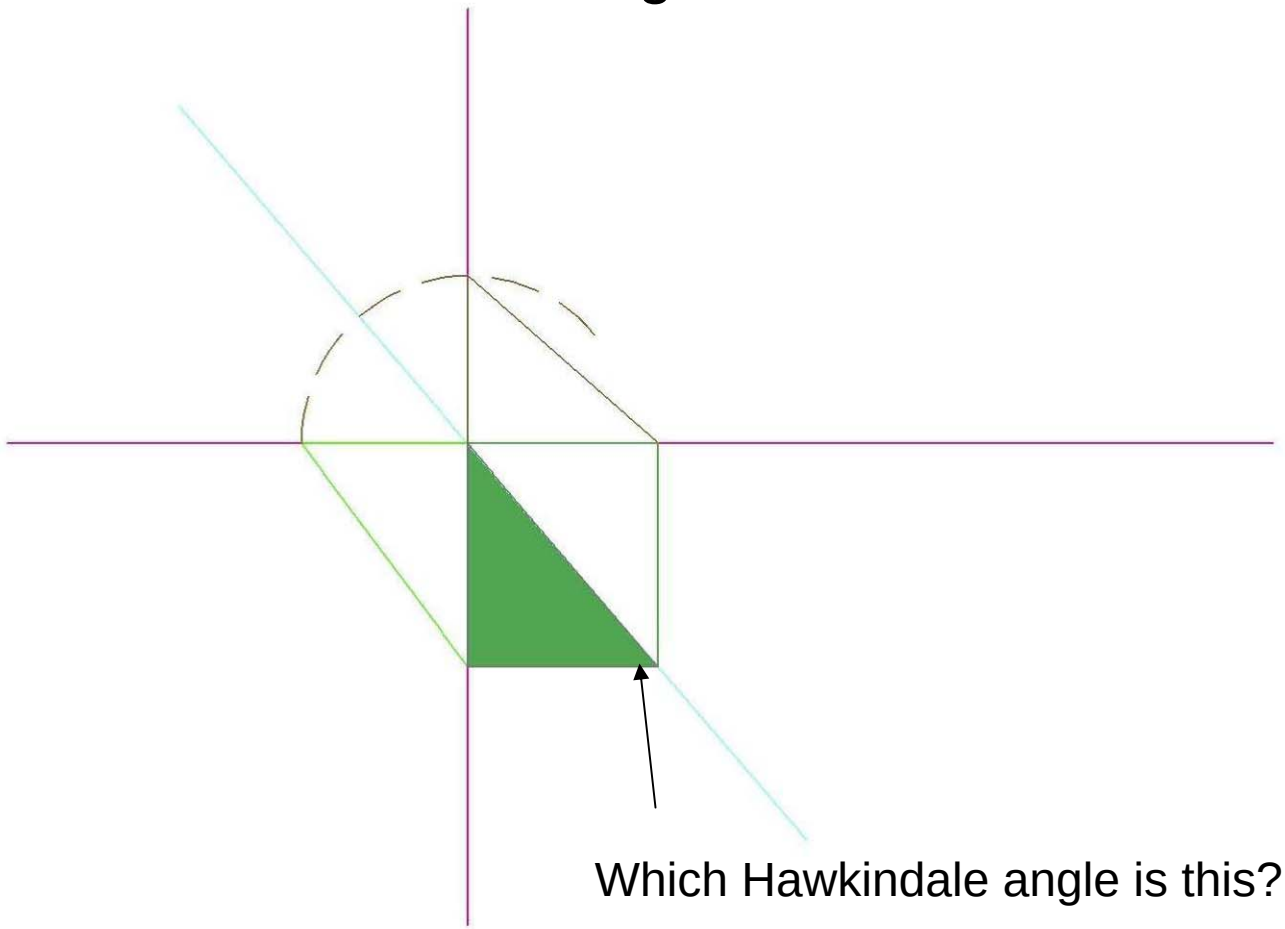
Since we know the run of the rafters we know the shape of the deck in plan view



By drawing the diagonal we define the run of the hip.
Extend this line as shown.

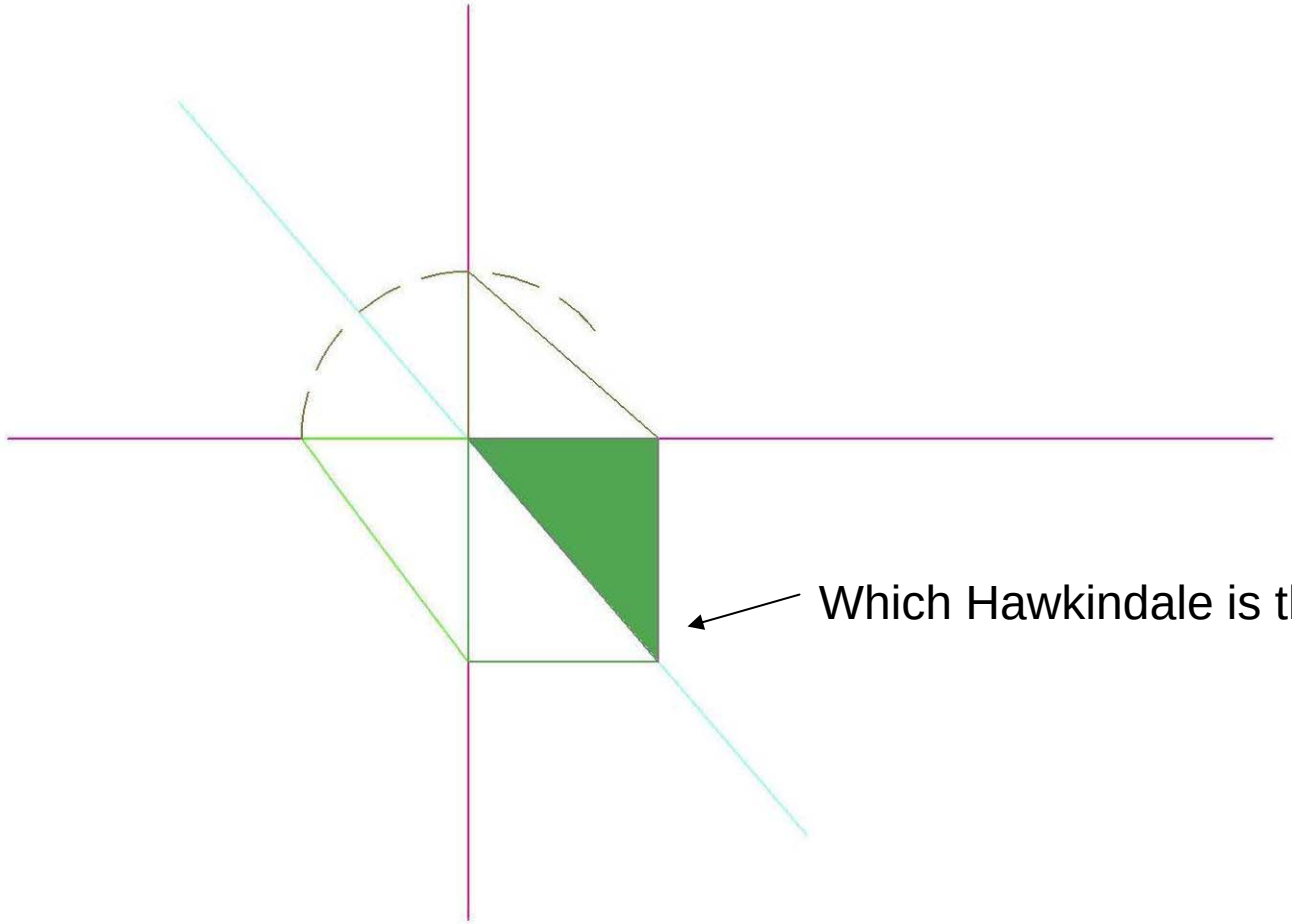


Since we know the run of each common roof we can determine the length of the hip run. Solve for the multipliers and angles.

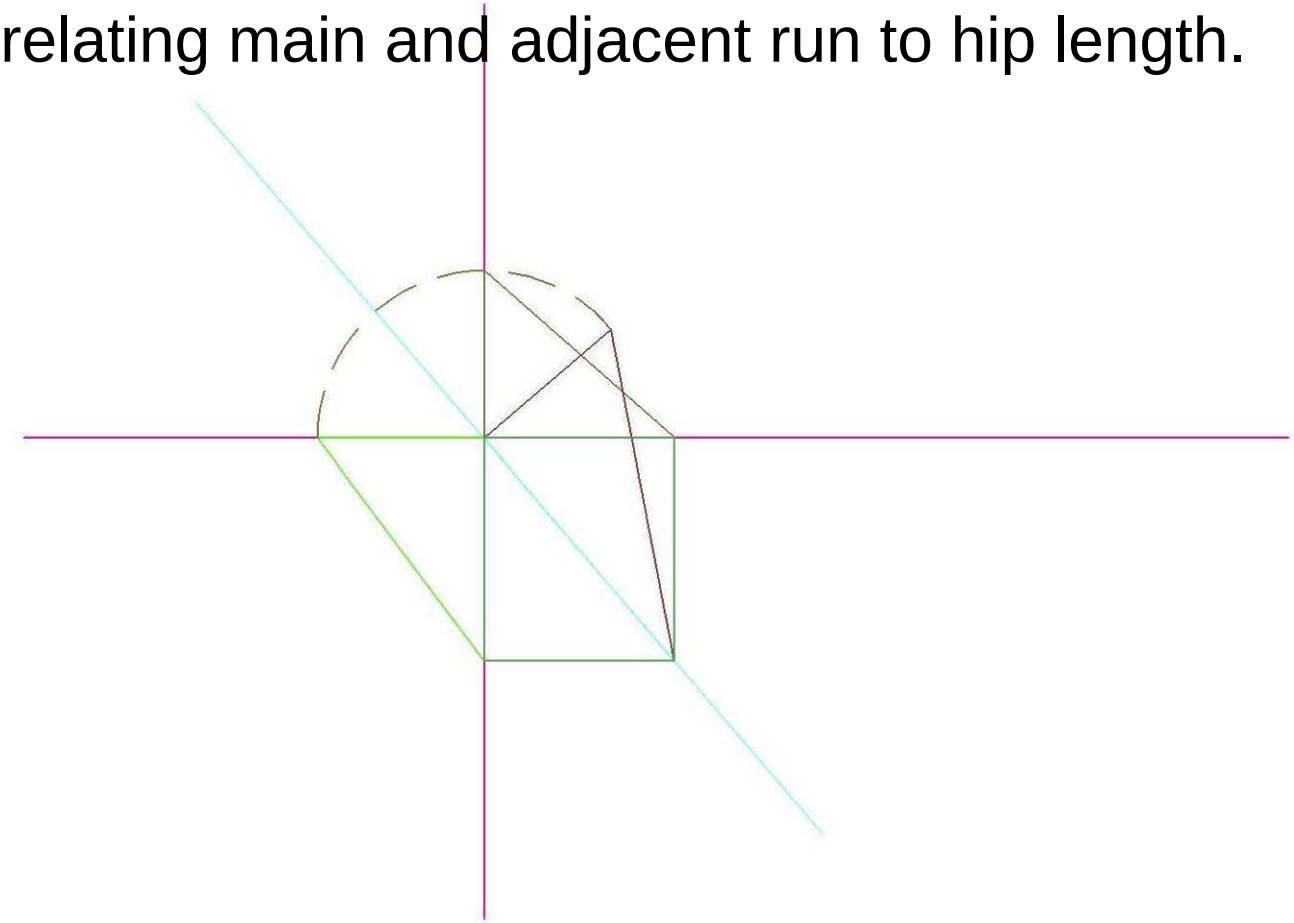


Which Hawkindale angle is this?

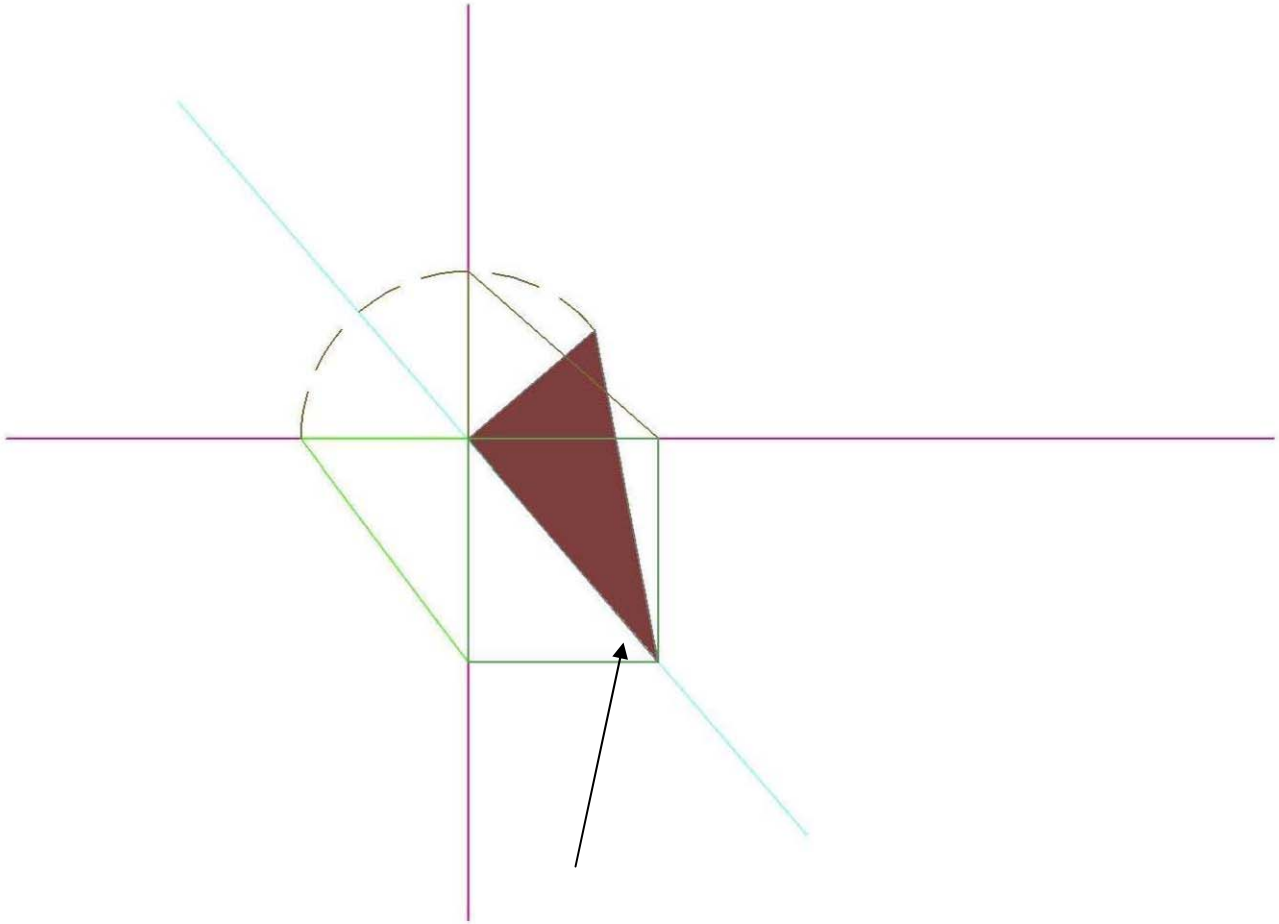
We can also solve for multipliers and angles for the adjacent deck.



Draw a line square to the hip run. The intersection of this line and the common rise defines the length of the hip.
Solve for: the hip length, the hip slope angle, the multipliers relating main and adjacent run to hip length.

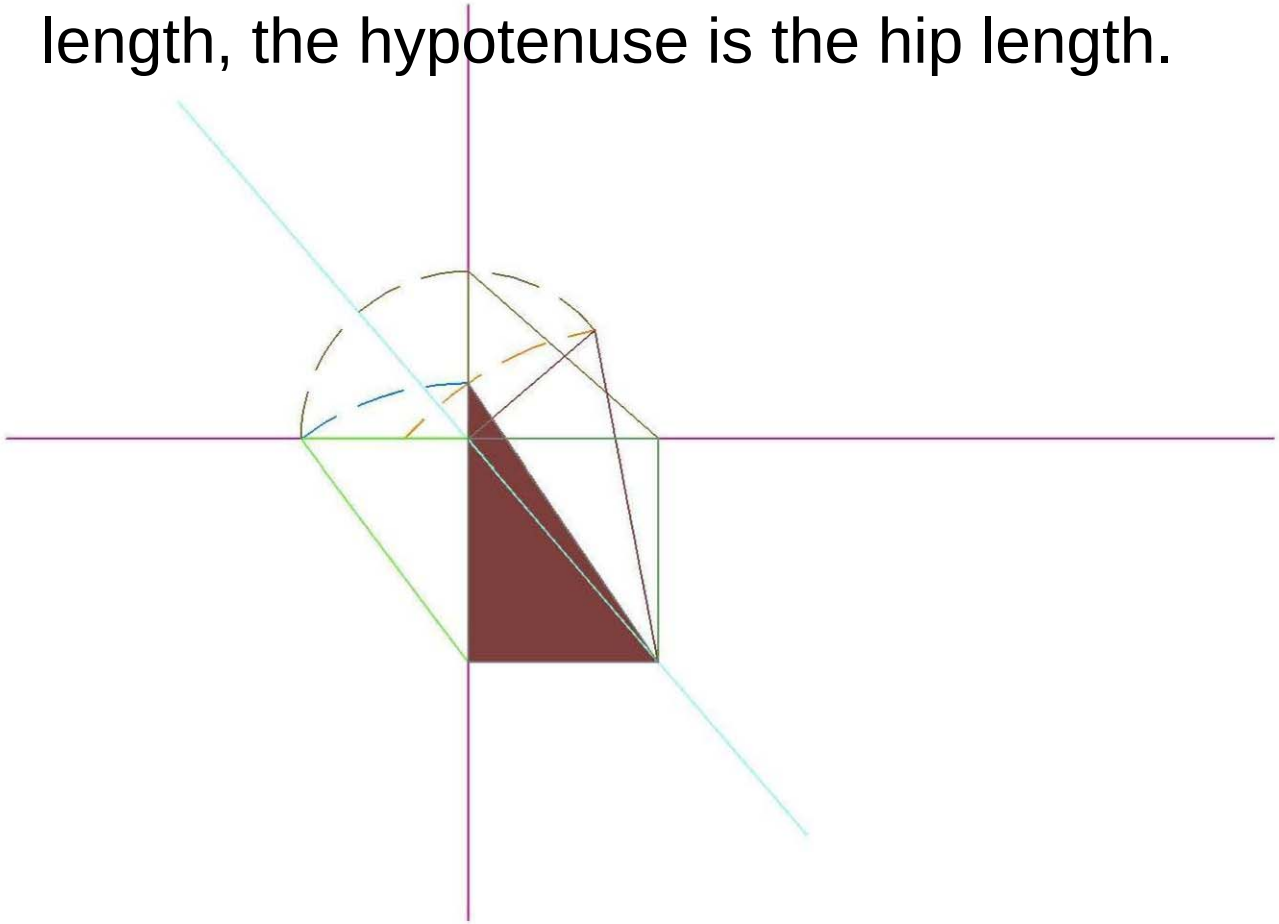


The hip elevation triangle defines hip plumb and level cuts



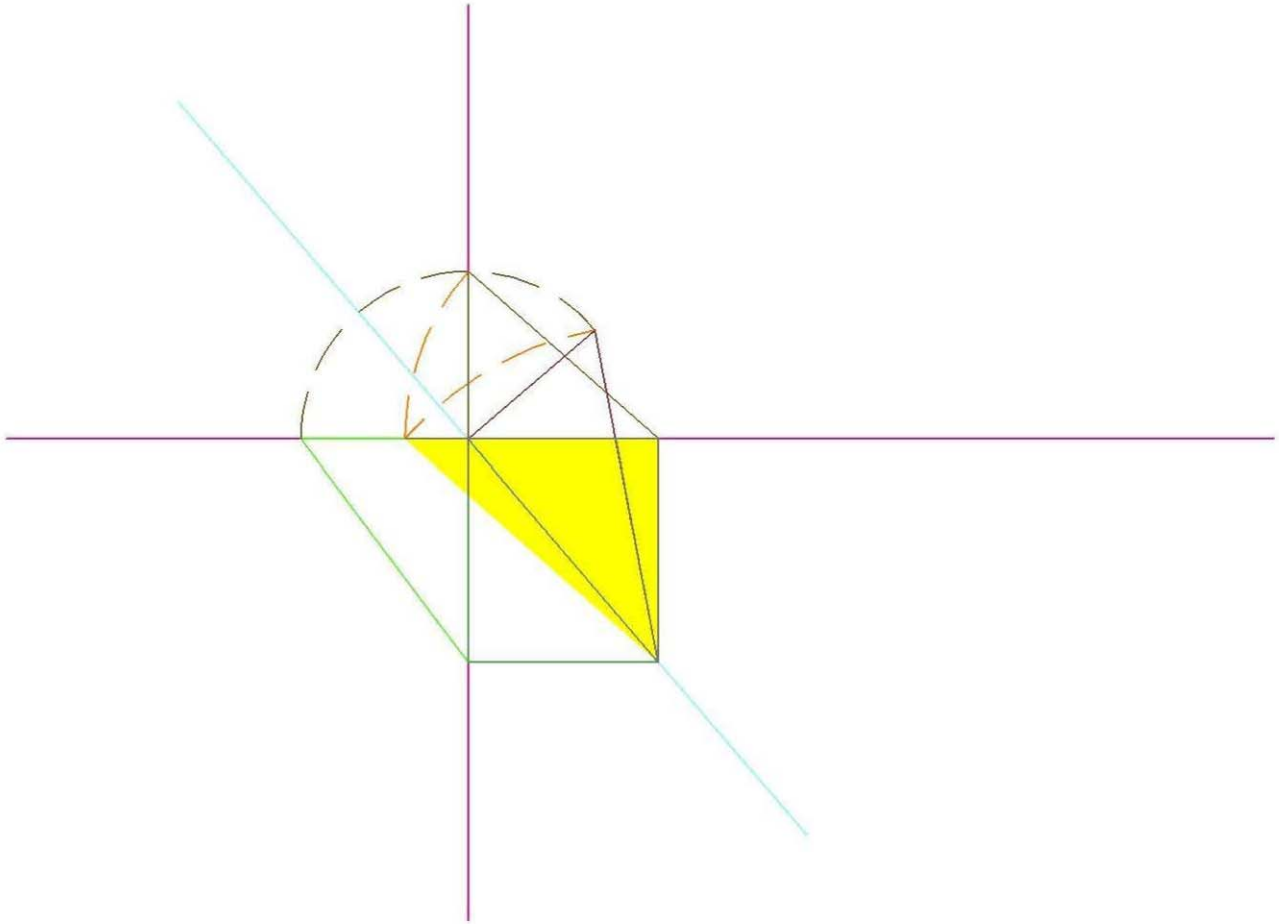
Which Hawkindale angle is this?

Bring the length of the main common rafter to the extension of the Main rafter run. Repeat with Hip Length. This forms a right traingle with Main eave square to main Common length, the hypotenuse is the hip length.



This plane is the Main roof sheathing plane. The angles for Main Jack rafter and Main Jack Purlin top cuts are found here. Solve for angles and label Hawkindale angles.

Repeat the exercise for the Adjacent roof



Label the Hawkindale angles.

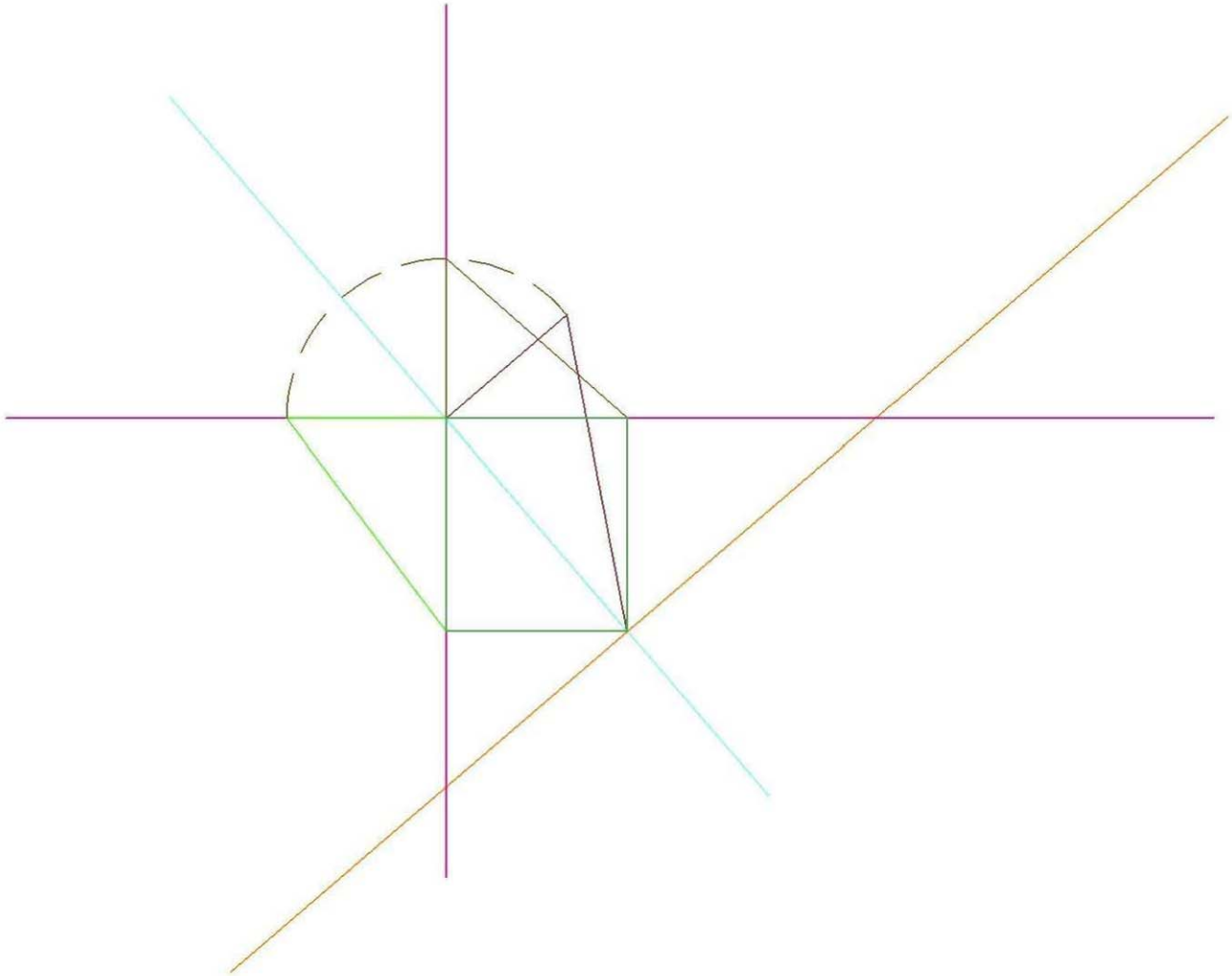
What do we know so far?

- All lengths and ratios of the common roof elevations: Main, Adjacent, Hip.
- All the ratios and angles of the roof planes.
- Unit length multipliers provide a means of determining length and rise components of our roof for any unit of run in plan view. In irregular roof work labeling everything helps.

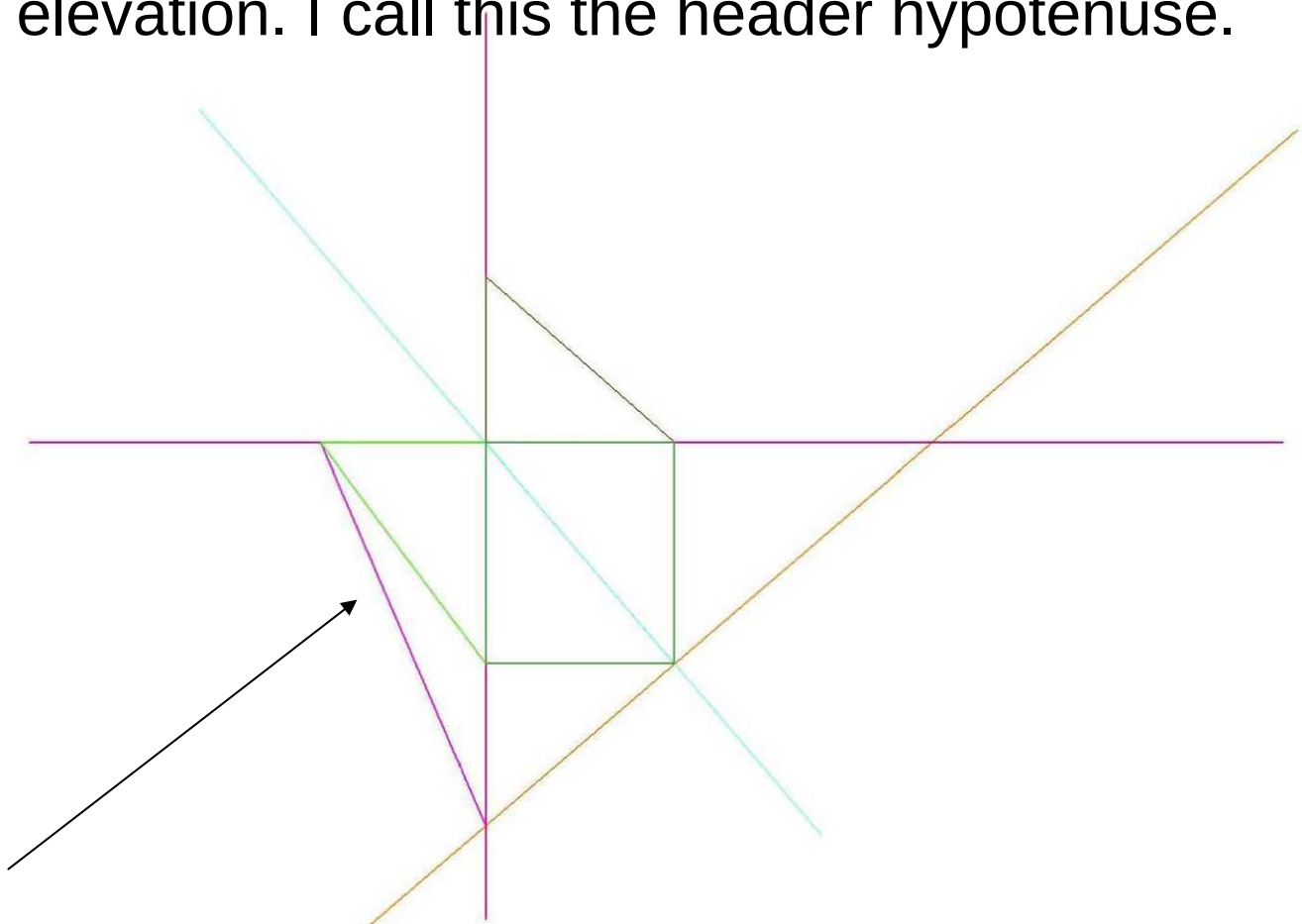
The Tangent

The tangent is drawn as a line square to the length of the hip rafter. This line is the hinge of the hip or valley. The tangent plane presents itself in the building as the uncut surface of the hip or valley rafter. Developing the angles of the eave corner and intersections with other building components is just a small part of the power of the tangent.

Draw the tangent line square to the hip run and extend as shown

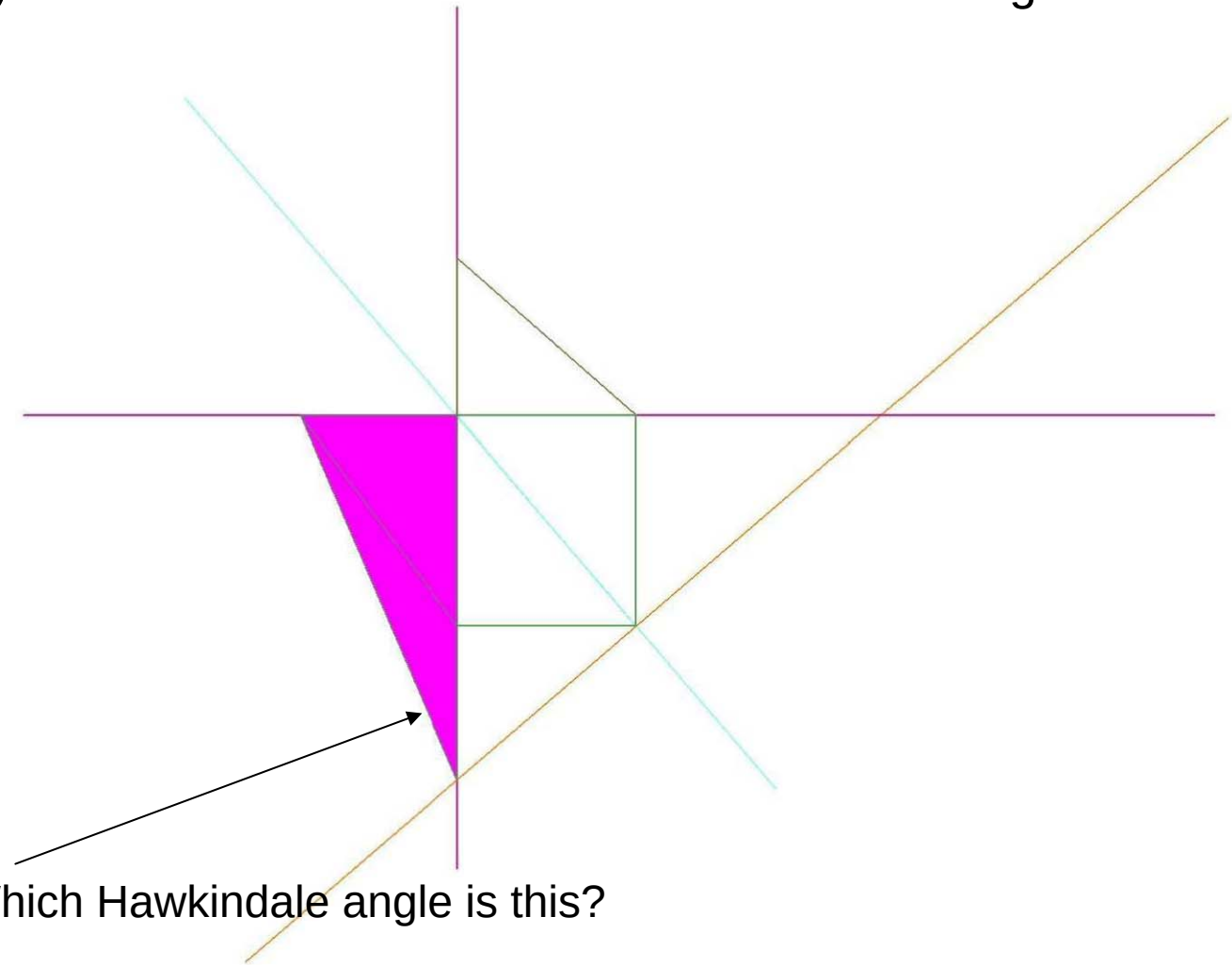


Draw a line from the intersection of the Main run extension and the tangent to the common rise in the Main Common elevation. I call this the header hypotenuse.



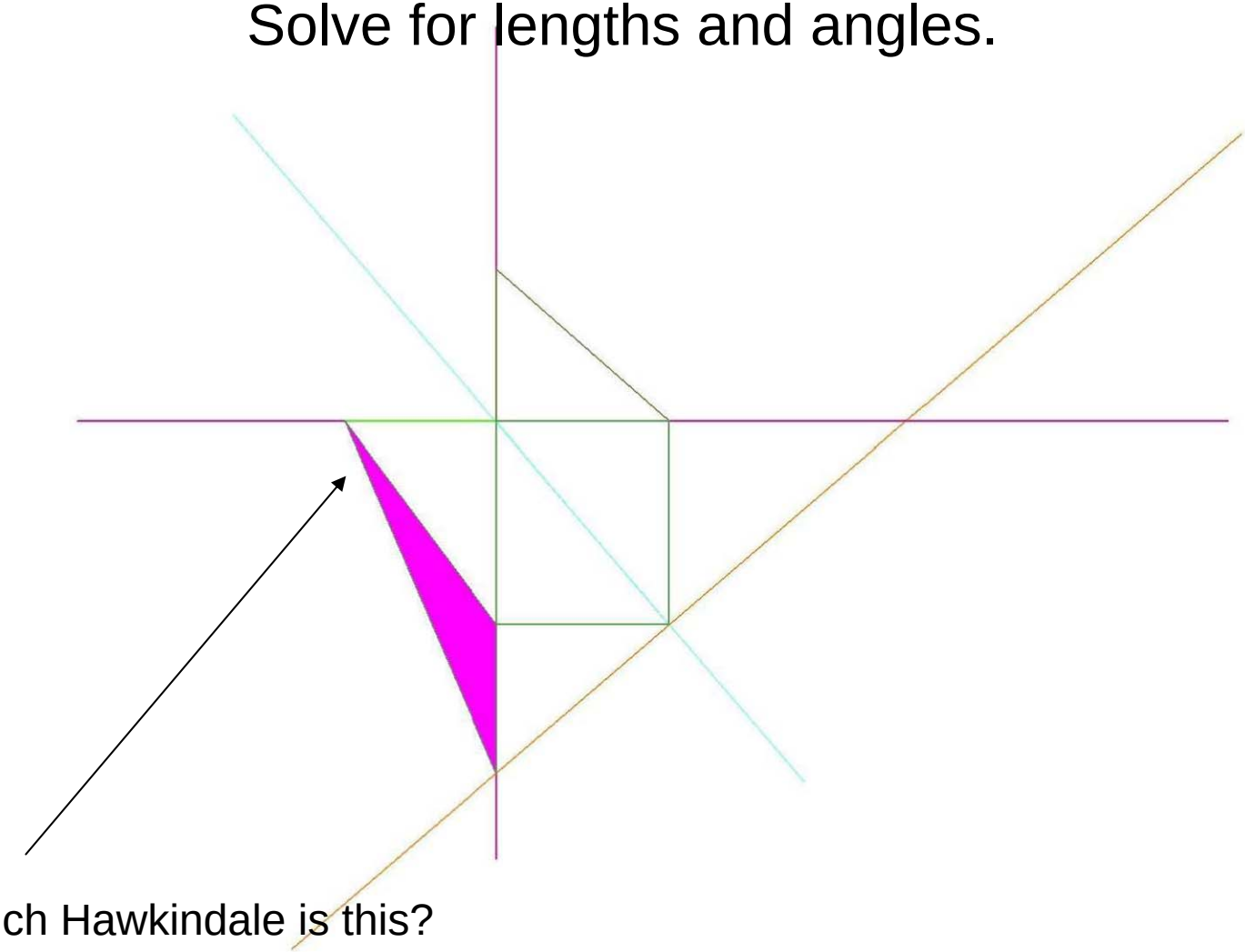
This line depicts the unbacked hip or valley rafter intersecting a plumb surface parallel to the Main common rafter.

This shaded angle is measured between a level line and the unbacked hip or valley in the common rafter elevation. Solve for lengths and angles



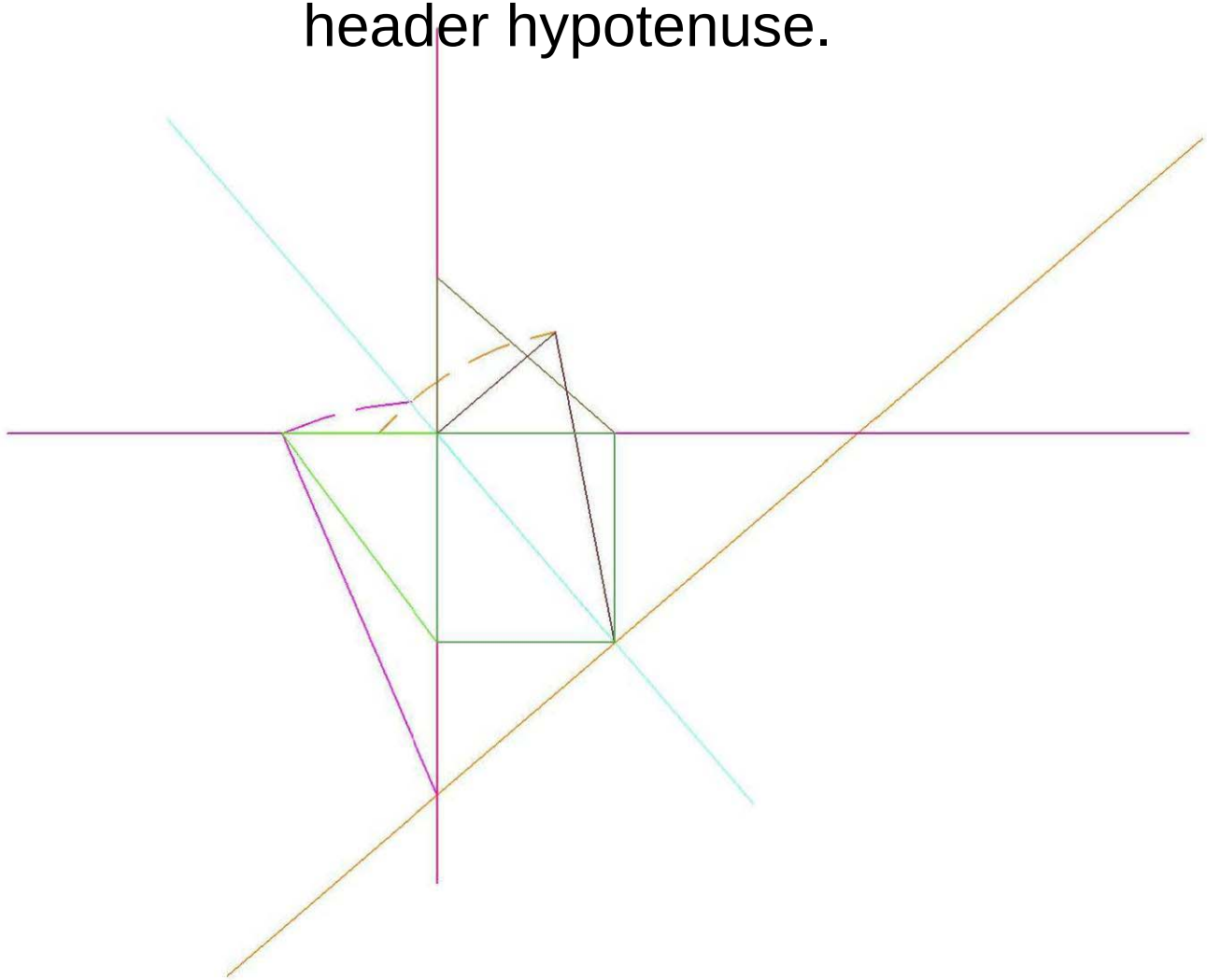
Which Hawkindale angle is this?

This shaded angle is the intersection between the Main common rafter and hip or valley.
Solve for lengths and angles.



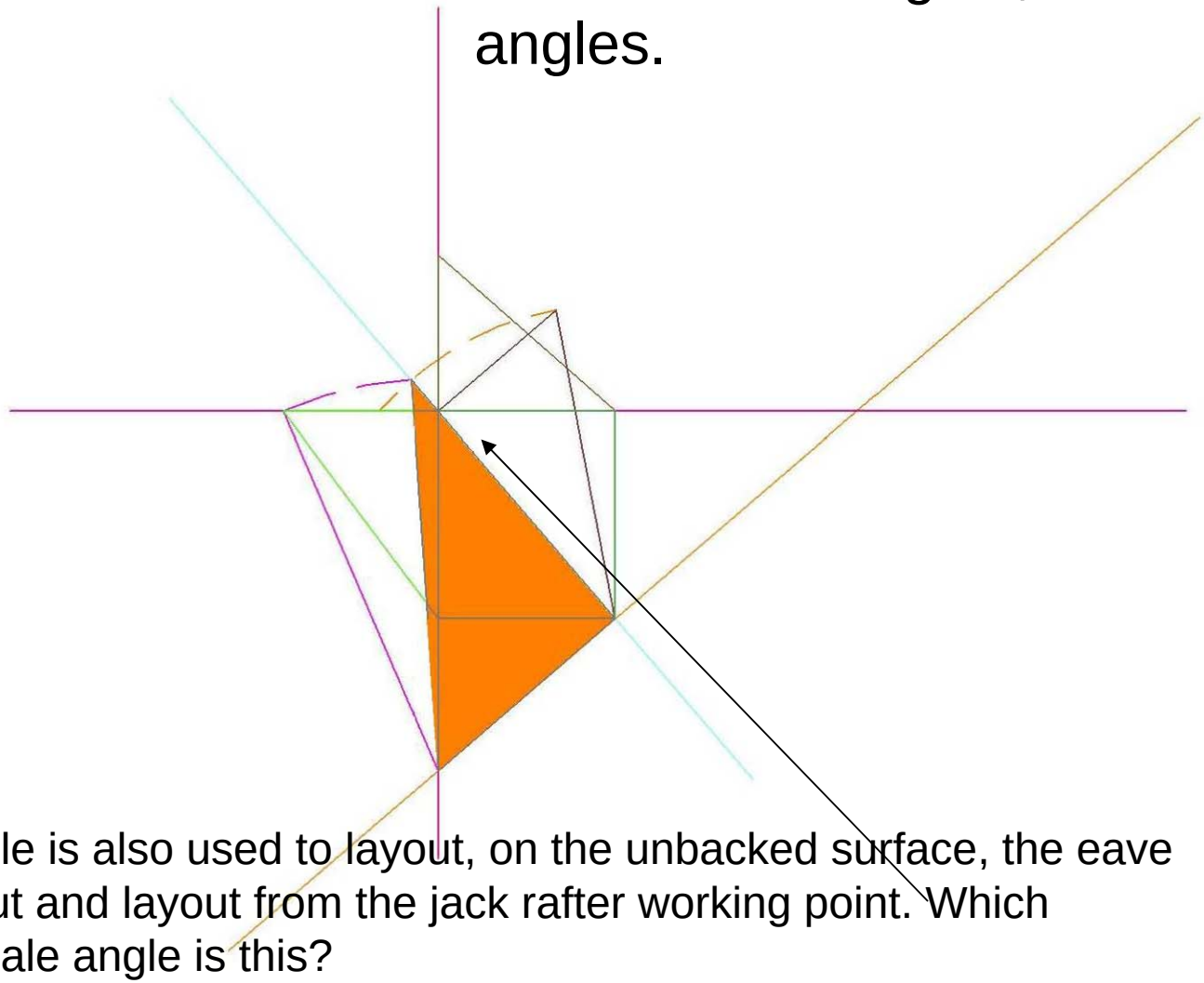
Which Hawkindale is this?

The Main Tangent plane is a right triangle with the Hip Length square to the Tangent. The hypotenuse is the main header hypotenuse.



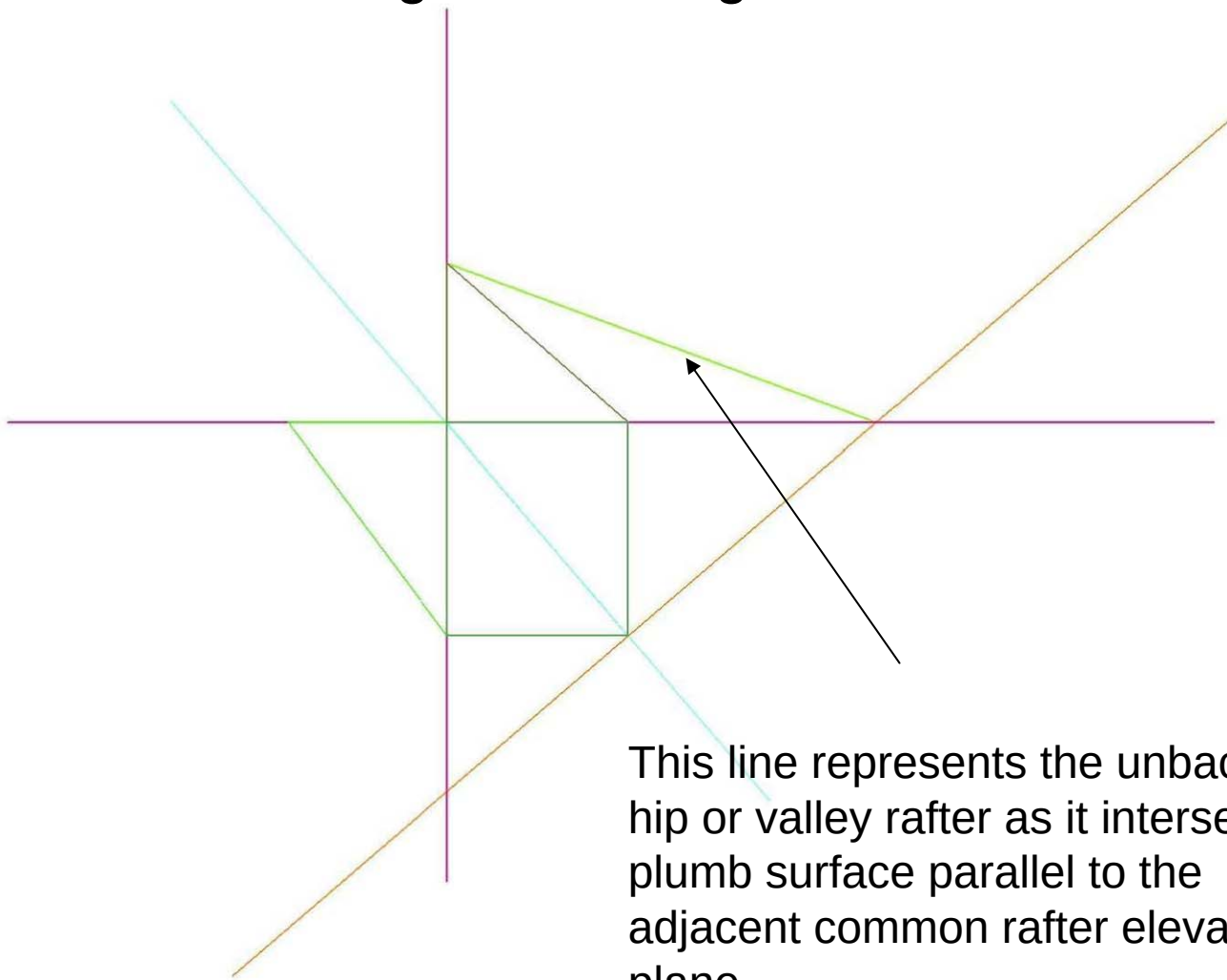
Bring the hip length and the Header Hypotenuse length to the hip run extension.

The shaded triangle contains the angles needed to lay out intersections of Hip or Valley with any plumb plane parallel to the Main Common rafter. Solve for lengths, ratios and angles.



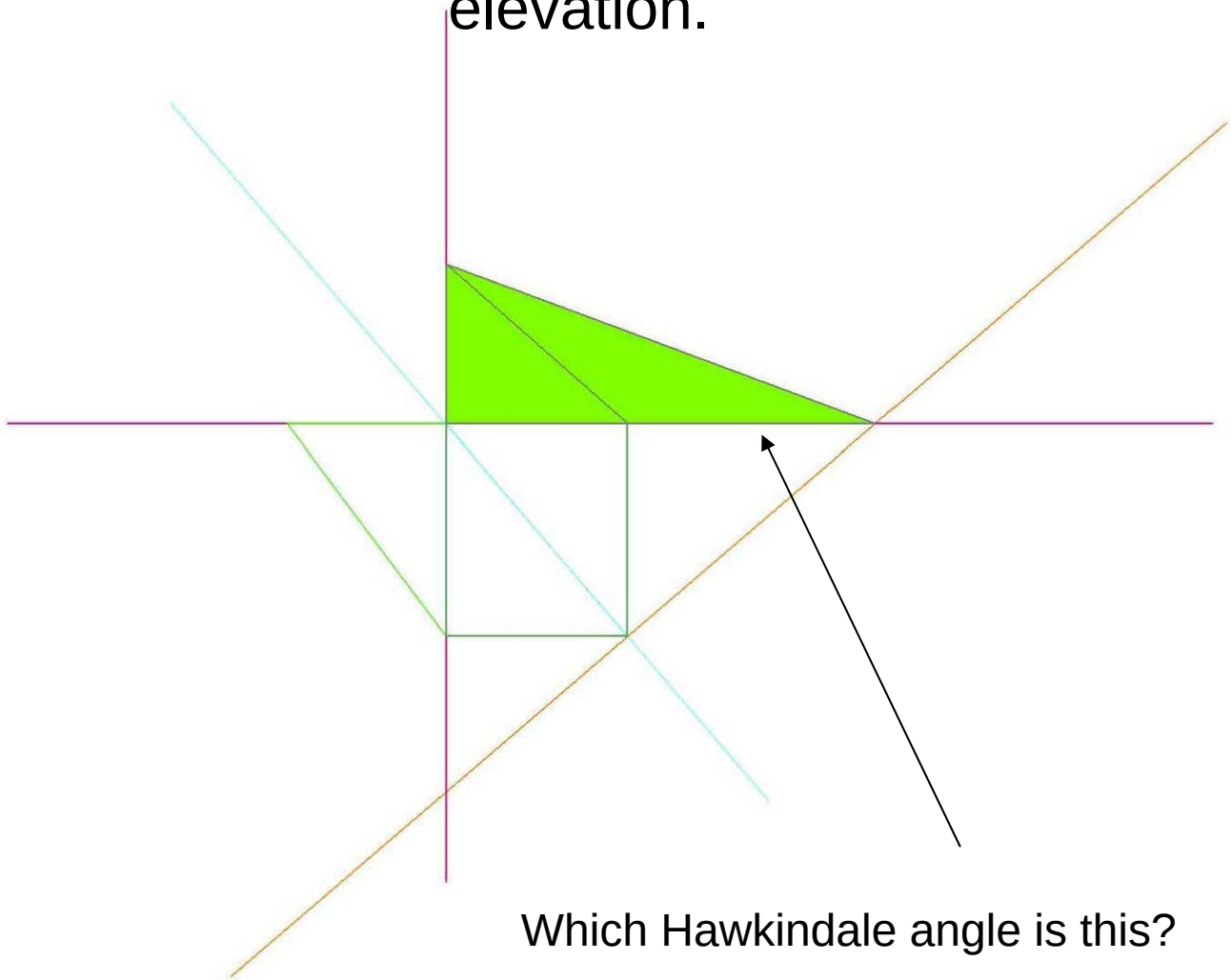
This angle is also used to layout, on the unbacked surface, the eave plumb cut and layout from the jack rafter working point. Which Hawkindale angle is this?

Repeat the exercise for the adjacent roof. Solve for all lengths and angles.



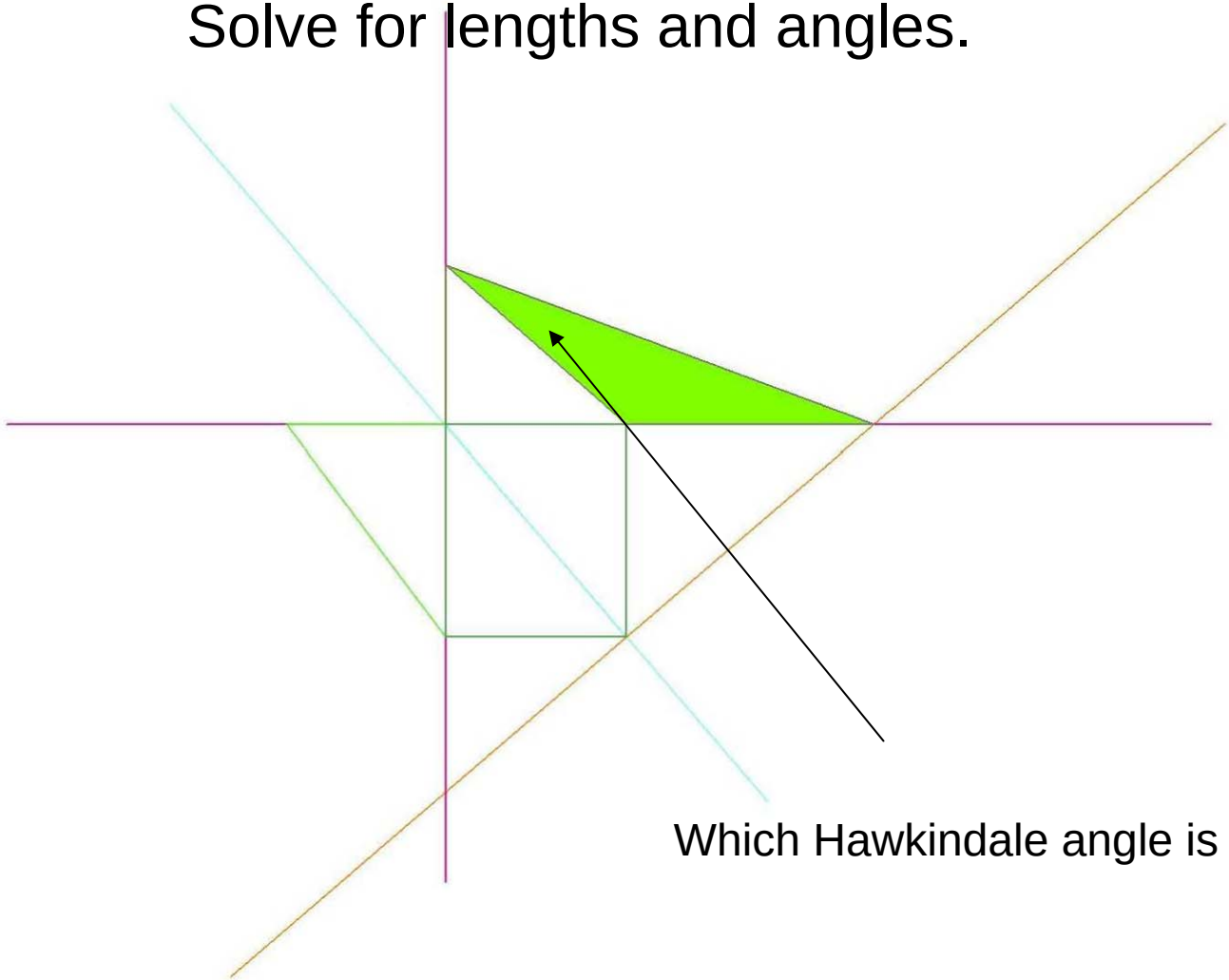
This line represents the unbacked hip or valley rafter as it intersects a plumb surface parallel to the adjacent common rafter elevation plane.

The shaded angle is measured between a level line and the unbacked hip or valley in the Adjacent Common rafter elevation.



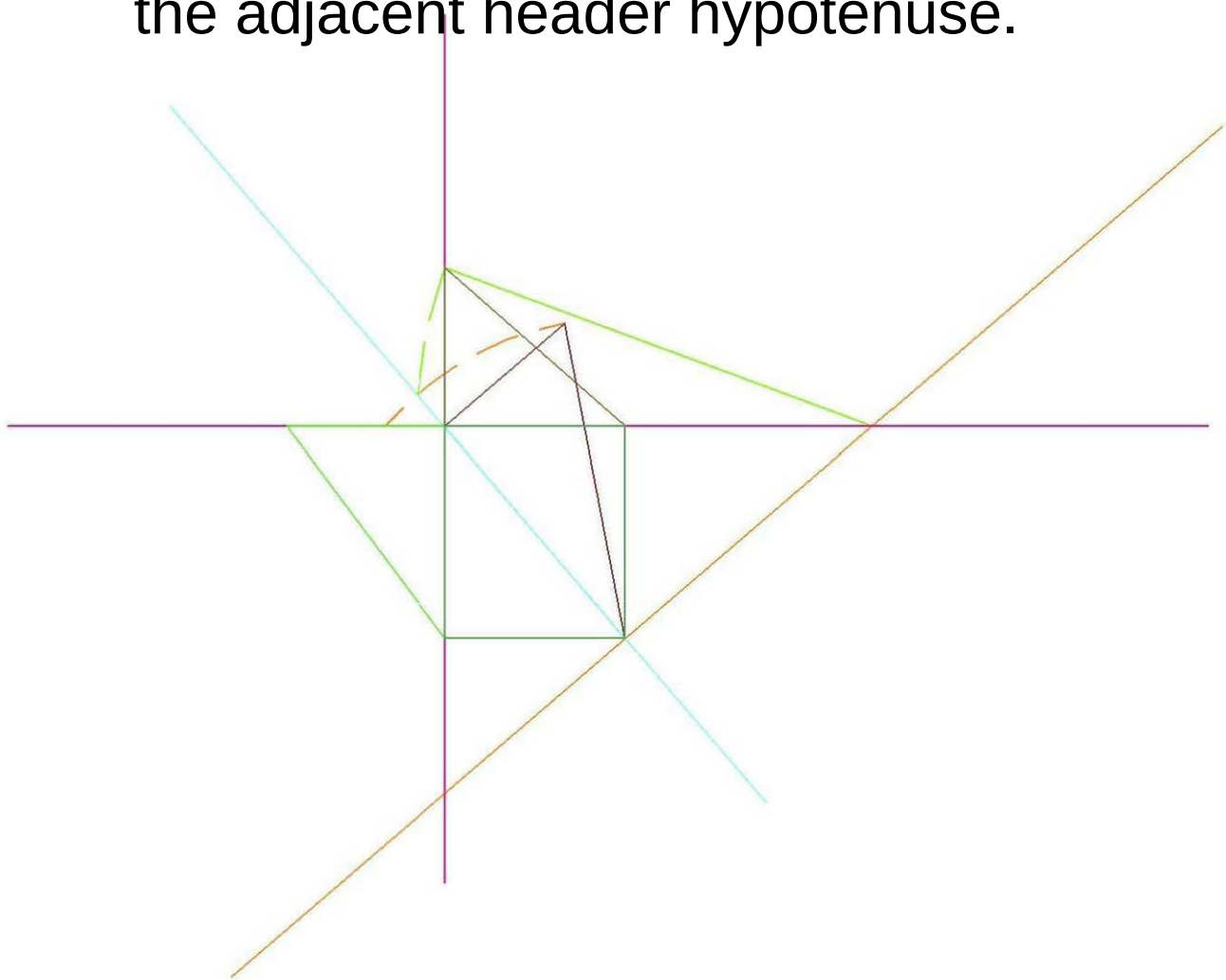
Which Hawkindale angle is this?

This shaded angle is the intersection between the Adjacent common rafter and unbacked hip or valley.
Solve for lengths and angles.



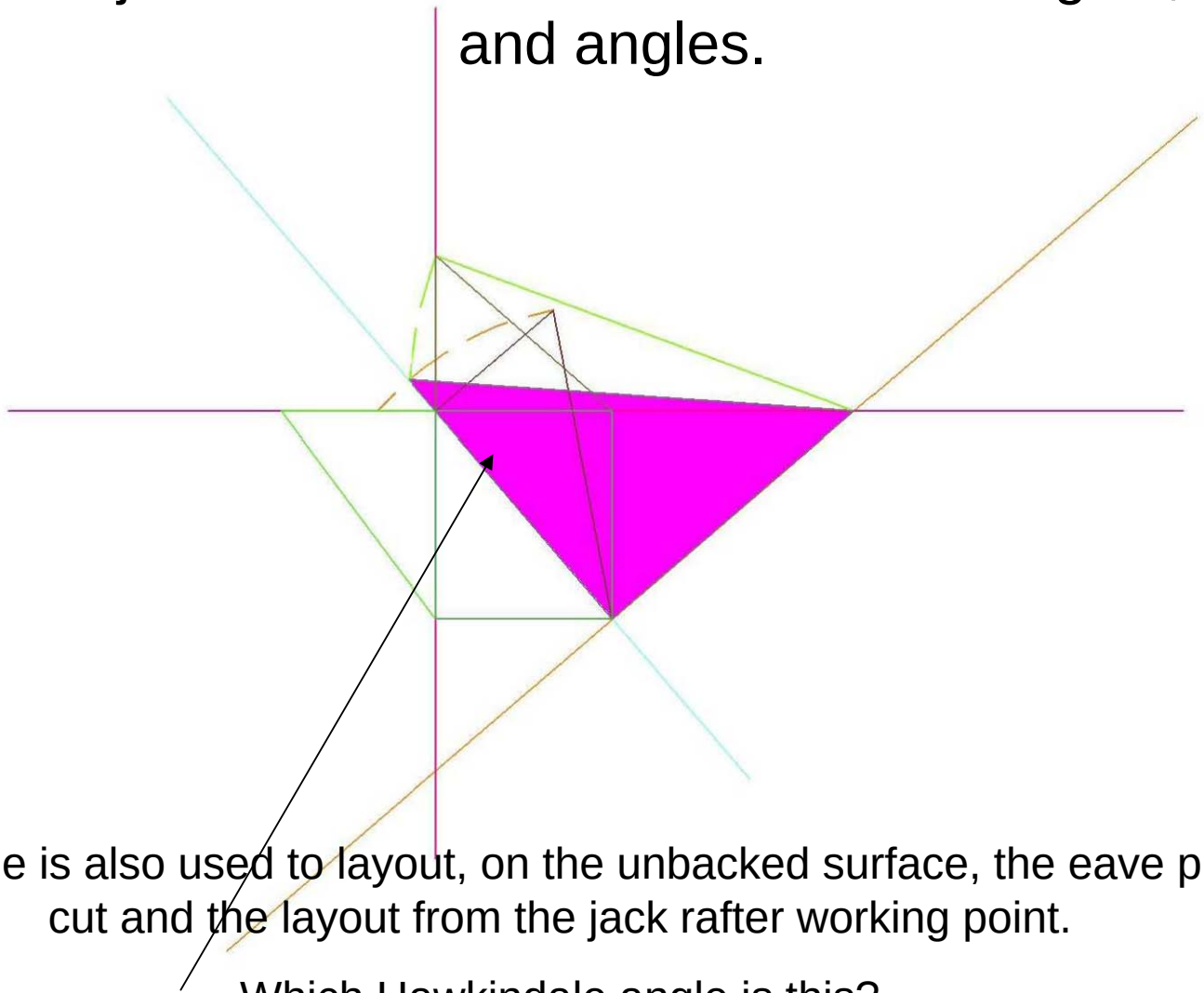
Which Hawkindale angle is this?

The Adjacent Tangent plane is a right triangle with the Hip Length square to the Main roof tangent. The hypotenuse is the adjacent header hypotenuse.



Bring the hip length and the header hypotenuse length to the hip run extension.

The shaded triangle contains the angles needed to lay out intersections of Hip or Valley with any plumb plane parallel to the Adjacent Common rafter. Solve for lengths, ratios and angles.



This angle is also used to layout, on the unbacked surface, the eave plumb cut and the layout from the jack rafter working point.

Which Hawkindale angle is this?

More information is needed

- We now have the information needed for laying out plumb cuts on the unbacked hip and valley.
- We have the information needed to layout the intersection of the unbacked hip or valley on surfaces parallel to the common rafter planes.
- The locations where these intersections occur can be determined knowing the plan view information and the correct multiplier.
- Given this information and the dimension of materials we can now solve for lengths, angles, housing sizes, and more.
- What happens when we intersect with a plane that is square to the common rafter length?

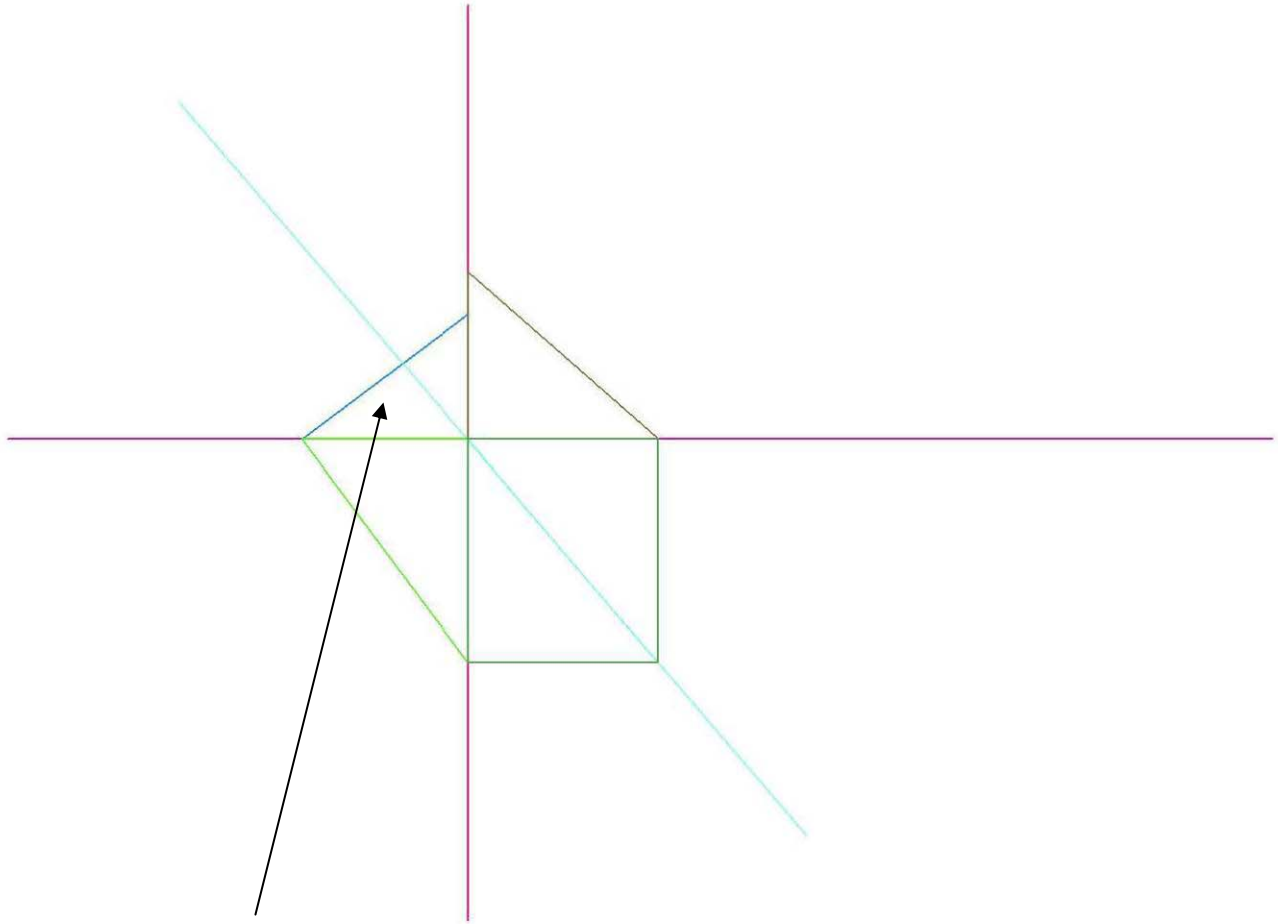
The Purlin Plane

- The purlin top and bottom surfaces are in or parallel to the sheathing plane.
- We have solved for the layout, on the top surface, of the intersection between purlin and hip or valley.
- The purlin plane, or the face of the purlin plane, is square to the common rafter length.
- How do we develop the cuts on the purlin?

Purlin Cautions!

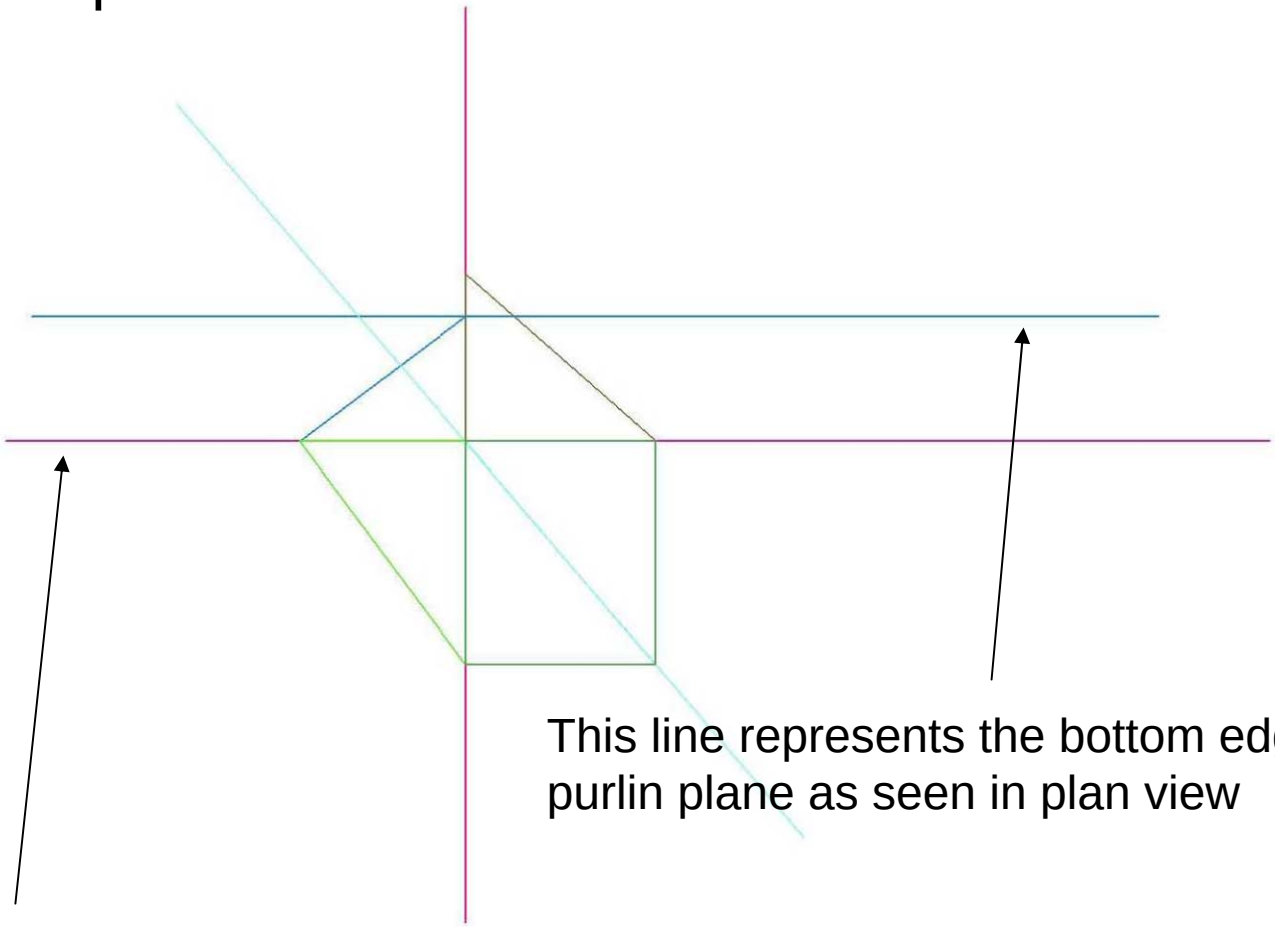
- We are viewing a hip roof kernel so the adjacent roof purlin travels in the vertical direction. Hip roof purlins are longer on the top surface than the bottom surface.
- If this were a Valley the adjacent roof purlin would travel left to right. Valley roof purlins are longer on the bottom surface than the top surface.

Draw a line square to the main common rafter length from the common rise to the extended run.



This line represents the face of the purlin

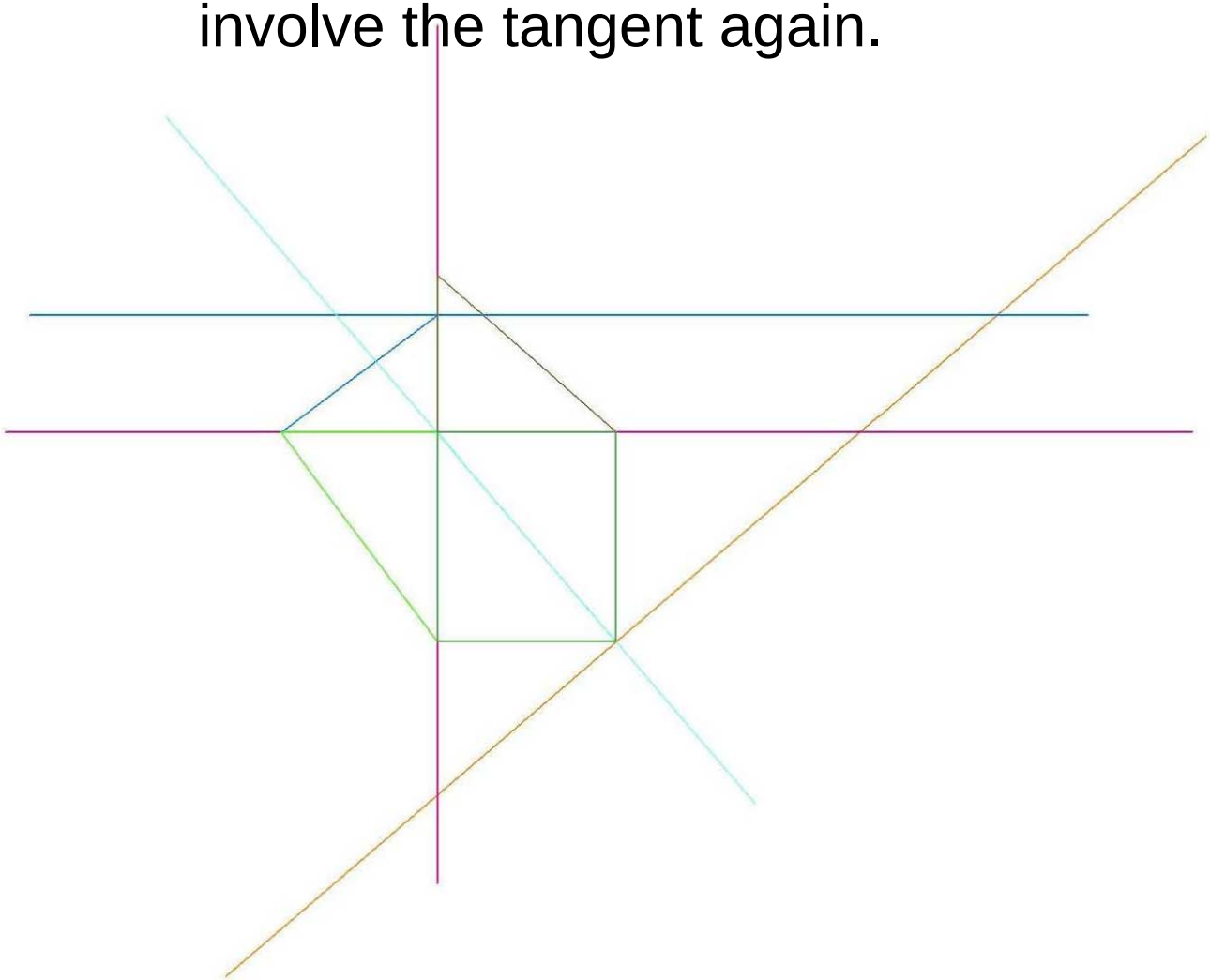
Draw a line parallel to the adjacent run through the intersection of the purlin face and the common run extension.



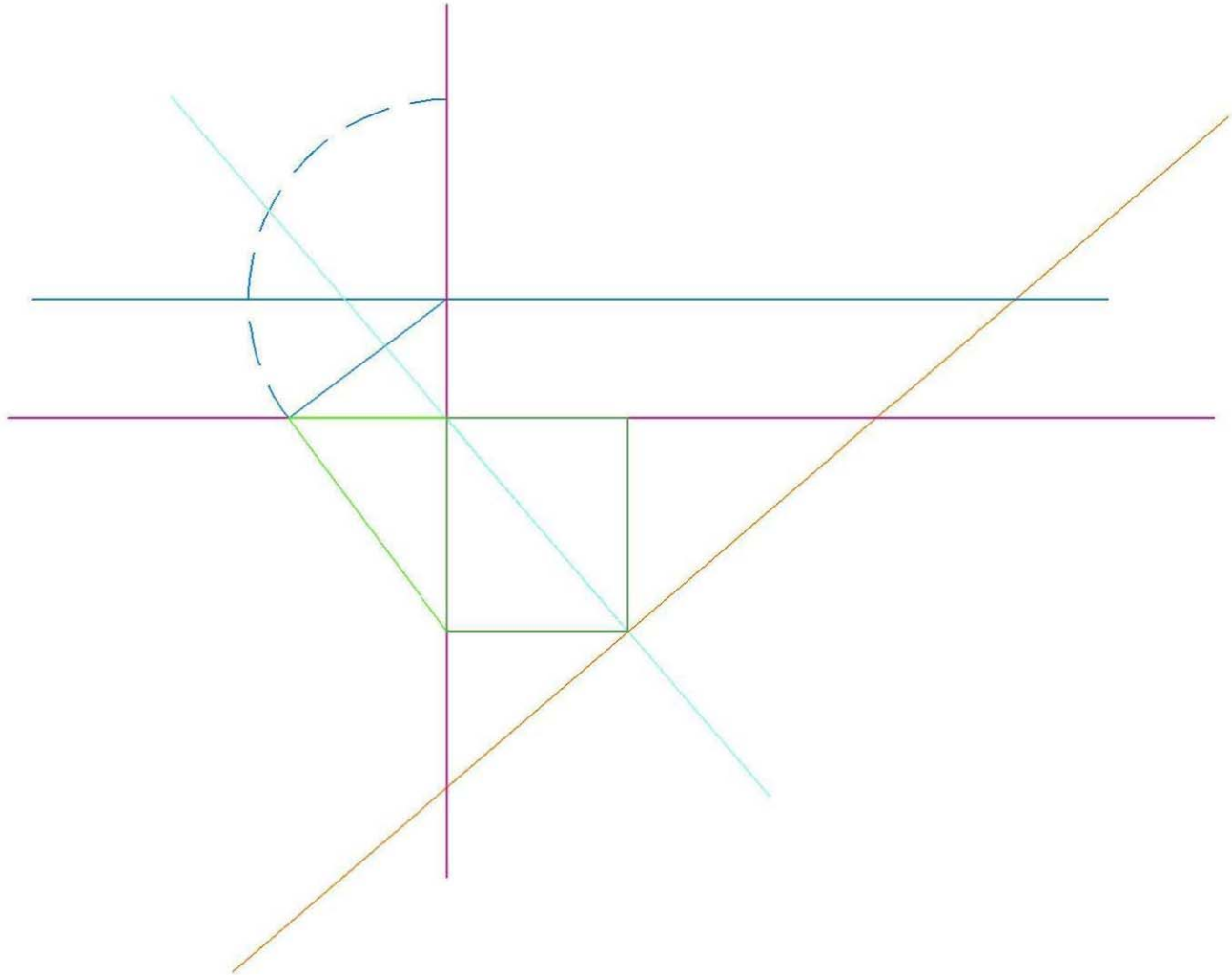
This line represents the bottom edge of the purlin plane as seen in plan view

This line represents the top edge of the purlin plane as seen in plan view

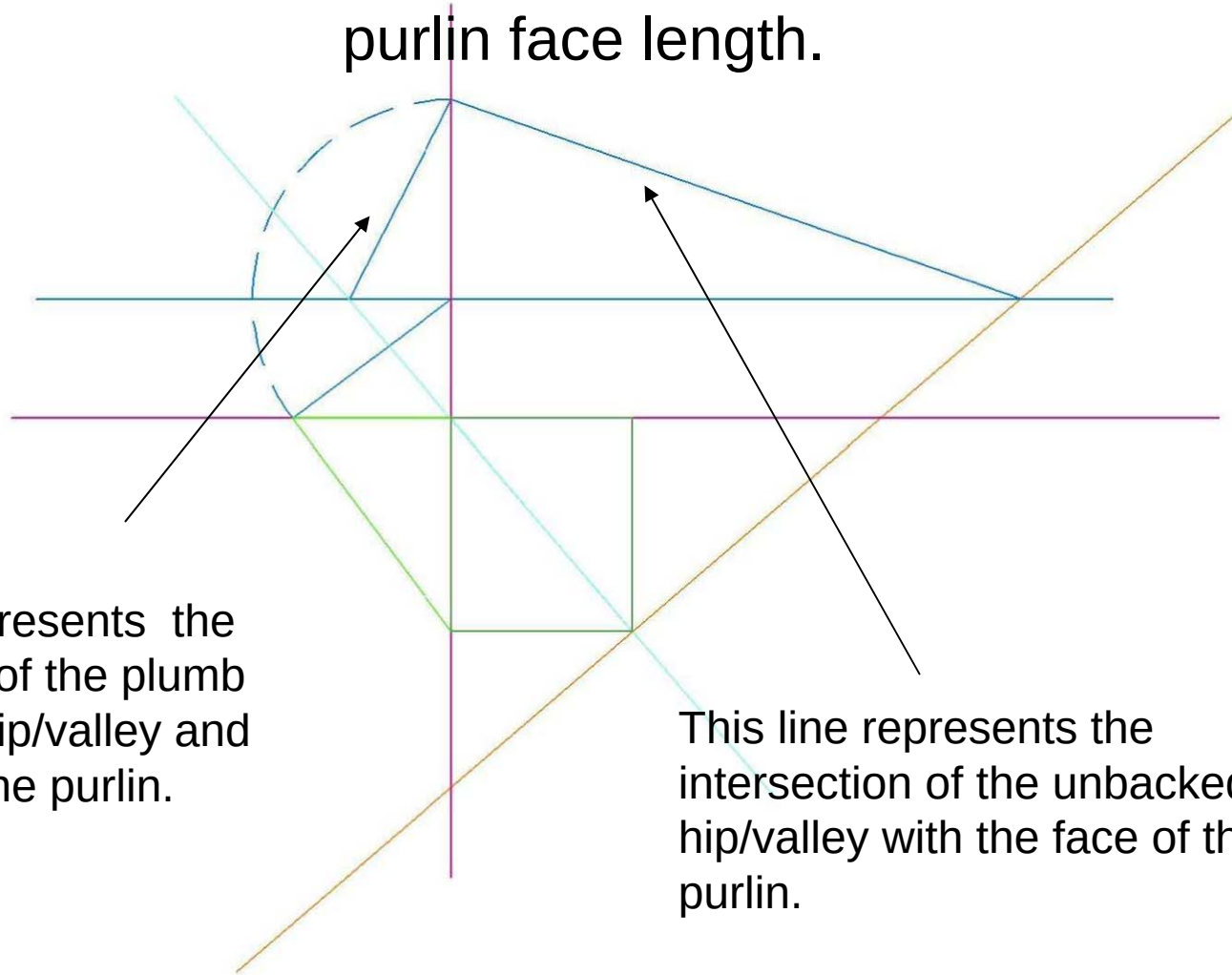
Since we are looking for information regarding the intersection of the unbacked hip/valley planes and purlin we need to involve the tangent again.



We need to see the purlin plane in true shape so begin by bringing the purlin face length to the common run extension.



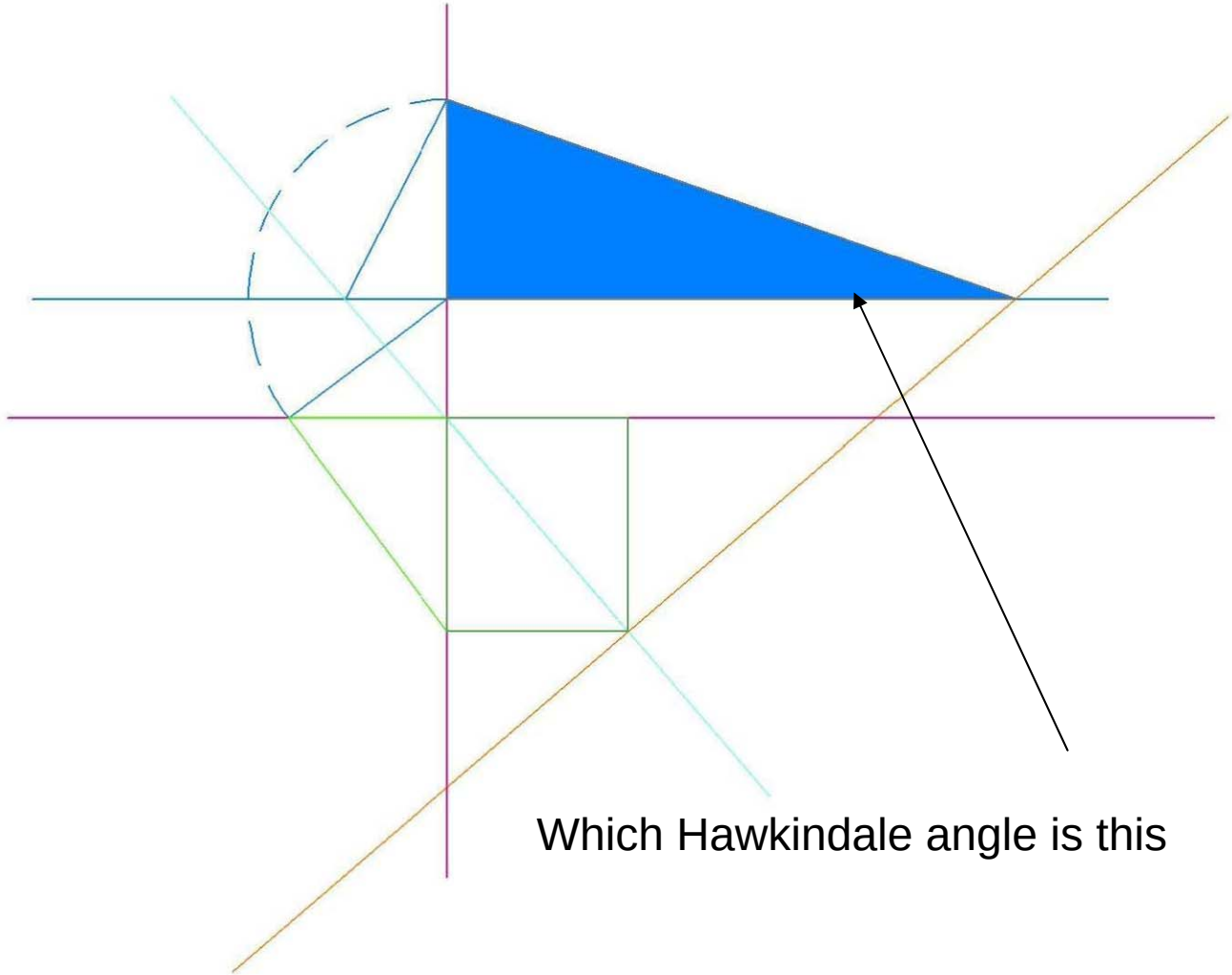
Connect the points where the purlin bottom line crosses the tangent to the purlin face length. Then connect the point where the hip run crosses the purlin bottom line to the purlin face length.



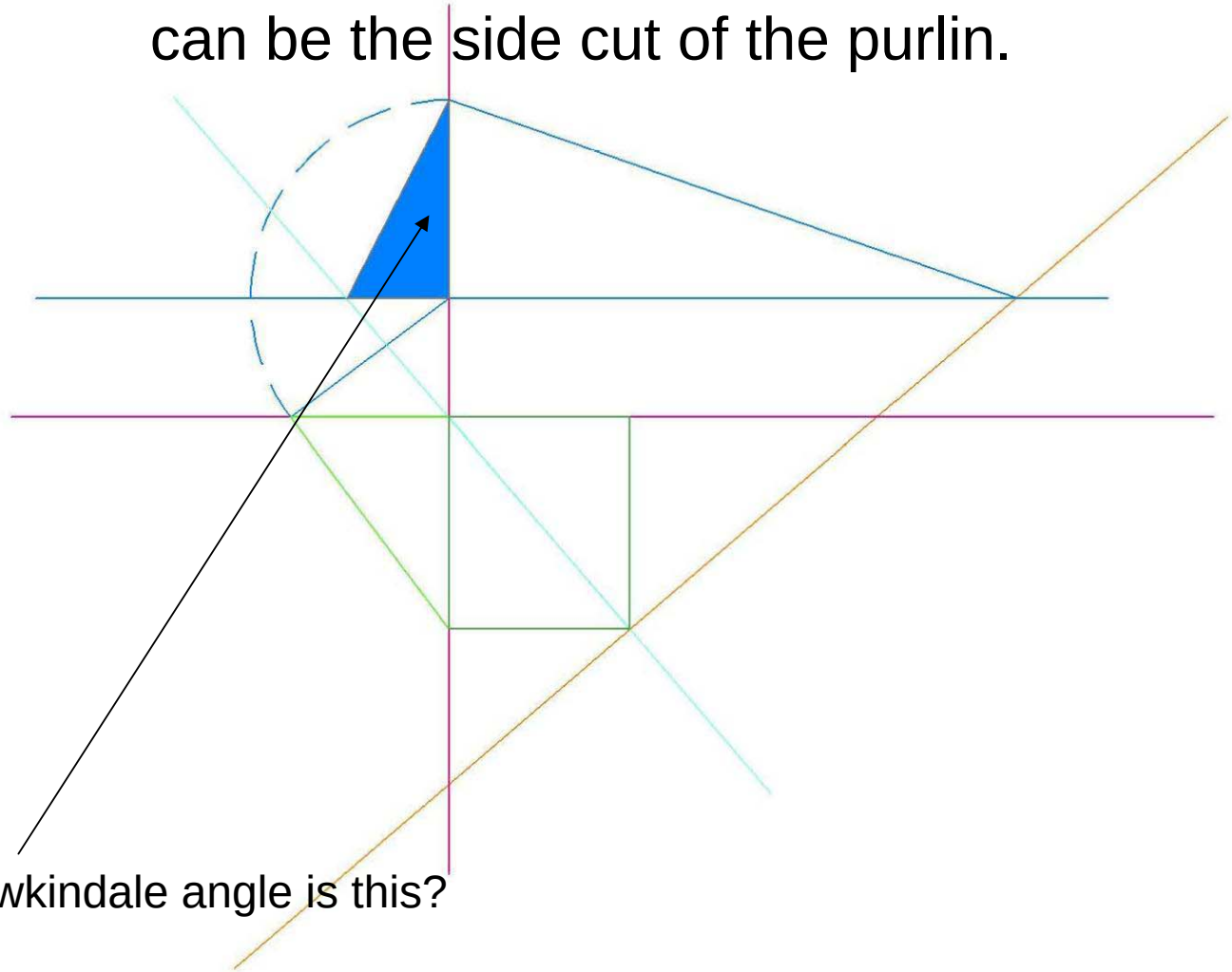
This line represents the intersection of the plumb side of the hip/valley and the face of the purlin.

This line represents the intersection of the unbacked hip/valley with the face of the purlin.

The shaded angle represents the intersection of the unbacked hip/valley with a purlin in the main common roof.

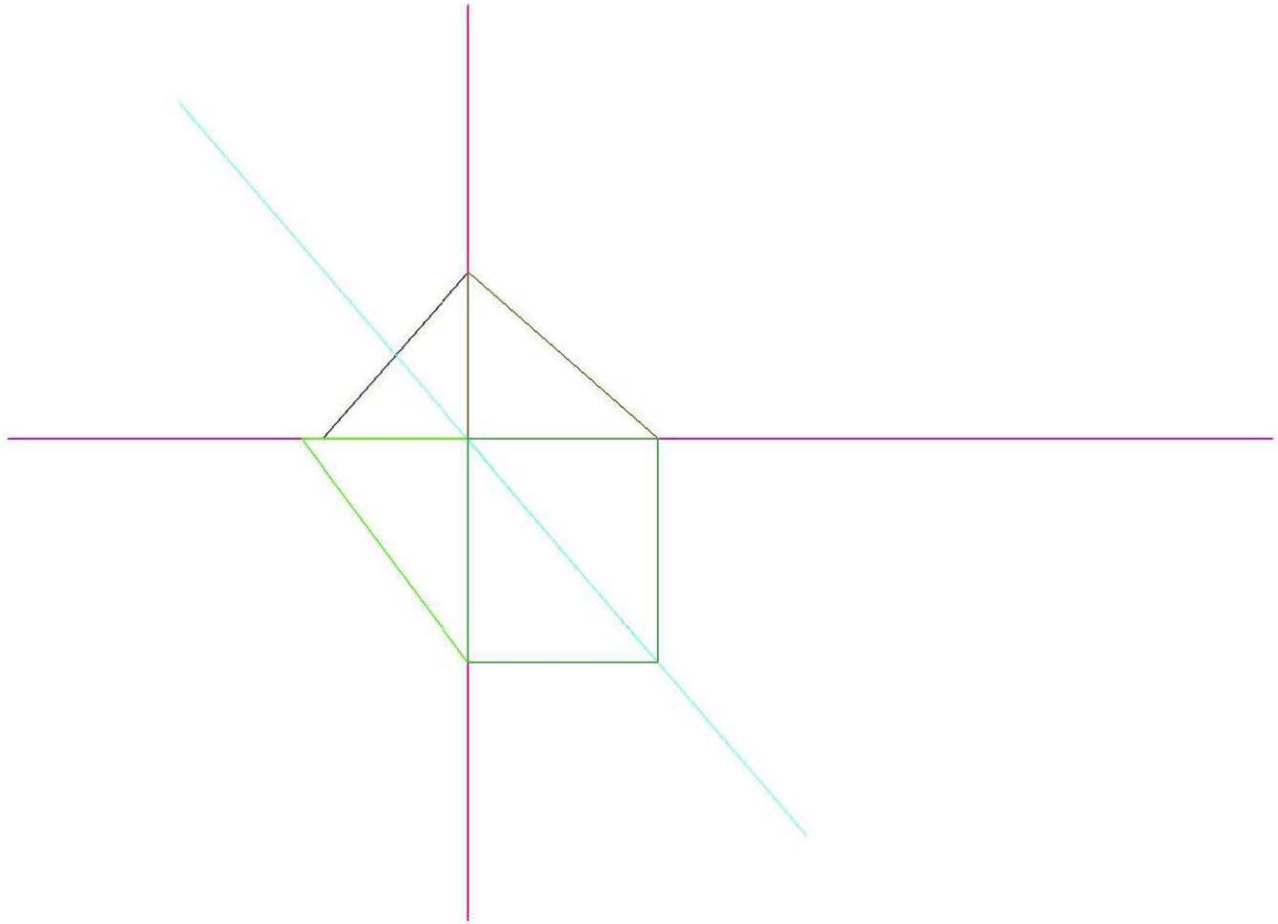


This shaded angle describes the intersection of the plumb side of the hip/valley and the face of the main purlin. This can be the hip/valley housing line on the purlin face or it can be the side cut of the purlin.

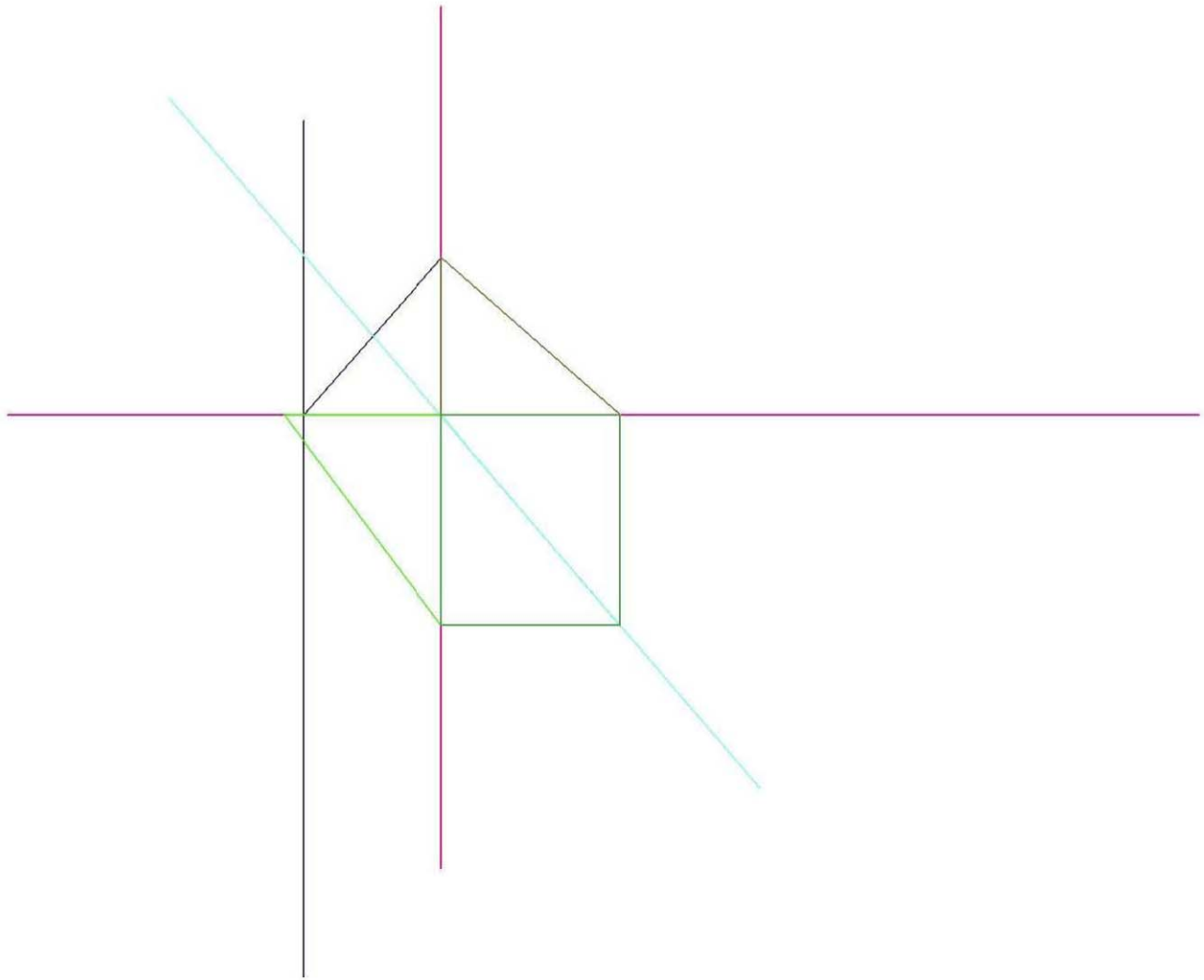


Which Hawkindale angle is this?

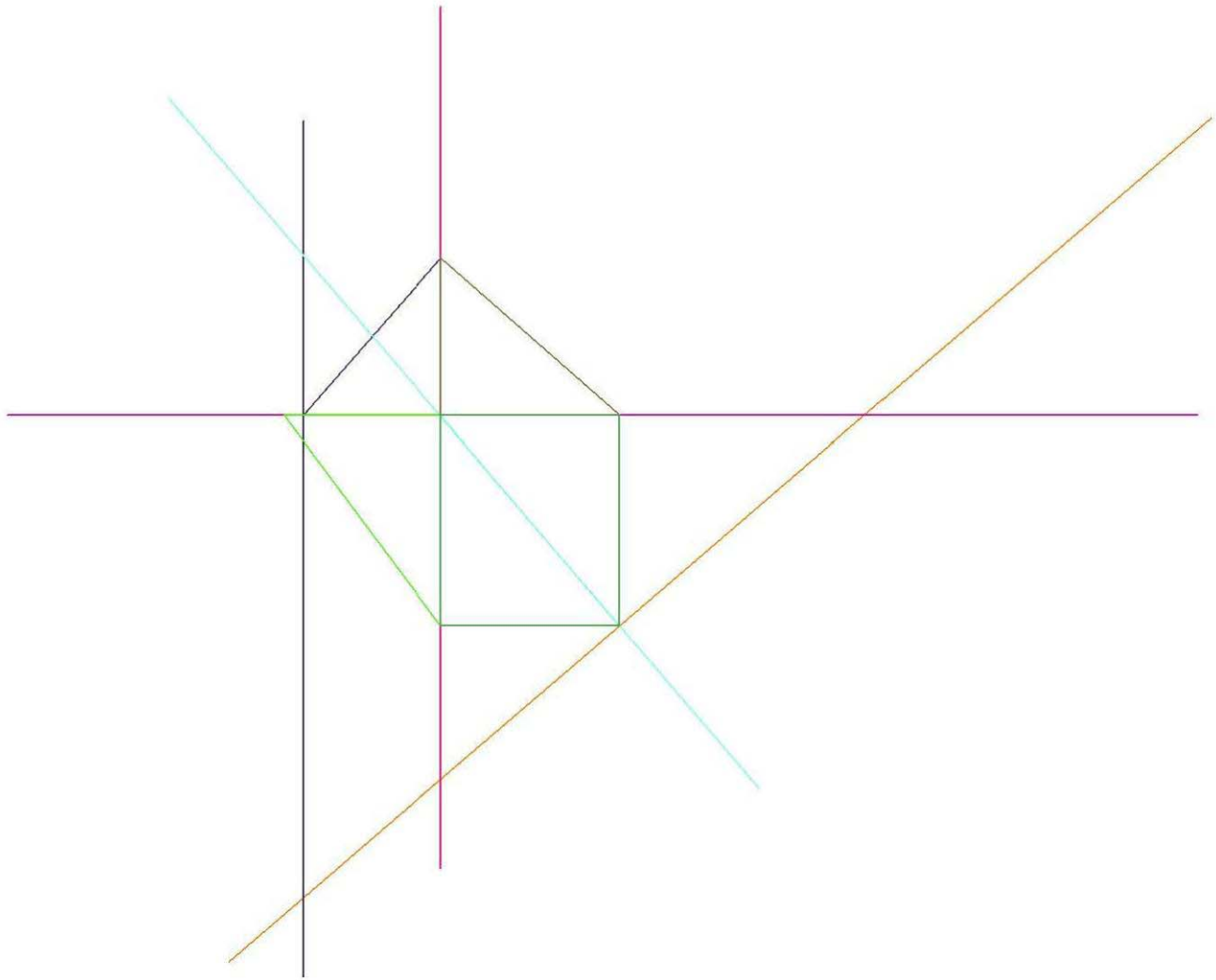
Repeat the exercise for the adjacent purlin. First add the face line.



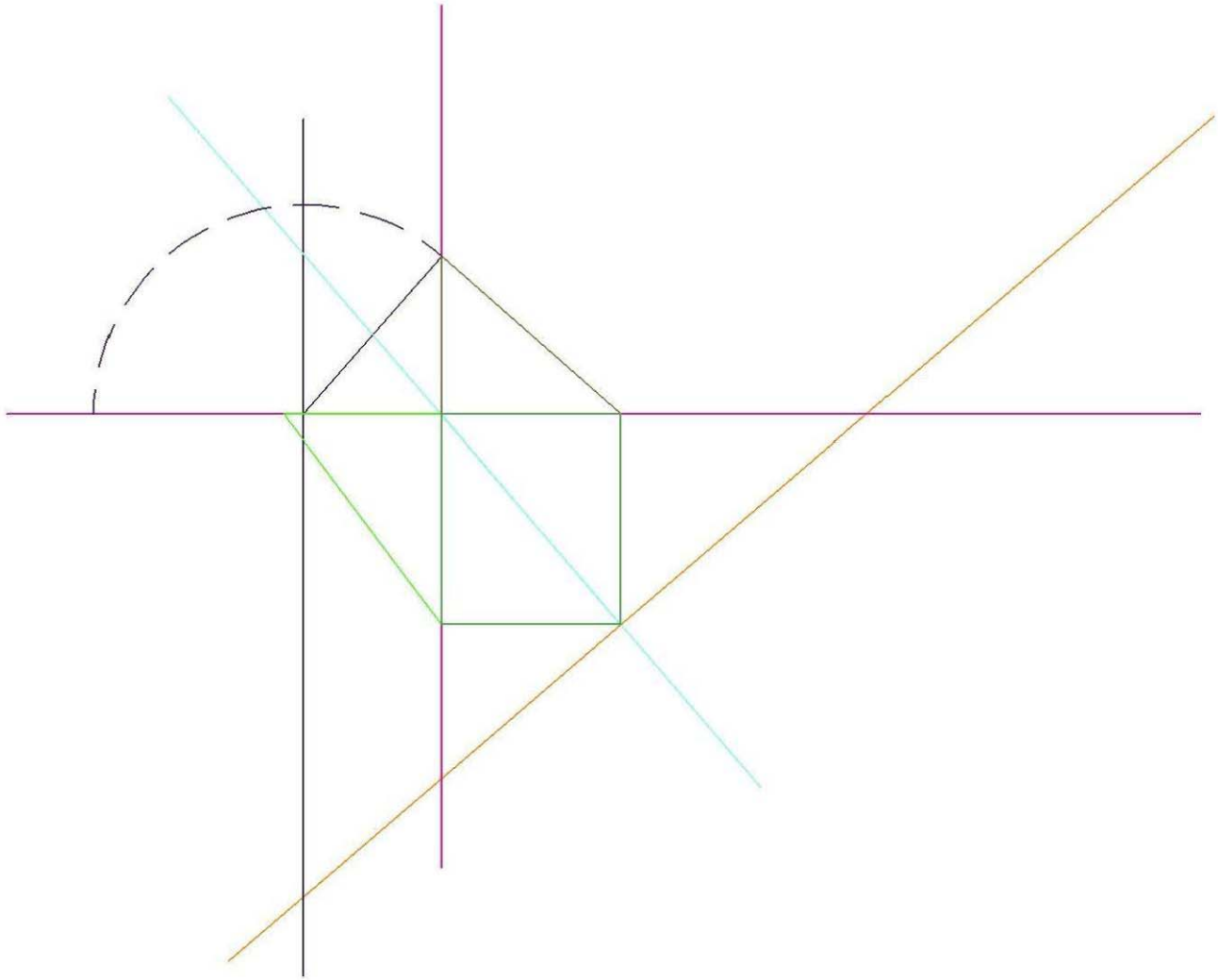
Add the bottom of the purlin line.



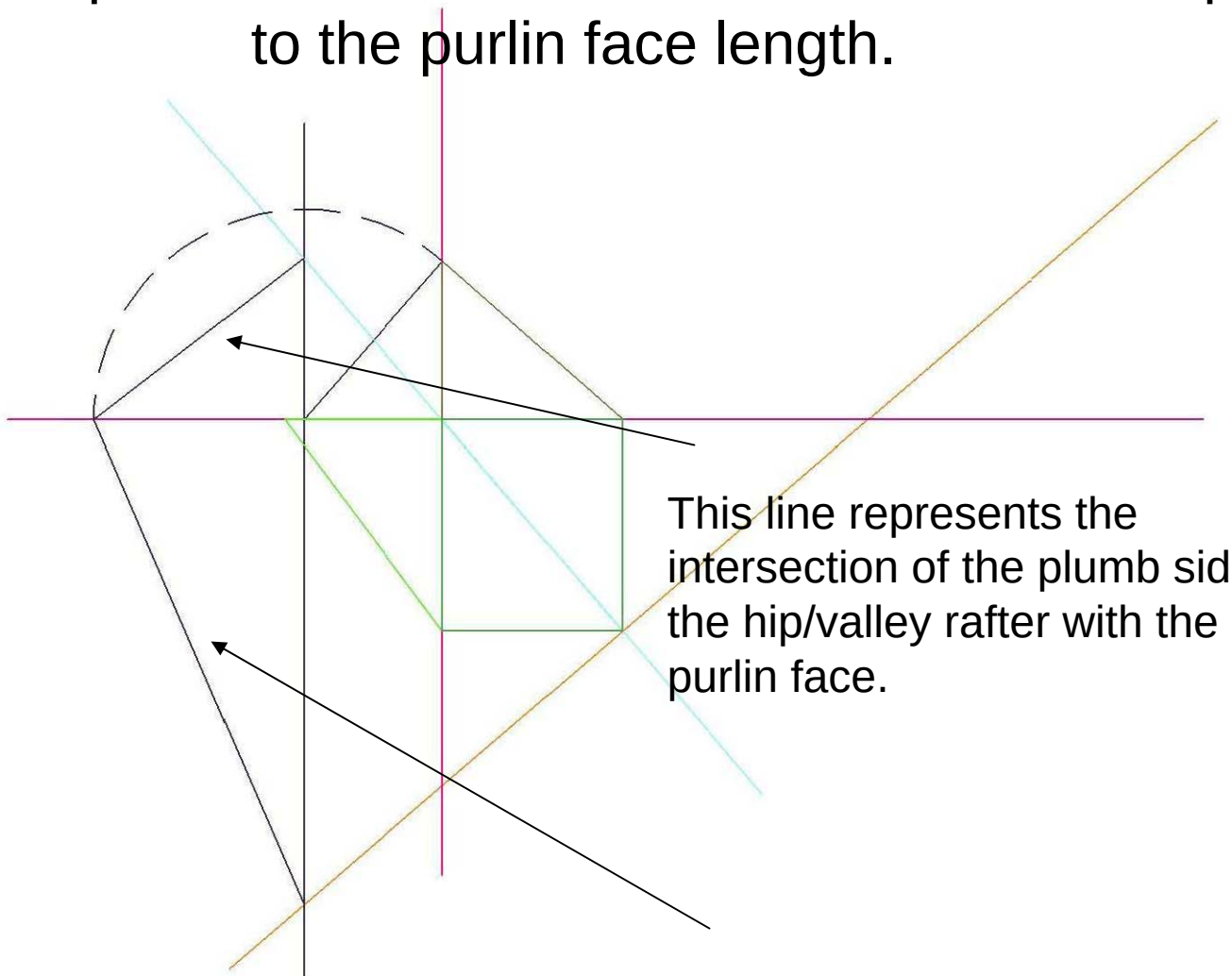
Next add the tangent.



Transfer the length of the adjacent purlin face to the extended adjacent common rafter run.



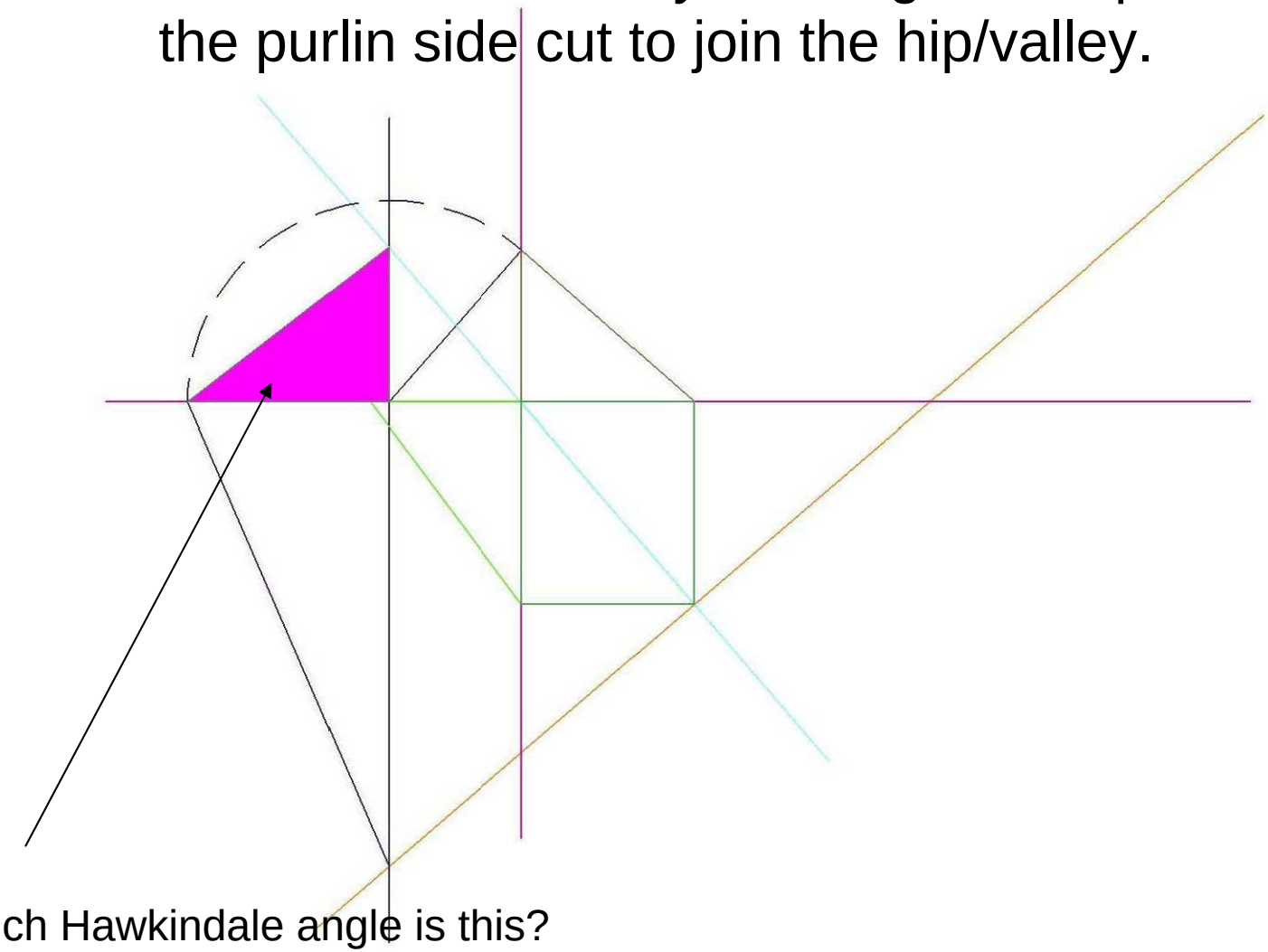
Connect the points where the bottom purlin line crosses the tangent to the purlin face length. Then connect the point where the purlin bottom line crosses the extended hip run to the purlin face length.



This line represents the intersection of the plumb side of the hip/valley rafter with the purlin face.

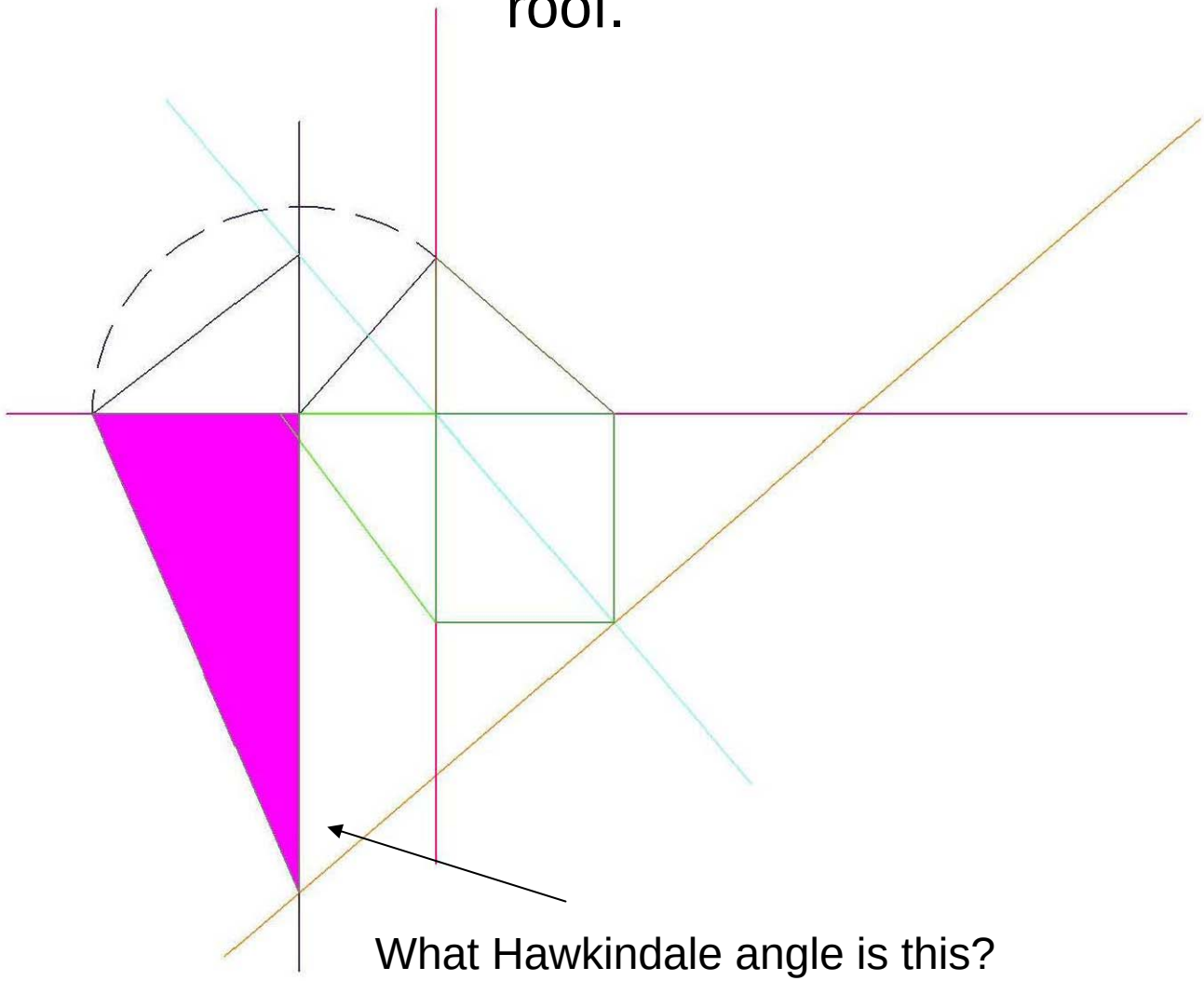
This line represents the intersection of the unbacked hip/valley with the face of the purlin.

This shaded angle occurs at the intersection of the plumb side of the hip/valley and the adjacent purlin face. This defines the side of the valley housing on the purlin or the purlin side cut to join the hip/valley.



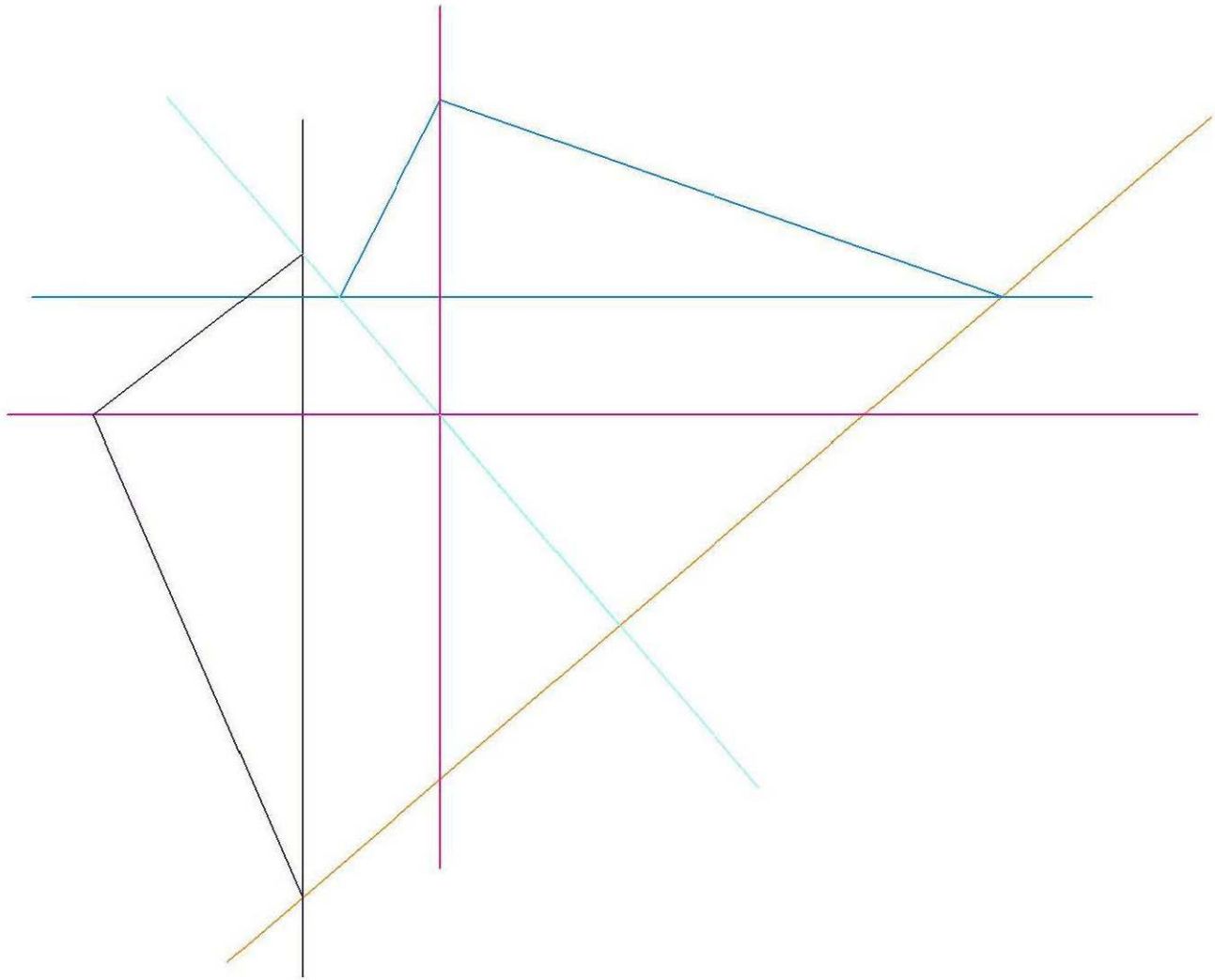
Which Hawkindale angle is this?

The shaded angle represents the intersection of the unbacked hip/valley with a purlin in the adjacent common roof.

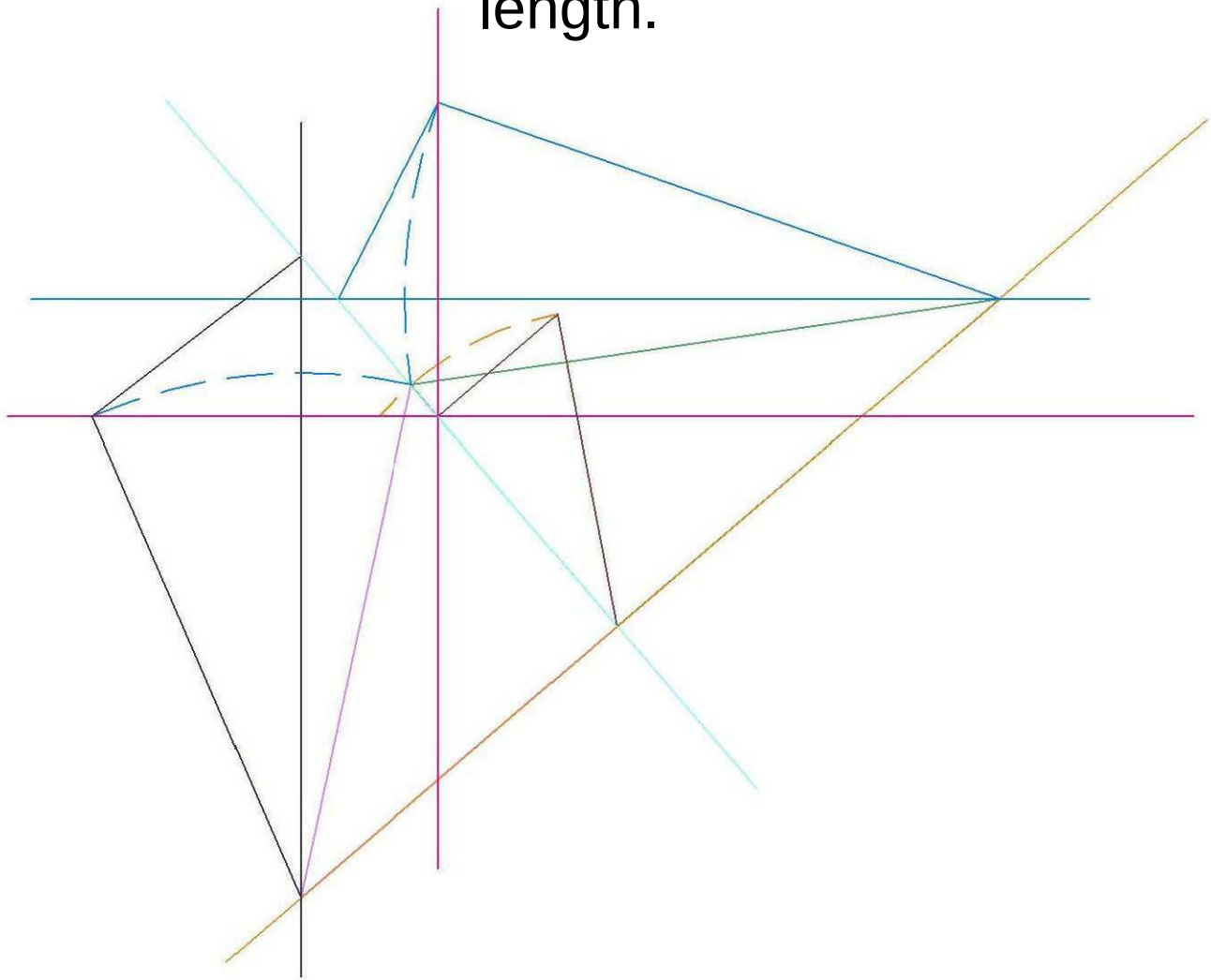


What Hawkindale angle is this?

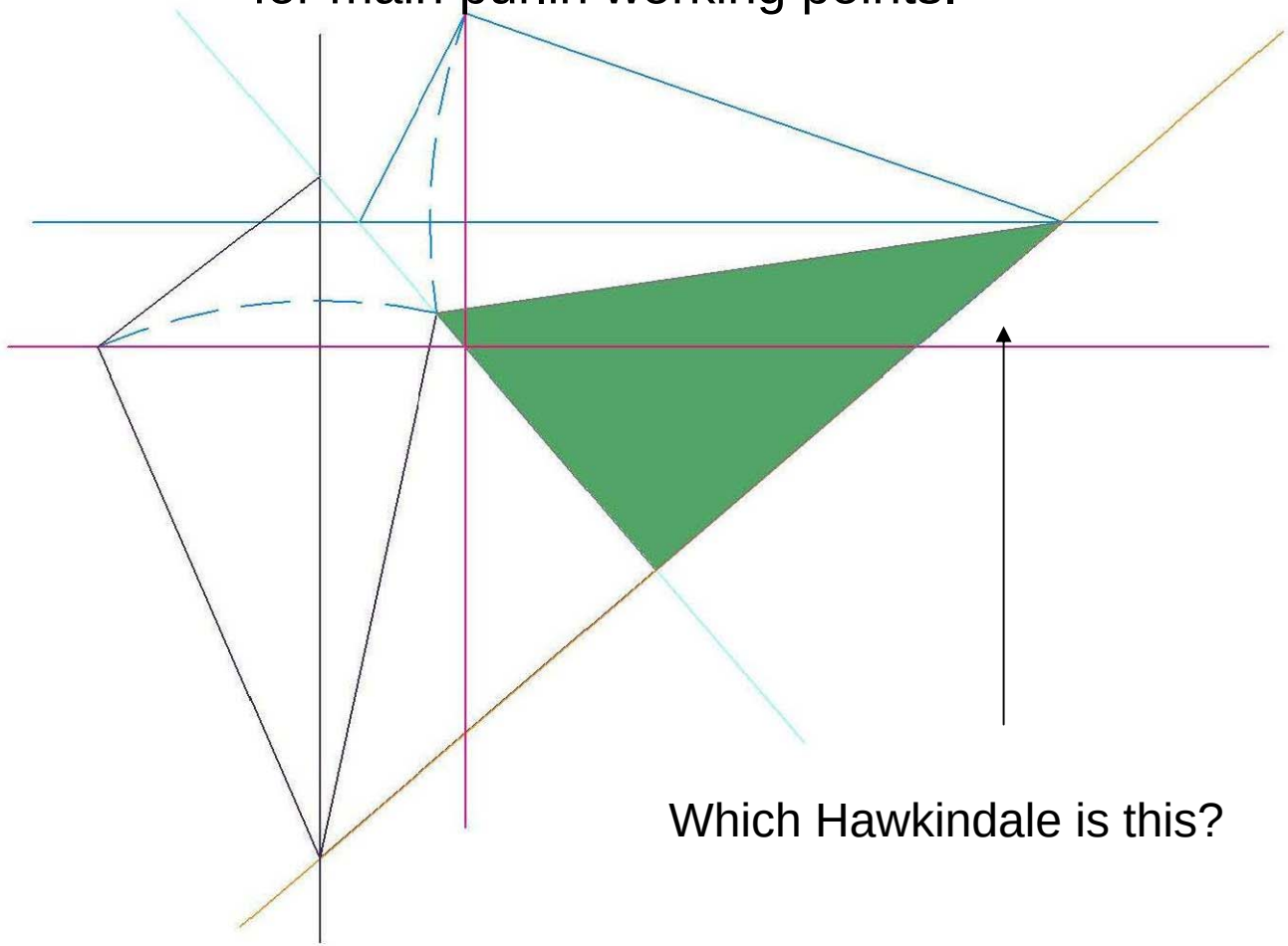
Consider both purlin face planes at the same time.



Swing the purlin hypotenuse lengths until they intersect the extended hip run. Note the convergence with the hip length.

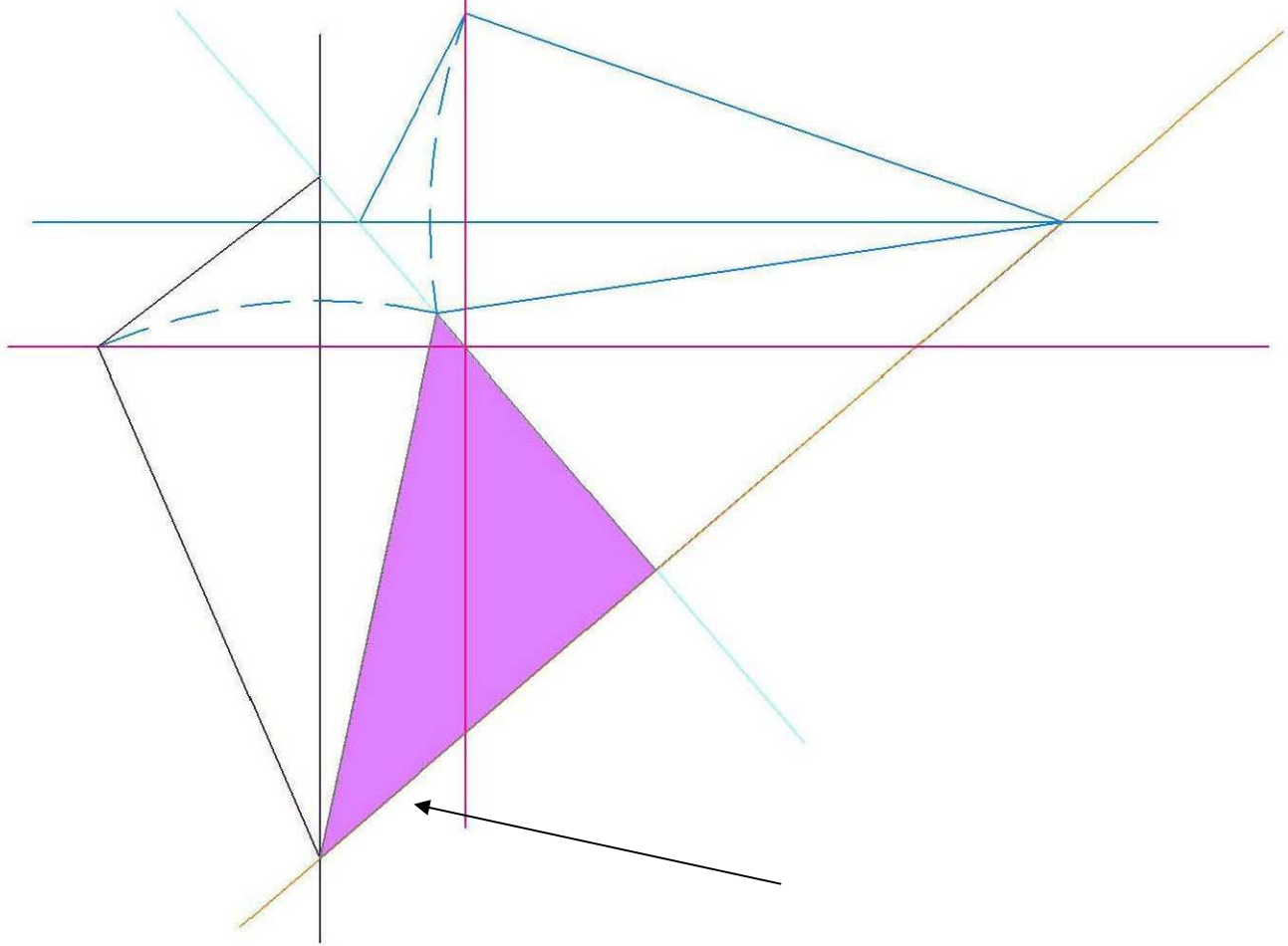


The shaded angle is the top cut of the unbacked hip/valley at the main roof purlin and the top cut of the hip/valley at the eave IF the hip/valley is cut in a plane square to the common pitch. Is also the layout angle for main purlin working points.



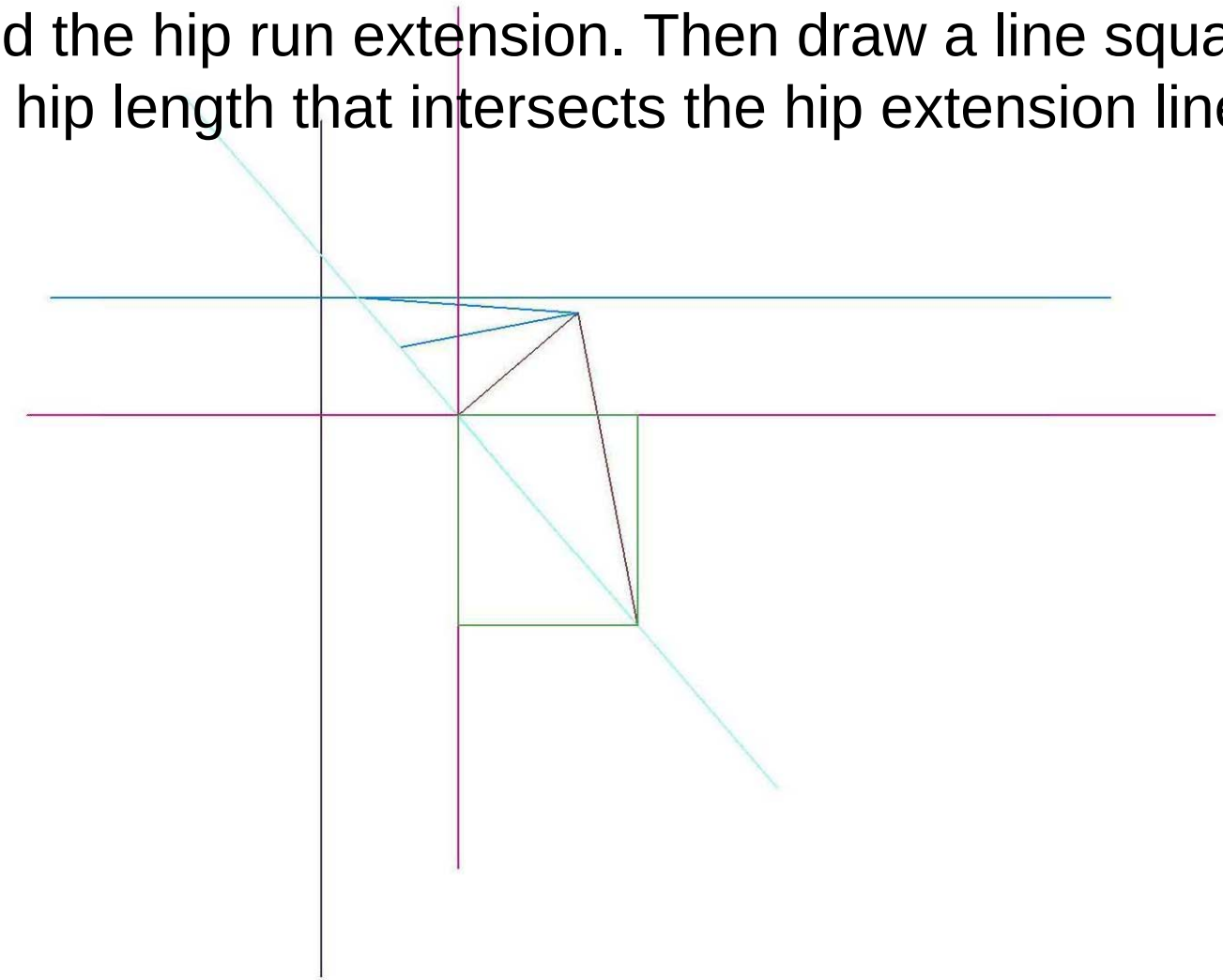
Which Hawkindale is this?

This shaded angle represents the top cut when the hip/valley intersects a purlin in the adjacent roof and it represents the top cut at the eave when the hip is cut a plane square to the common rafter length. This is also the layout for the adjacent purlin working points.

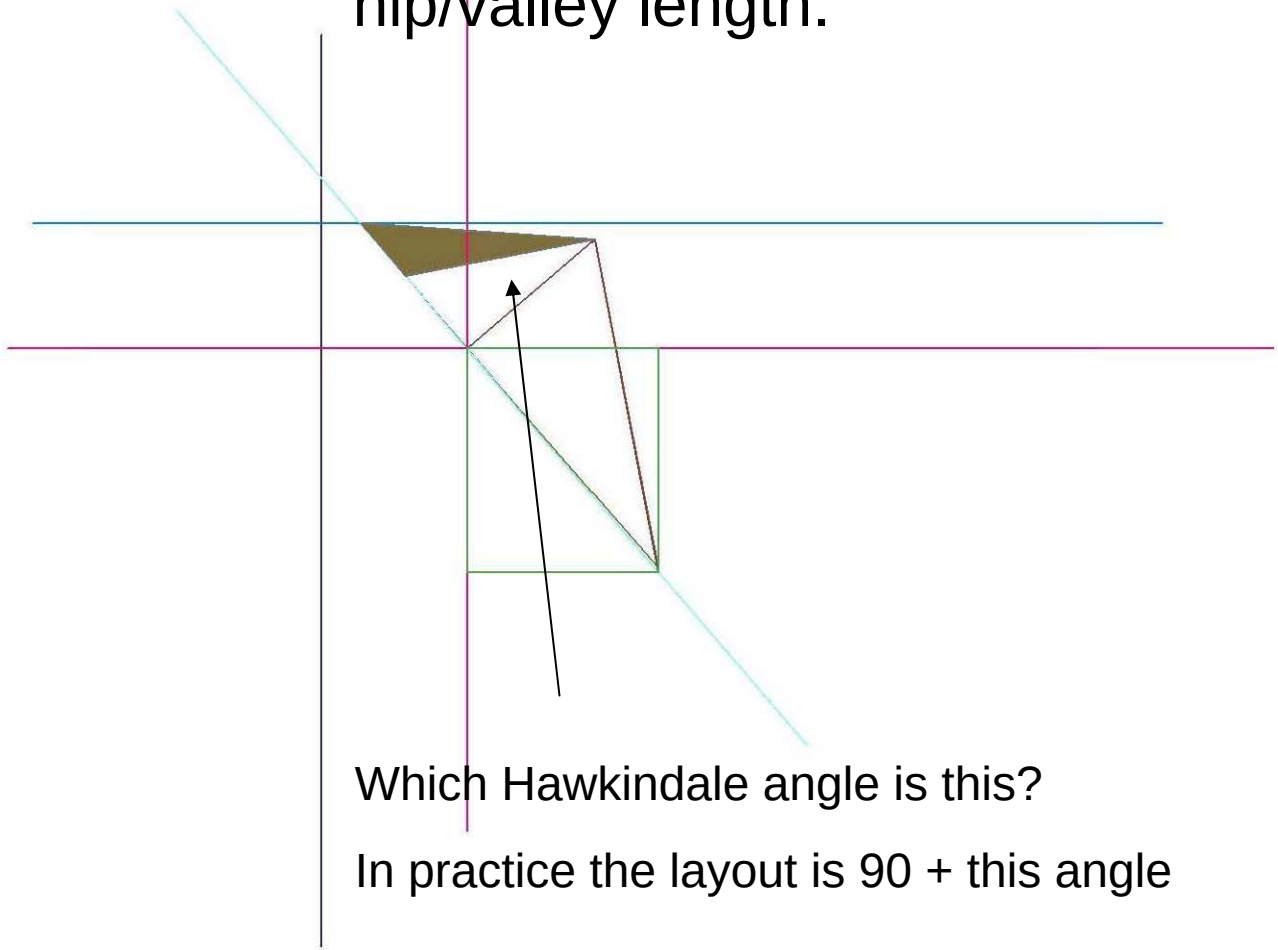


Which Hawkindale angle is this?

Draw a line from the intersection of the common rise and hip length to the intersection of the adjacent purlin bottom line and the hip run extension. Then draw a line square to the hip length that intersects the hip extension line.



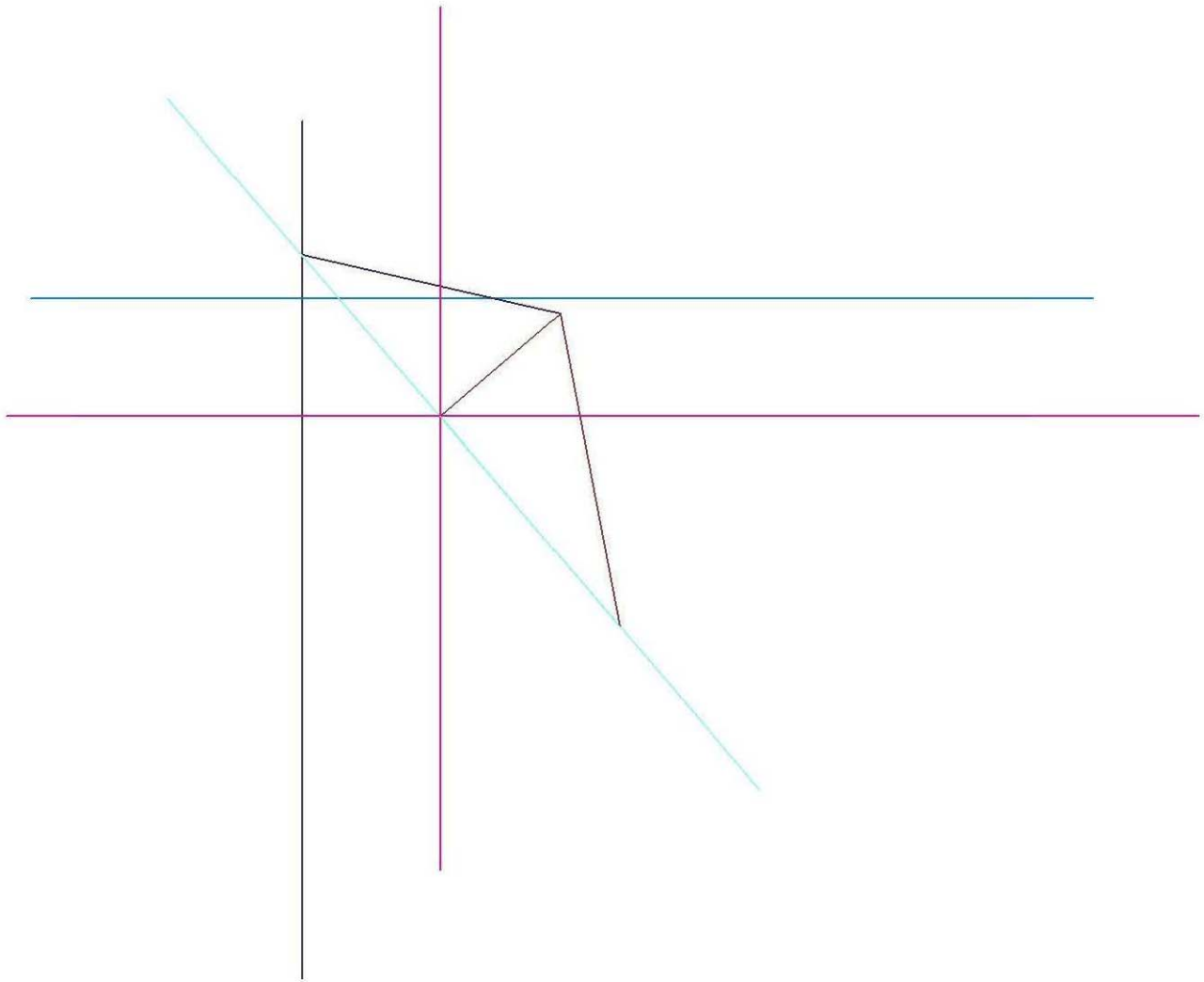
The shaded angle is the layout for the main purlin housing on the plumb side of the hip/valley.
This layout angle is marked out from a line square to the hip/valley length.



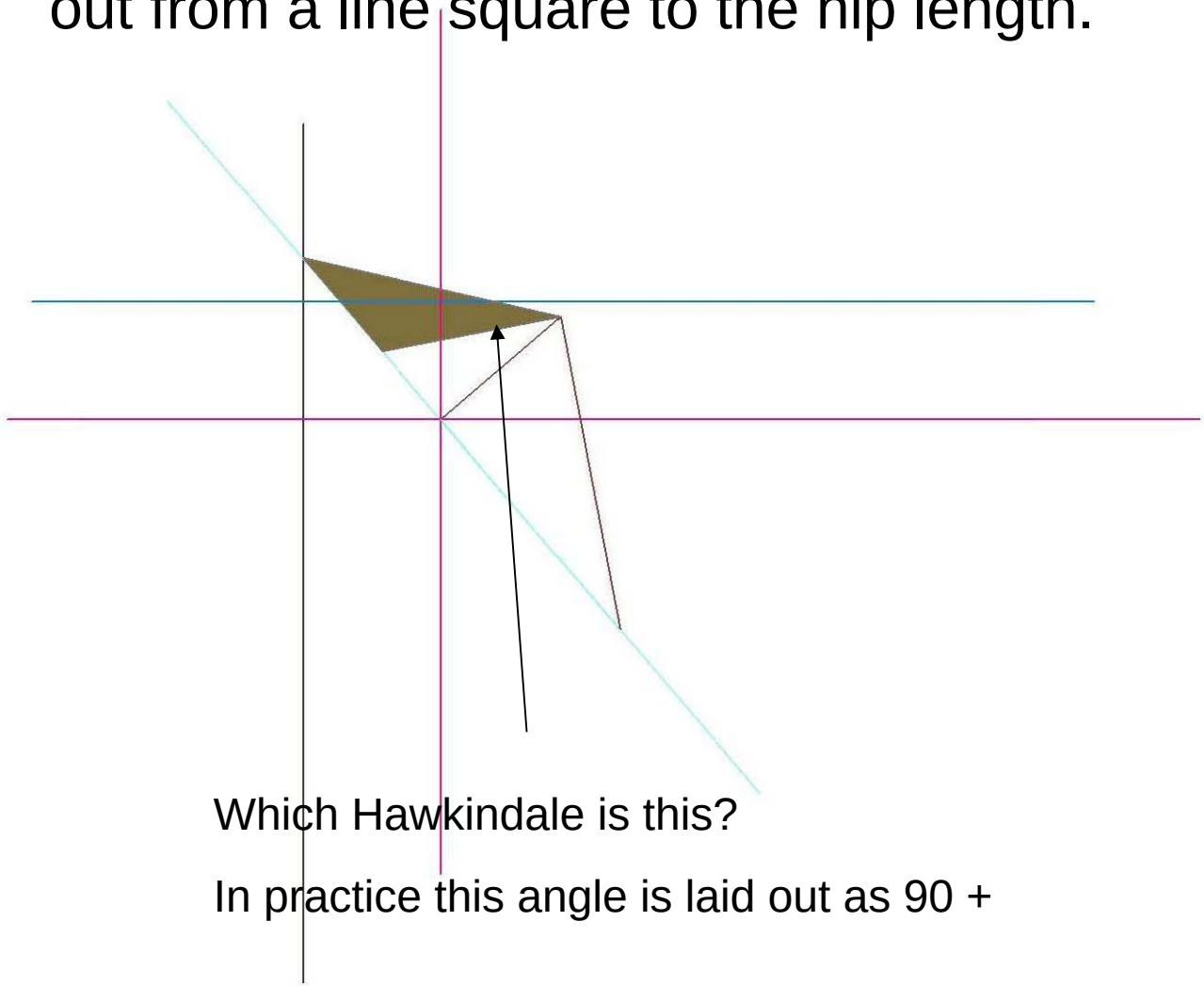
Which Hawkindale angle is this?

In practice the layout is 90 + this angle

Repeat the exercise for the adjacent purlin.



The shaded angle represents the intersection of the purlin and the plumb side of the hip/valley. The angle is marked out from a line square to the hip length.



Which Hawkindale is this?

In practice this angle is laid out as 90 +