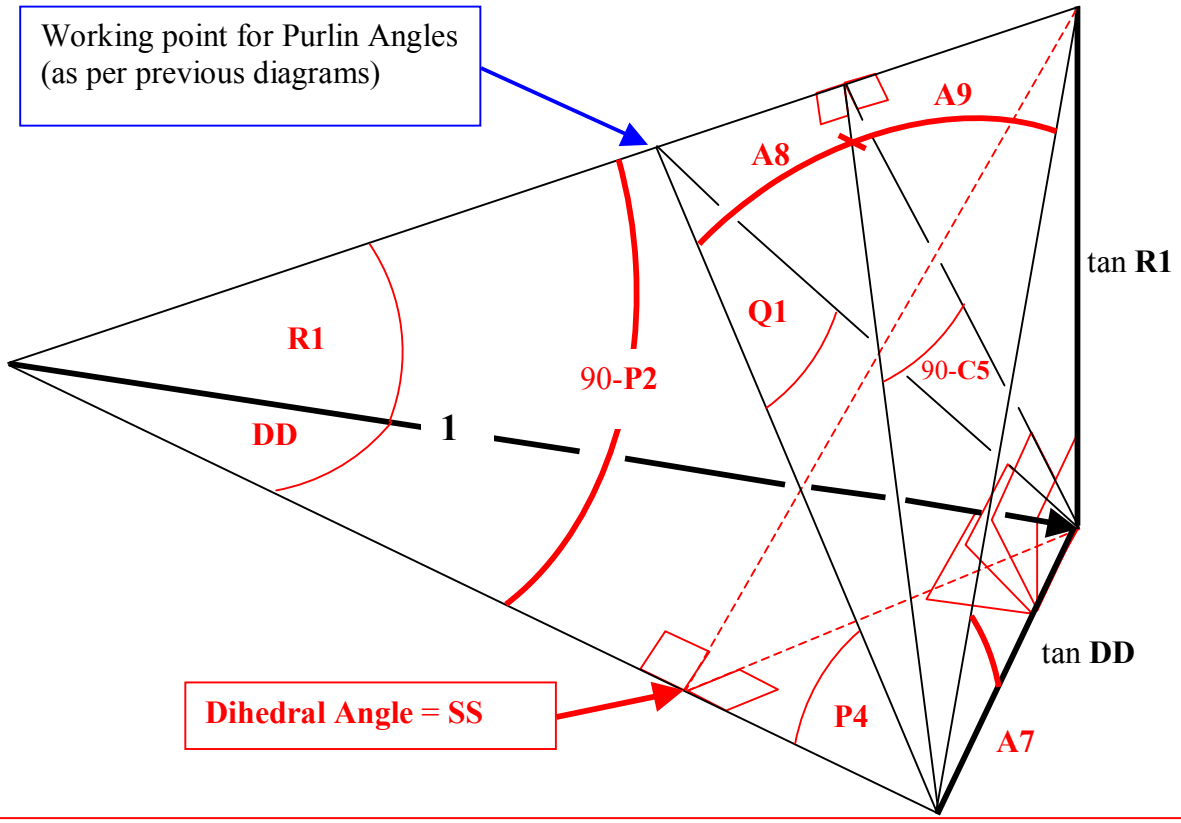
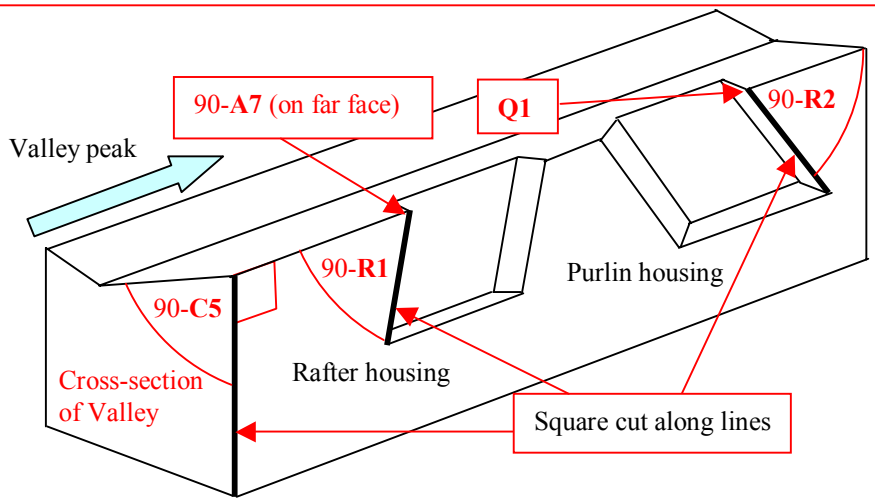
SQUARE CUT ANGLES:

General Model for Rafter and Purlin Angles



The same kernel geometry was required to solve backing angle **C5**, and the purlin related angles. Lines tan **DD**, tan **R1**, and the unit vector are mutually perpendicular. The planes of angles **A7**, **C5**, **Q1** and **DD** are all perpendicular to the plane of Hip/Valley pitch angle **R1**; that is, all of the planes created are at right angles to the side face of the Hip/Valley.

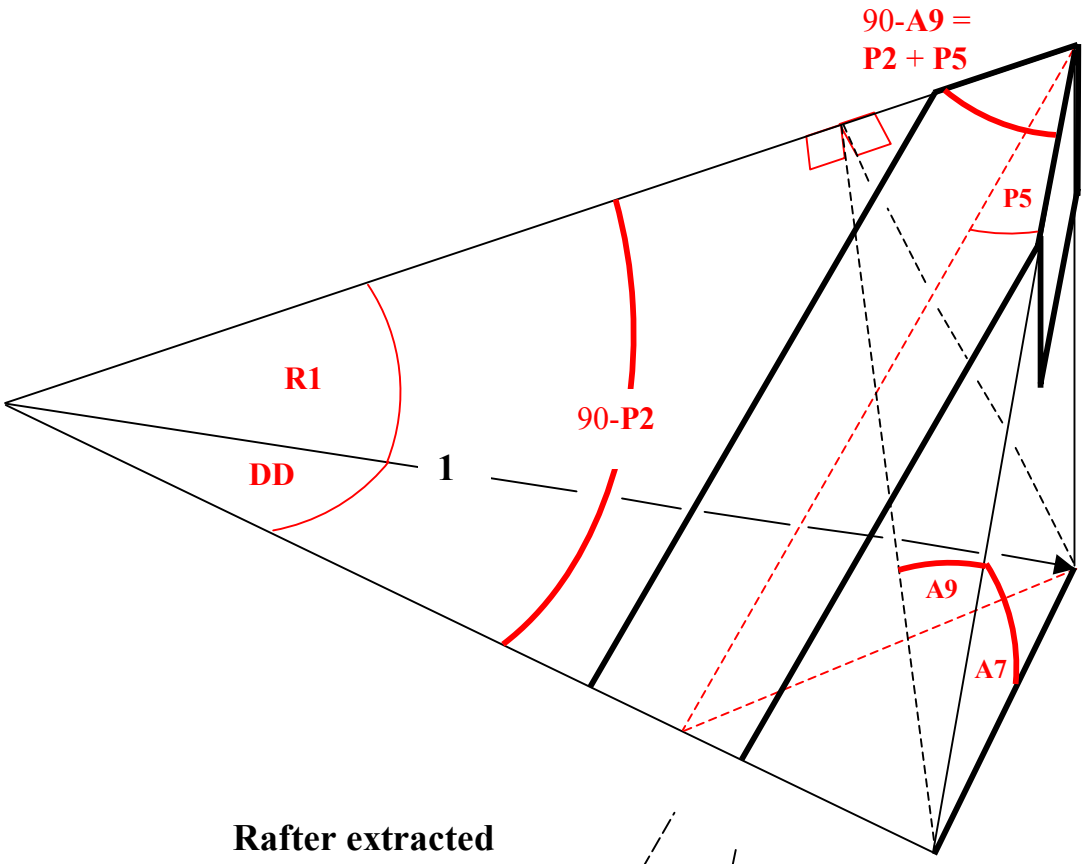
Imagine the plane of angle **A7**, the plumb backing angle, rotating about line tan **DD**. The right angle shown must remain a right angle, but as the triangle assumes different positions, the angle at the peak, 90-**A7**, assumes values 90-**C5**, **Q1**, and finally **DD**.



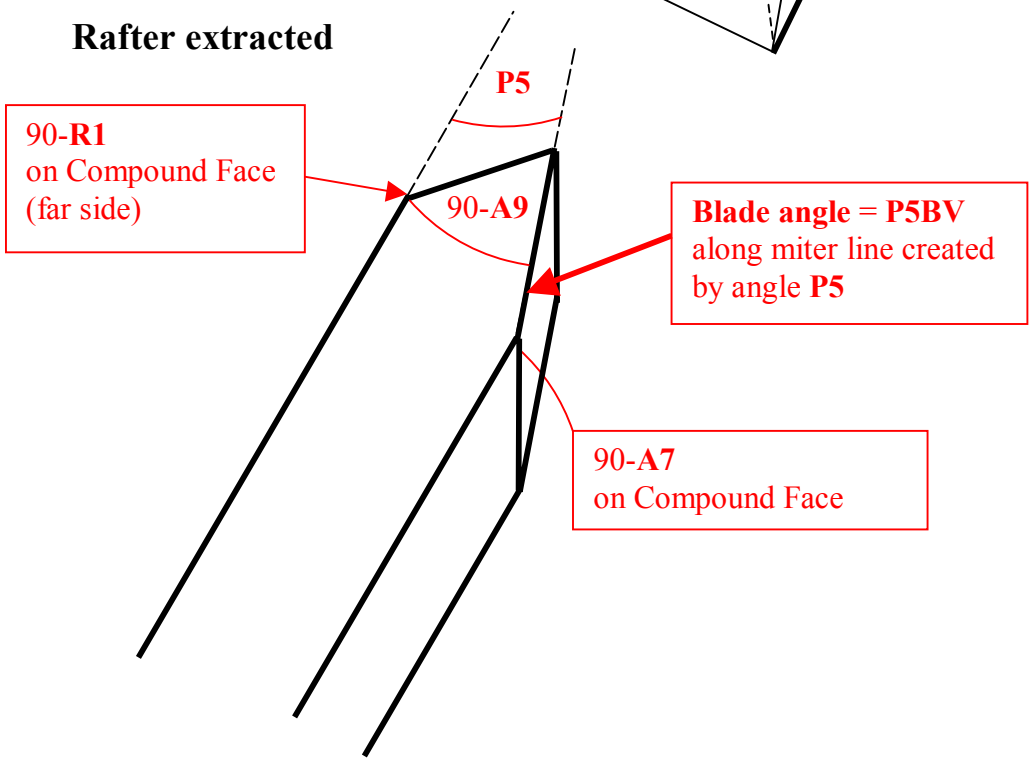
Sketch of housings on Valley rafter : The square cuts are made along the same lines and create the same angles as on the theoretical model.

SQUARE CUT ANGLES:

Rafter superimposed on Model

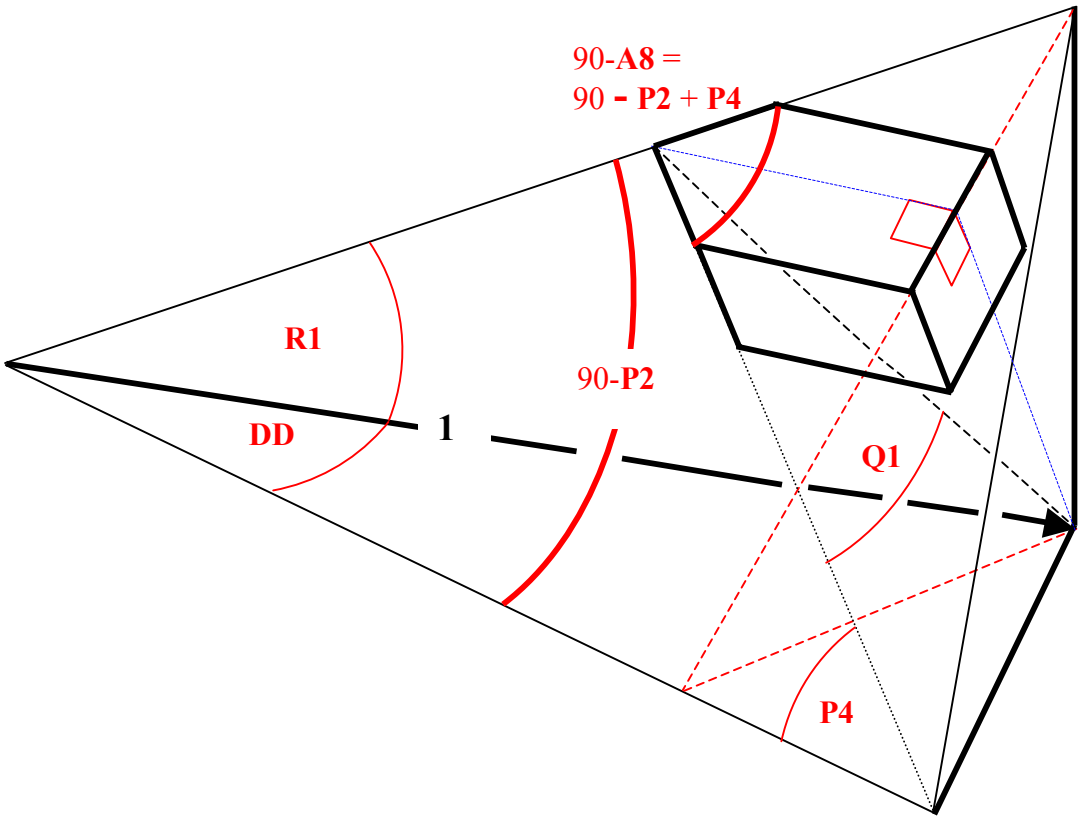


Rafter extracted

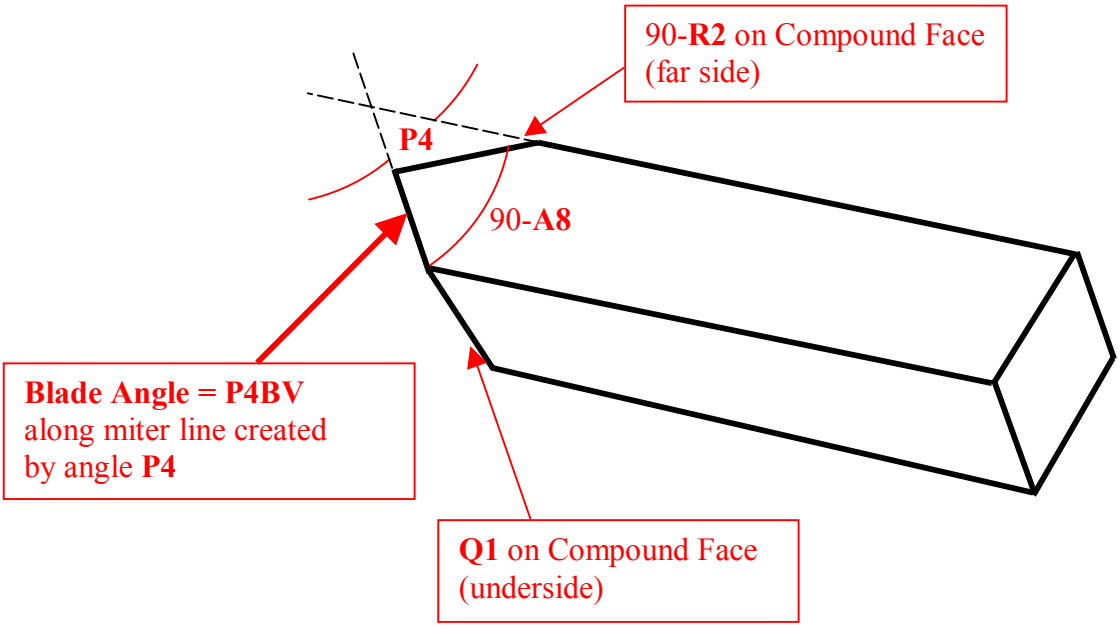


SQUARE CUT ANGLES:

Purlin superimposed on Model



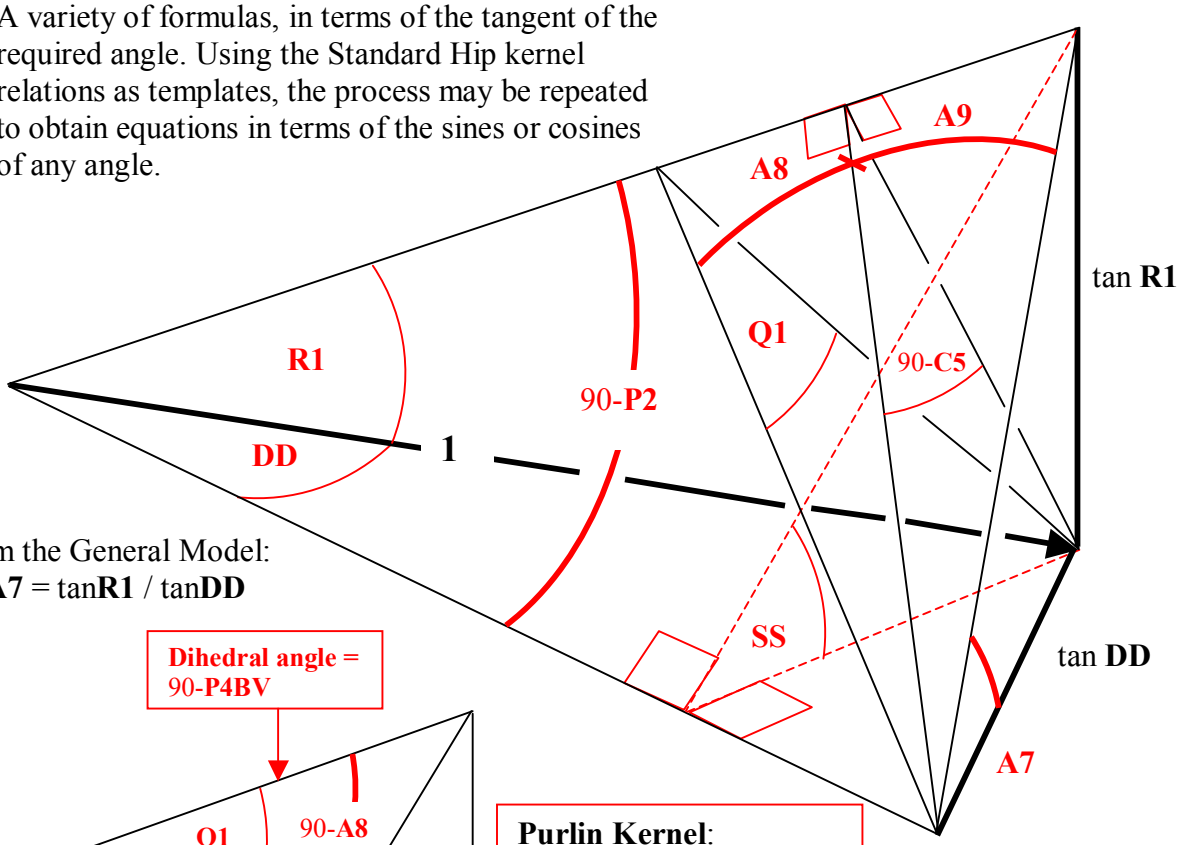
Purlin extracted



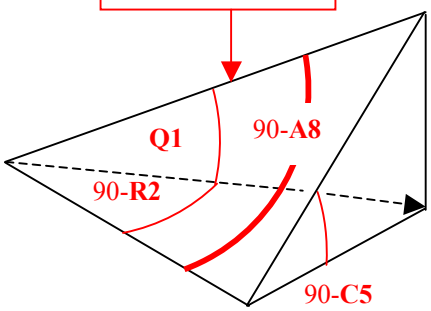
SQUARE CUT ANGLES:

Extracting Standard Hip Kernels from the General Model

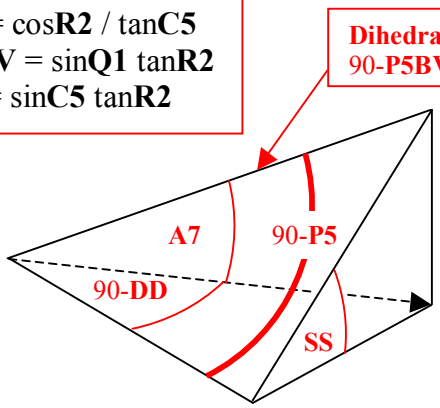
A variety of formulas, in terms of the tangent of the required angle. Using the Standard Hip kernel relations as templates, the process may be repeated to obtain equations in terms of the sines or cosines of any angle.

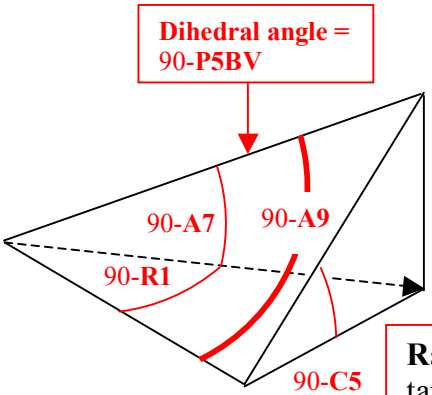


From the General Model:
tan**A7** = tan**R1** / tan**DD**



Purlin Kernel:
tan**Q1** = cos**R2** / tan**C5**
tan**P4BV** = sin**Q1** tan**R2**
tan**A8** = sin**C5** tan**R2**



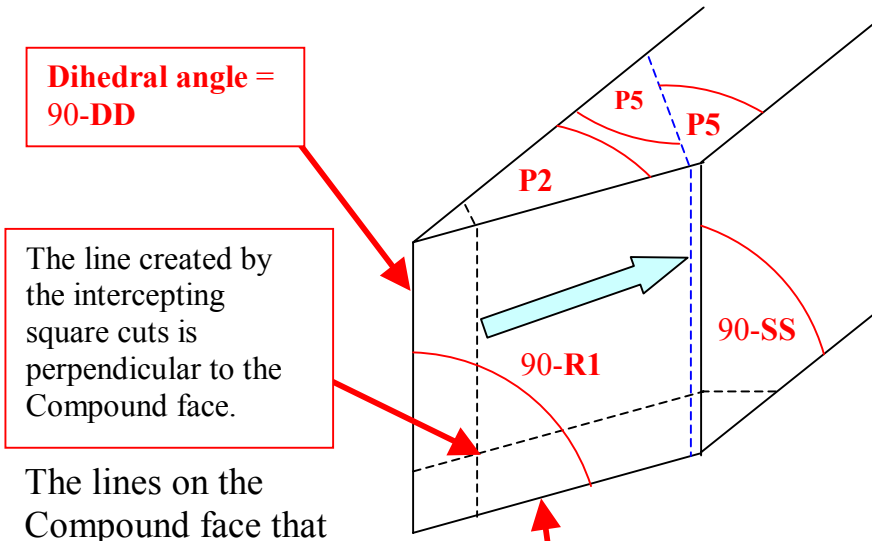


Rafter Kernel:
tan**A7** = tan**SS** cos**DD**
tan**P5BV** = sin**A7** tan**DD**
tan**P5** = cos**SS** tan**DD**

Rafter Kernel:
tan**A7** = tan**C5** / cos**R1**
tan**P5BV** = cos**A7** tan**R1**
tan**A9** = sin**C5** tan**R1**

Notes re: Square Cut Angles

Leaving the tenoned members cut at their "natural" angles causes forces within the member to act on the acute-angled edges. Transferred to the mortise, the forces tend to split the wood parallel to the grain. Square cutting the tenons removes the fragile "feather edges"; the corresponding mortise and housing cuts provide proper bearing surfaces to distribute the forces acting within the joint.



Dihedral angle = 90-**DD**

The line created by the intercepting square cuts is perpendicular to the Compound face.

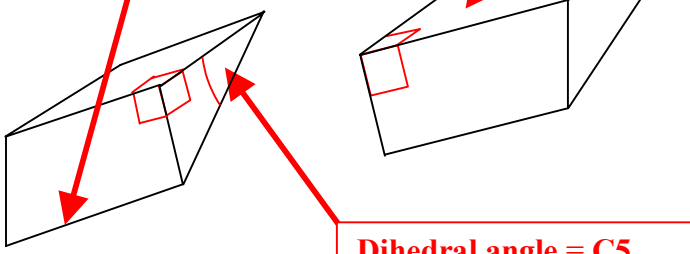
For the purpose of calculating angles, regardless of whether the angles occur on "the stick" or a geometric model: Parallel lines are equal lines. Parallel planes are equal planes. Consider the sketch of the **Common Rafter meets Valley** on the left: The face created by the compound angle cut (the plane of angle 90-**R1**) is equivalent to the side face of the Valley rafter that it meets.

The lines on the Compound face that the square cuts follow are parallel to the edges of the face. Imagine sliding the plumb line, and the corresponding planes, in the direction indicated by the arrow, until the line of the square cut is superimposed on plumb line 90-**SS**.

Dihedral angle = 90-**C5**

The plane of the square cut is perpendicular to the plane of the Compound Face.

Section of square cut

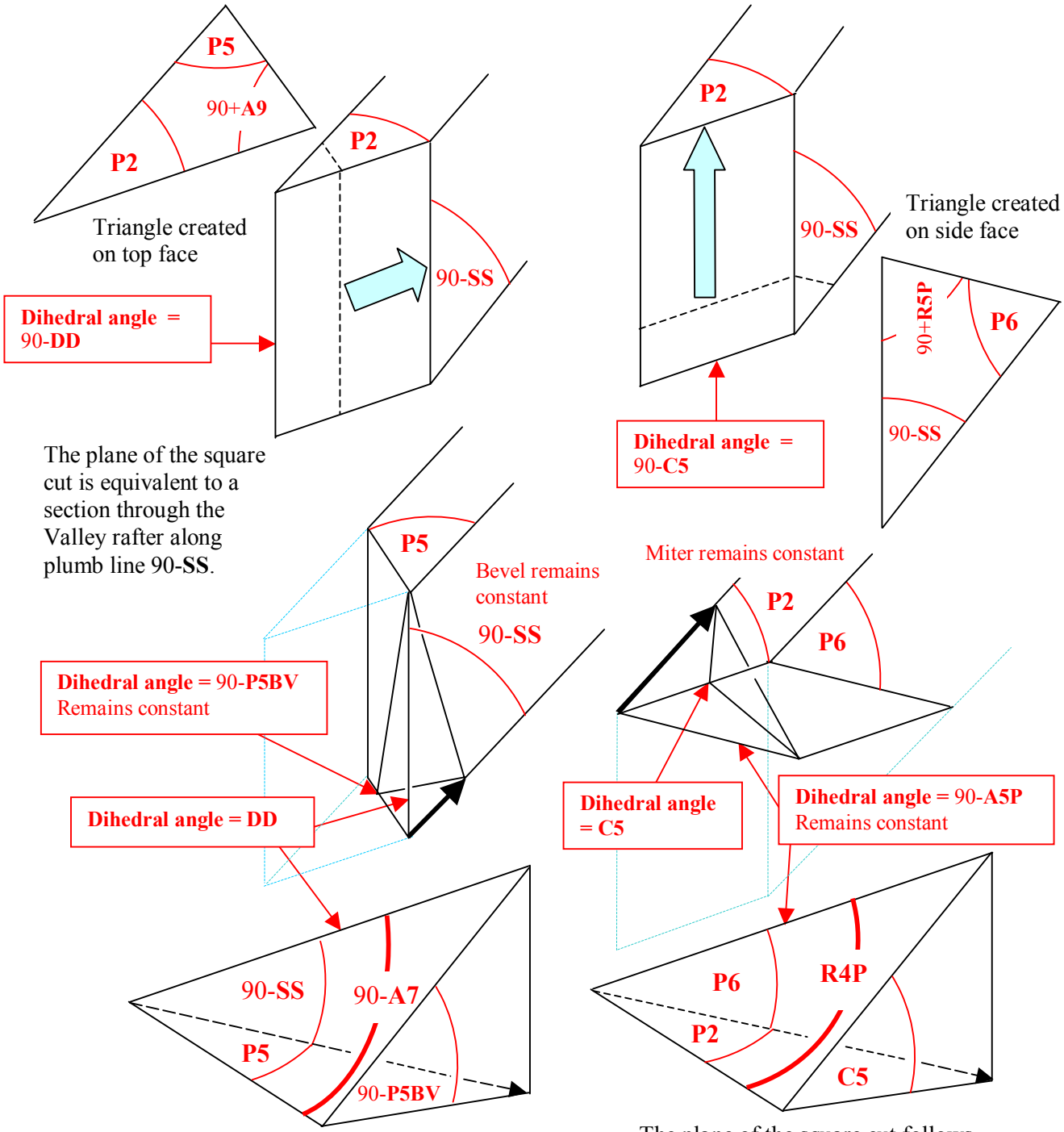


Bevel angle 90-**SS** remains unchanged. The dihedral angle along this edge is **DD**, since opposite planes on the rafter are parallel. The miter angle is **P5** (since the opposite edges are parallel); the dihedral angle along this line remains 90-**P5BV**.

Dihedral angle = C5
Due to the nature of the cut, the dihedral angle generated at the opposite end of the square cut is complementary to the dihedral angle at the edge of the Compound face.

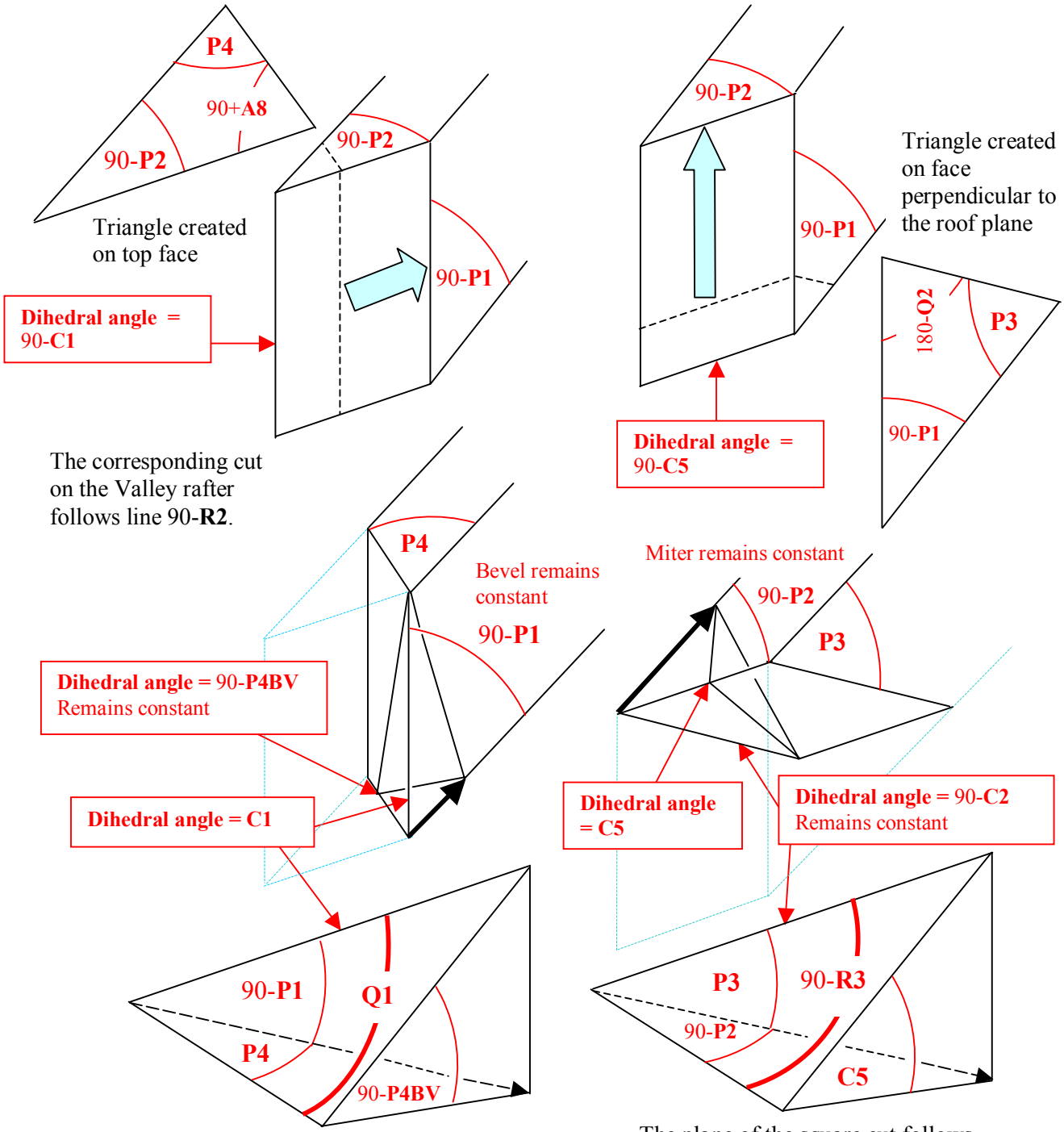
SQUARE CUT KERNELS:

Common Rafter meets Valley
Extracting kernels from "the stick"



SQUARE CUT KERNELS:

Purlin meets Valley
Extracting kernels from "the stick"



A kernel that relates **P4** to the other angles is difficult to extract from the General Square Cut Model: tan**P4** = tan**C1** cos**P1**

The plane of the square cut follows the bottom face of the Valley rafter. Compare to the kernel extracted from the General Hip/Valley Model.