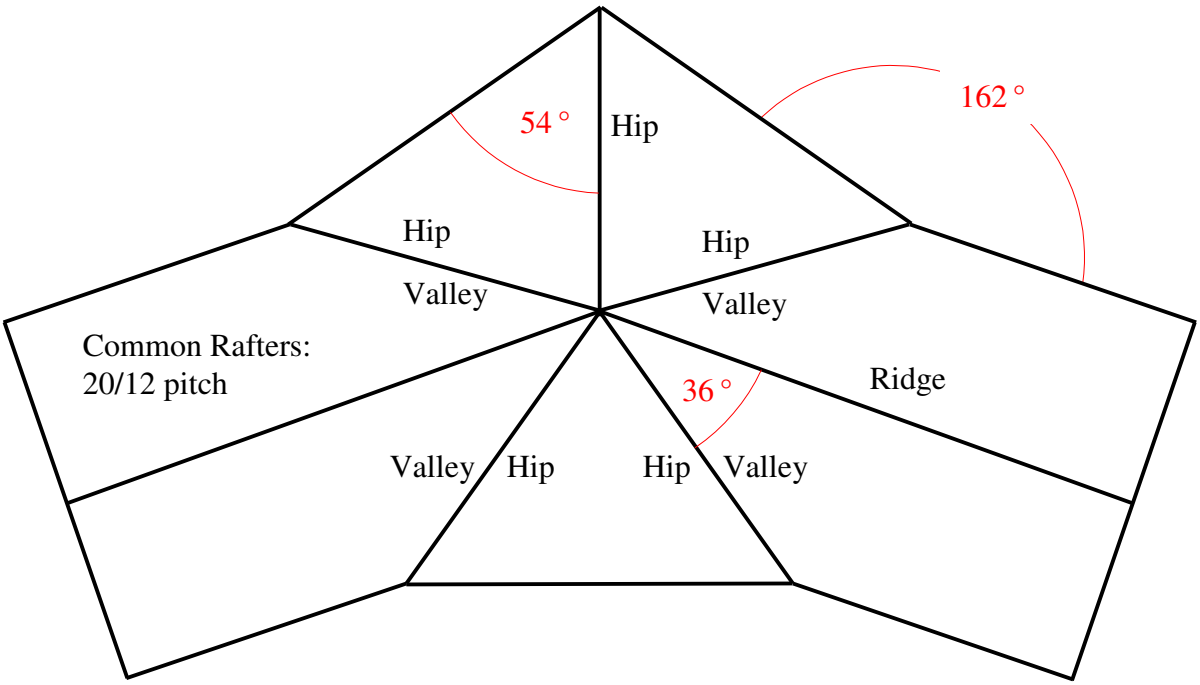
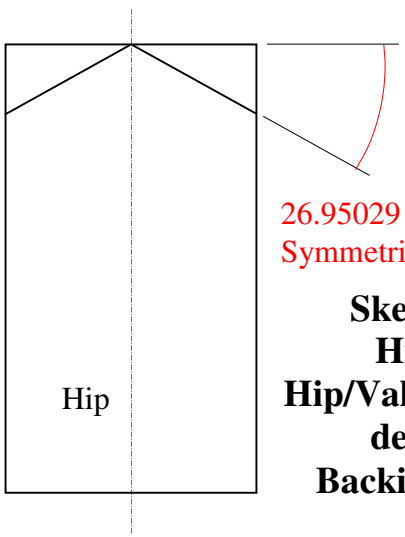
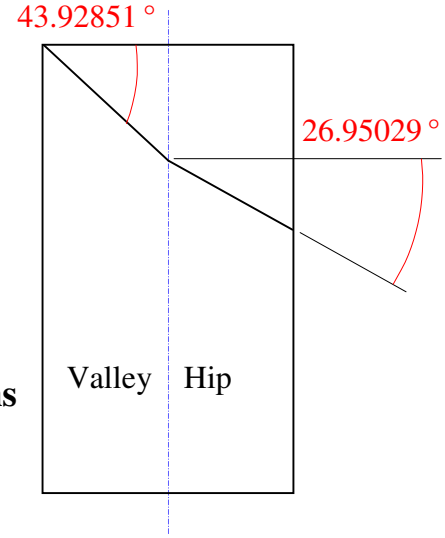
Pentagonal Roof Plan



Central Footprint: Pentagon 108° vertices
Eaves: Pentagon and wing exterior angle = 162°
Common Rafter pitches about ridges = 20/12
One rafter in the pentagon is a hip rafter, the remaining four rafters are hip/valleys. Ridges and rafters meet at geometric center of pentagon.



Sketches of Hip and Hip/Valley Sections detailing Backing Angles



Trigonometric or Linear Algebraic Calculation

Hip and Hip/Valley rafters are solved independently. This is the preferred method if **DD** or **D** exceeds 90 degrees, as values are confined to the first quadrant. Despite the different initial input values, **R4P**, **R5P**, and **A5P** on the Hip side equal **R4B**, **R5B**, and **A5B** respectively on the Valley side of the rafter, as required by theory. At the peaks all the rafters are symmetrical about their centerlines.

Hip and Hip/Valley evaluated independently					
Hip: 1.210904/1, 10^{12}/1, 54 °			Hip/Valley: 20/12, 10^{12}/1, 36 °		
Angle	Value	Over 12	Angle	Value	Over 12
SS	50.44911	14 17/32	**SS**	59.03624	20
DD	54.00000	16 17/32	**DD**	36.00000	8 23/32
R1	44.41081	11 3/4	**R1**	44.41081	11 3/4
P2	24.82694	5 9/16	**P2**	35.30394	8 1/2
90 **– P2**	65.17306	25 15/16	90 **– P2**	54.69606	16 15/16
C5	26.95029	6 3/32	**C5**	43.92851	11 9/16
R4P	27.42926	6 7/32	**R4B**	27.42926	6 7/32
R5P	38.39848	9 1/2	**R5B**	38.39848	9 1/2
A5P	24.28847	5 13/32	**A5B**	24.28848	5 13/32

Vector Product Calculation for 198 ° Total Deck Angle

Note the values of **DD**, **P2**m, and 180 **– P2**m returned by the combination of linear algebraic calculations and the reflex angle of 198 ° as inputs.

Hip/Valley, Vector Product Calculator					
1.210904/1, 20/12, 198 °					
Main Side: Hip Side			**Adjacent Side:** Valley Side		
Angle	Value	Over 12	Angle	Value	Over 12
SS	50.44911	14 17/32	**S**	59.03624	20
DD	126.00002	N/A	**D**	35.99998	8 23/32
R1	44.41080	11 3/4	**R1**	44.41080	11 3/4
P2m	65.17306	25 15/16	**P2**a	35.30395	8 1/2
180 **– P2**m	114.82696	N/A	90 **– P2**a	54.69605	16 15/16
C5m	26.95030	6 3/32	**C5**a	43.92852	11 9/16
R4Pm	27.42928	6 7/32	**R4B**a	27.42925	6 7/32
R5Pm	38.39847	9 1/2	**R5B**a	38.39848	9 1/2
A5Pm	24.28848	5 13/32	**A5B**a	24.28846	5 13/32

Trigonometric Calculation for 198 ° Total Deck Angle

Note the values of **DD** (equivalent to **DDB**), and **P2B** (normally 180 – **P2**) returned by a trigonometric calculation, and the negative values for some other angles. Returns may differ from those in the table below, depending on the formula used to evaluate an angle. For example, some formulas will return negative values for **C5** and **R1**.

Hip/Valley, Trigonometric Calculator					
1.210904/1, 20/12, 198 °					
Main Side: Hip Side			**Adjacent Side:** Valley Side		
Angle	Value	Over 12	Angle	Value	Over 12
SS	50.44911	14 17/32	**S**	59.03624	20
DD	53.99998	16 17/32	**D**	–35.99998	–8 23/32
DDB	126.00002	N/A	**DB**	35.99998	8 23/32
R1	44.41080	11 3/4	**R1**	44.41080	11 3/4
P2	24.82969	5 9/16	**P2**	35.30395	8 1/2
P2B	114.82696	N/A	**P2B**	54.69605	16 15/16
C5	26.95030	6 3/32	**C5**	43.92852	11 9/16
R4P	27.42928	6 7/32	**R4B**	–27.42925	–6 7/32
R5P	38.39847	9 1/2	**R5B**	38.39848	9 1/2
A5P	24.28848	5 13/32	**A5B**	–24.28846	–5 13/32

GENERAL NOTES

Regardless of the mode of calculation chosen, returns for **R1** and **C5** are consistent. The values of **R4P**, **R5P**, and **A5P** on the Hip side and **R4B**, **R5B**, and **A5B** respectively on the Valley side of the rafter agree.

Variations in returns for **DD** and **P2** angles are the result of the particular trig functions of the angles involved. Values are always of the form 90 ± or 180 ± the value obtained with calculations confined to the first quadrant.

General formulas tan **BLADE ANGLE** = sin **MITER** ÷ tan **BEVEL** and cos **ANGLE on COMPOUND FACE** = cos **MITER** cos **BEVEL** can be used to double-check returns.

Developing and creating simplified 3D models of the overall structure and proposed joints is the best method of validating results if there is any doubt regarding the quadrant or value of an angle.