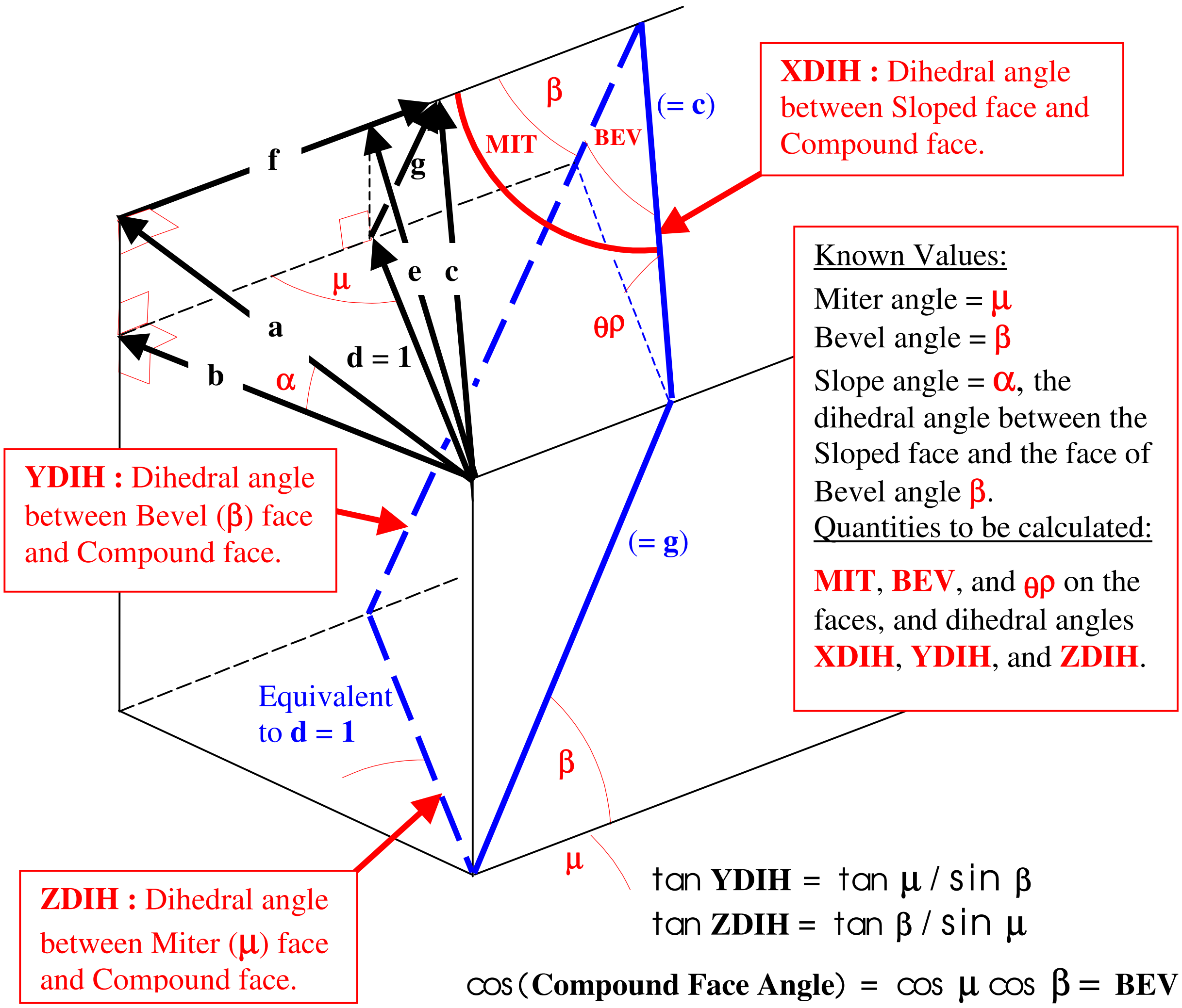
TIMBERS with NON-RECTANGULAR SECTIONS:

Vector Model



$\tan \mathbf{YDIH} = \tan \mu / \sin \beta$

$\tan \mathbf{ZDIH} = \tan \beta / \sin \mu$

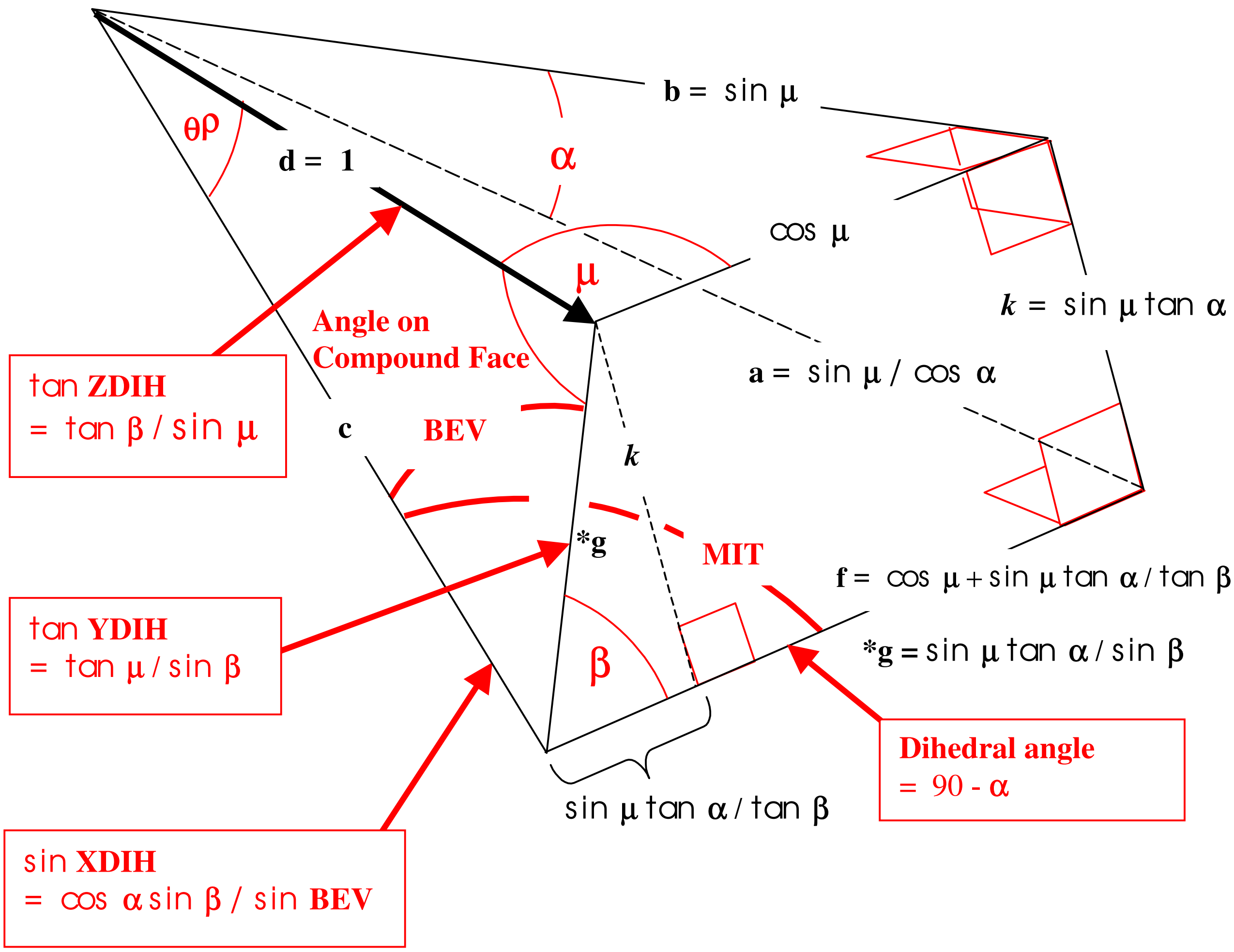
$\cos(\textbf{Compound Face Angle}) = \cos \mu \cos \beta = \textbf{BEV} + \theta\rho$

Direction Numbers of Vectors			
Vector	x	y	z
a	0	$\sin \mu$	$\sin \mu \tan \alpha$
b	0	$\sin \mu$	0
c	$\cos \mu + \sin \mu \tan \alpha / \tan \beta$	$\sin \mu$	$\sin \mu \tan \alpha$
d	$\cos \mu$	$\sin \mu$	0
e	$\cos \mu$	$\sin \mu$	$\sin \mu \tan \alpha$
f	$\cos \mu + \sin \mu \tan \alpha / \tan \beta$	0	0
g	$\sin \mu \tan \alpha / \tan \beta$	0	$\sin \mu \tan \alpha$
Equivalent values: **f** X **g** = (1,0,0) **b** X **d** = (0,0,1) **a** X **b** = **f** = (1,0,0)			

VECTOR MODEL compared to SQUARE CUT MODEL:

Vector Model extracted and re-positioned,
with the magnitudes labeled.

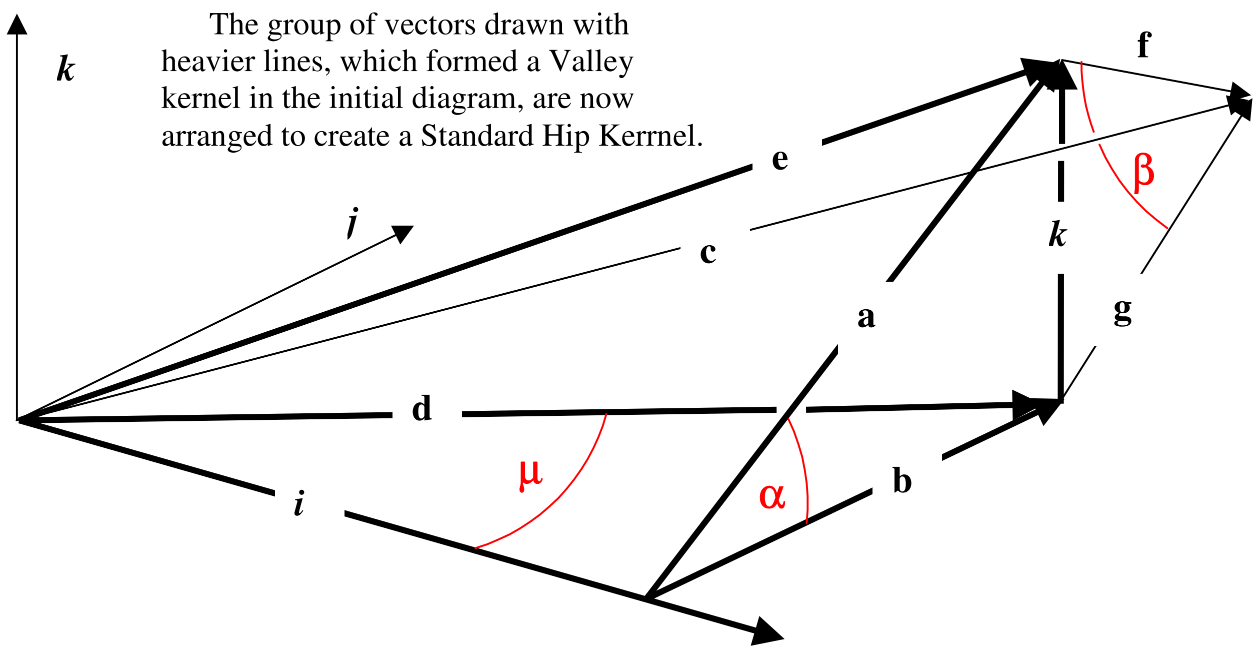
Note the similarity between the geometries of the Vector Model for Non-rectangular Sections and the Alternate Model for Square Cuts, in fact, if **XDIH** = 90 degrees, the models are identical.



It is possible to use combinations of **MIT**, **BEV**, α, β, μ , θρ, and the dihedral angles as givens to calculate the remaining angular values, using either formulas, or a program that can solve standard timber framing angles. Refer to Alternate TFA Program Scenarios or the tables in this section.

"SLIDING" the VECTORS:

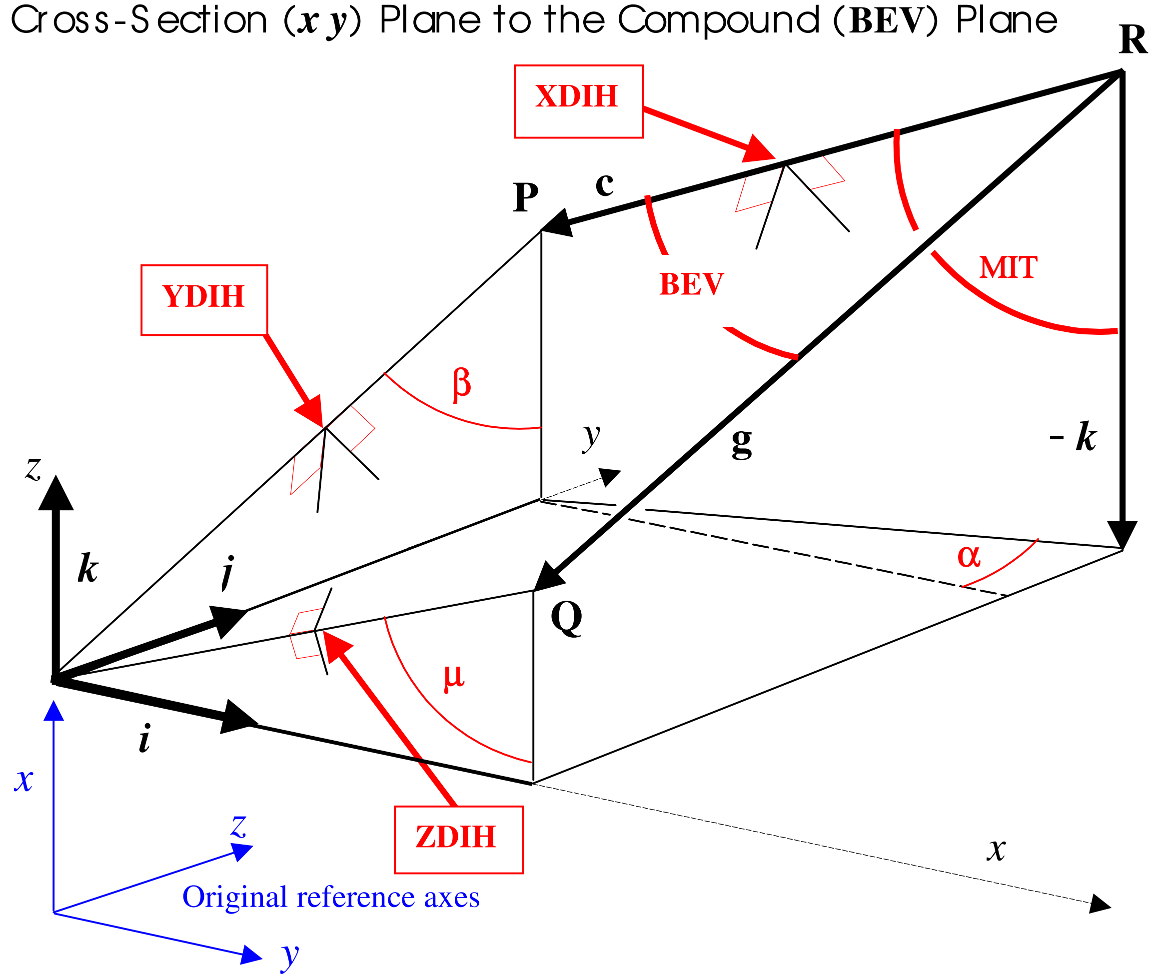
Vector orientation or direction remains the same as in the original model.



Simplified Table of Direction Numbers			
Vector	*x*	*y*	*z*
a	0	1	tan α
b (= ***j***)	0	1	0
c	1 / tan μ + tan α / tan β	1	tan α
d	1	tan μ	0
e	1	tan μ	tan μ tan α
f (= ***i***)	1	0	0
g	1	0	tan β
k	0	0	1
	(1,0,0) = ***i***, ⊥ to plane **ab*k***		
	(0,1,0) = ***j***, ⊥ to plane **fg*k***		
	(0,0,1) = ***k***, ⊥ to plane **bd*i***		
	(tan μ,−1,0) ⊥ to plane **de*k***		
	(0, tan α,−1) ⊥ to plane **aci** (= plane **cef**)		
	(-tan μ, 1, tan μ / tan β) ⊥ to plane **cdg**		

ROTATING the MODEL about the REFERENCE AXES:

Matrix for Projection of Points from the Cross-Section ($x\,y$) Plane to the Compound (**BEV**) Plane



x, y co-ordinates : $\mathbf{P} = (0, 1)$, $\mathbf{Q} = (1, 0)$, $\mathbf{R} = (1, 1 + \tan\alpha)$

$$z = \begin{vmatrix} x & y \\ -\cot\beta & \cot\mu \end{vmatrix}$$

$$\mathbf{g} = \mathbf{Q} - \mathbf{R} \qquad \mathbf{c} = \mathbf{P} - \mathbf{R}$$

$$\mathbf{r} = \begin{vmatrix} \boldsymbol{i} & \boldsymbol{j} & \boldsymbol{k} \\ x_g & y_g & z_g \\ x_c & y_c & z_c \end{vmatrix}$$

Solve quantities **g**, **c** and
$\mathbf{r} = \mathbf{g} \times \mathbf{c}$ (⊥ to **BEV** plane).
$\mathbf{c} \times -\boldsymbol{k}$ (⊥ to **MIT** plane).

Unit vectors $\boldsymbol{i}$, $\boldsymbol{j}$, and $\boldsymbol{k}$ represent the remaining planes.

SUBSTITUE VALUES for TRIGONOMETRIC PROGRAMS:

Entries for **XDIH**, **YDIH**, and **ZDIH** < 90°; if angles are ≥ 90°, results may be supplementary or complementary to the values listed in the table. Certain entries (example: 4th row) return ambiguous values for MITER ONLY, or β = 90°. To ensure accuracy, all results should be supplemented by 3-D models, and double-checked using vector analysis.

ENTRIES			RETURNS		
Main Side	Adjacent Side	Total Deck Angle	90−**P2** Main	90−**P2** Adjacent	90−**C5m** + 90−**C5a**
XDIH	90 - α	**MIT**	**BEV**	β	**YDIH**
α	**ZDIH**	μ	**MIT**	θρ	180 - **XDIH**
YDIH	90 - α	β	**BEV**	**MIT**	**XDIH**
YDIH	**XDIH**	**BEV**	β	**MIT**	90 - α
180 - **XDIH**	**ZDIH**	θρ	**MIT**	μ	180 + α
180 - **XDIH**	α	**MIT**	θρ	μ	180 + **ZDIH**

Table of Test Values					
Angle	General	Square Cut (**XDIH** = 90)		Miter only (**ZDIH** = 90)	Bevel only (**YDIH** = 90)
α	20	**C5**	20	20	20
β	60	90-**R1**	73.01695	90	60
μ	50	**R4P**	50	50	90
θρ	15.44452	**P6**	15.18892	15.57939	22.79588
MIT	45.40502	**P2**	48.23670	51.74437	78.82977
BEV	55.80825	90-**SS**	63.98951	74.42061	67.20412
XDIH	79.68680	90	90	77.29999	61.97568
YDIH	53.99479	90-**DD**	51.25270	50	90
ZDIH	66.14135	90-**A5P**	76.83217	90	60