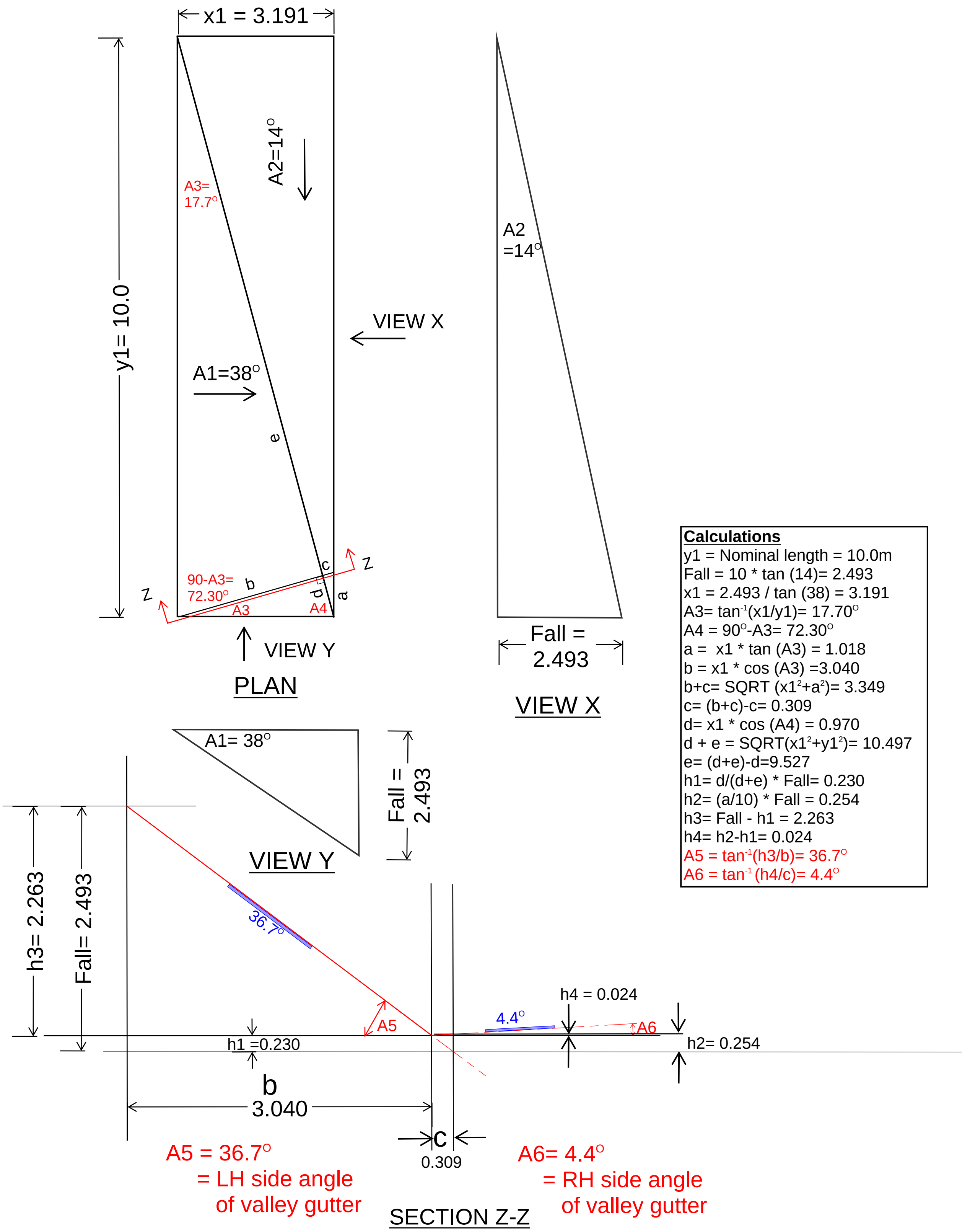
Beware of non-regular valley gutters

Beware when the slopes of intersecting roofs forming a valley gutter are not equal. In the example below, two roofs, having slopes of 38° and 14°, meet to form the line of the valley gutter. When viewing straight up / down the valley gutter, the side walls will have different slopes. However, the lower side wall slope can be much less than might be expected.

In the example below, although the lower roof slope of 14° is greater than the minimum roof slope of 12.5° permitted by AS/NZS 3500.3-2021 ('3500.3'), the lower side wall slope is only 4.4°, this being substantially less than the 'nominal' side angle of 16.5° specified in 3500.3, and certainly not enough to allow formation of an effective valley gutter.

Note that for two roofs sloping at 22.5°, the side wall slopes are both 16.3°, this being similar to the nominal side wall slope noted above. However, for two roofs intersecting at 12.5°, the side wall slopes are 8.9°, which is significantly less than 16.5°. Hence allowing the roof slopes to be as low as 12.5° appears to be anomaly in the code. Furthermore, the code is silent on non-regular valley gutters, and the example below highlights the danger of valley gutters formed from intersecting roofs having different slopes. This needs to be addressed in 3500.3, as this is not uncommon in contemporary roof designs.



Calculations

y1 = Nominal length = 10.0m
Fall = 10 * tan (14)= 2.493
x1 = 2.493 / tan (38) = 3.191
A3= $\tan^{-1}$(x1/y1)= 17.70°
A4 = 90°-A3= 72.30°
a = x1 * tan (A3) = 1.018
b = x1 * cos (A3) =3.040
b+c= SQRT ($x1^2+a^2$)= 3.349
c= (b+c)-c= 0.309
d= x1 * cos (A4) = 0.970
d + e = SQRT($x1^2+y1^2$)= 10.497
e= (d+e)-d=9.527
h1= d/(d+e) * Fall= 0.230
h2= (a/10) * Fall = 0.254
h3= Fall - h1 = 2.263
h4= h2-h1= 0.024
A5 = $\tan^{-1}$(h3/b)= 36.7°
A6 = $\tan^{-1}$(h4/c)= 4.4°

Beware of non-regular valley gutters (cont.)

In the general case, it can be shown that for a valley gutter formed from intersection roofs with roof slope angles A1 and A2, the slopes of the side walls, S1 and S2, respectively are as follows:

$$S1 = \tan^{-1}(\tan(A2)*[1-k1*\sin(k2)/SQRT(1+k1^2)]/(k1*\cos(k2))$$

$$S2 = \tan^{-1}(k1*\tan(A2)*(k1-\sin(k2)/SQRT(1+k1^2))/((k1^2)*\sin(k2))$$

where

$k1= \tan(A2)/\tan(A1)$ and

$k2= \tan^{-1}(k1)$

The slope of the valley gutter itself is determined as follows:

$$\text{Valley Gutter Slope} = \tan^{-1}(\tan(A2)/SQRT(1+k1^2))$$

These calculation are best performed using a spreadsheet. Some examples are provided below. Of particular interest is the combination of roof slopes of 38° & 22.5°, which results in side wall slopes of 34.6° and 11.0°. The lower side wall slope of 11.0° is significantly less than the side wall slopes of 16.3° for when both roof slopes are 22.5°. This result is not intuitive, and again highlights the dangers of forming valley gutters from roofs having different slopes.

Roof slopes (degrees)		Valley Gutter slopes (degrees)		
Roof 1 slope angle A1	**Roof 2 slope angle A2**	**Valley gutter slope**	**Side wall slope S1**	**Side wall slope S2**
22.5	22.5	16.3	16.3	16.3
20	20	14.4	14.4	14.4
16.5	16.5	11.8	11.8	11.8
12.5	12.5	8.9	8.9	8.9
38	22.5	20.1	34.6	11.0
38	14	13.4	36.7	4.3

Examples of Valley Gutter Side Wall Slopes