DEMYSTIFYING BOWSTRING TRUSSES

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The mushroom shaped bowstring roof truss is an efficient truss profile as it has a higher average truss depth and a lower ridge height that avoids unwieldy long webs at mid-span compared to a standard gable truss.

The top chord pitch is steeper at the eaves to shed water more effectively. The ridge does not require separate capping and the curved sheeting has inherent strength and stiffness to contribute to the roof structure.

The bowstring truss is not as complicated a shape to detail, as many believe. It is sometimes thought that the roofing curve has to be solved on site by using purlins of varying depths on a basic truss. The size and location of purlins would then become a nightmare for the installer.

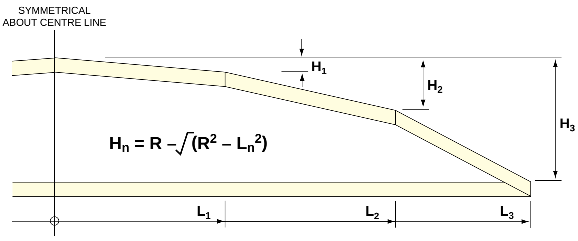
To overcome this difficulty, some detailers simply position top chord joints every purlin location. Many solve this segmented top chord truss profile by using CAD.

Those without CAD capability use formulae such as those in Figure 1 to calculate the various panel heights from horizontal positions. However, this results in many more joints than is necessary. Neither does it properly address the effect of overhang, as it is often requires a splice for a change of pitch too near or even past the heel.

Note that the batten depth should be deducted from the radius before applying the formulae, and also that the calculated heights are all between the top of top chords and not to the bottom chord. Furthermore, simply dividing the truss into equal horizontal distances result in actual batten spacing increasing from ridge to eaves.

My recommended approach is to make each segmented top chord length approximately double the batten spacing, typically 1600-2000mm between panel points for 900mm batten spacing. The total length (span plus overhangs) of the truss divided by the chosen total number of top chord segments should fall within this range.

Figure 1



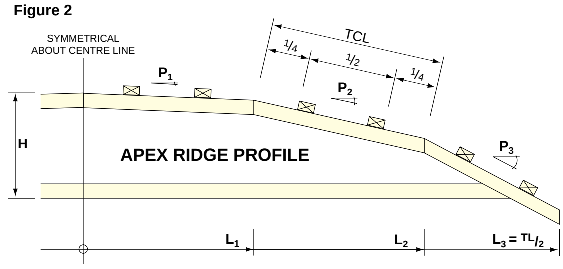
By making each top chord length exactly the same as each other, standard battens may simply be located at quarter panels to form a circular profile for the roof sheeting. The battens would also all be equally spaced. It does not matter if the batten spacing were slightly further than 900mm as the curved profile makes the roof sheet much more rigid than normal for enhanced span and load sharing capability.

The two sets of formulae in this guideline will provide all necessary information to build such symmetrical bowstring trusses without requiring the use of CAD. The appropriate set of formulae depends on whether there are odd (truncated ridge) or even (apex ridge) numbers of top chord segments.

The formulae for top chord length and truss height are given for information only as they are not usually required to detail the bowstring truss profile.

There is no need to add batten depth to the radius. The minimum radius of curvature for the roof sheeting is limited to 10m to ensure it does not clash with panel points. Lesser radii will require deeper battens. Simple adaptations of the formulae may be made for half trusses and asymmetrical bowstring trusses.

Figure 2



Bowstring Truss Profile	Apex Ridge Profile (Figure 2)	Truncated Ridge Profile (Figure 3)
Angle (A)	A = [arcsine (TL / 2 R)] / n	A = [arcsine (TL / 2 R)] / (n + 0.5)
Pitch (Pn)	P1 = 0.5 A, P2 = 1.5 A, P3 = 2.5 A, ... Pn = (n - 0.5) A	P0 = 0.0 A, P1 = 1.0 A, P2 = 2.0 A, ... Pn = n A
Distance (Ln)	L1 = R sine (1.0 A), L2 = R sine (2.0 A), L3 = R sine (3.0 A), ... Ln = R sine (n A)	L0 = R sine (0.5 A) L1 = R sine (1.5 A) L2 = R sine (2.5 A), ... Ln = R sine [(n + 0.5) A]
Top Chord Length (TCL)	TCL = 2 R sine (0.5 A)	TCL = 2 R sine (0.5 A)
Truss Height (H)	H = R [1 - cosine (n A)] + D / cosine (Pn) - OH tangent (Pn)	H = R [cosine (0.5 A) - cosine (n + 0.5) A] + D / cosine (Pn) - OH tangent (Pn)

Key:
- n = number of sloping top chords on each side of truss;
- TL = total truss length, i.e. span plus both overhangs;
- R = radius of roof sheeting;
- D = top chord depth;
- OH = overhang.

Figure 3